

# سر دارکوڑے خان پبلک ہائر سیکنڈری سکول مظفر گڑھ

نوٹس برائے جماعت نہم (اسلامیات)

ماہ جون کا سلیپس (سورۃ انفال کے پہلے تین رکوع)

- پہلا ہفتہ: درس الاول (الف): آیات نمبر ایک تا دس ترجمہ یاد کریں مع مشقی سوالات۔  
دوسرا ہفتہ: درس الاول (ب): آیات نمبر گیارہ تا دس ترجمہ یاد کریں مع مشقی سوالات۔  
تیسرا ہفتہ: درس الاول (ج): آیات نمبر بیس تا اٹھائیس ترجمہ یاد کریں مع مشقی سوالات۔  
چوتھا ہفتہ: تینوں اسباق کو دہرائیں

نوٹ: ترجمہ اپنی اسلامیات کی درسی کتاب سے یاد کریں۔

## الدرس الاول (الف)

س-1 اس سبق میں مومنوں کی کیا صفات بیان کی گئی ہیں؟

ج- اس سبق میں مومنوں کی درج ذیل صفات بیان کی گئی ہیں۔

(1)۔ جب اللہ تعالیٰ کا ذکر کیا جاتا ہے تو ان کے ڈر جاتے ہیں۔ (2) جب اللہ تعالیٰ کی آیات انہیں سنائی جاتی ہیں تو ان کے ایمان میں اضافہ ہو جاتا ہے

(3) وہ اپنے رب پر بھروسہ رکھتے ہیں (4) وہ نماز قائم کرتے ہیں (5) اللہ تعالیٰ نے جو انہیں مال دیا اس میں سے نیک کاموں میں خرچ کرتے ہیں۔

س-2 دو گروہوں سے کیا مراد ہے؟

ج- دو گروہوں سے مراد وہ کفار مکہ کے دو گروہ ہیں ان میں سے ایک تجارتی قافلہ تھا جو ابوسفیان کی سربراہی میں شام سے مکہ جا رہا تھا اور دوسرا جنگی لشکر تھا جو ابو جہل کی قیادت میں مسلمانوں پر حملہ کرنے کے لیے مدینہ کی جانب بڑھ رہا تھا۔

س-3 مندرجہ ذیل عبارت کا مفہوم بیان کیجیے؟

الف) فَاتَّقُوا اللَّهَ وَاصْلِحُوا ذَاتَ بَيْنِكُمْ.

مفہوم۔ غزوہ بدر کے اختتام پر مال غنیمت کے بارے میں کچھ مسلمانوں میں اختلاف پیدا ہوا تو یہ حکم ہوا کہ اللہ سے ڈرو اور مال غنیمت کے بارے میں آپس میں جھگڑا نہ کرو اور اپنے تعلقات درست کر لو۔

ب) اَطِيعُوا اللَّهَ وَرَسُولَهُ ان كُنْتُمْ مُؤْمِنِينَ.

مال غنیمت کے بارے میں مسلمانوں کو اختلاف ختم کرنے کا حکم دینے کے بعد فرمایا کہ اس بارے میں اللہ اور اس کے رسول کا حکم تسلیم کرو اگر تم مومن ہو۔ کیونکہ اللہ اور اس کے رسول کی اطاعت ایمان کا اولین تقاضا ہے۔

ج) اِذَا تَلَيْتَ عَلَيْهِمْ اِيْتُهُ زَادْتُهُمْ اِيْمَانًا.

اس آیت میں مومنوں کی یہ صفت بیان کی گئی ہے کہ جب انہیں اللہ تعالیٰ کی آیات انہیں سنائی جاتی ہیں تو ان کے ایمان میں اضافہ ہو جاتا ہے۔ اللہ تعالیٰ حکم من وعن قبول کرتے ہیں اور اس پر عمل کرتے ہیں۔

اضافی سوالات:

س-1 مال غنیمت سے کیا مراد ہے؟

ج-1 مسلمانوں کی کفار سے اللہ کی راہ میں جنگ ہو اور میدان جنگ میں فتح کی صورت میں کفار کا جو مال مسلمانوں کے قبضے میں آئے وہ مال غنیمت کہلاتا ہے۔

س-2 مال غنیمت کو انفال کیوں کہا جاتا ہے؟

ج-2 انفال "نفل" کی جمع ہے جس کا معنی ہے "زائد چیز"۔ غزوہ بدر میں جو مال حاصل ہوا تھا وہ ایک اضافی چیز تھی کیونکہ مسلمانوں نے غزوہ بدر میں جہاد مال کے حصول کیلئے نہیں کیا تھا بلکہ اپنے دفاع اور دین کی سر بلندی کیلئے کیا تھا۔ اس لیے مال غنیمت کو انفال کہا جاتا ہے۔

س-3 سورۃ انفال کے کتنے رکوع اور کتنی آیات ہیں؟

ج-3 سورۃ انفال کے دس رکوع اور پچھتر (۷۵) آیات ہیں۔

سورۃ انفال قرآن مجید کی سورۃ نمبر آٹھ ہے اور یہ پارہ نمبر نو اور دس میں ہے۔ سورۃ انفال مدنی سورت ہے کیونکہ یہ نبی کریم ﷺ کی مکہ سے مدینہ ہجرت کرنے کے بعد نازل ہوئی۔ جو سورتیں ہجرت سے پہلے نازل ہوئیں وہ مکی سورتیں کہلاتی ہیں۔

## الدرس الاول (ب)

س-1 اس سبق میں غزوہ بدر کے حوالے سے کن انعامات کا ذکر ہے؟

ج- غزوہ بدر میں اللہ تعالیٰ نے مسلمانوں پر درج ذیل انعامات فرمائے۔

(1)۔ ایک ہزار فرشتوں سے مسلمانوں کی مدد کی۔

(2) بارش برسا کر مسلمانوں کی پانی کی ضروریات کو پورا کر دیا اور شیطانی وسوسے دور کر دیے۔

(3) مسلمانوں پر میدان جنگ میں نیند طاری کر دی تاکہ انہیں اطمینان و سکون حاصل ہو۔

(4) میدان جنگ میں انہیں ثابت قدم رکھا۔

س-2- کفار کے ساتھ مقابلے کی صورت میں سورۃ انفال کی ان آیات میں کیا ہدایت کی گئی ہے؟  
ج- کفار کے ساتھ مقابلے کی صورت میں مسلمانوں کو یہ ہدایات دی گئی ہیں کہ وہ ان سے پیٹھ نہ پھیریں اور ڈٹ کر مقابلہ کریں سوائے جنگی چال کے طور پر یا اپنی فوج سے جا ملنے کے لیے ان دو صورتوں کے سوا جو میدان میں سے پیٹھ پھیرے گا وہ خدا کے غضب کا شکار ہوگا اور اس کا ٹھکانہ جہنم ہے اور وہ بہت بری جگہ ہے۔

س-3- کفار کو خطاب کرتے ہوئے ان آیات میں کیا تنبیہ کی گئی ہے؟  
ج- کفار کو خطاب کرتے ہوئے یہ تنبیہ کی گئی ہے کہ وہ نبی کریم ﷺ اور اسلام کی مخالفت سے باز آجائیں۔ اگر وہ باز نہ آئے تو دوبارہ انہیں ان کے کرتوتوں کی سزا دی جائے گی اور ان کی جماعت ان کے کچھ کام نہ آئے گی خواہ وہ کتنی ہی کثیر ہو۔  
س-4- مندرجہ ذیل عبارت کا مفہوم بیان کریں۔

(الف) يَا أَيُّهَا الَّذِينَ آمَنُوا إِذَا لَقَيْتُمُ الَّذِينَ كَفَرُوا رَحُّوا فَلا تُولُوهُمُ الْاَدْبَارَ.  
مفہوم۔ اس آیت میں مسلمانوں کو یہ ہدایت کی گئی ہے کہ کفار سے مقابلے کی صورت میں ڈٹ کر ان کا مقابلہ کرو اور ان سے پیٹھ نہ پھیرو سوائے جنگی چال کے طور پر یا اپنی فوج سے جا ملنے کے لیے ان دو صورتوں کے سوا جو کوئی ایسا کرے گا وہ خدا کے غضب کا شکار ہوگا اور جہنم میں جائے گا۔

(ب) وَمَا رَمَيْتَ اِذْ رَمَيْتَ وَلَكِنَّ اللّٰهَ رَمٰى.  
اس آیت کا مفہوم یہ ہے کہ غزوہ بدر میں نبی کریم ﷺ نے مٹھی بھر کنکریاں کفار کے لشکر کی طرف پھینکی تھیں جو پورے لشکر کو جا لگیں جس سے کفار کے حوصلے پست ہو گئے۔ اس فعل کی نسبت اللہ تعالیٰ نے اپنی طرف کی ہے اور فرمایا ہے کہ کنکریاں تو آپ نے پھینکی تھیں لیکن اس میں طاقت اور قدرت ہماری تھی۔  
(ج) وَلَنْ تَغْنِبَ عَنْكُمْ فِتْنَتَكُمْ شَيْنًا وَّلَوْ كَثُرَتْ  
اس آیت میں کفار کو خطاب کرتے ہوئے یہ تنبیہ کی گئی ہے کہ وہ نبی کریم ﷺ اور اسلام کی مخالفت سے باز آجائیں۔ اگر وہ باز نہ آئے تو انہیں دوبارہ ان کے کرتوتوں کی سزا دی جائے گی اور ان کی جماعت ان کے کچھ کام نہ آئے گی خواہ وہ کتنی ہی کثیر ہو۔

## الدرس الاول (ج)

س-1- شرالدوآب سے کیا مراد ہے؟  
شرالدوآب کے لفظی معنی "بدترین جاندار" کے ہیں اور اس سے مراد ایسے لوگ ہیں جو اللہ تعالیٰ کی آیات کا انکار کرتے ہیں۔ عقل اور شعور سے کام نہیں لیتے اور حق بات کو سنتے اور سمجھتے نہیں ہیں، اس لیے وہ جانوروں سے بھی بدتر ہیں۔  
س-2- ان آیات میں خیانت سے کیا مراد ہے؟

ج- ان آیات میں اللہ اور اس کے رسول ﷺ اور آپس کی خیانتوں سے منع کیا گیا ہے۔ اس آیت میں خاص طور پر نبی کریم ﷺ کے جنگی رازوں سے کسی دشمن کو آگاہ کرنا اور آپ کے احکامات سے انحراف کو خیانت قرار دیا گیا ہے۔ اس کے علاوہ تمام عہد اور ذمہ داریاں امانت کے دائرے میں آتی ہیں ان کی خلاف ورزی خیانت ہے۔

3- مندرجہ ذیل عبارت کا مفہوم بیان کیجئے؟  
(الف) وَلَا تَكُونُوا كَالَّذِينَ قَالُوا سَمِعْنَا وَهُمْ لَا يَسْمَعُونَ  
مفہوم۔ یہود اللہ اور اس کے رسول کے احکامات سن تو لیتے تھے لیکن اس پر عمل نہیں کرتے تھے۔ اس آیت میں اللہ تعالیٰ نے مسلمانوں کو یہود کی روش اختیار کرنے سے منع کرتے ہوئے فرمایا ہے کہ تم ان لوگوں کی روش اختیار نہ کرو بلکہ احکامات کو سن لینے کے بعد اس پر دل کی خوشی سے اس پر عمل کیا کرو۔  
(ب) - اِنَّ شَرَّ الدَّوَابِّ عِنْدَ اللّٰهِ الصُّمُّ الْبُكْمُ الَّذِيْنَ لَا يَعْقِلُوْنَ  
مفہوم۔ اس آیت میں ان لوگوں کو بدترین جاندار قرار دیا گیا ہے جو اللہ کی آیات کا انکار کرتے ہیں اور حق بات کو سنتے اور سمجھتے نہیں ہیں لہذا وہ جانوروں سے بھی بدتر ہیں۔

(ج) وَاَعْلَمُوْا اَنَّ اللّٰهَ يَحُوْلُ بَيْنَ الْمَرْءِ وَقَلْبِهٖ  
مفہوم۔ اس آیت کا مفہوم یہ ہے کہ جب انسان مسلسل اللہ تعالیٰ کی نافرمانی کرتا رہتا ہے اپنی ضد اور ہٹ دھرمی کی وجہ سے حق بات کو جھٹلاتا ہے تو اللہ تعالیٰ اس کے دل پر مہر لگا دیتا ہے اور اسے ہدایت کی توفیق نہیں دیتا۔

(د) وَاتَّقُوا فِتْنَةً لَا تُصِيبَنَّ الَّذِينَ ظَلَمُوا مِنْكُمْ خَاصَّةً

مفہوم۔ اس آیت کا مفہوم یہ ہے کہ جب نیک لوگ خود نیک کام کرتے رہیں لیکن دوسروں کو نیکی کی ترغیب نہ دیں اور برے کاموں سے نہ روکیں، حق کا ساتھ نہ دیں تو جب اللہ تعالیٰ کا عذاب ظالموں پر واقع ہوگا تو یہ لوگ بھی عذاب سے نہ بچ سکیں گے۔

(ه) وَاعْلَمُوا أَنَّمَا آمَاؤُكُمْ وَ أَوْلَادُكُمْ فِتْنَةٌ وَأَنَّ اللَّهَ عِنْدَهُ أَجْرٌ عَظِيمٌ

مفہوم۔ اس آیت میں مسلمانوں کو خبردار کیا گیا ہے کہ وہ مال اور اولاد کی محبت میں مبتلا ہو کر اللہ اور اس کے رسول ﷺ کی نافرمانی کے مرتکب نہ ہوں۔ اللہ تعالیٰ کے ہاں مال اور اولاد کچھ کام نہ آئیں گے بلکہ خدا کے ہاں نیکیاں کام آئیں گی اور یہ کہ خدا کے پاس نیکیوں کا بہت بڑا ثواب ہے۔

## Sardar kaurey khan public higher secondary school M.garh

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- Class 9<sup>th</sup>
- Subject biology
- syllabus for June
- Chapter 4
- Cells and tissues
- **Important MCQS**

1 The use of microscope is known as

(a)photography (b) endoscopy (c )microscopy (d )micrograph

2 Two first microscope was made in

(a)1995 (b)1895 (c)1595(d) 1685

3 Resolution power of human eye

(a)0.1mm (b)0.01 mm (c) 10 mm(d)10nm

4 A light microscope can magnify objects

(a)2500 x(b) 1500 x (c)1000 x (d)2000 x

5 The photograph taken by microscope is called

(a)Photograph (b) micrograph (c)cardiograph(d) Monograph

6 Magnification of light microscope is

(a)1300 X (b)1400 (c)1500 x (d)1600

7 In 1 millimetermicrometers are

(a)10 (b)100 (c)1000(d) 1/1000

8The resolution of modern electron microscope is

(a)0.2 nm(b) 0.3 nm(c)0.1 mm (d)0.12 nm

9 Robert Hooke use microscope to examine chock in

(a) 9958 (b) 1665 (c) 1560 (d) 1470

10 In 1831 \_\_\_\_\_ discovered nucleus in the cell

(a) Robert Brown (b) Robert Hooke (c) Louis Pasteur (d) Laveran

11 Robert Hooke was a scientist

(a) Greek (b) Iranian (c) Polish (d) British

12 In 1665 a British scientist first of all discovered cell

(a) Robert Brown (b) Robert Hooke (c) Aristotle (d) Lamarck

13 Cells were first discovered by

(a) Aristotle (b) Robert Brown (c) Robert Hooke (d) Schwann

14 Nucleus is discovered in plant cell

(a) 1930 (b) 1931 (c) 1731 (d) 1831

15 All cells are formed from preexisting cells is the saying of (a) Rudolf Virchow (b) Pasteur (c) Robert Hooke (d) Darwin

16 In the cell wall of plants the chemical present is

(a) Cellulose (b) chitin (c) lignin (d) none of these

17 Cell wall of fungi has

(a) Protein (b) chitin (c) cellulose (d) fats

18 Cell wall is found in all organisms except

(a) Plants (b) animals (c) bacteria (d) fungi

19 The major component of plant cell wall is

(a) Chitin (b) cellulose (c) cholesterol (d) peptidoglycan

20 The chemical substance found in large quantity in wood is

(a) Cotton (b) leggings (c) albumin (d) globulin

21 The cell wall of prokaryotes is composed of

(a) peptidoglycan (b) cellulose (c) peptidoglycan (d) chitin

22 Cell membrane is mainly composed of

(a) Lignin (b) proteins and lipids (c) cholesterol (d) peptidoglycan

23 Fluid mosaic model explains the structure of

(a) Cell wall (b) cell membrane (c) nucleus (d) ribosome

24 Which is not present in cell membrane structure

(a) Lipids (b) carbohydrates (c) proteins (d) DNA

25 It is not component of plasma membrane

(a) Lipids (b) carbohydrates (c) proteins (d) DNA

26 Which is not present in cell membrane

(a) DNA (b) lipids (c) proteins (d) carbohydrates

27 Microfilaments are made up of

(a) Tubulin (b) tropomyosin (c) myosin (d) actin

28 Ribosomal RNA is produced in

(a) Mitochondria (b) nucleolus (c) lysosomes (d) Golgi apparatus

29 Ribosomes are constructed in

(a) Endoplasmic reticulum (b) nucleoid (c) nucleus (d) nuclear pore

30 fluid of chloroplast is called

(a) cytoplasm (b) cytosol (c) stroma (d) nucleoplasm

31 Rough endoplasmic reticulum serves a function in the synthesis of

(a) carbohydrates (b) protein (c) lipids (d) vitamins

32 Golgi was awarded Nobel prize in

(A) 1908 (b) 1807 (c) 1906 (d) 1916

33 the flattened sacs in a Cell are called

(a) thylakoid (b) cristae (c) cisternae (d) centriole

34 who discovered lysosomes ?

(A) Duve (b) Brown (c) King (d) TWK

35 in 1947 Nobel prize for physiology and medicines was won by

(A) Rene de Due (b) Golgi (c) Lamarck (d) Aristotle

36 a polymer of amino acids and sugars is

(A) peptidoglycan (b) glycolipid (c) phosphalid (d) glycogen

37 human body is made of \_\_\_\_\_ type of cells

(a)100 (b)200 (c) 300(d)400

38 the number of subunits of ribosomes

(a)2 (b) 4(c) 6(d)8

39 Protein synthesis in a plant cell is a function of

(a)Golgi complex (b)mitochondria (c)nucleus (d)ribosomes

40 Ribosomes are the sites of synthesis

(a)Protein(b) RNA (c)DNA (d)glucose

41 The organelle which produces energy

(a)Ribosome(b) vacuole (c)nucleus(d) mitochondria

42What is the function of Mitochondria

(a)Protein synthesis (b)transport(c) respiration (d)excretion

43In a Cell aerobic respiration sites are

(a)Ribosomes (b)endoplasmic reticulum (c)mitochondria (d)vacuole

43 Inner layers of Mitochondria

(a)Cristae(b) matrices (c)stroma( d) Thylakoid

44 The stack of thylakoids is called

(a)Leucoplast(b)stroma(c)cristae(d)granum

45 Stroma is found in

(a)Mitochondria(b) ribosome (c)Golgi body (d)chloroplast

46 Smallest size of bacteria is

(a)0.4 micrometer (b)0.3micrometer(c) 0.2 micrometer (d) 0.1 micrometer

47Gas exchange in gills and lungs occurs by the process

(a) diffusion (b) osmosis (c) active transport(d) turgor

48 which of the following tissue is found in all blood vessels?

(a)Smooth muscles (b)endothelium(c) skeletal muscles (d)connective tissue

49 which type of muscles are responsible for birds wings flapping?

(a)Skeletal muscles (b)smooth muscles(c) cardiac muscles (d)epithelial tissues

50 Cardiac muscles are present in walls of

(a)Lungs(b) heart (c)kidney (d)stomach

51 Bone is an example of (a)epithelial tissue(b) nervous tissue(c) connective tissue (d)muscle tissue

52 The tissue which is composed of nerve cells

(a) connective tissue (b )muscle tissue (c)nervous tissue (d)epithelial tissue

53 The cell responsible for coordination in body is

(a)bone cell(b) nerve cell (c)heart cell(d) skin cell

54 Ground tissues are made of which cells?

(a) Parenchyma(b) vessel elements (c) Tracheids (d) sieve tubes

55 Epidermal tissue is found in (a)pigeon(b) sparrow (b)grow (b)onions

## Long Questions

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### Q.1 What is cell wall ? Write its structure and functions.

- Ans: **cell wall** All living organisms have cell walls around their cells, e.g animals and animal-like protists. Cell wall is a non-living and strong component of the cell, located outside the plasma membrane. It provides shape, strength, protection and support to the inner living matter (protoplasm) of cell

**Structure and composition of cell wall** Plant cells have a variety of chemicals in their cell walls.

The outer layer of the plant cell wall is known as primary wall and cellulose is the most common chemical in it.

Some plant cells, for example xylem cells, also have Secondary walls on the inner side of primary wall

It is much thicker and contains lignin and some other chemicals.

There are pores in the cell walls of adjacent cells, through which their cytoplasm is connected. These pores are called plasmodesmata.

### Cell wall of fungi and prokaryotes

Fungi and many protists have cells although they do not contain cellulose. Their cell walls are made of variety of chemicals for example chitin is present in the cell wall of fungi.

Prokaryotes have a cell wall composed or peptidoglycan that is a complex of amino acids and sugars.

### Q.2 what is cell membrane write ? some functions of cell membrane .

**Cell membrane** all prokaryotic and eukaryotic cells have a thin and elastic cell membrane covering the cytoplasm.

**Functions** the cell membrane functions as a semipermeable allowing a very few molecules across & while fencing the majority of chemicals inside cell in this way.

1 the membrane maintains internal composition of a cell

2 in addition to this vital role cell membrane can also sense chemical messages and can identify other chemicals.

### **Chemical compositions of cell membrane.**

Chemical analysis reveals that cell membrane is mainly composed of proteins and lipids with small quantities of carbohydrates electron microscopic examination of cell membranes have led to the development of the fluid mosaic model of cell membrane.

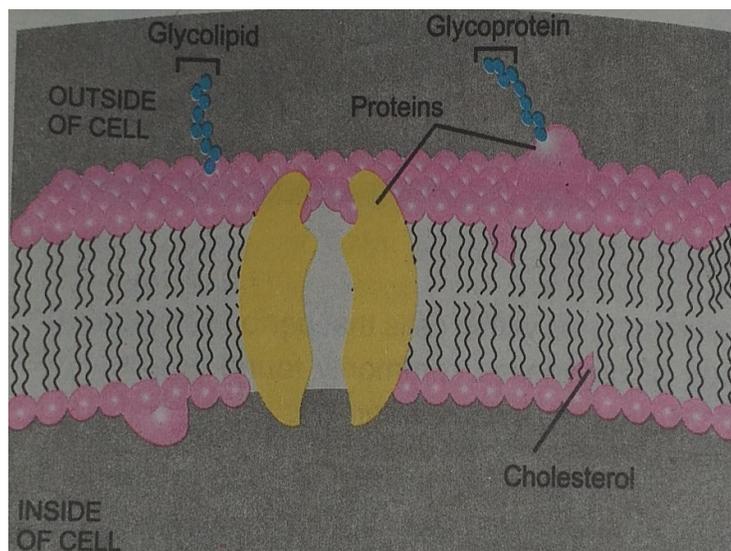
### **Fluid mosaic model of cell membrane.**

According to it

1 there is a lipid bilayer in which the protein molecules are embedded.

2 The lipid bilayer gives fluidity and elasticity to membrane.

3 small amount of carbohydrates are found in cell membrane these are



joined with proteins and lipids of membrane.

4 in eukaryotic cells cholesterol is also present in lipid bilayer.

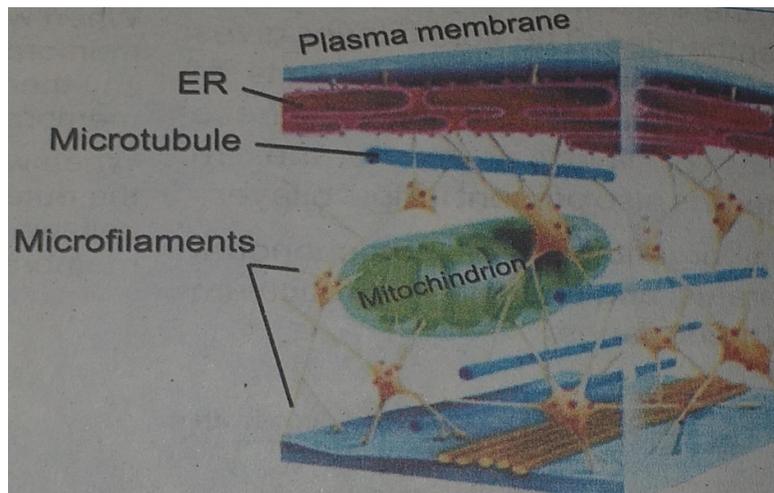
**Q.3 what is meant by cytoskeleton ?write its chemical composition and functions.**

### **Cytoskeleton**

the cytoskeleton is an important complex and dynamic cell component it is invisible under light microscope.

### **Important features**

- Cytoskeleton is a network of microfilaments and microtubules.
- Microtubules are made of tubulin protein and are used by cells to hold their shape they are also the major component of cilia and flagella.
- Microfilaments are thinner and are made of actin protein.They



have cells to change their shape.

**Q.4 why do you know about nucleus? write its structure and functions.**

### **Nucleus**

A prominent nucleus occurs in eukaryotic cells

### **Location**

In animal cells it is present in the center.

In mature plant cells due to the formation of large central vacuole it is pushed to side.

### **Structure and functions**

Nucleus is bounded by a double membrane known as nuclear envelope

Nuclear envelope contains many small pores that enable it to act as a semipermeable membrane

Inside nuclear envelope are granular fluid for example nucleoplasm is present.

Nucleoplasm contains one or two nucleoli and chromosomes.

Nucleolus is our dark spot and it is where ribosomal RNA are formed and assembled as ribosomes.

chromosomes are visible during cell division while during interphase of cell they are in the form of fine thread like structures known as chromatin and chromosomes are composed of the Deoxyribonucleic acids and proteins.

The prokaryotic cells do not contain prominent nucleus their chromosome is made of DNA only and submerged in cytoplasm.

#### **Q.5 write a short note on ribosomes.**

##### **Ribosome**

ribosomes are tiny granular structures that are either floating freely in the cytoplasm or bound to the endoplasmic reticulum.

##### **Structure of a Ribosome**

ribosome is made up of almost equal amount of proteins and ribosomal RNA.

Ribosomes are not bound by membranes and so are also found in prokaryotes.

Eukaryotic ribosomes are slightly larger than prokaryotic ones.



### **Functions of ribosomes.**

Ribosomes are the sites of protein synthesis .proteins and is extremely important to sales and so large number of ribosomes are found throughout the cells.

### **Subunits of ribosomes.**

Ribosome is not working disassembles into two smaller units.

**Q.6 what do you know about mitochondria ?write its structure and function.**

**Mitochondria.**

Mitochondria are the double membrane bound structures found only in eukaryotes.

### **Functions.**

These are the sites of aerobic respiration and are the major energy production centers in cells.

### **Structure.**

Mitochondria are bound by double membranes.

- The outer membrane of Mitochondria is smooth.
- The inner membrane of Mitochondria forms many infoldings called Cristae in the inner mitochondrial matrix. This helps to increase the surface areas of the inner membrane on which membrane bound reactions can take place.
- Mitochondria have their own DNA and ribosomes.
- The Ribosomes of Mitochondria are more similar to bacterial ribosomes than eukaryotic ribosomes.

### **Q.7 write a note on plastids.**

#### **Plastids.**

Plastids are also membrane bound organelles that only occur in plants and photosynthetic protists.

#### **Types of plastids**

There are three types. for example chloroplast, leucoplast and chromoplast.

#### **Chloroplast**

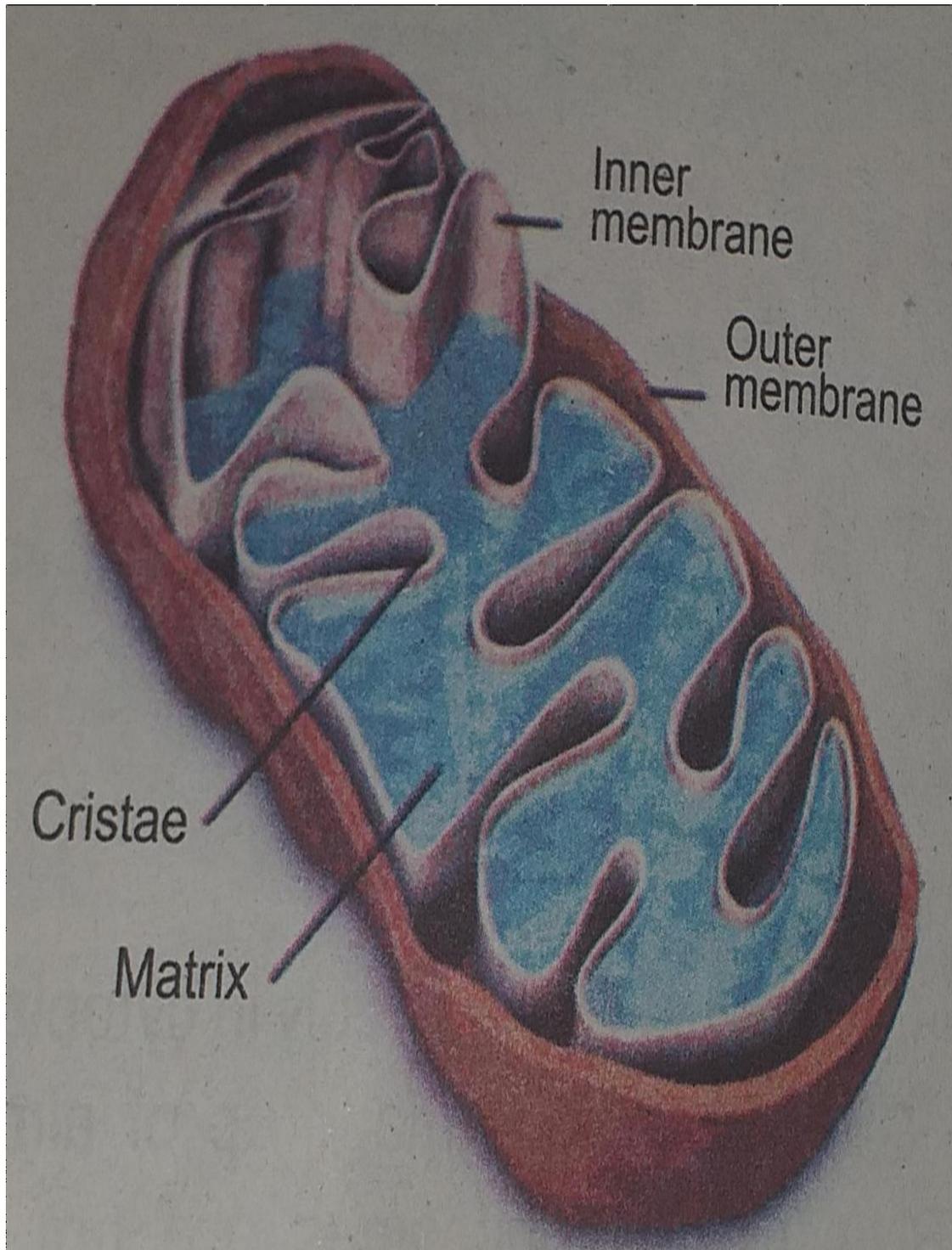
Like mitochondria chloroplast is also bound by a double membrane. The outer is smooth while the inner one gives rise to membranous sacs called thylakoids. The stack of thylakoids is called granum. Granum floats in the inner fluid of chloroplast for example stroma.

#### **Function**

Chloroplast are the sites of photosynthesis in eukaryotes they contain chlorophyll and associated pigments these pigments are present in the thylakoids of grana.

### **Chromoplast**

The second type of plastids in plant cell are chromoplast they contain pigment associated with the bright colors and present in the cell of flower



petals and fruits.

### **Functions**

Their function is to give color to these parts and has help in pollination and dispersal of fruit.

### **Leucoplast**

Leucoplast are the third type of plastids they are colourless and store starch protein and lipids they are present in the cells of those part where food is stored.

### **Q.8 write a note on endoplasmic reticulum.**

#### **Endoplasmic reticulum**

Endoplasmic reticulum is a network of interconnected channels that extends from cell membrane to the nuclear envelope.

**Types.** this network exist in two forms

#### **Rough endoplasmic reticulum.**

It is so named because of its rough appearance due to the numerous ribosomes attached to it due to the presence of ribosomes it serves a function in protein synthesis.

#### **Smooth endoplasmic reticulum.**

Smooth endoplasmic reticulum lacks ribosomes and is involved in lipid metabolism and in the transport of materials from one part of the cell to other it also detoxifies the harmful chemicals that have entered cell.

### **Q.9 write the structure and function of Golgi apparatus.**

#### **Golgi apparatus.**

#### **Discovery and structure.**

Italian physician Camillo Golgi discovered a set of flattened sacs cisterna in cell.

- In this set many cisterna are stacked over each other the complete set of the cisterna is called Golgi apparatus of Golgi complex.
- It is found in both plant and animal cells

**Function.**

It modifies molecules coming from the rough endoplasmic reticulum and packs them into small membrane bound sacs called Golgi vessels. These sacs can be transported to various locations in cell or to be its exterior in the form of secretions.

**Q.10 Who discovered lysosomes? write their structure and function.****Lysosomes**

**Discovery.** In the mid twentieth century the Belgian scientist **Christian Rene de Duve** discovered lysosomes.

**Structure**

These are single membrane bound organelle is lysosomes contain strong digestive enzyme and work for The breakdown of food and waste materials within the cell.

**Function**

During its functional lysosome fuses with the vacuole that contains the targeted material and its enzymes breakdown the material.

**Q.11 write down a note on vacuole.****Vacuole.**

Vacuoles are fluid-filled single membrane bound organelles present in cytoplasm of cells.

**Structure.**

vacuoles are flute filled single membrane bound organelles .cells have many small vacuoles in their cytoplasm. However when a plant cell matures its small vacuoles absorb water and fuse to form a single large vacuole in center

The cell in this state becomes turgid

**Functions**

- many cells take in materials from outside in the form of food vacuole and then digest the material with the help of lysosomes material

- some unicellular organism use contractile vacuoles for the elimination of waste from their bodies.

**Q.12 write down the main difference between prokaryotic and eukaryotic cell.**

Prokaryotes possess prokaryotic cells which are much simpler than the eukaryotic cells. The main differences between prokaryotic and **eukaryotic** cells are given below.

**Nucleus.** Eukaryotic cells have a prominent nucleus while prokaryotic cells do not have prominent nucleus their chromosomes consists of DNA only and it floats in cytoplasm near Centre this region is called nucleoid.

**Other organelles.** Eukaryotic cell have membrane bound organelle is like mitochondria Golgi apparatus endoplasmic reticulum etc while such membrane bound organelles are not present in prokaryotic cells.

- The Ribosomes of eukaryotic cells are larger in size as compared to the ribosomes of prokaryotic cells

**Size** eukaryotic cells are on average 10 times larger than prokaryotic cells.

**Cell wall** the cell wall of eukaryotic cell is made of cellulose or chitin all prokaryotic cells have cell wall is made of peptidoglycan.

**Q.13 what do you know about filtration? Explain it with the help of an example**

**Filtration**

Filtration is a process by which small molecules are forced to move across semipermeable membrane with the aid of hydrostatic pressure or blood pressure

**Explanation with example**

For example in the body of an animal blood pressure force is water and dissolved molecules to move through the semipermeable membranes of the capillary wall cells .infiltration the pressure cannot force large molecules such as proteins to pass through the membrane pores.

**Q.14 what is active transport? Explain with the help of an example**

## **Active transport**

active transport is the movement of molecules from an area of lower concentration to an area of higher concentration. This movement against the concentration gradient requires energy in the form of ATP. In this process, carrier proteins of the cell membrane use energy to move the molecules against the concentration gradient.

**Explanation with example** the membranes of nerve cells have carrier proteins in the form of sodium potassium pump. In a resting nerve cell, this pump spends energy to maintain a higher concentration of K<sup>+</sup> and a lower concentration of Na<sup>+</sup> inside the cell. For this purpose, the pump actively moves Na<sup>+</sup> to the outside of the cell where they are already in higher concentration. Similarly, this pump moves K<sup>+</sup> from outside to inside the cell where they are in higher concentration.

## **Q.15 Explain the types of epithelial tissues.**

### **Epithelial tissues**

- Epithelial tissue covers the outside of the body and lines organs and cavities.
- The cells in this type of tissue are very closely packed together.
- This tissue has many types on the basis of the shape of cells as well as the number of cell layers sometimes included.

### **Squamous epithelium**

Consists of a single layer of flat cells. It is found in lungs, heart, and blood vessels. Here it allows the movement of materials across it.

### **Cuboidal epithelium**

Consists of a single layer of cube-shaped cells. It is found in kidney tubules, small glands, etc. where it makes secretion.

### **Columnar epithelium**

Has tall, narrow cells. It is found in elementary canal, gallbladder, etc. where it makes secretion.

### **Ciliated columnar epithelium**

Has elongated cells with cilia it is present in trachea and bronchia and propels mucous.

### **Stratified squamous epithelium**

Has many layers of flat cells it is present in the lining of oesophagus and mouth and also over the skin it protects the inner parts.

### **Q.16 write a note on muscle tissues.**

Muscle tissue consists of bundles of long cells called muscles fibers

It is the most abundant tissue in animal

The cells of this tissue have ability to contract

### **Types of muscle tissues**

There are three kinds of muscle tissue

#### **Skeletal muscle**

Skeletal muscles or striated muscles are attached to bones their cells are striated and contain many nuclei they are responsible for the movement of bones. Skeletal muscles are voluntary action their contraction is under the control of our will.

#### **Smooth and Cardiac muscles**

Smooth and Cardiac muscles are involuntary in action their contraction is not under the control of our will. Smooth muscles are found in the walls of alimentary canal urinary bladder blood vessels etc there contains more cells each with single nucleus they are responsible for the movement of substances. Cardiac muscles are present in the wall of heart their cells are also striated but there is a single nucleus in each cells they produce heartbeat.

### **Q.17 write a note on meristematic tissue.**

#### **Meristematic tissue**

- these tissues are composed of cells which have the ability to divide
- the cells are thin walled have large nucleus and small or no vacuoles
- They do not have intercellular spaces among them.

- Two main types of meristematic tissues are recognized in plants.
- **Apical meristems** are located at the apices of root and shoot when they divide they cause increase in the length of plants such a growth is called primary growth.
- **Lateral meristems** located on the lateral sides of root and shoot by dividing they are responsible for increase in girth of plant parts this growth is called secondary growth.
- **Types of lateral meristems** they are further of two types vascular cambium and cork cambium

**Q.18 write a note on support tissues.**

This issues provides strength and flexibility to plants

**Types** they are further of two types of support tissues. These are

**Collenchyma tissue**

- They are found in cortex of young stems and in the midribs of leaves and in petals of flowers.
- They are made of elongated cells with unevenly thickened primary cell walls.
- They are flexible and function to support the organs in which they are found.

**Sclerenchyma tissue.**

They are composed of Cells with rigid secondary cell walls . the cell walls are hardened with lignin which is the main chemical component of wood .Mature sclerenchyma cells cannot elongate and most of them are dead.

**Q.19 write a note on xylem tissue.**

**Xylem tissue**

- Responsible for the transport of water and dissolved substances from roots to the aerial parts
- Due to the presence of lignin the secondary walls of its cells are thick and rigid.

- That is why xylem tissue provides support to the plant body.
- Two types of cell are found in xylem tissue for example vessel elements and tracheids.
- Vessel elements of cells have thick secondary cell walls they lack end walls and join together to form long tubes. Tracheids are slender cells with overlapping ends

**Q.20 write a note on phloem tissue.**

phloem tissue is responsible for the conduction of dissolved organic matter between different parts of the plant body. Phloem tissue contains sieve tube cells and companion cells

**Sieve tube cells**

They are long and their end walls have small pores. Many sieve tube cells join to form long sieve tubes.

**Companion cells**

They make proteins for sieve tube cells.

## Short Questions

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### 1 \_Who discovered the first compound microscope?

The first compound microscope was developed by Zacharias Janssen Holland in 1595. It was simply a tube with lenses at each end and its magnification range from 3x to 9X.

### 2\_Define magnification and resolution

**Magnification** the increase in the apparent size of an object is called magnification. It is an important factor in microscopy.

**Resolution** the measure of clarity of an image is called resolution or resolving power. It is the minimum distance at which two objects can be seen as separate objects.

### 3\_Define microscopy

The use of microscope is known as microscopy

### 4\_What is a micro graph?

A Photograph taken by a microscope is known as micro graph.

### 5\_What is meant by transmission electron microscope?

In TEM electrons are transmitted through the specimen. It is used to study the internal cell structure

### 6\_Write down any two principles included in a Cell theory?

1 all organisms are composed of one or more cells.

2 cells are the smallest living things the basic unit of organization of all organisms.

3 cells arise only by divisions in previously existing cells.

### 7\_Differentiate between primary and secondary cell wall

**Primary cell wall** the outer layer of the plant cell wall is known as primary wall and cellulose is the most common chemical in it.

**Secondary cell wall** some plant cells for example xylem cells also have secondary walls on the inner side of primary wall it is much thicker and contains Lignin and some other chemicals.

### **8\_ Define cell membrane?**

In prokaryotic and eukaryotic cells have a thin and elastic membrane which covers the cytoplasm it is called cell membrane.

### **9\_Write about fluid mosaic model of cell membrane**

Electron microscope reveals the fluid mosaic model of cell membrane according to it.

- 1 There is lipid bilayer in which protein molecules are embedded.
- 2 Lipid bilayer gives fluidity and elasticity to the membrane.
- 3 Small amount of carbohydrates are also found in cell membranes.
- 4 In eukaryotic cell Cholesterol is also present in lipids bilayer.

### **10\_Define plasmodesmata.**

**Plasmodesmata** there are pores in the cell wall of adjacent cell through which the cytoplasm is connected these pores are called plasmodesmata.

### **11\_Define thylakoids?**

The inner membrane of chloroplast give rise to sacs floating in the fluid stroma are called thylakoids.

### **12\_Define facilitated diffusion.**

The movement of molecules from higher concentration to lower concentration with the help of carrier protein is called facilitated diffusion.

### **13\_What is turgor pressure?**

The outward pressure on the cell wall exerted by internal water due to entry of water. when the plant cell is placed in hypotonic environment is called turgor pressure and this phenomena is called as turgor .

### **14\_Define plasmolysis**

**Plasmolysis** the process of shrinking of cytoplasm due to loss of water from cell when a plant is placed in hypertonic environment called plasmolysis.

**15\_ Define secondary growth.**

Lateral meristem are located on the lateral sides of roots and shoots .By dividing they are responsible for increase in thickness of plant parts this growth is called secondary growth.

**16\_ What is stroma?**

stroma is a fluid with in the chloroplast in which thylakoids floats.

**17\_ Why rough endoplasmic reticulum is called as rough endoplasmic reticulum?**

Due to the presence of ribosomes on its surface its appearance look rough so it is called as rough endoplasmic reticulum.

**18\_ What is diffusion?**

The movement of molecules from higher concentration to lower concentration is called as diffusion.

**19\_ Define active transport.**

the movement of molecules from the area of lower concentration to the area of higher concentration with the expenditure of energy in the form of ATP is called as active transport.

**20\_ What is filtration?**

filtration as a process by which small molecules are forced to move across the semipermeable membrane with the aid of hydrostatic pressure or blood pressure.

**21\_ What is meant by endocytosis? Also write names it's types.**

**Endocytosis** it is a the process of cellular injection of bulky material by the in folding of cell membrane the two forms of endocytosis are **phagocytosis** and **pinocytosis**

**22\_ Define exocytosis?**

It is the process from which bulky material is exported.

### **23\_ Write two differences between skeletal and smooth muscles**

**Smooth muscles** smooth muscles are found in the walls of alimentary canal urinary bladder blood vessels etc. they contain non striated cells each with a single nucleus they are responsible for the movement of substances.

**Skeletal muscles** the cells are striated and contain many nuclei they are responsible for the movement of bones.

### **24\_ Differentiate between simple tissues and compound tissues in plants.**

**Compound tissues** plant tissue composed of more than one type of cell is called a compound or complex tissue for example xylem and phloem.

**Simple tissues** The tissues which are made of single type of cells is called simple tissues.

### **25\_ What is meant by collenchyma tissue?**

They are found in cortex of young stems and in the midribs and petals of flowers. They are made of elongated cells and unevenly thickened primary cell wall.

### **26\_ What is meant by the term tonicity?**

The term refers to the relative concentration of solutes in the solution being compared.

### **27\_ Differentiate between Cristae and cisternae.**

**Cristae** the inner membrane of Mitochondria has many infoldings called Cristae .

**Cisternae** the set of flattened sacs of Golgi apparatus in cell is called cisternae.

### **28\_ What is the role of nucleus?**

Nucleus control all the activities of cell.

### **29\_ Differentiate between voluntary and involuntary muscles.**

**Voluntary muscles** The types of muscles are called voluntary muscles if their contraction is under the control of our will.

**Involuntary muscles** the type of muscles whose contraction are not under the control of our will are called in voluntary muscles.

**30\_ Write the functions of xylem and phloem tissues.**

**Xylem tissues** xylem tissue is responsible for the conduction of water and dissolved substance from roots to the aerial parts. Due to the presence of their lignin there walls are thick and provide support to the plant body.

**Phloem tissues** phloem tissues are responsible for the transmission of organic material to the different parts of plant.

# Chemistry Lectures (SSC) Part – I

9<sup>th</sup> Class CHEMISTRY

## CH # 3 Periodic Table & Periodicity of properties

Introduction,

Historical background of periodic table

Dobereiner's Triads, Newlands Octaves, Mendeleev's Periodic Table

Modern Periodic Law, Modern Periodic Table

&

Periodicity of Properties e.g.  
Atomic radii, I. E, E. A  
E. N & Shielding Effect



# Abd-ur-Rasheed

(Subject Specialist M. Phil Chemistry)



# Notes

# Introduction

## What is Periodic table?

In 19<sup>th</sup> century, chemists devoted much of their efforts in attempts to arrange elements in a systematic manner.

These efforts resulted in discovery of periodic law.

On the basis of this law, the elements known at that time, were arranged in the form of a table which is known as periodic table.

One of the significant features of the table was that it predicted the properties of those elements which were not even discovered at that time.

The vertical columns of that table were called groups and horizontal lines ( rows ) were called periods.

That orderly arrangement of elements generally coincided with their increasing atomic number.

The periodic table contains huge amount of information for scientists.

## PERIODIC TABLE

With the discovery of the periodic table the study of individual properties of the known elements is reduced to study of few groups & periods.

We will describe various attempts which were made to classify the elements into a tabular form.

## Dobereiner's Triads



Johann Wolfgang Döbereiner was a German chemist who is best known for work that foreshadowed the periodic law for the chemical elements, and for inventing the first lighter, which was known as the Döbereiner's lamp.

A German chemist Dobereiner ( 1829 ) observed relationship between atomic masses of several groups of three elements called triads.

In these groups, the central or middle element had atomic mass average of the other two elements.

### Dobereiner's Triads

Elements and their Atomic Mass

Average ( Mean ) Atomic Mass

Group 1

Lithium (Li)	Sodium (Na)	Potassium (K)
7.0	23.0	39.0

$$\frac{7.0 + 39.0}{2} = 23.0$$

Group 2

Calcium (Ca)	Strontium (Sr)	Barium (Ba)
40.0	88.0	137.0

$$\frac{40.0 + 137.0}{2} = 88.5$$

In Group 1 triad  
The atomic mass of Sodium is the average of the atomic masses of Lithium and Potassium.

In Group 2 triad  
The atomic mass of Strontium is the average of the atomic masses of Calcium and Barium.

### Reasons of failure

1. Only a few elements could be arranged in this way.
2. This classification did not get wide acceptance.



# Newlands Octaves

After successful determination of correct atomic masses of elements by Cannizzaro in 1860, attempts were again initiated to organize elements.

In 1864 British chemist Newlands put forward his observations in the form of 'law of octaves'.

He noted that there was a repetition in chemical properties of every eighth element if they were arranged by their increasing atomic masses.

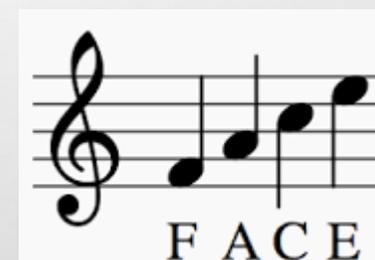
John Alexander Reina Newlands  
(26 November 1837 – 29 July 1898)

was a British chemist who worked concerning the periodicity of elements.

He compared it with musical notes.

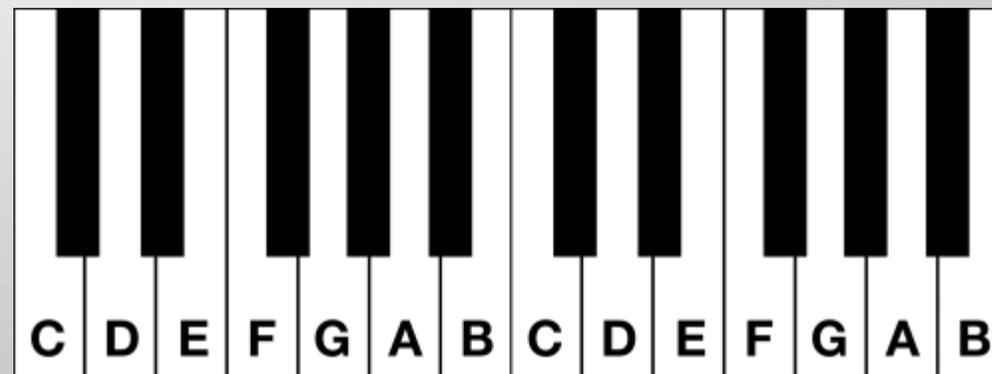
Music notes are named after the first Seven letters of the alphabet: A, B, C, D, E, F, G.

Newlands Octaves						
H	Li	Ga	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca				



## Reasons of failure

1. His work could not get much recognition as no space was left for undiscovered element.
2. The noble gases were also not known at that time.



Piano Keyboard

# Mendeleev's Periodic Table

Russian chemist, Dimitri Mendeleev arranged the known elements (only 63) in order of increasing atomic masses, in horizontal rows called periods.

So that elements with similar properties were in the same vertical columns called groups.

This arrangement of elements was called Periodic Table.

He put forward the results of his work in the form of periodic law, which is stated as

"properties of the elements are periodic functions of their atomic masses"

Although, Mendeleev periodic table was the first ever attempt to arrange the elements, yet it has a few demerits in it.

His failure to explain the position of isotopes and wrong order of the atomic masses of some elements suggested that atomic mass of an element cannot serve as the basis for the arrangement of elements.

Mendeleev's Periodic Table (1869)

I	II	III	IV	V	VI	VII	VIII	VIII	VIII
H 1.01									
Li 6.94	Be 9.01	B 10.8	C 12.0	N 14.0	O 16.0	F 19.0			
Na 23.0	Mg 24.3	Al 27.0	Si 28.1	P 31.0	S 32.1	Cl 35.5			
K 39.1	Ca 40.1		Ti 47.9	V 50.9	Cr 52.0	Mn 54.9	Fe 55.9	Co 58.9	Ni 58.7
Cu 63.5	Zn 65.4			As 74.9	Se 79.0	Br 79.9			
Rb 85.5	Sr 87.6	Y 88.9	Zr 91.2	Nb 92.9	Mo 95.9		Ru 101	Rh 103	Pd 106
Ag 108	Cd 112	In 115	Sn 119	Sb 122	Te 128	I 127			
Ce 133	Ba 137	La 139		Ta 181	W 184		Os 194	Ir 192	Pt 195
Au 197	Hg 201	Tl 204	Pb 207	Bi 209					
			Th 232		U 238				

## Mendeleev's Periodic Table

Mendeleev (1834-1907) was a Russian chemist and inventor. He was the creator of first version of periodic table of elements. With help of the table, he predicted the properties of elements yet to be discovered.



## Modern Periodic Law

In 1913 Henry Moseley discovered a new property of the elements i.e. atomic number.

He observed that atomic number instead of atomic mass should determine the position of element in the periodic table and accordingly the periodic law was amended as

"properties of the elements are periodic function of their atomic numbers".

Atomic number of an element is equal to

the number of electrons in a neutral atom / number of protons in the nucleus of an atom OR simple ions

So atomic number provides the basis of electronic configurations as well.



Do you know?

*Atomic number is a more fundamental property than atomic mass because atomic number of every element is fixed and it increases regularly by 1 from element to element. No two elements can have the same atomic number.*

## Test yourself 3.1

i. What was the contribution of Dobereiner towards classification of elements?

**Ans:** Dobereiner observed relationship between atomic masses of several groups of three elements called triads.

ii. How Newlands arranged the elements?

**Ans:** British chemist Newlands arranged elements in the form of 'law of octaves'.

He noted that there was a repetition in chemical properties of every eighth element if they were arranged by their increasing atomic masses.

iii. Who introduced the name Periodic Table ?

**Ans:** Dimitri Mendeleev introduced the name Periodic Table

iv. Why the improvement in Mendeleev's periodic table was made?

Ans: Because Mendeleev's Periodic table was based on the atomic masses which proved to be an unreliable basis to classify elements

v. State Mendeleev's periodic law.

Ans: Mendeleev's periodic law states

"properties of the elements are periodic functions of their atomic masses"

vi. Why and how elements are arranged in a period?

Ans: Atoms are arranged horizontally across a period by the order of increasing atomic numbers because it increases regularly.

## Modern Periodic Table

Atomic number of an element is more fundamental property than atomic mass in two respects,

(a) It increases regularly from element to element, (b) It is fixed for every element.

So the discovery of atomic number of an element in 1913

led to change in Mendeleev's periodic law which was based on atomic mass.

The modern periodic table is based upon the arrangement of elements according to increasing atomic number.

When the elements are arranged according to increasing atomic number from left to right in a horizontal row,

properties of elements were found repeating after regular intervals such that

elements of similar properties and similar configuration are placed in the same group.

It was observed that after every eighth element, ninth element had similar properties to the first element.

For example, sodium ( $Z=11$ ) had similar properties to lithium ( $Z=3$ ).

After atomic number 18, every nineteenth element was showing similar behaviour.

So the long rows of elements were cut into rows of eight and eighteen elements

and placed one above the other so that a table of vertical and horizontal rows was obtained.

# Long form of Periodic Table

The significance of atomic number

in the arrangement of elements in the modern periodic table lies in the fact that as electronic configuration is based upon atomic number,

so the arrangement of elements according to increasing atomic number shows the periodicity (repetition of properties after regular intervals)

in the electronic configuration of the elements that leads to periodicity in their properties.

Hence, the arrangement of elements based on their electronic configuration

created a long form of periodic table as shown in figure 3.1.

**See Text Book Page # 48**

## About Periods?

The horizontal rows of elements in the periodic table are called periods.

The elements in a period have continuously increasing atomic number

i.e. continuously changing electronic configuration along a period.

As a result properties of elements in a period are continuously changing.

The number of valence electrons decides the position of an element in a period. , For example, elements which have 1 electron in their valence shell occupies the left most position in the respective periods such as alkali metals. Similarly, the elements having 8 electrons in their valence shells

such as noble gases always occupy the right most position in the respective periods.

## About Groups?

The vertical columns in the periodic table are called groups.

These groups are numbered from left to right as 1 to 18.

The elements in a group do not have continuously increasing atomic numbers.

Rather the atomic numbers of elements in a group increase with irregular gaps.

But the elements of a group have similar electronic configuration

i.e. same number of electrons are present in their valence shells.

For example, the first group elements have only 1 electron in their valence shells.

Similarly, group 2 elements have 2 electrons in their valence shells.

It is the reason due to which elements of a group have similar chemical properties.

## Salient Features of Long Form of Periodic Table:

- i. This table consists of seven horizontal rows called periods.
  - ii. First period consists of only two elements.  
Second and third periods consist of 8 elements each.  
Fourth and fifth periods consist of 18 elements each.  
Sixth period has 32 elements while seventh period has 23 elements and is incomplete.
  - iii. Elements of a period show different properties.
  - iv. There are 18 vertical columns in the periodic table numbered 1 to 18 from left to right, which are called groups.
  - v. The elements of a group show similar chemical properties.
  - vi. Elements are classified into four blocks depending upon the type of the subshell which gets the last electron.

## About Blocks?

See Text Book page # 48

On the basis of completion of a particular subshell,

elements with similar subshell electronic configuration are referred as a block of elements.

There are four blocks in the periodic table

named after the name of the subshell which is in the process of completion by the electrons.

These are *s*, *p*, *d* and *f* blocks as shown in figure 3.2.

*s* – block

*d* – block

*p* – block

*f* – block

For example, elements of group 1 and 2 have valence electrons in 's' subshell.

Therefore, they are called **s-block elements** as shown in figure 3.2.

Elements of group 13 to 18 have their valence electrons in subshell.

Therefore, they are referred as **p-block elements**. as shown in figure 3.2.

The **d-block** lies between the s and p blocks. d-block constitutes period 4,5 and 6.

While **f-block** lies separately at the bottom.

Each period consists of ten groups starting from group 3 to group 12.

These are called **transition metals**

Alchemy! For thousand years alchemy remained field of interest for the scientists. They worked with two main objectives; change common metals into gold and second find cure to diseases and give eternal life to people. They believed all kinds of matter were same combination of four basic elements. Substances are different because these elements combine differently. Changing composition or ratio of any one element, new substances can be formed. The way of making gold from silver or lead was never found and secret of eternal life was never discovered. However, many methods and techniques invented by alchemists are still used in chemistry.



*Do you know?*

**Periods :** First period is called short period. It consists of only two elements, hydrogen and helium.

Second and third periods are called normal periods. Each of them has eight elements in it.

Second period consists of lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine and ends at neon, a noble gas.

Fourth and fifth periods are called long periods.

Each one of them consists of eighteen elements.

Whereas, sixth and seventh periods are called very long periods.

In these periods after atomic number 57 and 89, two series of fourteen elements each, were accommodated.

Because of space problem, these two series were placed separately below the normal periodic table to keep it in a manageable and presentable form.

Since the two series start after Lanthanum ( $Z=57$ ) and Actinium ( $Z=89$ ), so these two series of elements are named as Lanthanides and Actinides respectively.

Table 3.1 shows the distribution of elements in periods.

All the periods except the first period start with an alkali metal and end at a noble gas.

It is to be observed that number of elements in a period is fixed because of maximum number of electrons which can be accommodated in the particular valence shell of the elements.

**Table 3.1 Different Periods of the Periodic Table**

Period No.	Name of the Period	Number of elements	Range of atomic numbers	
1 <sup>st</sup>	Short period	2	1 to 2	
2 <sup>nd</sup>		8	3 to 10	
3 <sup>rd</sup>	Normal period	8	11 to 18	
4 <sup>th</sup>		Long period	18	19 to 36
5 <sup>th</sup>			18	37 to 54
6 <sup>th</sup>	Very Long Period	32	55 to 86	
7 <sup>th</sup>		[32]*	87 to 118*	

\*Since new elements are expected to be discovered, it is an incomplete period

## Groups 1

Group 1 consists of hydrogen, lithium, sodium, potassium, rubidium, cesium and francium. Although elements of a group do not have continuously increasing atomic numbers, yet they have similar electronic configuration in their valence shells.

That is the reason elements of a group are also called a family.

For example, all the group 1 elements have one electron in their valence shells, they are given the family name of alkali metals.

The groups 1 and 2 and 13 to 17 contain the normal elements.

In the normal elements, all the inner shells are completely filled with electrons, only the outermost shells are incomplete.

For example, group 17 elements (halogens) have 7 electrons in their valence (outermost) shell.

The groups 3 to 12 are called transition elements. In these elements 'd' sub-shell is in the process of completion. Table 3.2 shows the distribution of elements in groups.

**Table 3.2 Different Groups of the Periodic Table**

Valence electrons	Group number	Family name	General Electronic configuration
1 electron	1	Alkali metals	$ns^1$
2 electrons	2	Alkaline earth <b>Metals</b>	$ns^2$
3 electrons	13	Boron family	$ns^2 np^1$
4 electrons	14	Carbon family	$ns^2 np^2$
5 electrons	15	Nitrogen family	$ns^2 np^3$
6 electrons	16	Oxygen family	$ns^2 np^4$
7 electrons	17	Halogen family	$ns^2 np^5$
8 electrons	18	Noble gases	$ns^2 np^6$



**Do you know?**

Alchemy! For thousand years alchemy remained field of interest for the scientists. They worked with two main objectives; change common metals into gold and second find cure to diseases and give eternal life to people. They believed all kinds of matter were same combination of four basic elements. Substances are different because these elements combine differently. Changing composition or ratio of any one element, new substances can be formed. The way of making gold from silver or lead was never found and secret of eternal life was never discovered. However, many methods and techniques invented by alchemists are still used in chemistry.



*Test yourself?*  
3.2

- i. How the properties of elements repeat after regular intervals?
- ii. In which pattern modern periodic table was arranged?
- iii. How many elements are in first period and what are their names and symbols?
- iv. How many elements are placed in 4th period?
- v. From which element lanthanide series starts?
- vi. From which period actinides series starts?
- vii. How many elements are in 3rd period, write their names and symbols?
- viii. How many periods are considered normal periods ?
- ix. What do you mean by a group in a periodic table?
- x. What is the reason of arranging elements in a group?
- xi. What do you mean by periodic function?
- xii. Why the elements are called s or p block elements?
- xiii. Write down the names of elements of group 1 with their symbols?
- xiv. How many members are in group 17, is there any liquid, what is its name ?

# Answers

Test yourself? 3.2

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i. How the properties of elements repeat after regular intervals?

**Answer:** If the elements are arranged in the order of their atomic numbers from left to right in a horizontal row, their properties repeat after regular intervals. Elements having similar properties repeated at regular intervals. Elements with similar properties and similar electronic configuration are placed in a similar group.

ii. In which pattern modern periodic table was arranged?

**Answer:** The ascending order of atomic number is the pattern on which modern periodic table was arranged. This arrangement of elements shows the periodicity (repetition of properties after intervals) in their electronic configuration.

iii. How many elements are in first period and what are their names and symbols?

**Answer:** there are two elements in the first period of the modern periodic table

1. Hydrogen (**H**)

2. Helium (**He**)

iv. How many elements are placed in 4th period?

**Answer:** In the 4<sup>th</sup> period **18** elements are placed

v. From which element lanthanide series starts?

**Answer:** The Lanthanide series starts from Cerium (**Ce**)

vi. From which period actinides series starts?

**Answer:** The actinide series starts from 7<sup>th</sup> period

vii. From which period lanthanide series starts?

**Answer:** The lanthanide series starts from 6<sup>th</sup> period

viii. How many elements are in 3<sup>rd</sup> period, write their names and symbols?

**Answer:** There are 8 elements in the 3<sup>rd</sup> period:

1. Sodium (**Na**)
2. Magnesium (**Mg**)
3. Aluminium (**Al**)
4. Silicon (**Si**)
5. Phosphorus (**P**)
6. Sulphur (**S**)
7. Chlorine (**Cl**)
8. Argon (**Ar**)

ix. How many periods are considered normal periods ?

**Answer:** " 2<sup>nd</sup> and 3<sup>rd</sup> period are considered normal periods. Each having 8 elements

x. What do you mean by a group in a periodic table?

**Answer:** "A vertical column of elements in the periodic table is called a group"

xi. What is the reason of arranging elements in a group?

**Answer:** This is because they have similar electronic configuration in their valence shells

xii. What do you mean by periodic function?

**Answer:** A function which repeats elements having similar positions in the periodic table to have similar properties is called periodic function

xiii. Why the elements are called s or p block elements?

**Answer:** The elements in which last electron enters the "s" subshell are called s-block elements and the elements which have the last electrons in the "p" subshell are called p-block elements.

xiv. Write down the names of elements of group 1 with their symbols?

**Answer:**

- |              |      |             |      |
|--------------|------|-------------|------|
| 1. Hydrogen  | (H)  | 5. Rubidium | (Rb) |
| 2. Lithium   | (Li) | 6. Cesium   | (Cs) |
| 3. Sodium    | (Na) | 7. Francium | (Fr) |
| 4. Potassium | (K)  |             |      |

### 3.2.1 Atomic Size and Atomic Radius

As we know that atoms are very small and don't have defined boundaries that fix their size.

So it is difficult to measure the size of an atom.

Therefore, the common method to determine the size of an atom is to assume that atoms are spheres.

When they lie close to each other, they touch each other.

Half of the distance between the nuclei of the two bonded atoms is referred as the atomic radius of the atom.

For example, the distance between the nuclei of two carbon atoms in its elemental form is 154 pm,

its means its half 77 pm is radius of carbon atom as shown in Figure 3.3:

When we move from left to right in a period although atomic number increases, yet the size of atoms decreases gradually. It is because with the increase of atomic number, the effective nuclear charge increases gradually because of addition of more and more protons in the nucleus.

But on the other hand addition of electrons takes place in the same valence shell i.e. shells do not increase.

There is gradual increase of effective nuclear charge which increases due to addition of protons.

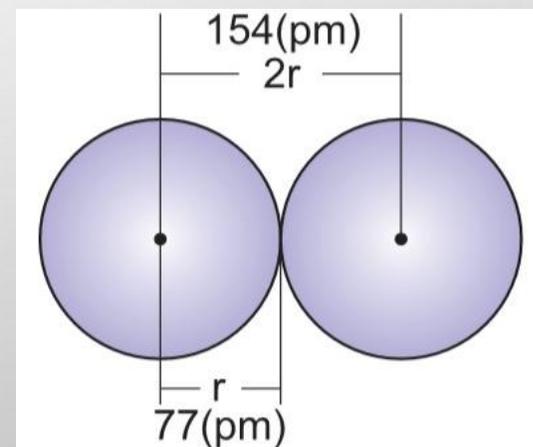


Fig. 3.3 The radius of carbon atom.

This force pulls down or contracts the outermost shell towards the nucleus.

For example, atomic size in period 2 decreases from Li (152 pm) to Ne (69 pm).

2 <sup>nd</sup> period elements	<sup>3</sup> Li	<sup>4</sup> Be	<sup>5</sup> B	<sup>6</sup> C	<sup>7</sup> N	<sup>8</sup> O	<sup>9</sup> F	<sup>10</sup> Ne
Atomic radii (pm)	152	113	88	77	75	73	71	69

1 <sup>st</sup> group elements	Atomic radii (pm)
--------------------------------	-------------------

<sup>3</sup>Li

152

<sup>11</sup>Na

186

<sup>19</sup>K

227

<sup>37</sup>Rb

248

<sup>55</sup>Cs

265

The size of atoms or their radii increases from top to bottom in a group. It is because a new shell of electrons is added up in the successive period, which decreases the effective nuclear charge.

The trend of atomic size of transition elements has slight variation when we consider this series in a period. atomic size of the elements first reduces or atom contracts and then there is increase in it when we move from left to right in 4th period.

### Shielding Effect

The electrons present between the nucleus and the outer most shell of an atom, reduce the nuclear charge felt by the electrons present in the outer most shell.

The attractions of outer electrons towards nucleus is partially reduced because of presence of inner electrons.

As a result valance electron experiences less nuclear charge than that of the actual charge, which is called effective nuclear charge ( $Z$ ). It means that the eff electrons present in the inner shells screen or shield the force of attraction of nucleus felt by the valance shell electrons. This is called shielding effect.

With increase of atomic number, the number of electrons in an atom also increases, that results in increase of shielding effect.

The shielding effect increases down the group in the periodic table as shown in the figure 3.4. Because of this it is easy to take away electron from Potassium ( $Z=19$ ) than from Sodium ( $Z=11$ ) atoms.

Similarly the shielding effect decreases in a period if we move from left to right.

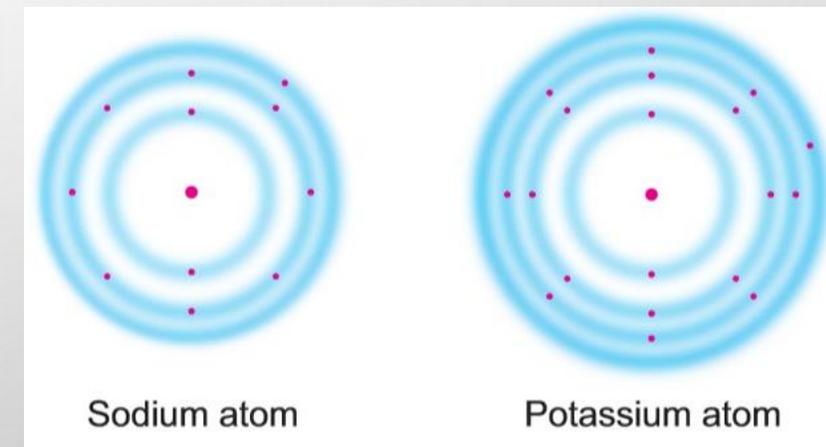


Fig. 3.4: Shielding effect is more in potassium atom than that of sodium atom.

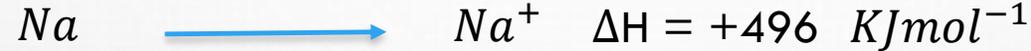
## Ionization Energy

The ionization energy is the amount of energy required to remove the most loosely bound electron from the valence shell of an isolated gaseous atom.

of energy needed to remove successive electrons present in an atom increases.

only 1 electron in the valence shell, the energy required to remove it will be called first ionization energy.

For example, the first ionization energy of sodium atom is  $+ 496 \text{ KJmol}^{-1}$ .



But when there are more than one electrons in the valence shell, they can be removed one by one by providing more and more energy.

Such as group 2 and 3 elements have more than one electrons in their shells. Therefore, they will have more than one ionization energy values.

If we move from left to right in a period, the value of ionization energy increases.

It is because the size of atoms reduces and valence electrons are held strongly by the electrostatic force of nucleus.

Therefore, elements on left side of the periodic table have low ionization energies as compared to those on right side of the periodic table as shown for the 2 period.



Ionization energy increasing in a period

2 <sup>nd</sup> period elements	<sup>3</sup> Li	<sup>4</sup> Be	<sup>5</sup> B	<sup>6</sup> C	<sup>7</sup> N	<sup>8</sup> O	<sup>9</sup> F	<sup>10</sup> Ne
<b>Ionization Energy</b> <i>KJmol<sup>-1</sup></i>	520	899	801	1086	1402	1314	1681	2081

As we move down the group more and more shells lie between the valence shell and the nucleus of the atom,

these additional shells reduce the electrostatic force felt by the electrons present in the outermost shell.

Resultantly the valence shell electrons can be taken away easily.

Therefore, ionization energy of elements decreases from top to bottom in a group.

1 <sup>st</sup> Group Elements	Ionization Energy <i>KJmol<sup>-1</sup></i>
<sup>3</sup> Li	520
<sup>11</sup> Na	496
<sup>19</sup> K	419
<sup>37</sup> Rb	403
<sup>55</sup> Cs	377



Ionization energy decreasing in a group

As we move down the group more and more shells lie between the valence shell and the nucleus of the atom, these additional shells reduce the electrostatic force felt by the electrons present in the outermost shell.

Resultantly the valence shell electrons can be taken away easily. Therefore, ionization energy of elements decreases from top to bottom in a group.

## Electron Affinity

Electron Affinity is defined as the amount of energy released when an electron is added in the outermost shell of an isolated gaseous atom.

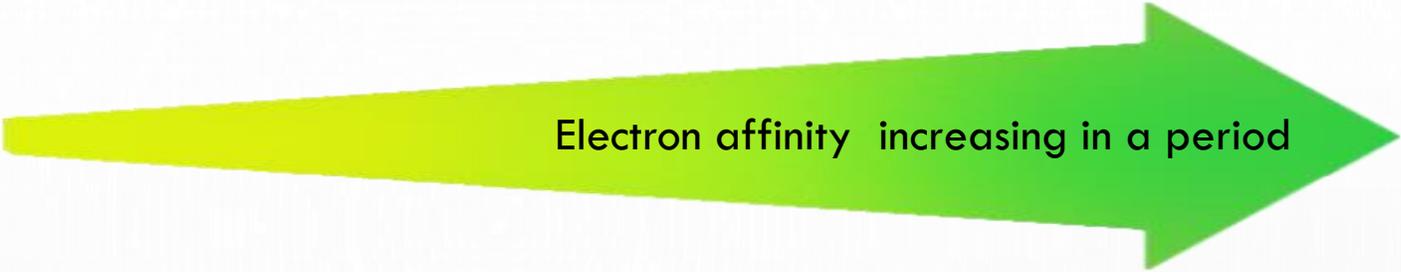


Affinity means attraction. Therefore, electron affinity means tendency of an atom to accept an electron to form an anion.

For example, the electron affinity of fluorine is  $-328 \text{ kJ mol}^{-1}$  i.e. one mole atom of fluorine release 328 kJ of energy to form one mole of fluoride ions.

Let us discuss the trend of electron affinity in the periodic table. Electron affinity values increase from left to right in the period.

2 <sup>nd</sup> period elements	<sup>3</sup> Li	<sup>3</sup> Be	<sup>5</sup> B	<sup>6</sup> C	<sup>7</sup> N	<sup>8</sup> O	<sup>9</sup> F	<sup>10</sup> Ne
<b>Electron affinity</b> ( $\text{KJmol}^{-1}$ )	-60	>0	-29	-122	0	-141	-328	0



Electron affinity increasing in a period

The reason for this increase is, as the size of atoms decreases in a period, the attraction of the nucleus for the incoming electron increases.

That means more is attraction for the electron, more energy will be released.

In a group electron affinity values decrease from top to bottom because the size of atoms increases down the group.

With the increase in size of atom shielding effect increases that results in poor attraction for the incoming electron i.e. less energy is released out.

For example, as the size of iodine atom is bigger than chlorine, its electron affinity is less than iodine, as given in the adjacent table.

17 <sup>th</sup> group elements	Electron affinity ( $\text{kJmol}^{-1}$ )
${}^9\text{F}$	-328
${}^{17}\text{Cl}$	-349
${}^{35}\text{Br}$	-325
${}^{53}\text{I}$	-295



Electron affinity decreasing in a group

## Electronegativity

The ability of an atom to attract the shared pair of electrons towards itself in a molecule, is called electronegativity.

It is an important property especially when covalent type of bonding of elements is under consideration. The trend of electronegativity is same as of ionization energy and electron affinity.

It increases in a period from left to right because higher  $Z$  shortens distance eff from the nucleus of the shared pair of electrons.

This enhances the power to attract the shared pair of electrons. For example, electronegativity values of group 2 are as follow:

2 <sup>nd</sup> period elements	<sup>3</sup> Li	<sup>4</sup> Be	<sup>5</sup> B	<sup>6</sup> C	<sup>7</sup> N	<sup>8</sup> O	<sup>9</sup> F
Electronegativity	1.0	1.6	2.0	2.6	3.0	3.4	4.0

Electronegativity increasing in a period

It generally decreases down a group because size of the atom increases. .

Thus attraction for the shared pair of electrons weakens. For example, electronegativity values of group 17 (halogens) are presented here.

17 <sup>th</sup> group elements	electro negativity
<sup>9</sup> F	4.0
<sup>17</sup> Cl	3.2
<sup>35</sup> Br	3.0
<sup>53</sup> I	2.7

Electronegativity decreasing in a group

i. Define atomic radius? ii. What are SI units of atomic radius? iii. Why the size of atoms decreases in a period? iv. Define ionization energy. v. Why the 2 ionization energy of an elements is higher than first one? vi. What is the trend of ionization energy in a group? vii. Why the ionization energy of sodium is less than that of magnesium? viii. Why is it difficult to remove an electron from halogens? ix. What is shielding effect? x. How does shielding effect decrease the forces of electrostatic attractions between nucleus and outer most electrons? xi. Why does the bigger size atoms have more shielding effect? xii. Why does the trend of electron affinity and electronegativity is same in a period? xiii. Which element has the highest electronegativity?



Test your self  
3.3

i. Define atomic radius?

**Answer:** The half of the distance between the nuclei of the two bonded atoms is called the atomic radius of the atom .

ii. What are SI units of atomic radius?

**Answer:** The SI units of atomic radius are nanometer and picometer

$$1 \text{ nm} = 10^{-9} \text{ m} ; 1 \text{ pm} = 10^{-12} \text{ m}$$

iii. Why the size of atoms decreases in a period?

**Answer:** It is because with the increase of atomic number , the effective nuclear charge increases gradually with the Addition of more and more protons in the nucleus . This force pulls down and contracts the outermost shell towards the nucleus

iv. Define ionization energy.

**Answer:**

*"The amount of energy required to remove the most loosely bonded electron from the valence shell of an isolated gaseous atom is called ionization energy."*

v. Why the 2<sup>nd</sup> ionization energy of an elements is higher than first one?

**Answer:** The 2<sup>nd</sup> ionization energy is higher because after the removal of an electron from an atom, the number of electron decreases , so nuclear charge becomes dominant and the remaining electrons are attracted more strongly towards the nucleus. Thus more energy is required to knock out other electron. That is why the 2<sup>nd</sup> ionization energy value

of an element is higher than first one. e.g.  $Mg_{(g)} \rightarrow Mg_{(g)}^{+} + 1e^{-}$   $I.E_1 = +738KJmol^{-1}$



vi. What is the trend of ionization energy in a group?

**Answer:** The ionization energy of elements decreases from top to bottom in a group.

vii. Why the ionization energy of sodium is less than that of magnesium?

**Answer:** The it is because of the following three reasons

1. Higher atomic size of Na than Mg
2. Lower nuclear charge (Na=11) than Mg(Mg=12)
3. Less stable configuration than Mg

Viii. Why is it difficult to remove an electron from halogens?

**Answer:** It is due to;

1. Decrease in atomic size
2. Increase in nuclear charge

ix. What is shielding effect?

**Answer:** The effect of decrease in forces of attraction between the nucleus and valence electrons due to the increase in inner shells or inner shell electrons between them is called shielding effect

x. How does shielding effect decrease the forces of electrostatic attractions between nucleus and outermost electrons?

**Answer:** The shielding effect decreases the forces of electrostatic attractions between nucleus and outermost electrons by partially cancelling or blocking the nuclear attraction for outermost electrons.

xi. Why do the bigger sized atoms have more shielding effect?

**Answer:** The bigger sized atoms have a greater number of inner shell electrons and thus, have more shielding effect.

Xii Why does the trend of electron affinity and electronegativity is same in a period?

**Answer:** The electron affinity and the electronegativity increase on moving from left to right in a period. This is because of the increase in nuclear charge and decrease in atomic size this increases the force of attraction between the nucleus and the valence electrons. As a result, the atom has greater tendency to gain additional electron from the outside the nuclear charge increases from left to right while electrons enter the same shell.

The increased nuclear charge attracts the shared pair of electrons more strongly. This results in higher electronegativity.

xiii. Which element has the highest electronegativity?

**Answer:** Fluorine has the highest electronegativity (4.0).

## Multiple Choice Questions

Put a ( ✓ ) on the correct answer

1. The atomic radii of the elements in Periodic Table:

- (a) increase from left to right in a period  
(b)  increase from top to bottom in a group  
(c) do not change from left to right in a period  
(d) decrease from top to bottom in a group

2. The amount of energy given out when an electron is added to an atom is called:

- (a) lattice energy  
(b) ionization energy  
(c) electronegativity  
(d)  electron affinity

3. Mendeleev Periodic Table was based upon the:

- (a) electronic configuration  
(b)  atomic mass  
(c) atomic number  
(d) completion of a subshell

4. Long form of Periodic Table is constructed on the basis of:

- (a) Mendeleev Postulate  
(b)  atomic number  
(c) atomic mass  
(d) mass number

5. 4<sup>th</sup> and 5<sup>th</sup> periods of the long form of Periodic Table are called:

- (a) short periods  
(b) normal periods  
(c)  long periods  
(d) very long periods

6. Which one of the following halogen has lowest electronegativity? (a) fluorine (b) chlorine (c) bromine (d) iodine ✓

7. Along the period, which one of the following decreases:

(a) atomic radius ✓ (b) ionization energy (c) electron affinity (d) electronegativity

8. Transition elements are: (a) all gases (b) all metals ✓ (c) all non-metals (d) all metalloids

9. Mark the incorrect statement about ionization energy:

(a) it is measured in  $\text{kJmol}^{-1}$  (b) it is absorption of energy ✓ (c) it decreases in a period (d) it decreases in a group

10. Point out the incorrect statement about electron affinity:

(a) it is measured in  $\text{kJmol}^{-1}$  (b) it involves release of energy ✓ (c) it decreases in a period (d) it decreases in a group

Short answer questions.

1. Why are noble gases not reactive?
2. Why Cesium (at. no.55) requires little energy to release its one electron present in the outermost shell?
3. How is periodicity of properties dependent upon number of protons in an atom?
4. Why shielding effect of electrons makes cation formation easy?
5. What is the difference between Mendeleev's periodic law and modern periodic law?
6. What do you mean by groups and periods in the Periodic Table?
7. Why and how are elements arranged in 4 period?
8. Why the size of atom does not decrease regularly in a period?
9. Give the trend of ionization energy in a period.

## Short Questions (Exercise)

1. Why are noble gases not reactive?

**Answer:** The Noble gases do not have valence electrons in their outer shells that's why they are not reactive.

2. Why Cesium (at. no.55) requires little energy to release its one electron present in the outermost shell?

**Answer:** this is because the force of attraction between the nucleus and outermost electron is decreased due to the atomic size

3. How is periodicity of properties dependent upon number of protons in an atom?

**Answer:** It depends upon the number of protons in an atom they vary when we move left to right across a period or from top to bottom in any group

4. Why shielding effect of electrons makes cation formation easy?

**Answer:** The greater the shielding effect, the greater the chances of atoms losing electrons and forming cations. This is due to decrease of nuclear charge on outermost electrons. Low ionization energy with more shielding effect makes the cation formation easy

6. What is the difference between Mendeleev's periodic law and modern periodic law?

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Answer:	Mendeleev's periodic law	Modern periodic law
	1. based on atomic masses	1. Based on atomic number
	2."properties of the elements are periodic functions of their atomic masses"	2."properties of the elements are periodic functions of their atomic numbers"

7. What do you mean by groups and periods in the Periodic Table?

**Answer:** Groups;

Vertical columns of elements in a periodic table are called groups.

periods;

horizontal rows of elements in a periodic table are called periods.

8. Why and how are elements arranged in 4<sup>th</sup> period

**Answer:** The number of elements in 4<sup>th</sup> period is equal to the number of electrons required to fill the 4<sup>th</sup> shell. The maximum Number of electrons which can be accommodated in 4<sup>th</sup> shell is 18. thus 4<sup>th</sup> period contains 18 elements.

9. Why the size of atom does not decrease regularly in a period

**Answer:** The size of atoms does not increase regularly in a period because of the poor shielding effect.

10. Give the trend of ionization energy in a period

**Answer:** The ionization energy increases from left to right in a period

**THE END**

# SARDAR KAUREY KAHN PUBLIC H/S/S MUZAFFARGARH

## COMPUTER CLASS 9<sup>TH</sup>

### Ist Term Notes Unit # 1

By : Muhammad Qasim

### Syllabus Breakup 2020-2021

Month	Week	Days	W.Days	Topic/Content	Lab Days
June	1	1-6	6	<p><b>Lecture No.1 :</b></p> <ul style="list-style-type: none"> <li>➤ Problem Solving</li> <li>➤ Problem Solving Steps</li> <li>➤ Defining a Problem</li> <li>➤ Understanding a Problem</li> <li>➤ Solve Activity 1.1</li> </ul> <p><b>Lecture No. 2 :</b></p> <ul style="list-style-type: none"> <li>➤ Planning a Solution</li> <li>➤ Defining Candid Solutions</li> <li>➤ Solve Activity 1.2</li> </ul> <p><b>Lecture No. 3 :</b></p> <ul style="list-style-type: none"> <li>➤ Selecting the Best Solution</li> <li>➤ Flowcharts</li> <li>➤ Flowchart definition</li> <li>➤ Importance of Flowcharts in Problem Solving</li> </ul> <p><b>Lecture No. 4 :</b></p> <ul style="list-style-type: none"> <li>➤ Determining Requirements for a Flowchart</li> <li>➤ Flowchart Symbols</li> </ul> <p><b>Lecture No. 5 :</b></p> <ul style="list-style-type: none"> <li>➤ Examples of Flowcharts</li> <li>➤ Example No.1</li> <li>➤ Example No.2</li> <li>➤ Example No. 3</li> </ul> <p><b>Lecture No. 6</b></p> <ul style="list-style-type: none"> <li>➤ Example No.4</li> <li>➤ Example No.5</li> <li>➤ Example No.6</li> </ul>	
June	2	1-6	6	<p><b>Lecture No.7 :</b></p> <ul style="list-style-type: none"> <li>➤ Flowcharts</li> <li>➤ Example No.7</li> <li>➤ Example No.8</li> </ul> <p><b>Lecture No. 8 :</b></p> <ul style="list-style-type: none"> <li>➤ Flowcharts</li> <li>➤ Example No.9</li> <li>➤ Example No.10</li> </ul> <p><b>Lecture No. 9 :</b></p> <ul style="list-style-type: none"> <li>➤ Flowcharts</li> <li>➤ Example No.11</li> <li>➤ Example No.12</li> </ul> <p><b>Lecture No. 10 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Definition of Algorithm</li> <li>➤ Role of Algorithms in Problem Solving</li> </ul> <p><b>Lecture No. 11 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Formulation of an Algorithm</li> <li>➤ Example No.1</li> <li>➤ Activity No. 1.6</li> </ul> <p><b>Lecture No. 12</b></p> <ul style="list-style-type: none"> <li>➤ Revisions</li> </ul>	

June	3	1-6	6	<p><b>Lecture No.13 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Example No.2</li> <li>➤ Example No.3</li> <li>➤ Activity No. 1.7</li> </ul> <p><b>Lecture No. 14 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Example No.4</li> <li>➤ Example No.5</li> <li>➤ Activity No. 1.8</li> </ul> <p><b>Lecture No. 15 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Example No.6</li> <li>➤ Example No.7</li> </ul> <p><b>Lecture No. 16 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Example No.8</li> <li>➤ Example No.9</li> </ul> <p><b>Lecture No. 17 :</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Efficiency of Algorithms Example No.1</li> <li>➤ Example No. 2</li> </ul> <p><b>Lecture No. 18</b></p> <ul style="list-style-type: none"> <li>➤ Algorithm</li> <li>➤ Activity No. 1.9</li> </ul>	2
June	4	1-6	6	<p><b>Lecture No.19 :</b></p> <ul style="list-style-type: none"> <li>➤ Difference between an Algorithm and a Flowchart</li> <li>➤ Advantages of Flowchart</li> <li>➤ Disadvantages of Flowchart.</li> <li>➤ Advantages of Algorithm</li> <li>➤ Disadvantages of Algorithm</li> </ul> <p><b>Lecture No. 20 :</b></p> <ul style="list-style-type: none"> <li>➤ Test Data</li> <li>➤ Activity No. 1.10</li> <li>➤ Importance of Testing</li> </ul> <p><b>Lecture No. 21 :</b></p> <ul style="list-style-type: none"> <li>➤ Types of Test Data</li> <li>➤ Verification and Validation</li> <li>➤ Example No.1</li> <li>➤ Example No.2</li> </ul> <p><b>Lecture No. 22 :</b></p> <ul style="list-style-type: none"> <li>➤ Identification and Correction of Errors</li> <li>➤ Trace Table</li> <li>➤ Using Invalid Data for Testing</li> </ul> <p><b>Lecture No. 23 :</b></p> <ul style="list-style-type: none"> <li>➤ Activity No. 1.11</li> <li>➤ Solve Exercise No.1 to 7</li> </ul> <p><b>Lecture No. 24</b></p> <ul style="list-style-type: none"> <li>➤ Solve MCQ's</li> <li>➤ Solve Fill in the Blank</li> <li>➤ Solve Exercise 1.4</li> </ul>	

# Lecture No.1 :

- Problem Solving
- Problem Solving Steps
- Defining a Problem
- Understanding a Problem
- Solve Activity 1.1

## PROBLEM SOLVING

### INTRODUCTION

Dear students :

We face different problem every day in different places like.

- At home.
- work place
- play ground
- study place
- And even in general store.

There are different steps to solve a problem.

1. Defining a problem
2. Understanding a problem
3. Planning a solution
4. Define Candid solution
5. Selecting the best solution

### 1- Defining a problem

A well defined problem is :

- It does not contain any ambiguities.
- All the conditions are clearly specified.
- It has clear goal.
- It is easy to understand. It is easy to solve.

### What is a Problem statement ?

We are given a problem statement. How we solve it ?

- First of all we need to see whether the problem is defined well or not.
- If the problem is not defined well the we can use one of the following strategies to define the problem.

#### **1- Gain background knowledge.**

- We try to know the situation and circumstances in which the problem is happening ?
- We can identify the given state.
- By identifying problem state helps us to know what a good solution will look.
- And also we shall be able to measure the solution.

#### **2- Use Guesses.**

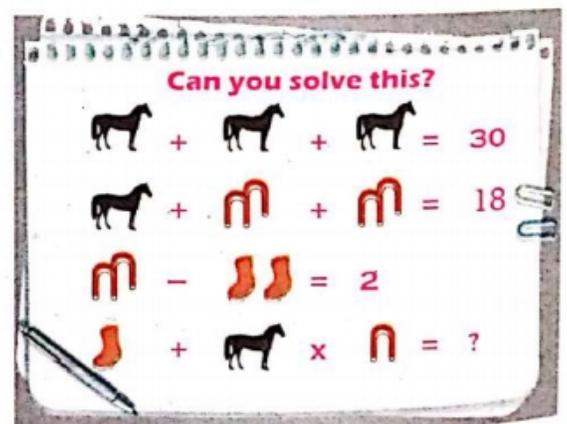
- We try to guess the unknown information through appropriate guesses.
- These guesses may be bases upon our past experiences.

#### **3- Draw a picture.**

- If the problem is not well- defined , we can draw a picture and fill the undefined information.
- Following picture shows the pictorial representation of a problem.

#### **2- Understanding a problem**

- It is important to understand the problem before jumping into the solution of problem.



- A clear understanding of problem makes it easier to solve and helps to save money , time and resources.
- Understanding of problem usually includes identification of the 5 Ws.
- What are 5 Ws ? These are :
- What ?
- Who ?
- When ?
- Where ?
- Why ?
- Problem analysis is the process to figure out these 5 Ws from the problem statement.
- These are the basic elements which lead towards solution of a given problem.

"Suppose your class teacher assigns you a task to prepare a list of students in your school whose names start with letter 'A'. The list is required in order to prepare an alphabetical directory of all school students and there is only one week to complete the task."

### Example of Understanding a problem

We can analyze this problem by identifying 5Ws in the problem statement as given below.

- **What** : List of student's naming starting with letter 'A'
- **WHO** : Student
- **Why** : To prepare the directory of students.
- **When** : with in a week
- **Where** : School

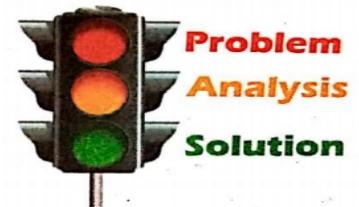


Figure 1-2 From problem to solution

Figure 1-2 shows representation of problem

- **Red** light shows problem
- **Yellow** light shows analysis
- **Green** light shows solution.

### Activity 1.1

Students are put in groups of two or three, and each group is provided two different lists of students' names.

One list contains the marks of students in mathematics subject while the other list is for physics subject. Each group is supposed to prepare the following lists.

- a) Top 5% students in mathematics.
- b) Top 5% students in physics.
- c) Students having more than 90% marks in both subjects.

Identify 5 Ws for this problem.

### Solution of activity 1.1

We can analyze this problem by identifying 5Ws in the problem statement as given below.

- **What** : 1- Top 5% students in Mathematic  
2- Top 5% students in Physics  
3- Students having more than 90% marks in both subjects.
- **WHO** : Student
- **Why** : To prepare the subject %age.
- **When** : with in period
- **Where** : School

- Planning a Solution
- Defining Candid Solutions
- Solve Activity 1.2

### 3- Planning a solution

- In this phase , we formulate a plan that may lead us towards the solution of a problem.
- This phase includes finding the right strategy for problem solving. Some of strategies are :

- 1- Divide and conquer
- 2- Guess Check and improve
- 3- Act it Out
- 4- Prototype (Draw)

#### 1- Divide and conquer

- ✓ Break the problem into smaller parts.
- ✓ Each part is solved independently
- ✓ The problem became simple and easier this method.
- ✓ The technique of dividing problem in smaller parts is called TOP DOWN DESIGN.
- ✓ It is also known as DIVIDE and CONQUIRE RULE.

#### 2- Guess Check and improve

- The designer guesses a solution to a problem and then checks the correctness of the solution.
- If the solution is not according to its expectations then he refines the solution.
- The refinement is a iterative process.

#### 3- Act it Out

- In this strategy the designer defines the list of “to do” tasks.
- Afterwards he performs the task.

#### 4- Prototype (Draw)

- This technique is used to draw a pictorial representation of the solution.
- It is not final solution.
- It only helps the designer to understand the important component of the solution.



Figure 1-3 Planning for success

with

### 1.1.4 Defining Candid Solutions :

- The word candid refers to something spontaneous and unplanned.
- For example , if you ask to find the number of student in your school who can play cricket.
- You can estimate by finding cricket players in your class and then multiplying it by the total number of classes in your school.
- Your answer in this way is candid solution.
- Your thinking about any object is called candid solution.
- Candid solution can help to save time.

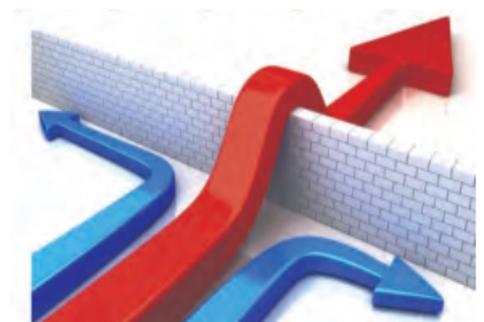


Figure 1-4 Multiple solutions of a problem

Solve this activity if problem arises to solve this activity contact Muhammad Qasim  
Whatsapp No. 0300-0236917

#### Activity 1.2

Your task is to find average height of your class fellows. Give a candid answer and also the method to find the exact solution.

One method is to use a measuring tape. Mark the height on the tape and then read the exact measurement from the tape. After recording the height of every student, you can calculate the average height of all the students in your classroom.

Or you can even find out the candid height of a student through some object of known height, like a book. Let's say that the height of your textbook is 8cm. You can mark the height of the book on a wall. Using the book several times, you can make a scale with intervals of 8cm. Then, by standing next to the wall you can get a candid solution to the student's height.

## **Lecture No. 3 :**

- Selecting the Best Solution
- Flowcharts
- Flowchart definition
- Importance of Flowcharts in Problem Solving

### **1.1.5 Selecting the Best solution**

- We find more than one solutions of a problem.
- We have to choose the best one.
- For example the names of student are available on your school website.
- Your are asked to search a particular name.
- You can solve this problem by using the following method.



Figure 1-5 Levels of a solution

#### **Method No.1 :**

- Look at each name on the website one by one until the name is found or list is over.

#### **Method No.2 :**

- Take printout and search the required name.

#### **Method No.3 :**

- Copy all name and send to MS-Excel sheet and sort there name in alphabetically order. Searching in a sorted list comparatively easy.

#### **Method No. 4:**

- Press CTL +F and type the required name in the web browser to search automatically.
- Here Method 4 is the best solution.

## **1.2 Flowcharts**

- Flowchart is a combination of two words flow and chart.
- A chart is consists of different symbols to display information about any program.
- It is a graphical representation of a problem.
- It helps to understand problem easily.
- It is also helpful in understanding the flow of control and data in algorithm.

### **1.2.2 Importance of flowchart in Problem solving**

- It is used to plan a solution.
- If the flowchart is developed ,we can find the way how a problem can be solved.
- Flowchart is more effective to visualize a solution graphically than text.
- It helps us whether a solution is correct or not .
- It is a good way to communicate the solution of a problem to an other people.

## **Lecture No. 4 :**

- Determining Requirements for a Flowchart
- Flowchart Symbols

### 1.2.3 Determining Requirements for a flowchart

Following are the requirements to develop a flowchart.

- **Inputs :** It means taking data from the user. It is very important to know how many and what type of inputs are required.
- **Processing :** It means how calculation performed and storing results of calculation
- **Decision making:** To determine whether a statement is true or False and taking appropriate steps accordingly, is called decision making.
- **Outputs:** The outputs are used to display information.

### 1.2.4 Flowchart Symbols

#### 1- Start / Terminal

Oval is used to represent the start or end of the flowchart. It is also called Terminal.



#### 2- INPUT / OUTPUT

Parallelogram represent the Input or output of the flowchart.



#### 3- PROCESS

Rectangle is used to represent a processing or computational operation in the flowchart.

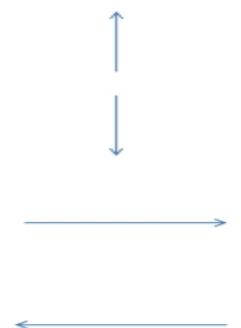


#### 4- FLOWLINES

Arrows are used to represent the direction of flow in the flowchart .

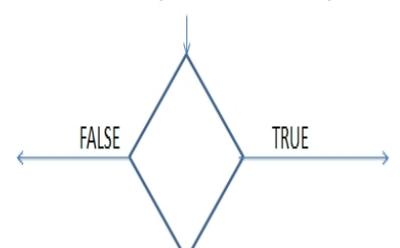
There are four flow lines.

- 1- up arrow
- 2- Down arrow
- 3- Right arrow
- 4- Left arrow



#### 5- DECISION

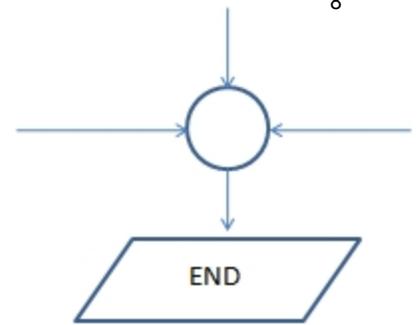
- Diamond symbol is used to represent decision step in the flowchart.
- Condition is given in the diamond box.
- Flow of control from diamond box may go in two possible direction.
- If condition is TRUE or YES go to one direction.
- If condition is FALSE or NO go to other direction.



## 6- CONNECTOR

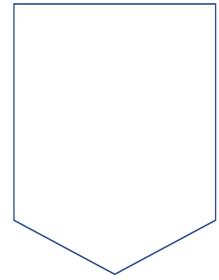
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- Connector is used to connect different lines.
- It is used when different flow lines come from different directions and move to one direction.



## 7- OFF PAGE /ON PAGE CONNECTOR

- It is used when the flowchart is bigger than one page.
- This symbol at the end of page indicates that the remaining part of the flowchart is on the next page.



## 8- Predefined Process ( Function/subroutine)

- It is used to indicate a function or subroutine.



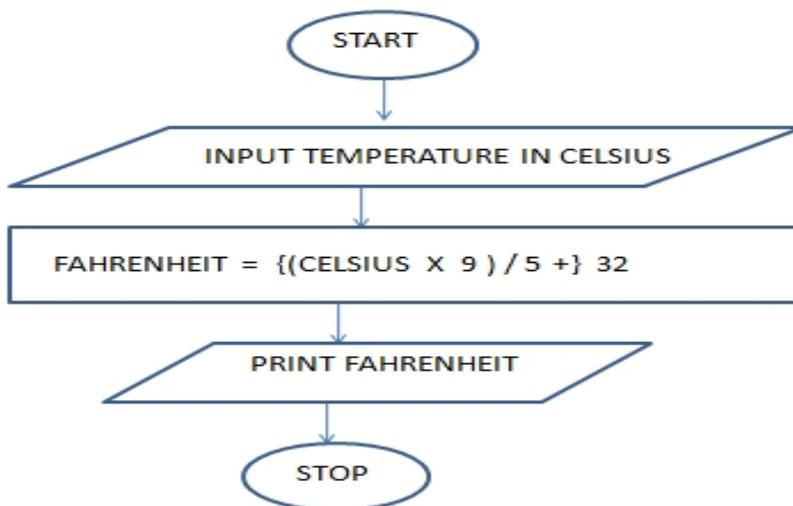
**9- Remarks** The Annotation symbol is used to indicate remarks in the flowchart.



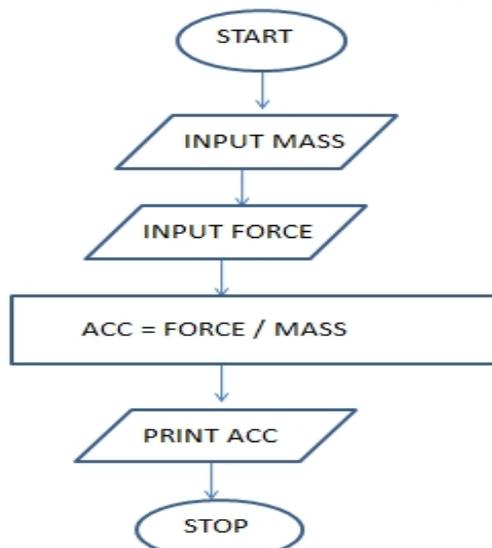
## Lecture No. 5 :

- Examples of Flowcharts
- Example No.1
- Example No.2
- Example No. 3

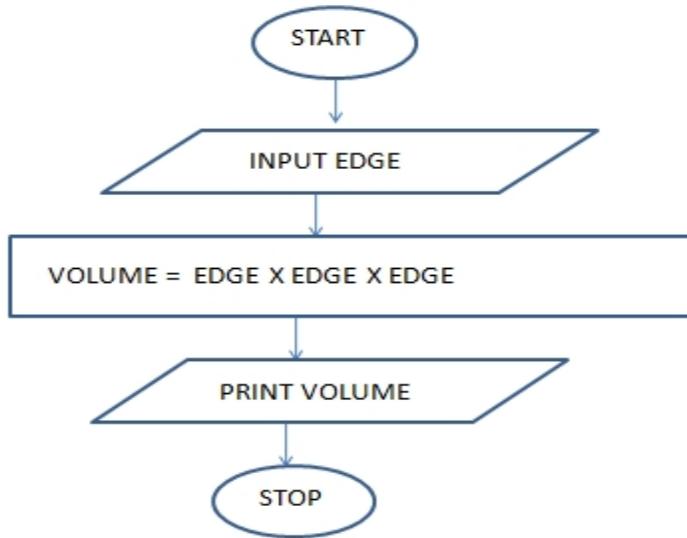
### 1- To convert Celsius to Fahrenheit Temperature



### 2- To Find the acceleration of a moving object with given mass and the force applied



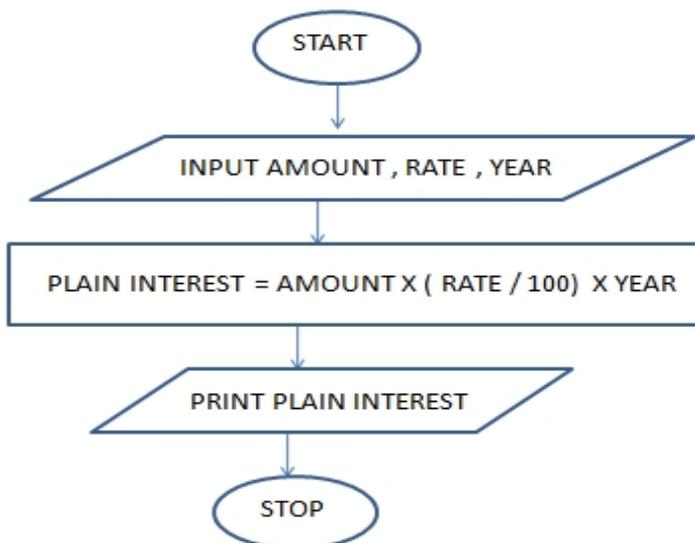
### 3- To Find the Volume of a Cube



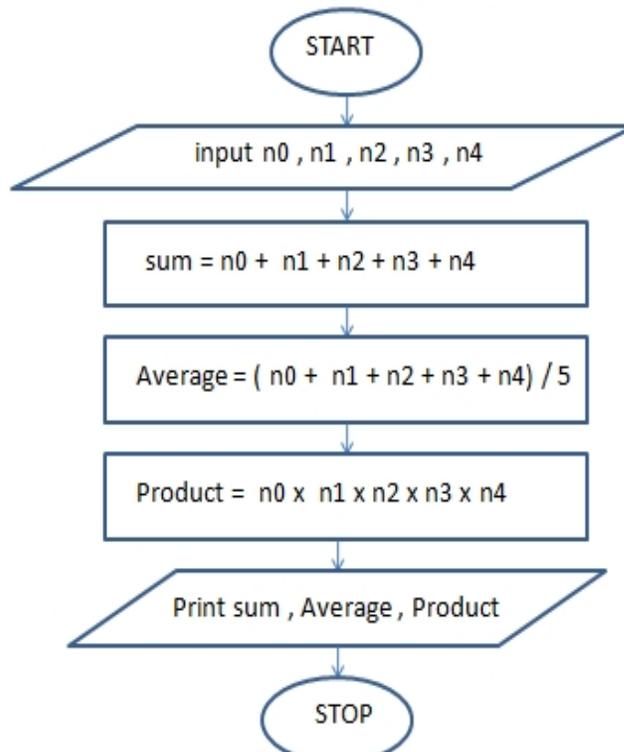
### Lecture No. 6

- Example No.4
- Example No.5
- Example No.6

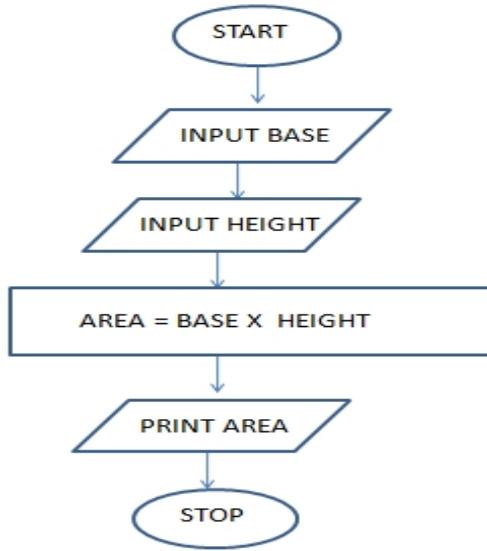
### 4- To Find Plain the interest on an amount



### 5. To find the sum , Product , and average of five given numbers.



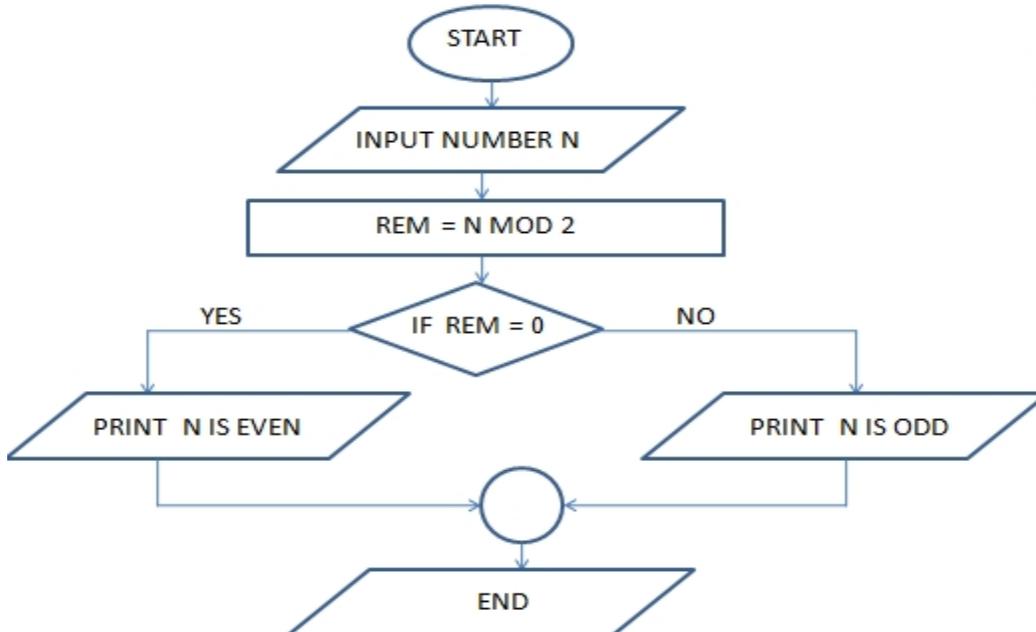
## 6- To Find the area of Parallelogram.



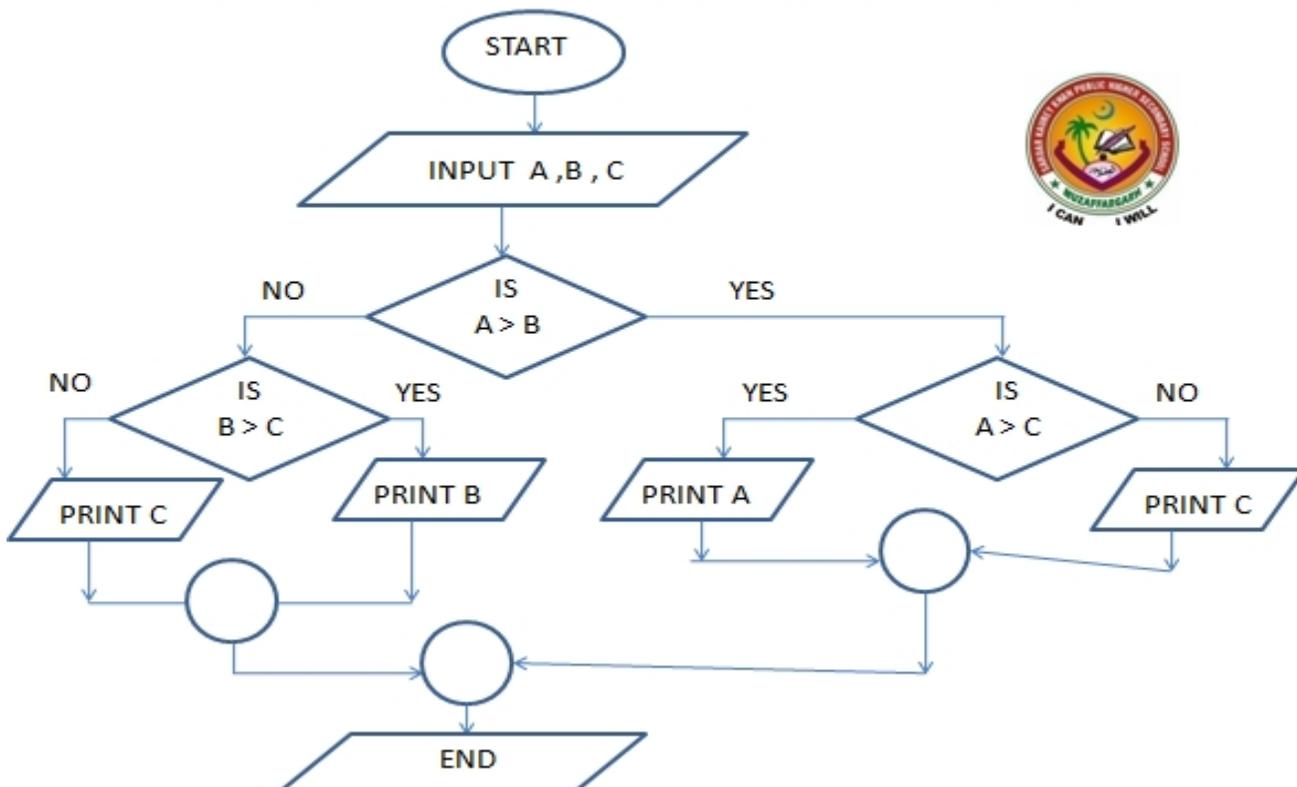
### Lecture No.7 :

- Flowcharts
- Example No.7
- Example No.8

## 7- To determine whether a given number is odd or even.



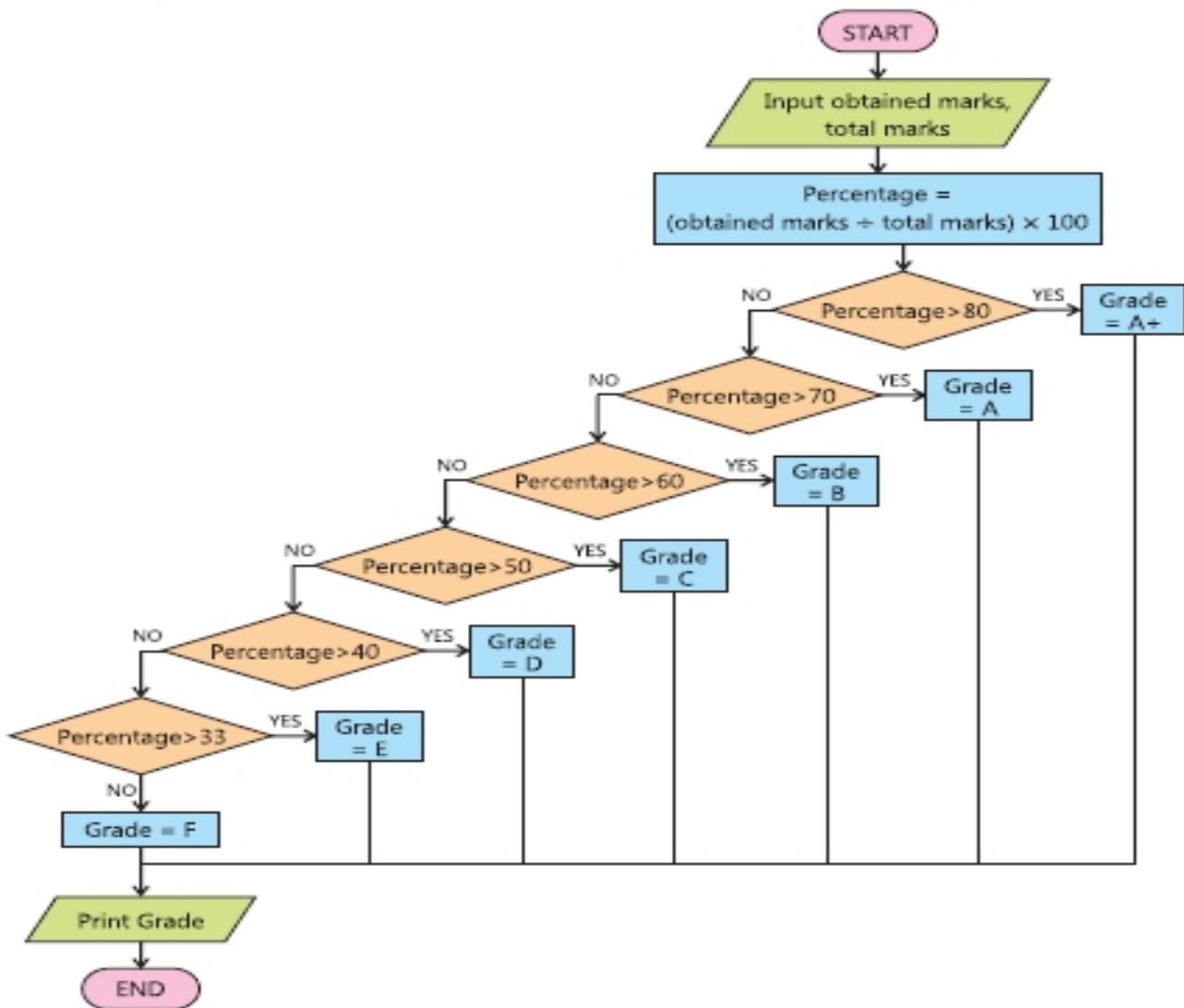
## 8- Find the larger one out of the three given unequal numbers.



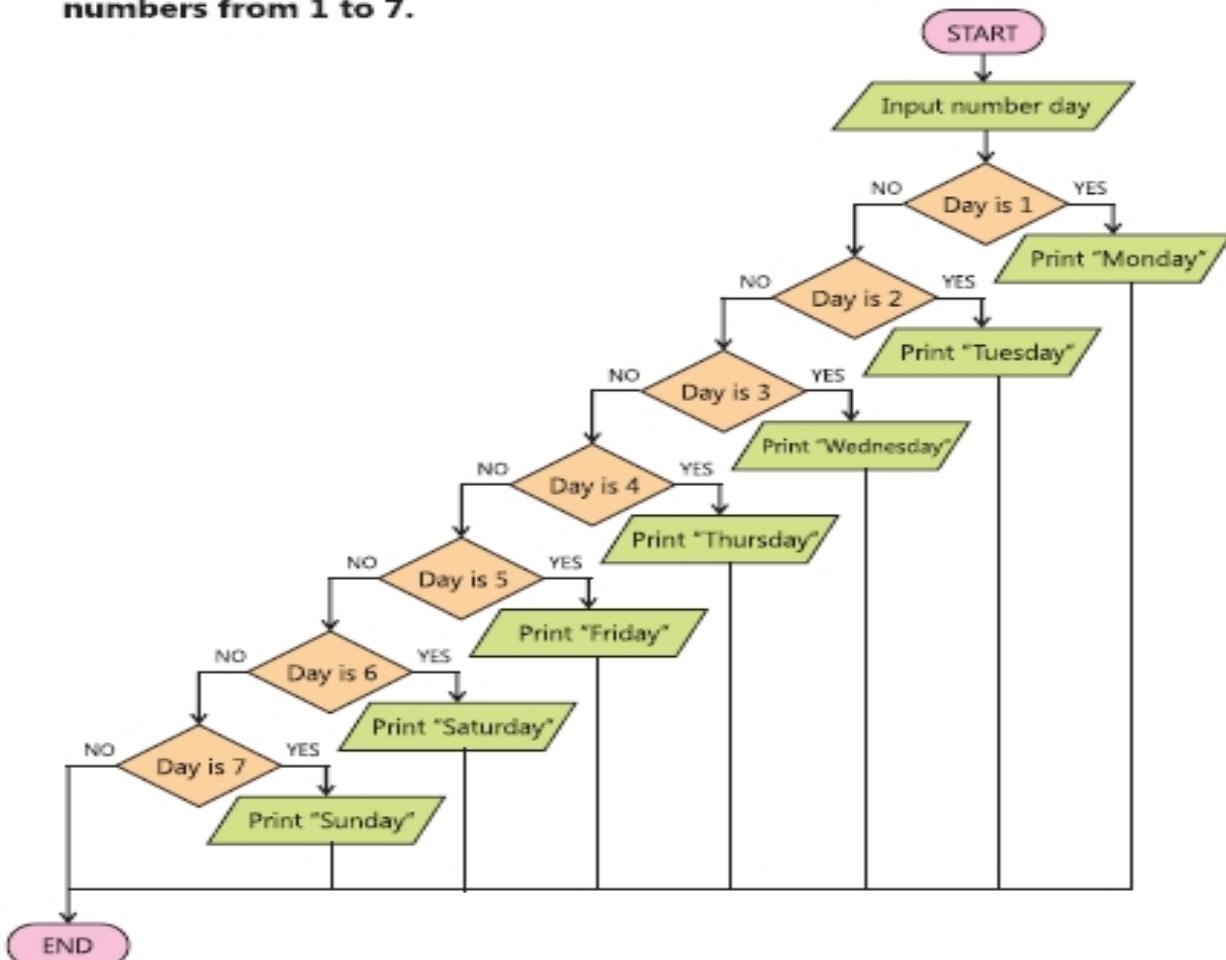
## Lecture No. 8 :

- Flowcharts
- Example No.9
- Example No.10

9. To assign grade to a subject based on total marks and obtained marks.



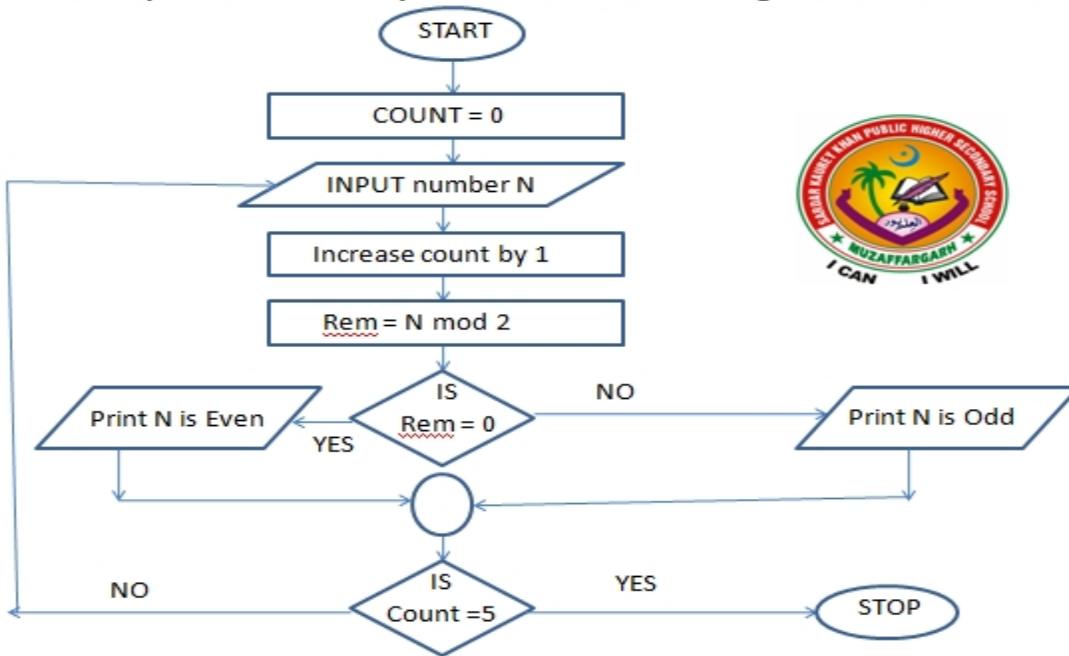
10. To determine name of a week day from a given number where weekdays are assumed from Monday to Sunday and their respective numbers from 1 to 7.



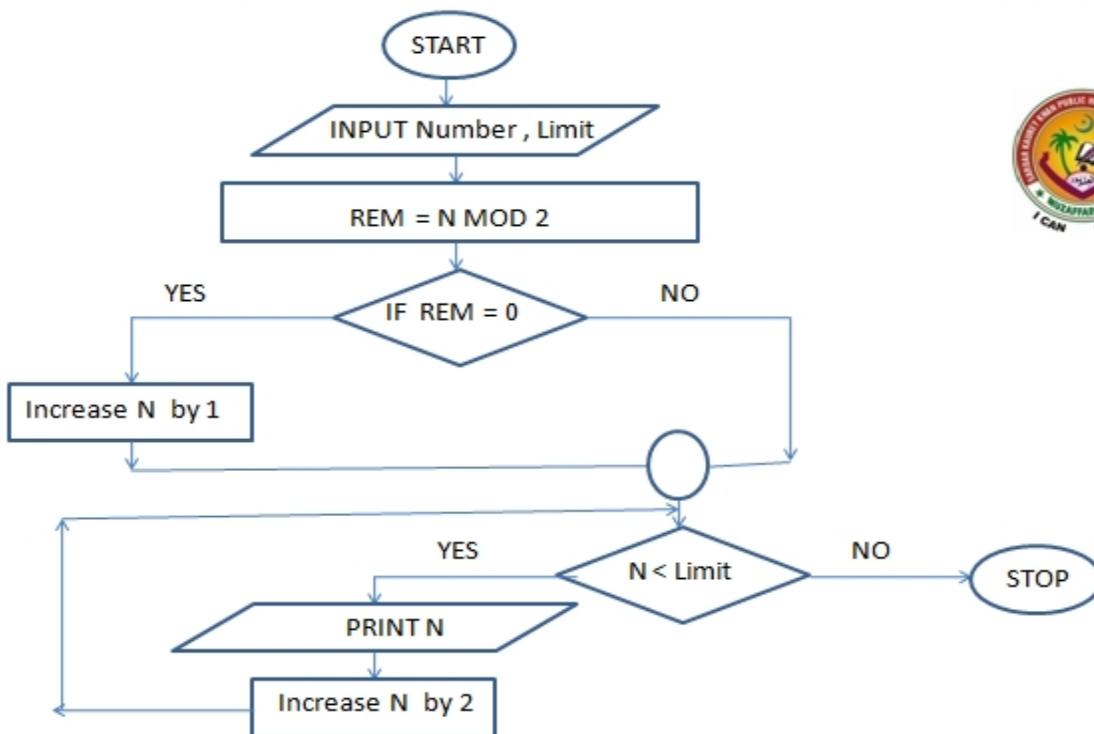
## Lecture No. 9 :

- Flowcharts
- Example No.11
- Example No.12

11- To input 5 values one by one and determine if the given value is odd or even.



12- To find the sequence of Odd numbers starting from given number till some .



## Lecture No. 10 :

- Algorithm
- Definition of Algorithm
- Role of Algorithms in Problem Solving

### 1.3 Algorithm :

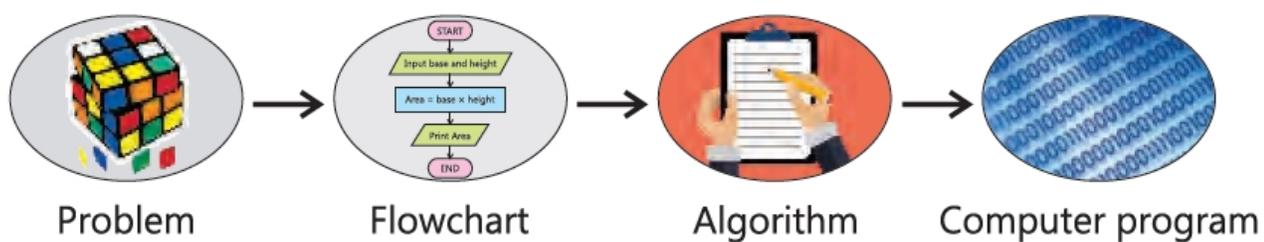
- An algorithm is a step-by-step procedure to solve a problem.
- It is better to write algorithm before writing the actual computer program.

#### Algorithm to make a Tea

1. Start
2. Take a kettle
3. Pour water in it,
4. Put the kettle on fire.
5. Add sugar and Milk
6. Wait till boils
7. Remove the kettle from fire.
8. End

#### 1.3.2 Role of Algorithm in Problem Solving.

- An algorithm has vital role in problem solving as it provides a step by step guide to the problem solver.
- It is a complete description of the solution.
- A computer programmer first write an algorithm and then translates it into the code of some programming language.
- Sometime the designer of the program first convert algorithm into flowchart and then then translates it into the code of some programming language.



**Figure 1-8 Role of Algorithm**

## Lecture No. 11 :

- Algorithm
- Formulation of an Algorithm
- Example No.1
- Activity 1.6

### 1.3.3 Formulation of an Algorithm

There are different notations (keywords) to write an algorithm.

- **Start** : It is the starting point of an algorithm. Every algorithm must have one starting (entry) point.
- **Input** : It is used to get input from a user and store it in computer memory with some name.
- **Set** : It is used to give name to data in computer memory. It is also used to update the value of existing data.

#### **If – else :**

- It is used to check the condition. For example, the condition .
- If ( $a < b$ ) A condition is evaluated as true or false.
- In case the condition is true then the statements related with if part are executed.
- otherwise the statements of else part are executed.

#### **Usage:**

- Suppose  $a=5$  and  $b=7$ , if( $a<5$ ) Set  $c$  to 10 else Set  $c$  to 20.

Writing else part is optional.

#### **Goto :**

- It is used to transfer control to a certain step of an algorithm.
- It is usually required in loops.

#### **Output:**

It is used to display values.

#### **Stop:**

It is the termination point of an algorithm.

### 1- To find the sum, product and average of five given numbers.

Step 1 : **Start**

Step 2 : **Input** numbers,  $n_0$  ,  $n_1$  ,  $n_2$  ,  $n_3$  ,  $n_4$

Step 3 : **Set**  $sum$  to  $n_0 + n_1 + n_2 + n_3 + n_4$ .

Step 4 : **Set**  $product$  to  $n_0 \times n_1 \times n_2 \times n_3 \times n_4$

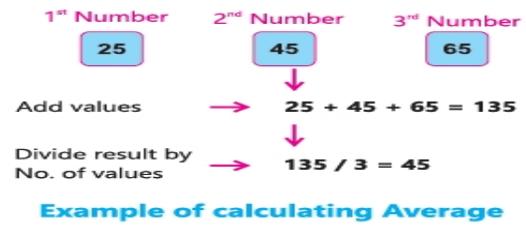
Step 5 : **Set**  $average$  to  $\frac{n_0 + n_1 + n_2 + n_3 + n_4}{5}$

5

Step 6 : **Output**  $sum$ ,  $product$ ,  $average$

Step 7 : **End**

The Figure shows a simple example of calculating average of three numbers, 25, 45 and 65. Write an algorithm with these fixed values to calculate and display average values. Note that in this case no input is required from a user.



Step 1 : **Start**

Step 2 : **Set** sum to  $25 + 45 + 65$

Step 3 : **Set** average to  $(25 + 45 + 65)/3$

Step 4 : **Output** 135, 45

Step 5 : **End**

### Lecture No.12 :

Revision of previous syllabus

### Lecture No.13 :

- Algorithm
- Example No.2
- Example No.3
- Activity No. 1.7

**2- To find acceleration of a moving object with given mass and the applied force.**

Step 1 : **Start**

Step 2 : **Input** numbers, *mass, force*

Step 3 : **Set** *acceleration* to Force

**mass**

Step 4 : **Output** *acceleration*

Step 5 : **End**

**3- To find the volume of a cube.**

Step 1 : **Start**

Step 2 : **Input** numbers, *side*

Step 3 : **Set** *volume* to *side x side x side*.

Step 4 : **Output**  
*volume*

Step 5 : **End**

### Activity 1.7

Change the above algorithm for finding volume of a Cylinder and Sphere. The formula for the volume of a Sphere is  $\frac{4}{3} \times \pi r^3$  where  $r$  is radius. The formula for the volume of cylinder is  $\pi r^2 h$  where  $r$  is radius and  $h$  is height.

Step 1 : **Start**

Step 2 : **Input** numbers,  $r, h$

Step 3 : **Set** volume of Sphere to  $\frac{4}{3} \times \pi r^3$

Step 3 : **Set** volume of cylinder to  $\pi r^2 h$

Step 4 : **Output** *volume*

Step 5 : **End**

### **Lecture No. 14 :**

- Algorithm
- Example No.4
- Example No.5
- Activity No. 1.8

#### **4- To find the area of a parallelogram.**

Step 1 : **Start**

Step 2 : **Input** numbers, *base, height*

Step 3 : **Set** *area* to *base x height*

Step 4 : **Output** *area*

Step 5 : **End**

#### **5- To display the larger one out of the three given numbers**

**Step 1 : Start**

**Step 2 : Input** numbers, *n0 , n1 ,n2*

**Step 3 : if** *n1 > large* **Set** *large* to *n1*

**Step 4 : if** *n2 > large* **Set** *large* to *n2*

**Step 5 : Output**  
*large*

**Step 5 : End**

#### **Activity 1.8**

Change the above algorithm for finding the area of a triangle, rhombus, or trapezium.

#### **1- Area of Triangle**

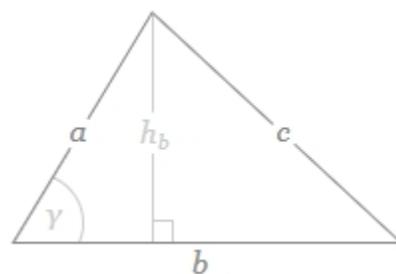
Step 1 : **Start**

Step 2 : **Input** numbers, *base, height*

Step 3 : **Set** *area* to  $\frac{1}{2} \times \text{base} \times \text{height}$

Step 4 : **Output** *area*

Step 5 : **End**



#### **2- Area of rhombus**

Step 1 : **Start**

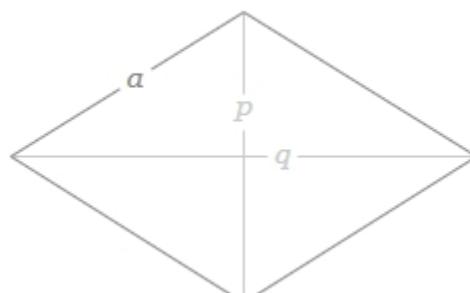
Step 2 : **Input** numbers, *p, q*

Step 3 : **Set** *area* to  $\frac{p \times q}{2}$

2

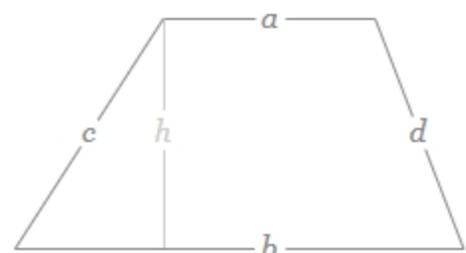
Step 4 : **Output** *area*

Step 5 : **End**



#### **3- Area of trapezium**

Step 1 : **Start**



Step 2 : **Input** numbers, *base* , *height*

Step 3 : **Set** area to  $1/2 ( \mathbf{base} + \mathbf{height} ) \times h$

Step 4 : **Output** area

Step 5 : **End**

**Lecture No. 15 :**

- Algorithm
- Example No.6
- Example No.7

**6- To assign grade to a subject based on the achieved marks.**

Step 1 : **Start**

Step 2 : **Input** numbers, *obtained\_marks*, *total\_marks*

Step 3 : **Set** *percentage* to  $\frac{\mathbf{obtained\_marks}}{\mathbf{total\_marks}} \times 100$

Step 4 : if *percentage* > 80 **Set** *grade* to *A+*  
else

if *percentage* >70 **Set** *grade* to *A*  
else

if *percentage* > 60 **Set** *grade* to *B*  
else

if *percentage* > 50 **Set** *grade* to *C*  
else

if *percentage* > 40 **Set** *grade* to *D*  
else

if *percentage* >33 **Set** *grade* to *E*  
else

**Set** *grade* to *F*.

Step 5.      **Output** *grade*

Step 6.      **End**

**7- To find the interest on an amount.**

Step 1 : **Start**

Step 2 : **Input** numbers, *amount*, *rate*, *years*

Step 3 : **Set** plain interest to  $( \mathbf{amount} \times \mathbf{rate} ) \times \mathbf{years}$

*100*

Step 4 : **Output** plain interest

Step 5 : **End**

## **Lecture No. 16 :**

- Algorithm
- Example No.8
- Example No.9

### **8- To convert Celsius to Fahrenheit temperature and vice versa.**

Step 1 : **Start**

Step 2 : **Input** numbers, *Celsius*

Step 3 : **Set** *Fahrenheit* to  $\frac{Celsius \times 9}{5} + 32$

Step 4 : **Output** *Fahrenheit*

Step 5 : **Input** numbers, *Fahrenheit*

Step 6 : **Set** *Celsius* to  $(Fahrenheit - 32) \times 5/9$

Step 7 : output *Celsius*

Step 8 : **End**

### **9- Find even numbers in integers ranging from n1 to n2 (where n2 is greater than n1).**

Step 1 : **Start**

Step 2 : **Input** numbers, n1 , n2

Step 3 : **if** (n1 <= n2)

{

Step 4 : **if** ( n1 mod 2 equal 0) output n1

Step 5 : **Set** n1 to n1 + 1

Step 5 : **go** to step 3

}

Step 6 : **End**

## **Lecture No. 17 :**

- Algorithm
- Efficiency of Algorithms

### **1.3.5 : Efficiency of Algorithms**

- There can be more than one algorithms to solve the same problem.
- Which one is better, depends upon the efficiency of the available solution algorithms.
- Efficiency of an algorithm is measured on the basis of two metrics.

1. **Number of steps:** An algorithm is considered more efficient if it takes less number of steps to reach the results.
2. **Space used in computer memory:** We have observed in algorithms that some data is stored in computer memory which is latter used to give results. An algorithm using less space in computer memory is considered more efficient with respect to memory space

### Lecture No. 18

- Algorithm
- Activity No. 1.9

### Activity 1.9

Compare the algorithm 9 presented in Section 1.3.4 with the following one and try to find which one is efficient. Note that both are solving the same problem. In order to answer this question, assume two values for  $n_1$  and  $n_2$  and start count the number of steps used in both algorithms.

- Step 1. Start
- Step 2. Input numbers,  $n_1, n_2$
- Step 3. if  $n_1$  is odd, set  $n_1$  to  $n_1 + 1$
- Step 4. Output  $n_1$
- Step 5. Set  $n_1$  to  $n_1 + 2$
- Step 6. if  $n_1 < n_2$  go to Step 4
- Step 7. End

### Lecture No.19 :

- Difference between an Algorithm and a Flowchart
- Advantages of Flowchart
- Disadvantages of Flowchart.
- Advantages of Algorithm
- Disadvantages of Algorithm

### Compare flowchart and algorithm

FLOWCHART	ALGORITHM
The symbols are used to draw flowchart.	Simple English is used to write algorithm.
Flowchart is more time consuming.	Algorithm is less time consuming.
It is difficult to modify.	It is easy to modify.
It is graphical representation. It is a movie.	It is a step by step procedure. It is a story.

### Advantages of Flowchart :

- Easy to draw.
- Easy to understand problem solving.
- Easy to identify errors (if any).
- Easy to observe flow from one step to the other.

## **Disadvantages of Flowchart :**

- More time is required to draw a flowchart.
- Modifying a flowchart is not very easy every time

## **Advantages of Algorithm :**

- Easy to write.
- Techniques to write an algorithm are easy to understand.
- To solve a large problem, algorithms are helpful.

## **Disadvantages of Algorithm :**

- Modifying an existing algorithm is not very easy every time.
- Showing the flow from one step to the other is not very easy.
- Usage of goto makes it difficult to identify errors.

## **Lecture No. 20 :**

- Test Data
- Activity No. 1.10
- Importance of Testing

### **1.4 Test Data :**

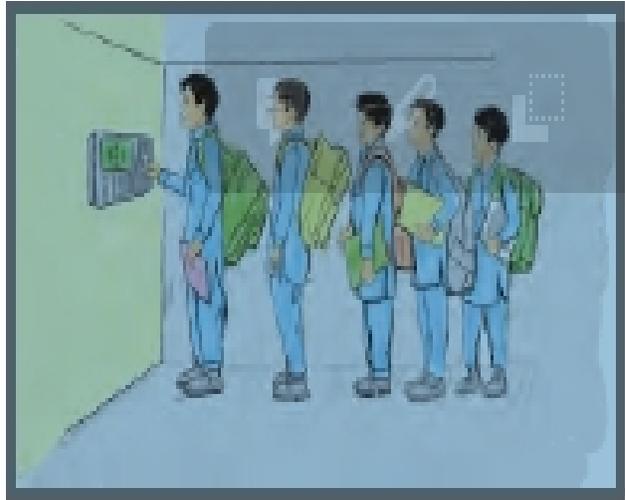
- After solving a problem, we need to test whether the solution is correct or not, and for testing, we need "Test Data".
- For example, if we want to test the algorithm to find the largest among three given numbers  $n_0$ ,  $n_1$ , and  $n_2$ .
- We need three values. These values can be positive, negative or zero.

- For Example : ( $n_0 = 5$  ,  $n_1 = 15$ ,  $n_2 = 3$ ), So, for thinking about testing, we also need to think about test data. 21

### Activity 1.10

Assume that you are given an automatic attendance system for testing. In this system, a camera observes each student entering in the classroom. The camera is connected to a computer which contains the database of pictures of all the students. The solution compares each student with the pictures in database and mark the attendance is picture is found there.

You are asked to provide test data for the system. Write your points in a way that can help the solution provider to check and improve quality of the solution. You can think about different dresses in different weathers, identical twins, different haircuts or any other points where one can look different in front of camera.



#### 1.4.1 Importance of Testing

- Testing is essential to point out the defects and errors made during finding a solution to some problem.
- It helps in improving a solution.
- If one solves a problem and someone else uses that solution for commercial purposes, then the commercial activities depend upon the correctness of that solution.
- For example, if we develop a solution for finance management and some bank starts using it then any error in that solution may result in a financial loss. So, testing is important for a solution.
- A car is delivered to a customer after testing.
- Upon launching a new car, it is usually tested with a robot driver who hits the car with a wall. It is used to test whether the air bags and other security systems are functioning or not.
- Moreover, it also allows the car designers to suggest further security measures to reduce the damage.
- This test can help to make a car safe. So, testing helps to improve quality.

#### Lecture No. 21 :

- Types of Test Data
- Verification and Validation
- Example No.1
- Example No.2

Types of Test Data include:

1. **Valid test data:**
2. **Invalid test data:**
3. **Boundary test data values:**
4. **Wrong data formats:**
5. **Absent data**

### 1- Valid test data:

- It is the test data that complies with the input requirements of the algorithm.
- If an algorithm is supposed to take a numeric value between 1 and 100 as input, then any value between 1 and 100 is a valid test data.

### 2- Invalid test data:

- It is the data that does not comply with the input requirements of the algorithm.
- It is necessary to make sure that the solution correctly works for invalid values, shows the relevant messages notifying the user that the provided input values are improper.

### 3- Boundary test data values:

- A solution is tested on extreme values.
- For example, to calculate interest we can consider principal amount as 0 or a very huge amount.

### 4- Wrong data formats :

- It is wise to check how the system reacts on entering data in an inappropriate format.
- For example, giving an alphabet as input when a numeric value is expected.

### 5- Absent data :

- It is also important to investigate that the solution still works if less number of inputs are given than expected.
- For example, if a system asks to enter driving license number, then every one cannot provide this information.
- It is important to see how the system reacts in such situations.

## 1.5 Verification and Validation

### Verification :

- Verification means to test if the solution is actually solving the same problem for which it was designed.
- For example, if you are asked to give a solution for calculating compound interest then verification means to know that it is giving results for compound interest not for the plain interest.

### Validation :

- Validation means to test whether the solution is correct or not.

- For example, if you are asked to give a solution for calculating compound interest then validation means to know whether it is finding the correct compound interest or not.
- If a solution is verified, then it is validated with the help of test data .

### **Example no.1 of Verification and Validation**

- Let's assume that you go to a pizza shop
- and order a chicken pizza.
- You state your requirement that it should be less spicy.
- You also expect that it would taste good.
- When the pizza arrives,
- you can observe that it is a chicken pizza.
- This is called verification.
- Now, when you eat the pizza,
- you can check whether it is less spicy or not,
- it tastes good or not. This is called validation.

### **Example no.2 of Verification and Validation**

- Let's assume that you are asked to write an algorithm that takes as input a list of numbers.
- The algorithm should display the list arranged in ascending order.
- After writing the algorithm you submit it to your teacher.
- Your teacher provides a list of numbers to the algorithm.
- If your algorithm displays a list of numbers then it is verified.
- Instead if your algorithm displays an answer in *yes* or *no*, or displays something else, then it is not verified.
- If your algorithm is verified, your teacher moves to the next step of validation.
- He checks whether the list of numbers displayed are actually in ascending order or not.
- If the list is in ascending order and no element is missing then your solution is also validated.

### **Lecture No. 22 :**

- Identification and Correction of Errors
- Trace Table
- Using Invalid Data for Testing

### **1.6 Identification and Correction of Errors**

- If an algorithm is failed during verification, then it is important to identify the root cause of failure and then to correct it.
- Sometimes the error is logical. It means the solution is working but not giving required results.
- For example, to recruit students for our school volleyball team,
- we need students having height between 144 cm and 164 cm.
- To count qualified students, we develop the following algorithm.
- Step 1. Start
- Step 2. Set count to 0
- Step 3. Set all\_heights to [154,140,155,164,144,166,160,143]
- Step 4. For each height in the list all\_heights
- Step 5. If  $height > 144$  and  $height < 164$  then
- Set count to count + 1
- Step 6. Output count
- Step 7. Stop

### 1.6.1 Trace Table

- A trace table is a technique used to test algorithms,
- In order to make sure that no logical errors occur while the algorithm is being processed.
- The table usually takes the form of a multi-column, multi-row table;
- with each column showing names of data, and each row showing values of the data at each step.
- Table 1-3 shows a trace table for the algorithm presented in Section 1.6
- The blank means there is no change and — means that a value is not concerned.
- In the following table Step 1 has no effect on data.
- Step 2 is assigning 0 to *count*.
- and in Step 3, list *all\_heights* is introduced.
- In Step 4, there is no change in both *count* and *all\_heights*
- but the data 154 is stored in *height* It is compared
- in Step 5 and the value in *count* is updated if data is in given range.
- Steps 4 and 5 are repeated for each value as shown in Table 1-3.

	count	all_heights	height
Step 1	--	--	--
Step 2	0	--	--
Step 3		[154, 140, 155, 164, 144, 166, 160, 143]	
Step 4			154
Step 5	1		
Step 4			140
Step 5	1		
Step 4			155
Step 5	2		
Step 4			164
Step 5	3		
Step 4			144
Step 5	3		
Step 4			166
Step 5	4		
Step 4			160
Step 5	5		
Step 4			143
Step 5	5		
Step 6			
Step 7			

Table 1-3

### 1.6.2 Using Invalid Data for Testing

- Testing an algorithm using invalid data ensures that the algorithm can gracefully handle unexpected data inputs.
- If an algorithm requires your age in number of days .
- but you give date of birth as input then the algorithm may not work properly.
- The purpose of testing using invalid test data is to detect such situations.
- In this case error messages are shown as output.
- Moreover, this kind of testing helps you to improve the quality of solution.

#### Activities

#### Lecture No. 23 :

- Activity No. 1.11

### Activity 1.11

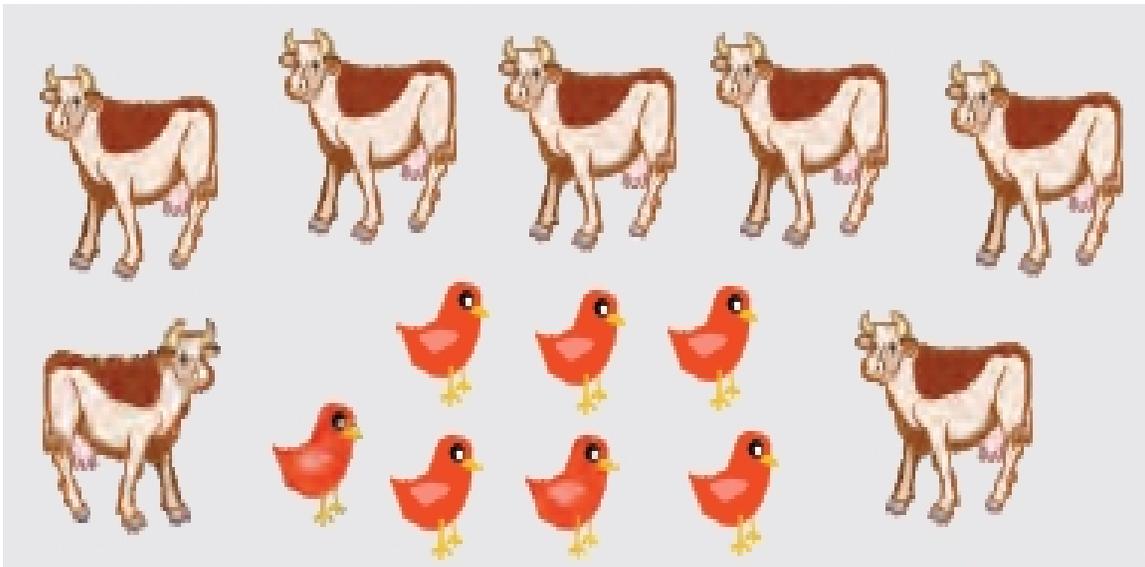
Write all the above discussed algorithms keeping in mind the invalid test data inputs. Class teacher may divide class in few groups and assign them one or more algorithm(s). Students are supposed to discuss and rewrite algorithms so that upon invalid inputs, appropriate messages are displayed.



## EXERCISE

### 1.1 Answer the following questions.

1. In a farm there are some cows and birds. If there are total 35 heads and 110 legs then how many cows and birds are there?



2. Define problem analysis. Explain your answer along with an example.
3. Define an algorithm and argue on its role and importance in problem solving.
4. Suppose a problem has multiple algorithms. How would you choose the most efficient one? Explain with examples.
5. How do you determine requirements for a flowchart?
6. Explain types of test data.
7. Describe a trace table.

- Solve MCQ's
- Solve Fill in the Blank
- Solve Exercise 1.4

## 1.2 Choose the correct option.

1. Which solutions are not reached through proper algorithms or work planning?

- |                            |                      |
|----------------------------|----------------------|
| (i) Prepared solution      | (ii) Candid solution |
| (iii) strategized solution | (iv) best solution   |

2. \_\_\_\_\_ is a graphical representation of an algorithm.

- |                 |               |
|-----------------|---------------|
| (i) Matrix      | (ii) Graph    |
| (iii) Flowchart | (iv) solution |

3. Which symbol in the flowchart is used to either start or end the flowchart?

- |               |                |
|---------------|----------------|
| (i) Terminal  | (ii) Connector |
| (iii) Process | (iv) decision  |

4. \_\_\_\_\_ means to test if the required solution is there.

- |                  |                |
|------------------|----------------|
| (i) Verification | (ii) Algorithm |
| (iii) Validation | (iv) Flowchart |

5. In a \_\_\_\_\_ error, the solution is working but not giving required results.

- |                    |                    |
|--------------------|--------------------|
| (i) Random error   | (ii) logical error |
| (iii) syntax error | (iv) Runtime error |

## 1.3 Fill in the blanks.

1. Before problem solving, we need to first \_\_\_\_\_ a problem.
2. An algorithm produces a defined set of \_\_\_\_\_.
3. A flowchart utilizes various \_\_\_\_\_ and \_\_\_\_\_ to map out the order of steps.
4. In flowcharts symbol  is used to show a \_\_\_\_\_.
5. \_\_\_\_\_ is used to test the solutions.

## 1.4 Draw the flowcharts for the following problems.

1. Input two numbers  $n_1$  and  $n_2$ . Determine whether  $n_1$  divides  $n_2$  or not.
2. Input a year and determine whether it is a leap year or not.
3. Input a number and calculate its factorial.
4. Find LCM (Least Common Multiple) of two numbers.
5. Input a number and display its factors.

## Sardar Kaurey Khan Public Higher Secondary School Muzaffargarh

### Notes Unit 5-7

#### Unit 5 Daffodils by William Wordsworth

##### Lecture 1. Summary

“Daffodils” is a wonderful poem gleaned by the pen of William Wordsworth, a great romantic poet who always found something in the company of Nature either for delight or even for nourishment of human soul. Wordsworth, as we all know, is considered the greatest romantic poet that used to describe Nature in its very essence and shape. Daffodils, a splendid manifestation of Natural Beauty, not only astound but also enslave the thought pattern of the poet. At one place Wordsworth himself expresses;

‘Come forth into the light of things

Let nature be your Teacher’.

Wordsworth relates that he had the craze of enjoying the company of Nature,

On one such occasion while he was roaming about a lake, he found a “host of golden daffodils” the daffodils were dancing in the wind. They were growing besides a lake. The setting of the scene inspired the poet to the extent that he was lost in the beauty and appealing fascination of the daffodils.

Wordsworth then goes on to compare these dancing flowers; daffodils, to the twinkling stars that appear at night in the Milky way. Probably, he wishes to create a resemblance of the way the stars attract us and the impression of the daffodils on the poet’s first sight. The poet was fascinated to find such a wonderful host of golden daffodils as we are amazed to see numerous stars shining in the sky. The poet relates that the flower’s movement is no less beautiful than the twinkling of the stars that captures our sight and senses.

“The waves beside them danced; but they outdid the sparkling waves in glee”.

The clear water of the lake appears to be the Milky way whereas the number of stars a person can see in a sight is ten thousand. There were daffodils in such a big (huge) number that the poet could say,

‘Ten thousand saw I at a glance’

Wordsworth then goes on to compare those daffodils to the moving water and waves of the lake. He declares that the beauty of the dancing daffodils clearly eclipsed the beauty of entire Nature around them.

The poet finds himself lucky to have viewed the scene:

“I gazed and gazed but little thought what wealth the show to me had brought”.

The fever and fret of life are suspended for the time being and he is lost in the world of beautiful images and thoughts.

“The mind that is wise, mourns less for what age takes away;

Than what it leaves behind”

=====

#### Lecture 2 Unit 6 Quaid’s Vision And Pakistan

1- Why did the Quaid have to take long tours during early days of independence?

Ans: He had to take long tours to raise people’s spirits.

2- Why did Quaid want oneness of the whole nation?

The Quaid wanted the oneness of the whole nation as he wished to make the whole nation strong and prosperous.

3- Are we working according to the expectations of the great leader?

We are not working according to the expectations of our great leader. we are disunited. We are not making Pakistan great and strong.

4- What is the result of neglecting advice of the Quaid?

We are divided into sects and groups. Due to our disunity, we have not emerged as a strong and great nation.

#### Lecture 3 Comprehension

1- How much confidence did Quaid-e-Azam have in his nation?

He had great confidence in his nation. He said in a speech that they were made of sterling material and second to one.

2- What was the Quaid’s concept of our nation?

He wished our nation to think beyond personal, local, lingual, ethnic, sectarian or provincial identities and prejudices, he wished us to unite and work collectively.

3- What was the ideology of Pakistan in view of the Quaid?

The ideology of Quaid-e-Azam was based on the principle that the Muslims are an independent nation. Any attempt to merge their identity will be strongly resisted.

4- What can be the possible solution to our present problems?

Unity in our ranks and collective efforts of all the Pakistanis as a nation can be the possible solution to our present problems.

5- How can we become a strong nation?

We can become a strong if we observe national unity and overcome our differences.

#### Lecture 4 Vocabulary

B- Consult a thesaurus and find the synonyms of the given words.

	Words	Synonyms
1-	Morale	mettle, confidence
2-	Voyage	journey
3-	Ambition	aspiration, desire
4-	Nomenclature	terminology
5-	Identity	individuality
6-	Distinctive	peculiar, marked, unique
7-	Emergence	advent, appearance
8-	Struggle	labour, effort
9-	Numerous	innumerable
10-	Strong	muscular
11-	Ideology	dogma, philosophy

-----

Lecture 5      Unit 7 Sultan Ahmad Masjid

1-      Who started the construction of the Blue Masjid?

Sultan Ahmad 1 started the construction of the Blue Masjid in 1609. It was completed in 1616.

2-      In whose reign the construction of the Blue Masjid completed?

Ans:    The construction of the Blue Masjid was completed in the reign of Mustafa-I

3-      Where is royal room situated?

Ans:    Royal room is situated at the south east corner of the masjid.

4-      Why is the Sultan Ahmad Masjid also known as the Blue Masjid?

Ans:    It is known as the Blue Masjid because of blue tiles that embellish its interior.

5-      Who was appointed as the architect of the Masjid?

Ans:    The royal architect Sedfehar Mehmat Aga was appointed the architect of the Masjid.

6-      What was the purpose of hanging a heavy iron chain at the entrance of the court?

Ans:    The purpose was to make Sultan lower his head every time he entered the court. It indicated humility of the ruler in the face of the divine.

**Lecture 6**

7-      How does the interior of the Masjid look?

Ans:    The interior of the Masjid is adorned with more than 20,000 handmade ceramic tiles and blue paint. They are in designs of flowers, fruit and cypresses. Two hundred glass windows and chandeliers illuminate it. Most important element in the decoration is the mehrab, which is finely carved with marble.

8-      Why do you think madrassah and hospice were part of the Masjid?

Ans:    It was custom at that time to build masjid with comprised a tomb of the founder, a madrssa and a hospice.

9-      Who constructed the Masjid Sophia?

Ans:    In the beginning, this building was constructed as a church by the Byzantine Emperor, Justianian the Great later when the Ottoman Turks conquered Constantinople they converted the building into a masjid.

## **Vocabulary.**

Words	Synonyms
Embellish	decorate
Integrate	harmonise, combine, unite
Splendor	glory
Majesty	grandeur, sublimity
Illuminate	light up, brighten

## **Lecture 7**

### **C- words and their sentences.**

- 1- Impressive: His performance in the examination is impressive.
- 2- Dexterously: He acted dexterously and succeeded.
- 3- Spacious: Our school is very spacious.
- 4- Humility: His humility wins others' hearts.
- 5- Flamboyant: Women usually wear flamboyant dresses in marriage ceremonies.

### **Grammar.**

#### **Position of Adverbs:**

#### **Rules:**

- i- Adverbs of manner, place and time are placed after the intransitive verb or after the object of a transitive verb. E.g I shall go there. Adverb of place He went to Lahore yesterday. Adv of time
- ii- Adverbs of frequency are normally placed before the verb or between the helping verb and the main verb. These adverbs answer the question "How often"? e.g never, seldom, rarely etc.
- iii- An adverb is usually placed between a helping verb and the main verb. E.g She is still waiting for you.
- iv- The adverb "Enough" is always placed after the word it modifies. E.g He was kind enough to help me.
- v- When there are two or more adverbs after a verb, the normal order is:
  - 1- Manner

2- Place

3- Time (MPT)

e.g Ahmad sang sweetly in the class yesterday.

### **Exercise**

A- Place the adverbs at appropriate position.

1- She often comes here.

2- Sometimes, he goes to Lahore.

3- The teacher was hardly ever late.

4- We are usually tired by the end of the day.

5- I have just posted a letter to them.

6- He did his work carefully.

**Sardar Kaurey Khan Public Higher Secondary School Muzaffargarh**

**Class: 9<sup>th</sup>**

**Chapter: 01**

**Subject: English**

Ans:1 Arabia is a land of trackless sandy deserts and dunes. It has unparalleled charm and beauty in the dazzling rays of tropical sun.

Ans:2 Arabic language has a rich literary and cultural heritage of the eloquent Arabians in prose and poetry. So the Holy Quran was sent in this language for its preaching.

Ans:3 The Arabs were famous for their remarkable memory and eloquent expression in prose and poetry.

Ans: 4 Before the Holy Prophet's proclamation of Touheed, the mankind stood on the verge of moral and social decay, ignorance and chaos.

Ans 5 The Holy Prophet stayed in the cave of Hira for meditation and remembrance of Allah.

Ans 6 The first revelation was "Read in the solitude name of thy lord who created, created man from a clot of congealed blood. Read and thy lord is most bountiful who taught the use of pen, taught man which he knew not".

Ans 7 The pagan Arabs threatened the Holy Prophet's uncle because the new faith (Islam) was challenging their centuries old prevailing superstitions and wrong belief through divine bliss and true faith.

Ans 8 About the life of the Holy Prophet Hazrat Ayesha (R.A) said, "His morals and characters are an embodiment of the Holy Quran".

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**Sardar Kaurey Khan Public Higher Secondary School Muzaffargarh**

**Class: 9<sup>th</sup>**

**Chapter: 02**

**Subject: English**

Ans 1 Patriotism means love for mother land and devotion to one's country.

Ans 2 A patriot loves his country and renders sacrifice to uphold and protect sovereignty of his motherland.

Ans 3 As a citizen of Pakistan, we must develop a sense of patriotism which galvanizes us all into a united and strong nation".

Ans 4 The spirit of patriotism makes us stay alert in the wake of foreign invasion.

Ans 5 Jinnah's quote ' we must ----- nation", means that we must look after the interest, progress and prosperity of the country beyond personal and provincial interest and limited nationalism based on colour and creed.

**Sardar Kaurey Khan Public Higher Secondary School Muzaffargarh**

**Class: 9<sup>th</sup>**

**Chapter: 03**

**Subject: English**

Ans 1 The most important function that media performs is the provision of news and information to the people.

Ans 2 Electronic media and print media are the two major means of communication.

Ans 3 Media provides entertainment through films, dramas, live programs, dabates, talk shows and sports activities.

Ans 4 When media is allowed to play its unchecked, it spreads fake and false news to the people. Then it becomes source of disinformation rather raising awareness about social evils in the society.

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**Sardar Kaurey Khan Public Higher Secondary School Muzaffargarh**

**Class: 9<sup>th</sup>**

**Hazrat Asma (R.A)**

**Chapter: 04**

**Subject: English**

1- When Abu Jehl asked about Hazrat Abu Bakar (R.A), Hazrat Asma (R.A) remained steadfast and did not reveal the secret. This response, infuriated Abu Jehl and he slapped on her face causing her earring to fall.

2- Harat Abu Kuhafaa (R.A) thought that Abu Bakar (R.A) had taken away all the wealth with him leaving the children empty handed and helpless.

3- Hazrat Asma (R.A) consoled him by placing stone pieces at the place of jewels. She covered them with a cloth and made him feel that those were jewels and gold.

4- Hazrat Abdullah-Bin-Zubair was that son of Hazrat Asma (R.A).

5- Binding the pack of food with her belt and regularly fetching the food to the Rasool at the cave of (Thaor) shows her love and respect for the Holy Prophet (S.A).

6- Hazrat Asma (R.A) sold her inherited garden and gave away the money to the poor and needy. Also nobody ever returned empty handed from her door step. This shows her generosity.

7- From the life of Hazrat Asma (R.A), we get the message of loyalty, sincerity, courage wisdom, steadfastness and generosity to follow.

8- Her life would be beacon of light for all of us, because we can practically follow, the light giving footsteps and golden principles of her life for the generations to come in the history of Islam.

## Unit 4

# Algebraic Expressions and Algebraic Formulas

## Exercise 4.1

### Polynomials

A polynomial in the variable  $x$  is an algebraic expression of the form

$$p(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0, a_n \neq 0$$

Where  $n$ , the highest power of  $x$ , is a non-negative integer called the degree of the polynomial and each coefficient  $a_n$  is a real number.

**Q1. Identify whether the following algebraic expressions are polynomials (yes or no)**

(i)  $3x^2 + \frac{1}{x} - 5$

(ii)  $3x^3 - 4x^2 - x\sqrt{x} + 3$

(iii)  $x^2 - 3x + \sqrt{2}$

(iv)  $\frac{3x}{2x-1} + 8$

**Solution:**

(i) No

(ii) No

(iii) Yes

(iv) No

**Q2. State whether each of the following expression is a rational expression or not.**

(i)  $\frac{3\sqrt{x}}{3\sqrt{x}+5}$

(ii)  $\frac{x^3 - 2x^2 + \sqrt{3}}{2 + 3x - x^2}$

(iii)  $\frac{x^2 + 6x + 9}{x^2 - 9}$

(iv)  $\frac{2\sqrt{x} + 3}{2\sqrt{x} - 3}$

**Solution:**

(i) No

(ii) Yes

(iii) Yes

(iv) No

**Q3. Reduce the following rational expressions to the lowest forms.**

$$(i) \frac{120x^2y^3z^5}{30x^3yz^2}$$

$$(ii) \frac{8a(x+1)}{2(x^2-1)}$$

$$(iii) \frac{(x+y)^2 - 4xy}{(x-y)^2}$$

$$(iv) \frac{(x^3 - y^3)(x^2 - 2xy + y^2)}{(x-y)(x^2 + xy + y^2)}$$

$$(v) \frac{(x+1)(x^2-1)}{(x+1)(x^2-4)}$$

$$(vi) \frac{x^2 - 4x + 4}{2x^2 - 8}$$

$$(vii) \frac{64x^5 - 64x}{(8x^2 + 8)(2x + 2)}$$

$$(viii) \frac{9x^2 - (x^2 - 4)^2}{4 + 3x - x^2}$$

**Solution:**

$$1. \frac{120x^2y^3z^5}{30x^3yz^2} = \frac{30 \times 4y^3xz^{5-2}}{30x^{3-2}} = \boxed{\frac{4y^2z^3}{x}}$$

$$2. \frac{8a(x+1)}{2(x^2-1)} = \frac{2(4a)(x+1)}{2(x+1)(x-1)} = \boxed{\frac{4a}{x-1}}$$

$$3. \frac{(x+y)^2 - 4xy}{(x-y)^2} = \frac{x^2 + y^2 + 2xy - 4xy}{(x-y)^2} = \frac{x^2 + y^2 - 2xy}{(x-y)^2} = \frac{(x-y)^2}{(x-y)^2} = \boxed{1}$$

$$4. \frac{(x^3 - y^3)(x^2 - 2xy + y^2)}{(x-y)(x^2 + xy + y^2)} = \frac{(x^3 - y^3)(x-y)^2}{(x-y)(x^2 + xy + y^2)}$$

$$= \frac{(x-y)(x^2 + xy + y^2)(x-y)^2}{(x-y)(x^2 + xy + y^2)} = \boxed{(x-y)^2}$$

$$5. \frac{(x+1)(x^2-1)}{(x+1)(x^2-4)} = \frac{(x+2)(x+1)(x-1)}{(x+1)(x+2)(x+1)} = \boxed{\frac{(x-1)}{x+1}}$$

$$6. \frac{x^2 - 4x + 4}{2x^2 - 8} = \frac{x^2 - 4x + 2^2}{2(x^2 - 4)} = \frac{(x-2)^2}{2(x+2)(x-2)} = \boxed{\frac{x-2}{2(x+2)}}$$

$$7. \frac{64x^5 - 64x}{(8x^2 + 8)(2x + 2)} = \frac{64x(x^4 - 1)}{8(x^2 + 1)2(x + 1)} = \frac{64x(x^2 + 1)}{16(x^2 + 1)(x + 1)} = \frac{4x(x^2 - 1)}{x + 1}$$

$$= \frac{4x(x + 1)(x - 1)}{x + 1} = \boxed{4x(x - 1)}$$

$$8. \frac{9x^2 - (x^2 - 4)^2}{4 + 3x - x^2} = \frac{(3x)^2 - (x^2 - 4)^2}{4 + 3x - x^2} = \frac{[3x + (x^2 - 4)][3x - (x^2 - 4)]}{4 + 3x - x^2}$$

$$= \frac{(x^2 + 3x - 4)(4 + 3x - x^2)}{4 + 3x - x^2} = \boxed{x^2 + 3x - 4}$$

**Q4. Evaluate (a)**  $\frac{x^3y - 2z}{xz}$  **for**

i.  $x = 3, y = -1, z = -2$

ii.  $x = -1, y = -9, z = 4$

**(b)**  $\frac{x^2y^3 - 5z^4}{xyz}$  **for**  $x = 4, y = -2, z = -1$

**Solution:**

**(a)**  $\frac{x^3y - 2z}{xz}$

**(i)** Putting  $x = 3, y = -1, z = -2$  in the above equation, we get

$$\frac{x^3y - 2z}{xz} = \frac{(3)^3(-1) - 2(-2)}{3(-2)}$$

$$= \frac{-27 + 4}{-6} = \frac{-23}{-6} = \frac{23}{6}$$

$$= \boxed{3\frac{5}{6}}$$

(ii) Putting  $x = -1$ ,  $y = -9$ ,  $z = 4$  in the above equation, we get

$$\begin{aligned}\frac{x^3y - 2z}{xz} &= \frac{(-1)^3(-9) - 2(4)}{(-1)(4)} \\ &= \frac{9 - 8}{-4} = \frac{1}{-4} \\ &= \boxed{-\frac{1}{4}}\end{aligned}$$

(b)  $\frac{x^2y^3 - 5z^4}{xyz}$

Putting  $x = 4$ ,  $y = -2$ ,  $z = -1$  in the above equation, we get

$$\begin{aligned}&= \frac{(4)^2(-2)^3 - 5(-1)^4}{4(-2)(-1)} \\ &= \frac{16(-8) - 5(1)}{8} = \frac{-128 - 5}{8} = -\frac{133}{8} \\ &= \boxed{-16\frac{5}{8}}\end{aligned}$$

**Q5. Perform the indicated operation and simplify.**

i.  $\frac{15}{2x-3y} - \frac{4}{3y-2x}$

ii.  $\sqrt{3}$

iii.  $\frac{x^2 - 25}{x^2 - 36} - \frac{x+5}{x+6}$

iv.  $\frac{x}{x-y} - \frac{y}{x+y} - \frac{2xy}{x^2 - y^2}$

v.  $\frac{x-2}{x^2+6x+9} - \frac{x}{2x^2-18}$

vi.  $\frac{1}{x-1} - \frac{1}{x+1} - \frac{2}{x^2+1} - \frac{4}{x^4-1}$

**Solution:**

$$\begin{aligned}
 \text{i. } & \frac{15}{2x-3y} - \frac{4}{3y-2x} \\
 &= \frac{15}{2x-3y} - \frac{4}{-2x+3y} \\
 &= \frac{15}{2x-3y} - \frac{4}{-(2x-3y)} \\
 &= \frac{15}{2x-3y} + \frac{4}{2x-3y} \\
 &= \frac{15+4}{2x-3y} \\
 &= \frac{19}{2x-3y}
 \end{aligned}$$

$$\begin{aligned}
 \text{ii. } & \frac{1+2x}{1-2x} - \frac{1-2x}{1+2x} \\
 &= \frac{(1+2x)^2 - (1-2x)^2}{(1-2x)(1+2x)} \\
 &= \frac{1+4x+4x^2 - (1-4x+4x^2)}{(1-2x)(1+2x)} \\
 &= \frac{1+4x+4x^2 - 1+4x-4x^2}{(1-2x)(1+2x)} \\
 &= \frac{8x}{1-4x^2}
 \end{aligned}$$

$$\begin{aligned}
 \text{iii. } & \frac{x^2-25}{x^2-36} - \frac{x+5}{x+6} \\
 &= \frac{(x+5)(x-5)}{(x+6)(x-6)} - \frac{x+5}{x+6} \\
 &= \frac{x+5}{x+6} \left( \frac{x-5}{x-6} - 1 \right) \\
 &= \frac{x+5}{x+6} \left\{ \frac{x-5x(x-6)}{x-6} \right\}
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{x+5}{x+6} \left( \frac{x-5-x+6}{x-6} \right) \\
 &= \frac{x+5}{x+6} \times \frac{1}{x-6} = \frac{x+5}{x^2-36}
 \end{aligned}$$

iv.  $\frac{x}{x-y} - \frac{y}{x+y} - \frac{2xy}{x^2-y^2}$

$$\begin{aligned}
 &\frac{x}{x-y} - \frac{y}{x+y} - \frac{2xy}{(x+y)(x-y)} \\
 &= \frac{x(x+y) - y(x-y) - 2xy}{(x+y)(x-y)} \\
 &= \frac{x^2 + xy - xy + y^2 - 2xy}{(x+y)(x-y)} \\
 &= \frac{x^2 + y^2 - 2xy}{(x+y)(x-y)} \\
 &= \frac{(x-y)^2}{(x+y)(x-y)} \\
 &= \frac{x-y}{x+y}
 \end{aligned}$$

v.  $\frac{x-2}{x^2+6x+9} - \frac{x+2}{2x^2-18}$

$$\begin{aligned}
 &= \frac{x-2}{(x+3)^2} - \frac{x+2}{2(x^2-9)} \\
 &= \frac{x-2}{(x+3)^2} - \frac{x+2}{2(x+3)(x-3)} \\
 &= \frac{(x-2)2(x-3) - (x+2)(x+3)}{2(x+3)^2(x-3)} \\
 &= \frac{2(x^2-5x+6) - (x^2+5x+6)}{2(x+3)^2(x-3)} \\
 &= \frac{2x^2-10x+12-x^2-5x-6}{2(x+3)^2(x-3)} \\
 &= \frac{x^2-15x+6}{2(x+3)^2(x-3)}
 \end{aligned}$$

$$\begin{aligned}
 \text{vi. } & \frac{1}{x-1} - \frac{1}{x+1} - \frac{2}{x^2+1} - \frac{4}{x^4-1} \\
 &= \frac{1}{x-1} - \frac{1}{x+1} - \frac{2}{x^2+1} - \frac{4}{(x^2+1)(x+1)(x-1)} \\
 &= \frac{(x^2+1)(x+1) - (x^2+1)(x-1) - 2(x+1)(x-1) - 4}{(x^2+1)(x+1)(x-1)} \\
 &= \frac{x^3+x^2+x+1 - (x^3-x^2+x-1) - 2(x^2-1) - 4}{x^4-1} \\
 &= \frac{x^3+x^2+x+1 - x^3+x^2-x+1 - 2x^2+2-4}{x^4-1} \\
 &= \frac{0}{x^4-1} \\
 &= 0
 \end{aligned}$$

**Q6 Perform the indicated operation and simplify.**

$$(i) (x^2 - 49) \cdot \frac{5x+2}{x+7}$$

$$(ii) \frac{4x-12}{x^2-9} + \frac{18-2x^2}{x^2+6x+9}$$

$$(iii) \frac{x^6y^6}{x^2-y^2} + (x^4 + x^2y^2 + y^4)$$

$$(iv) \frac{x^2-1}{x^2+2x+1} \cdot \frac{x+5}{1-x}$$

$$(v) \frac{x^2+xy}{y(x+y)} \cdot \frac{x^2+xy}{y(x+y)} + \frac{x^2-x}{xy-2y}$$

**Solution:**

$$(i) (x^2 - 49) \cdot \frac{5x+2}{x+7}$$

$$= \frac{(x+7)(x-7)}{1} \times \frac{(5x+2)}{x+7}$$

$$= \frac{(x+7)(x-7)(5x+2)}{x+7}$$

$$= (x-7)(5x+2)$$

$$= 5x^2 + 2x - 35x - 14$$

$$= 5x^2 - 33x - 14$$

$$(ii) \frac{4x-12}{x^2-9} + \frac{18-2x^2}{x^2+6x+9}$$

$$\begin{aligned} &= \frac{4x-12}{x^2-9} \times \frac{x^2+6x+9}{18-2x^2} \\ &= \frac{4(x-3)}{(x+3)(x-3)} \times \frac{(x+3)^2}{2(9-x^2)} \\ &= \frac{2(x-3) \times (x+3) \times (x+3)}{(x+3)(x+3)(3-x)(3+x)} \\ &= \frac{-2(3-x)(3+x)(x+3)}{(x+3)(x-3)(3-x)(x+3)} \\ &= \frac{-2}{x-3} \\ &= \frac{2}{3-x} \end{aligned}$$

$$(iii) \frac{x^6-y^6}{x^2-y^2} + (x^4+x^2y^2+y^4)$$

$$\begin{aligned} &= \frac{x^6-y^6}{x^2-y^2} \times \frac{1}{(x^4+x^2y^2+y^4)} \\ &= \frac{(x^3+y^3)(x^3-y^3)}{(x+y)(x-y)} \times \frac{1}{x^4+2x^2y^2+y^4-x^2y^2} \\ &= \frac{(x+y)(x^2-xy+y^2)(x-y)(x^2+xy+y^2)}{(x+y)(x-y)\{(x^2+y^2)^2-(xy)^2\}} \\ &= \frac{(x^2-xy+y^2)(x^2+xy+y^2)}{\{(x^2+y^2)+(xy)\}\{(x^2+y^2)-(xy)\}} \\ &= \frac{(x^2-xy+y^2)(x^2+xy+y^2)}{(x^2-xy+y^2)(x^2+xy+y^2)} \\ &= 1 \end{aligned}$$

$$(iv) \frac{x^2-1}{x^2+2x+1} \times \frac{x+5}{1-x}$$

$$\begin{aligned} &= \frac{(x+1)(x-1)}{(x+1)^2} \times \frac{x+5}{1-x} \\ &= \frac{-(x+1)(1-x)(x+5)}{(x+1)(x+1)(1-x)} \\ &= \frac{-(x+5)}{x+1} \end{aligned}$$

$$\begin{aligned} \text{(v)} \quad & \frac{x^2+xy}{y(x+y)} \times \frac{x^2+xy}{y(x+y)} \div \frac{x^2-x}{xy-2y} \\ &= \frac{x^2+xy}{y(x+y)} \times \frac{x^2+xy}{y(x+y)} \times \frac{xy-2y}{x^2-x} \\ &= \frac{x(x+y)}{y(x+y)} \times \frac{x(x+y)}{y(x+y)} \times \frac{y(x-2)}{x(x-1)} \\ &= \frac{x(x-2)}{y(x-1)} \end{aligned}$$

ClassNotes

## Exercise 4.2

**Q1 (i)** If  $a+b=10$  and  $a-b=6$  then find the value of  $(a^2+b^2)$ .

**(ii)** If  $a+b=5$  and  $a-b=\sqrt{17}$ , then find the value of  $ab$ .

**Solution:**

**(i)  $a+b=10$ ,  $a-b=6$**

$$(a+b)^2 + (a-b)^2 = 2(a^2+b^2)$$

$$(10)^2 + (6)^2 = 2(a^2+b^2)$$

$$100+36 = 2(a^2+b^2)$$

$$2(a^2+b^2) = 136$$

$$a^2+b^2 = 68$$

**(ii)  $a+b=5$ ,  $a-b=\sqrt{17}$**

$$(a+b)^2 - (a-b)^2 = 4ab$$

$$(5)^2 - (\sqrt{17})^2 = 4ab$$

$$25-17 = 4ab$$

or

$$4ab = 8$$

$$ab = 2$$

**Q2.** If  $a^2+b^2+c^2=45$  and  $a+b+c=-1$ , find the value of  $ab+bc+ca$ .

**Solution:**

$$a^2 + b^2 + c^2 = 45, \quad a + b + c = -1$$

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$$

$$(-1)^2 = 45 + 2(ab + bc + ca)$$

$$1 = 45 + 2(ab + bc + ca)$$

$$1 - 45 = 2(ab + bc + ca)$$

$$2(ab + bc + ca) = -44$$

$$\Rightarrow ab + bc + ca = -22$$

**Q3. If  $m+n+p=10$  and  $mn+np+mp=27$ , find the value of  $m^2 + n^2 + p^2$ .**

**Solution:**

$$(m + n + p)^2 = m^2 + n^2 + p^2 + 2(mn + np + mp)$$

$$(10)^2 = m^2 + n^2 + p^2 + 2(27)$$

$$100 - m^2 + n^2 + p^2 + 54$$

So

$$m^2 + n^2 + p^2 = 100 - 54 = 46$$

**Q.4 If  $x+y+z=78$ , and  $xy+yz+zx=59$ , find the value of  $x+y+z$ .**

**Solution:**

$$x^2 + y^2 + z^2 = 78, xy + yz + zx = 59$$

$$\begin{aligned}(x + y + z)^2 &= x^2 + y^2 + z^2 + 2(xy + yz + zx) \\ &= 78 + 2(59)\end{aligned}$$

$$(x + y + z)^2 = 78 + 118 = 196$$

$$x + y + z = \pm\sqrt{196} = \pm 14$$

**Q.5** If  $x+y+z=12$  and  $x^2 + y^2 + z^2 = 64$  find the value of  $xy+yz+zx$ .

**Solution:**

$$x + y + z = 12$$

$$x^2 + y^2 + z^2 = 64$$

$$(x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$$

$$(12)^2 = 64 + 2(xy + yz + zx)$$

$$xy + yz + zx = 40$$

**Q6.** If  $x+y+z=7$  and  $xy=12$ , then the value of  $x^3 + y^3 + z^3$

**Solution:**

$$x + y + z = 7$$

$$xy = 12$$

$$(x + y)^3 = x^3 + y^3 + 3xy(x + y)$$

$$(7)^3 = x^3 + y^3 + 3(12)(7)$$

$$343 = x^3 + y^3 + 252$$

or

$$x^3 + y^3 = 343 - 252 = 91$$

**Q7. If  $3x+4y=11$  and  $xy=12$ , then find the value of  $27x^3 + 64y^3$**

**Solution:**

$$3x + 4y = 11, xy = 12 \quad (3x + 4y)^3 = (3x)^3 + (4y)^3 + 3(3x)(4y)(3x + 4y)$$

$$(11)^3 = 27x^3 + 64y^3 + 36xy(11)$$

$$1331 = 27x^3 + 64y^3 + 4752$$

or

$$27x^3 + 64y^3 = 1331 - 4752$$

$$27x^3 + 64y^3 = -3421$$

**Q8. If  $x-y=4$  and  $xy=21$ , then find the value of  $x^3 - y^3$ .**

**Solution:**

$$x - y = 4,$$

$$xy = 21$$

$$(x - y)^3 = x^3 - y^3 - 3xy(x - y)$$

$$(4)^3 = x^3 - y^3 - 3(21)(4)$$

$$64 = x^3 - y^3 - 252$$

$$x^3 - y^3 = 64 + 252 = 316$$

**Q9. If  $5x-6=13$  and  $xy=6$ , then find the value of  $125x^3 - 216y^3$**

**Solution:**

$$5x - 6y = 13$$

$$xy = 6$$

$$(5x - 6y)^3 = (5x)^3 - (6y)^3 - 3(5x)(6y)(5x - 6y)$$

$$(13)^3 = 125x^3 - 216y^3 - 1170(6)$$

$$2197 = 125x^3 - 216y^3 - 7020$$

$$125x^3 - 216y^3 = 2197 + 7020 = 9217$$

**Q10.** If  $x + \frac{1}{x} = 3$ , then find the value of  $x^3 + \frac{1}{x^3}$

**Solution:**

$$x + \frac{1}{x} = 3 \left( x + \frac{1}{x} \right)^3 = x^3 + \frac{1}{x^3} + 3x \left( \frac{1}{x} \right) \left( x + \frac{1}{x} \right) (3)^3 = x^3 + \frac{1}{x^3} + 9$$

$$27 = x^3 + \frac{1}{x^3} + 9$$

$$x^3 + \frac{1}{x^3} = 27 - 9 = 18$$

**Q11.** If  $x - \frac{1}{x} = 7$  then find the value of  $x^3 - \frac{1}{x^3}$

**Solution:**

$$x - \frac{1}{x} = 7$$

$$\left(x - \frac{1}{x}\right)^3 = x^3 - \frac{1}{x^3} - 3\left(x\right)\left(\frac{1}{x}\right)\left(x - \frac{1}{x}\right)$$

$$(7)^3 = x^3 - \frac{1}{x^3} - 21$$

$$343 = x^3 - \frac{1}{x^3} - 21$$

$$x^3 - \frac{1}{x^3} = 343 + 21 = 364$$

**Q12.** If  $\left(3x + \frac{1}{3x}\right)$  then find the value of  $\left(27x^3 - \frac{1}{27x^3}\right)$

**Solution:**

$$\left(3x + \frac{1}{3x}\right)^3 = (3x)^3 + \frac{1}{(3x)^3} + 3(3x)\left(\frac{1}{3x}\right)\left(3x + \frac{1}{3x}\right)$$

$$(5)^3 = 27^3 + \frac{1}{27x^3} + 3(5)$$

$$125 = 27x^3 + \frac{1}{27x^3} + 15$$

So

$$27x^3 + \frac{1}{27x^3} = 125 - 15 = 110$$

**Q13.** If  $\left(5x - \frac{1}{5x}\right) = 6$ , then find the value of  $\left(125x^3 - \frac{1}{125x^3}\right)$

**Solution:**

$$\left(5x - \frac{1}{5x}\right)^3 = (5x)^3 - \left(\frac{1}{5x}\right)^3 - 3(5x)\left(\frac{1}{5x}\right)\left(5x - \frac{1}{5x}\right)$$

$$(6)^3 = 125x^3 - \frac{1}{125x^3} - 3(6)$$

$$216 = 125x^3 - \frac{1}{125x^3} = 216 + 18 = 234$$

**Q14. Factorize**

(i)  $x^3 - y^3 - x + y$

$$= (x - y)(x^2 + xy + y^2) - 1(x - y)$$

$$= (x - y)(x^2 + y^2 - 1)$$

(ii)  $8x^3 - \frac{1}{27y^3}$

$$= (2x)^3 - \left(\frac{1}{3y}\right)^3$$

$$= \left(2x - \frac{1}{3y}\right) \left( (2x)^2 + 2x \cdot \frac{1}{3y} + \left(\frac{1}{3y}\right)^2 \right)$$

$$= \left(2x - \frac{1}{3y}\right) \left( 4x^2 + \frac{2x}{3y} + \left(\frac{1}{3y}\right)^2 \right)$$

$$= \left(2x - \frac{1}{3y}\right) \left( 4x^2 \frac{2x}{3y} + \frac{1}{9y^2} \right)$$

**Q15. Find the product, using formulas.**

(i)  $(x^2 + y^2)(x^4 - x^2y^2 + y^4)$

$$= (x^2 + y^2)((x^2)^2 - x^2 \cdot y^2 + (y^2)^2)$$

$$= (x^2)^3 + (y^2)^3 = x^6 + y^6$$

$$\text{(ii)} \quad (x^3 - y^3)(x^6 + x^3y^3 + y^6)$$

$$= (x^2 + y^2)((x^2)^2 - x^2 \cdot y^2 + (y^2)^2)$$

$$= (x^3)^3 - (y^3)^3 = x^9 - y^9$$

$$\text{(iii)} \quad (x - y)(x + y)(x^2 + y^2)(x^2 + xy + y^2)(x^2 - xy + y^2)(x^4 - x^2y^2 + y^4)$$

$$= ((x - y)(x^2 + xy + y^2))((x + y)(x^2 - xy + y^2))((x^2 + y^2)(x^4 - x^2y^2 + y^2))$$

$$= (x^3 - y^3)(x^3 + y^3)((x^2)^3 + (y^2)^3)$$

$$= ((x^3)^2 - (y^3)^2)(x^6 + y^6)$$

$$= (x^6 - y^6)(x^6 + y^6)$$

$$= (x^6)^2 - (y^6)^2$$

$$= x^{12} - y^{12}$$

$$\text{(iv)} \quad (2x^2 - 1)(2x^2 + 1)(4x^4 + 2x^2 + 1)$$

$$\begin{aligned} &= \left( (2x^2 - 1)(4x^4 + 2x^2 + 1) \right) \left( (2x^2 + 1)(4x^4 - 2x^2 + 1) \right) \\ &= (2x^2 - 1) \left( (2x^2)^2 + 2x^2 \cdot 1 + (1)^2 \right) (2x^2 + 1) (4x^4 - 2x^2 + 1) \\ &= (2x^2 - 1) \left( (2x^2)^2 + 2x^2 \cdot 1 + (1)^2 \right) (2x^2 + 1) (2x^2 + 1)^2 \left( (2x^2)^2 - (2x^2)(1) + (1)^2 \right) \\ &= \left( \left( (2x^2)^3 - (1)^3 \right) \right) \left( (2x^2)^3 + (1)^3 \right) \\ &= (8x^6 - 1)(8x^6 + 1) \\ &= (8x^6)^2 - (1)^2 \\ &= 64x^{12} - 1 \end{aligned}$$

ClassNotes

## Exercise 4.3

**Q1. Express each of the following surds in the simplest form.**

**Solution:**

$$\begin{aligned} \text{(i)} \quad & \sqrt{180} \\ &= \sqrt{90 \cdot 2} \\ &= \sqrt{9 \cdot 4 \cdot 5} = 3 \cdot 2 \cdot \sqrt{5} = 6\sqrt{5} \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad & 3\sqrt{162} \\ &= 3\sqrt{81 \cdot 2} = 3 \cdot 9 \cdot \sqrt{2} \\ &= 27\sqrt{2} \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad & \frac{3}{4} \sqrt[3]{128} \\ &= \frac{3}{4} \sqrt[3]{64 \cdot 2} \\ &= \frac{3}{4} \sqrt[3]{4^3 \cdot 2} = \frac{3}{4} \cdot 4 \sqrt[3]{2} \\ &= 3 \sqrt[3]{2} \end{aligned}$$

$$\begin{aligned} \text{(iv)} \quad & \sqrt[3]{96x^6y^7z^8} \\ &= \sqrt[3]{32 \cdot 3 \cdot x^5 \cdot x \cdot y^5 \cdot y^2 \cdot z^5 \cdot z^3} \\ &= \sqrt[3]{(2xyz)^5 \cdot 3xy^2z^3} \\ &= 2xyz \sqrt[3]{3xy^2z^3} \end{aligned}$$

**Q2. Simplify**

**Solution:**

$$\begin{aligned} \text{(i)} \quad & \frac{\sqrt{18}}{\sqrt{3}\sqrt{2}} \\ &= \frac{\sqrt{18}}{\sqrt{6}} = \sqrt{\frac{18}{6}} \\ &= \sqrt{3} \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad & \frac{\sqrt{21}\sqrt{9}}{\sqrt{63}} \\ &= \frac{\sqrt{21 \times 9}}{\sqrt{63}} = \frac{\sqrt{189}}{\sqrt{63}} \\ &= \sqrt{\frac{189}{63}} = \sqrt{3} \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad & \sqrt[5]{243x^5y^{10}z^{15}} \\ &= (3^5x^5y^{10}z^{15})^{\frac{1}{5}} \\ &= 3xy^2z^3 \end{aligned}$$

$$\begin{aligned} \text{(iv)} \quad & \frac{4}{5}\sqrt[3]{125} \\ &= \frac{4}{5}\sqrt[3]{5^3} = \frac{4}{5} \cdot 5 = 4 \end{aligned}$$

$$\begin{aligned} \text{(v)} \quad & \sqrt{21} \times \sqrt{7} \times \sqrt{3} \\ &= \sqrt{21} \times \sqrt{21} \\ &= (\sqrt{21})^2 = 21 \end{aligned}$$

**Q3. Simplify by combining similar terms.**

**Solution:**

$$\begin{aligned}
 \text{(i)} \quad & \sqrt{45} - 3\sqrt{20} + 4\sqrt{5} \\
 &= \sqrt{9 \times 5} - 3\sqrt{4 \times 5} + 4\sqrt{5} \\
 &= 3\sqrt{5} - 3 \times 2\sqrt{5} + 4\sqrt{5} \\
 &= 3\sqrt{5} - 6\sqrt{5} + 4\sqrt{5} \\
 &= (3 - 6 + 4)\sqrt{5} \\
 &= \sqrt{5}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad & 4\sqrt{12} + 5\sqrt{27} - 3\sqrt{75} + \sqrt{300} \\
 &= 4\sqrt{4 \times 3} + 5\sqrt{9 \times 3} - 3\sqrt{25 \times 3} + \sqrt{100 \times 3} \\
 &= 4 \times 2 \times \sqrt{3} + 5 \times 3 \times \sqrt{3} - 3 \times 5 \times \sqrt{3} + 10 \times \sqrt{3} \\
 &= (8 + 15 + 15 + 10)\sqrt{3} \\
 &= 18\sqrt{3}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad & \sqrt{3}(2\sqrt{3} + 3\sqrt{3}) \\
 &= \sqrt{3} \cdot \sqrt{3}(6 - 3) \\
 &= (\sqrt{3})^2 (5) = 3 \times 5 \\
 &= 15
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad & 2(6\sqrt{5} - 3\sqrt{5}) \\
 &= 2 \cdot \sqrt{5}(6 - 3) \\
 &= 2 \cdot \sqrt{5} \times 3 = 6\sqrt{5}
 \end{aligned}$$

**Q4. Simplify**

**Solution:**

$$\begin{aligned} \text{(i)} & (3+\sqrt{3})(3-\sqrt{3}) \\ & = (3)^2 - (\sqrt{3})^2 = 9-3=6 \end{aligned}$$

$$\begin{aligned} \text{(ii)} & (\sqrt{5}+\sqrt{3})^2 \\ & = (\sqrt{5})^2 + (\sqrt{3})^2 + 2\sqrt{5}\cdot\sqrt{3} \\ & = 5+3+2\sqrt{15} \\ & = 8+2\sqrt{15} \end{aligned}$$

$$\begin{aligned} \text{(iii)} & (\sqrt{5}+\sqrt{3})(\sqrt{5}-\sqrt{3}) \\ & = (\sqrt{5})^2 - (\sqrt{3})^2 \\ & = 5-3=2 \end{aligned}$$

$$\begin{aligned} \text{(iv)} & \left(\sqrt{2}+\frac{1}{\sqrt{3}}\right)\left(\sqrt{2}-\frac{1}{\sqrt{3}}\right) \\ & = (\sqrt{2})^2 - \left(\frac{1}{\sqrt{3}}\right)^2 \\ & = 2 - \frac{1}{3} = \frac{6-1}{3} = \frac{5}{3} \end{aligned}$$

$$\text{(v)} (\sqrt{x}+\sqrt{y})(\sqrt{x}-\sqrt{y})(x+y)(x^2+y^2)$$

$$\begin{aligned} &= \left( (\sqrt{x})^2 - (\sqrt{y})^2 \right) (x+y)(x^2+y^2) \\ &= (x-y)(x+y)(x^2+y^2) \\ &= (x^2-y^2)(x^2+y^2) \\ &= (x^2)^2 - (y^2)^2 \\ &= x^4 - y^4 \end{aligned}$$

ClassNotes

## Exercise 4.4

Q1. Rationalize the denominator of the following.

$$\text{i) } \frac{3}{4\sqrt{3}}$$

$$= \frac{3}{4\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{3\sqrt{3}}{4 \cdot 3} = \frac{\sqrt{3}}{4}$$

$$\text{ii) } \frac{14}{\sqrt{98}}$$

$$= \frac{14}{\sqrt{98}} \cdot \frac{\sqrt{98}}{\sqrt{98}} = \frac{14\sqrt{98}}{98} = \frac{1}{14} \sqrt{49 \times 2} = \frac{1}{7} \cdot 7 \cdot \sqrt{2} = \sqrt{2}$$

$$\text{iii) } \frac{6}{\sqrt{8}\sqrt{27}}$$

$$= \frac{6}{\sqrt{8}\sqrt{27}} \cdot \frac{\sqrt{8}\sqrt{27}}{\sqrt{8}\sqrt{27}}$$

$$= \frac{6}{8 \times 27} \cdot \sqrt{8}\sqrt{27}$$

$$= \frac{1}{36} \cdot \sqrt{4 \cdot 2} \cdot \sqrt{9 \cdot 3}$$

$$= \frac{1}{4 \times 9} \times 2 \times 3 \cdot \sqrt{2} \sqrt{3}$$

$$= \frac{1}{6} \sqrt{6} = \frac{\sqrt{6}}{6}$$

$$\text{iv) } \frac{1}{3+2\sqrt{5}}$$

$$\begin{aligned}
 &= \frac{1}{3+2\sqrt{5}} \cdot \frac{3-2\sqrt{5}}{3-2\sqrt{5}} \\
 &= \frac{3-2\sqrt{5}}{(3)^2 - (2\sqrt{5})^2} = \frac{3-2\sqrt{5}}{9-20} \\
 &= \frac{3-2\sqrt{5}}{-11} = -\frac{1}{11}(3-2\sqrt{5})
 \end{aligned}$$

v)  $\frac{15}{\sqrt{31}-4}$

$$\begin{aligned}
 &= \frac{15}{\sqrt{31}-4} \times \frac{\sqrt{31}+4}{\sqrt{31}+4} \\
 &= \frac{15\sqrt{31}+4}{(3)^2 - (4)^2} = \frac{15(\sqrt{31}+4)}{31-6} \\
 &= \frac{15(\sqrt{31}+4)}{15} = \sqrt{31}+4
 \end{aligned}$$

vi)  $\frac{2}{\sqrt{5}-\sqrt{3}}$

$$\begin{aligned}
 &= \frac{2}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}} \\
 &= 2 \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}^2 - \sqrt{3}^2} = \frac{2(\sqrt{5}+\sqrt{3})}{2} \\
 &= \sqrt{5}+\sqrt{3}
 \end{aligned}$$

vii)  $\frac{\sqrt{3}-1}{\sqrt{3}+1}$

$$\begin{aligned}
 &= \frac{\sqrt{3}-1}{\sqrt{3}+1} \times \frac{\sqrt{3}-1}{\sqrt{3}-1} \\
 &= \frac{(\sqrt{3}-1)^2}{(\sqrt{3})^2 - (1)^2} = \frac{(\sqrt{3})^2 - 2\sqrt{3} + (1)^2}{3-1} \\
 &= \frac{3-2\sqrt{3}+1}{2} = \frac{4-2\sqrt{3}}{2} \\
 &= \frac{2(2-\sqrt{3})}{2} = 2-\sqrt{3}
 \end{aligned}$$

$$\text{viii) } \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}$$

$$\begin{aligned}
 &= \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}} \\
 &= \frac{(\sqrt{5}+\sqrt{3})^2}{(\sqrt{5})^2 - (\sqrt{3})^2} = \frac{5+2\sqrt{15}+3}{5-3} \\
 &= \frac{8+2\sqrt{15}}{2} = \frac{2(4+\sqrt{15})}{2} \\
 &= 4+\sqrt{15}
 \end{aligned}$$

**Q2. Find the conjugate of  $x+\sqrt{y}$**

- |                   |                    |
|-------------------|--------------------|
| i) $3+\sqrt{7}$   | iv) $2+\sqrt{5}$   |
| ii) $4-\sqrt{5}$  | v) $5+\sqrt{7}$    |
| iii) $2+\sqrt{3}$ | vi) $4-\sqrt{15}$  |
| vii) $7-\sqrt{6}$ | viii) $9-\sqrt{2}$ |

**Solution:**

- i) **Conjugate of  $3+\sqrt{7}$  is  $3-\sqrt{7}$**

- ii) **Conjugate of  $4 - \sqrt{5}$  is  $4 + \sqrt{5}$**
- iii) **Conjugate of  $2 + \sqrt{3}$  is  $2 - \sqrt{3}$**
- iv) **Conjugate of  $2 + \sqrt{5}$  is  $2 - \sqrt{5}$**
- v) **Conjugate of  $5 + \sqrt{7}$  is  $5 - \sqrt{7}$**
- vi) **Conjugate of  $4 - \sqrt{15}$  is  $4 + \sqrt{15}$**
- vii) **Conjugate of  $7 - \sqrt{6}$  is  $7 + \sqrt{6}$**
- viii) **Conjugate of  $9 - \sqrt{2}$  is  $9 + \sqrt{2}$**

**Q3.**

(i) If  $x = 2 - \sqrt{3}$ , find  $\frac{1}{x}$

(ii) If  $x = 4 - \sqrt{7}$ , find  $\frac{1}{x}$

(iii) If  $x = \sqrt{3} + 2$ , find  $x + \frac{1}{x}$

**Solution:**

i)  $x = 2 - \sqrt{3}$

$$\frac{1}{x} = \frac{1}{2 - \sqrt{3}}$$

$$= \frac{1}{2 - \sqrt{3}} \times \frac{2 + \sqrt{3}}{2 + \sqrt{3}}$$

$$= \frac{2 + \sqrt{3}}{(2)^2 - (\sqrt{3})^2} = \frac{2 + \sqrt{3}}{4 - 3}$$

$$= 2 + \sqrt{3}$$

ii)  $x = 4 - \sqrt{17}$

$$\begin{aligned}
 \frac{1}{x} &= \frac{1}{4-\sqrt{17}} \\
 &= \frac{1}{4-\sqrt{17}} \times \frac{4+\sqrt{17}}{4+\sqrt{17}} \\
 &= \frac{4+\sqrt{17}}{(4)^2 - (\sqrt{17})^2} = \frac{4+\sqrt{17}}{16-17} \\
 &= -(4+\sqrt{17}) = -4-\sqrt{17}
 \end{aligned}$$

iii)  $x = \sqrt{3} + 2$

$$\begin{aligned}
 \frac{1}{x} &= \frac{1}{\sqrt{3}+2} \\
 &= \frac{1}{\sqrt{3}+2} \times \frac{\sqrt{3}-2}{\sqrt{3}-2} = \frac{\sqrt{3}-2}{(\sqrt{3})^2 - (2)^2} \\
 &= \frac{\sqrt{3}-2}{3-4} = \frac{\sqrt{3}-2}{-1} \\
 &= -(\sqrt{3}-2) \\
 &= -\sqrt{3}+2 = 2-\sqrt{3} \\
 \therefore x + \frac{1}{x} &= \sqrt{3}+2+2-\sqrt{3} = 4
 \end{aligned}$$

**Q4. Simplify:**

(i)  $\frac{1+\sqrt{2}}{\sqrt{5}+\sqrt{3}} + \frac{1-\sqrt{2}}{\sqrt{5}-\sqrt{3}}$

(ii)  $\frac{1}{2+\sqrt{3}} + \frac{2}{\sqrt{5}-\sqrt{3}} + \frac{1}{2+\sqrt{5}}$

(iii)  $\frac{2}{\sqrt{5}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{2}} - \frac{3}{\sqrt{5}+\sqrt{2}}$

**Solution:**

$$\begin{aligned}
 \text{(i)} \quad & \frac{1+\sqrt{2}}{\sqrt{5+\sqrt{3}}} + \frac{1-\sqrt{2}}{\sqrt{5-\sqrt{3}}} \\
 & \frac{1+\sqrt{2}}{\sqrt{5+\sqrt{3}}} + \frac{1-\sqrt{2}}{\sqrt{5-\sqrt{3}}} \\
 & = \frac{(1+\sqrt{2})(\sqrt{5-\sqrt{3}}) + (1+\sqrt{2})(\sqrt{5+\sqrt{3}})}{(\sqrt{5+\sqrt{3}})(\sqrt{5-\sqrt{3}})} \\
 & = \frac{\sqrt{5-\sqrt{3}} + \sqrt{10} - \sqrt{6} + \sqrt{5} + \sqrt{3} - \sqrt{10} + 6}{(\sqrt{5})^2 - (\sqrt{3})^2} \\
 & = \frac{2\sqrt{5} - 2\sqrt{6}}{5-3} = \frac{2(\sqrt{5} - \sqrt{6})}{2} \\
 & = \sqrt{5} - \sqrt{6}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad & \frac{1}{2+\sqrt{3}} + \frac{2}{\sqrt{5-\sqrt{3}}} + \frac{1}{2+\sqrt{5}} \\
 & = \frac{1}{2+\sqrt{3}} \cdot \frac{2-\sqrt{3}}{2-\sqrt{3}} + \frac{2}{\sqrt{5-\sqrt{3}}} \cdot \frac{\sqrt{5+\sqrt{3}}}{\sqrt{5+\sqrt{3}}} + \frac{1}{2+\sqrt{5}} \cdot \frac{2-\sqrt{5}}{2-\sqrt{5}} \\
 & = \frac{2-\sqrt{3}}{4-3} + \frac{2(\sqrt{5+\sqrt{3}})}{5-3} + \frac{2-\sqrt{5}}{4-5} \\
 & = 2 - \sqrt{3} + \sqrt{5} + \sqrt{3} - 2 + \sqrt{5} \\
 & = 2\sqrt{5}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad & \frac{2}{\sqrt{5+\sqrt{3}}} + \frac{1}{\sqrt{3+\sqrt{2}}} - \frac{3}{\sqrt{5+\sqrt{2}}} \\
 & = \frac{2}{\sqrt{5+\sqrt{3}}} \cdot \frac{\sqrt{5-\sqrt{3}}}{\sqrt{5-\sqrt{3}}} + \frac{1}{\sqrt{3+\sqrt{2}}} \cdot \frac{\sqrt{3-\sqrt{2}}}{\sqrt{3-\sqrt{2}}} - \frac{3}{\sqrt{5+\sqrt{2}}} \cdot \frac{\sqrt{5-\sqrt{2}}}{\sqrt{5-\sqrt{2}}} \\
 & = \frac{2(\sqrt{5}-\sqrt{3})}{5-3} + \frac{(\sqrt{3}-\sqrt{2})}{1} - \frac{3(\sqrt{5}-\sqrt{2})}{5-2}
 \end{aligned}$$

$$= \sqrt{5} - \sqrt{3} + \sqrt{3} - \sqrt{2} - (\sqrt{5} - \sqrt{2})$$

$$= \sqrt{5} - \sqrt{2} - \sqrt{5} + \sqrt{5} + \sqrt{2} = 0$$

**Q5. i) If  $x = 2 + \sqrt{3}$ , find the value of  $x - \frac{1}{x}$  and  $\left(x - \frac{1}{x}\right)^2$**

**ii)  $x = \frac{\sqrt{5} - \sqrt{2}}{\sqrt{5} + \sqrt{2}}$ , find the value of  $x + \frac{1}{x}$ ,  $x^2 + \frac{1}{x^2}$  and  $x^3 + \frac{1}{x^3}$**

$$\left[ \begin{array}{l} \text{Hint: } a^2 + b^2 = (a+b)^2 - 2ab \quad \text{and} \\ a^3 + b^3 = (a+b)^3 - 3ab(a+b) \end{array} \right]$$

**Solution:**

**i)  $x = 2 + \sqrt{3}$**

$$\frac{1}{x} = \frac{1}{2 + \sqrt{3}} = \frac{1}{2 + \sqrt{3}} \cdot \frac{2 - \sqrt{3}}{2 - \sqrt{3}}$$

$$= \frac{2 - \sqrt{3}}{4 - 3} = 2 - \sqrt{3}$$

$$x - \frac{1}{x} = 2 + \sqrt{3} - 2 + \sqrt{3} = 2\sqrt{3}$$

and

$$\left(x - \frac{1}{x}\right)^2 = (2\sqrt{3})^2 = 4 \times 3 = 12$$

**ii)  $x = \frac{\sqrt{5} - \sqrt{2}}{\sqrt{5} + \sqrt{2}}$**

$$\frac{1}{x} = \frac{\sqrt{5} + \sqrt{2}}{\sqrt{5} - \sqrt{2}}$$

$$x + \frac{1}{x} = \frac{\sqrt{5} - \sqrt{2}}{\sqrt{5} + \sqrt{2}} + \frac{\sqrt{5} + \sqrt{2}}{\sqrt{5} - \sqrt{2}}$$

$$\begin{aligned}
 &= \frac{(\sqrt{5}-\sqrt{2})^2 + (\sqrt{5}+\sqrt{2})^2}{(\sqrt{5})^2 + (2)^2} \\
 &= \frac{(\sqrt{5})^2 + (\sqrt{2})^2 + (\sqrt{5})^2 + (\sqrt{2})^2}{5-2} \\
 &= \frac{5+2+5+2}{3} = \frac{14}{3}
 \end{aligned}$$

$$\left(x + \frac{1}{x}\right)^2 = \left(\frac{14}{3}\right)^2$$

$$x^2 + \frac{1}{x^2} + 2 = \frac{196}{9}$$

$$= \frac{196}{9} - 2$$

$$= \frac{196-18}{9} = \frac{178}{9}$$

$$x^3 + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right)$$

$$= \left(\frac{14}{3}\right)^3 - 3\left(\frac{14}{3}\right)$$

$$= \frac{2744-378}{27} = \frac{2366}{27}$$

**Q6. Determine the rational number a and b if**

$$\frac{\sqrt{3}-1}{\sqrt{3}+1} + \frac{\sqrt{3}+1}{\sqrt{3}-1} = a + b\sqrt{3}$$

**Solution:**

$$\frac{\sqrt{3}-1}{\sqrt{3}+1} + \frac{\sqrt{3}+1}{\sqrt{3}-1} = a + b\sqrt{3}$$

$$\Rightarrow \frac{(\sqrt{3}-1)^2 + (\sqrt{3}+1)^2}{(\sqrt{3}+1)(\sqrt{3}-1)} = a + b\sqrt{3}$$

$$\Rightarrow \frac{3-2\sqrt{3}+1+3+2\sqrt{3}+1}{3-1} = a + b\sqrt{3}$$

$$\frac{8}{2} = a + b\sqrt{3}$$

$$4 = a + b\sqrt{3}$$

$$4 + 0 = a + b\sqrt{3}$$

By comparing both sides of the equation

$$\Rightarrow a = 4, \quad b = 0$$

ClassNotes

## Unit 5

# Factorization

## Exercise 5.1

### Q1. Factorize

(i)  $2abc - 4abx + 2abd$

$$= 2ab(c - 2x + d)$$

(ii)  $9xy - 12x^2y + 18y^2$

$$= 3y(3x - 4x^2 + 6y)$$

(iii)  $-3x^2y - 3x + 9xy^2$

$$= -3x(xy + 1 - 3y^2)$$

(iv)  $5ab^2c^3 - 10a^2b^3c - 20a^3bc^2$

$$= 5abc(bc^2 - 2b^2 - 4a^2c)$$

(v)  $3x^3y(x-3y) - (7x^2y^2(x-3y))$

$$= (x-3y)(3x^3y - 7x^2y^2)$$

$$= (x-3y)x^2y(3x-7y)$$

$$= x^2y(x-3y)x^2y(3x-7y)$$

$$\begin{aligned}
 \text{(vi)} \quad & 2xy^3(x^2+5)+8xy^2(x^2+5) \\
 &= (x^2+5)(2xy^3+8xy^2) \\
 &= (x^2+5)(2xy^2)(y+4) \\
 &= 2xy^2(x^2+5)(y+4)
 \end{aligned}$$

## Q.2

$$\begin{aligned}
 \text{(i)} \quad & 5ax-3ay-5bx+3by \\
 &= 5ax-5bx-3ay+3by \\
 &= 5x(a-b)(5x-3y)
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad & 3xy+2y-12x-8 \\
 &= 3xy-12x+2y-8 \\
 &= 3x(y-4)+2(y-4) \\
 &= (y-4)(3x+2)
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad & x^3+3xy^2-2x^2-6y^3 \\
 &= x(x^2+3y^2)-2y(x^2+3y^2) \\
 &= (x^2+3y^2)(x-2y)
 \end{aligned}$$

$$\text{(iv)} \quad (x^2-y^2)z+(y^2-z^2)x$$

$$\begin{aligned}
&= x^2z - y^2z + y^2x - z^2x \\
&= x^2z - z^2x + y^2x - y^2z \\
&= xz(x - z) + y^2x - y^2z \\
&= (x - z)(xz + y^2)
\end{aligned}$$

**Q.3**

$$(i) 144a^2 + 24a + 1$$

$$\begin{aligned}
&= 144a^2 + 12a + 12a + 1 \\
&= 12a(12a + 1) + 1(12a + 1) \\
&= (12a + 1)(12a + 1) = (12a + 1)^2
\end{aligned}$$

$$(ii) \frac{a^2}{b^2} - 2 + \frac{b^2}{a^2}$$

$$\begin{aligned}
&= \left(\frac{a}{b}\right)^2 - 2\left(\frac{a}{b}\right)\frac{b}{a} + \left(\frac{b}{a}\right)^2 \\
&= \left(\frac{a}{b} - \frac{b}{a}\right)^2
\end{aligned}$$

$$(iii) (x + y)^2 - 14z(x + y) + 49z^2$$

$$\begin{aligned}
&= (x + y)^2 - 2(x + y)(7z) + (7z)^2 \\
&= (x + y - 7z)^2
\end{aligned}$$

$$(iv) 12x^2 - 36x + 27$$

$$\begin{aligned}
 &= 3(4x^2 - 12x + 9) \\
 &= 3[(2x)^2 - 2(2x)(3) + (3)^2] \\
 &= 3(2x - 3)^3
 \end{aligned}$$

**Q4.**

**(i)**  $3x^2 - 75y^2$

$$\begin{aligned}
 &= 3(x^2 - 25y^2) \\
 &= 3[(x^2) - (5y)^2] \\
 &= 3(x + 5y)(x - 5y)
 \end{aligned}$$

**(ii)**  $x(x-1) - y(y-1)$

$$\begin{aligned}
 &= x^2 - x - y^2 + y \\
 &= x^2 - y^2 - x + y \\
 &= (x + y)(x - y) - 1(x - y) \\
 &= (x - y)(x + y - 1)
 \end{aligned}$$

**(iii)**  $128am^2 - 242an^2$

$$\begin{aligned}
 &= 2a(64m^2 - 121n^2) \\
 &= 2a\{(8m^2) - (11n^2)\} \\
 &= 21(8m + 11n)(8m - 11n)
 \end{aligned}$$

**(iv)**  $3x - 243x^3$

$$\begin{aligned}
 &= 3x(1 - 81x^2) \\
 &= 3x((1)^2 - (9x^2)) \\
 &= 3x(1 + 9x)(1 - 9x)
 \end{aligned}$$

**Q.5**

**(i)**  $x^2 - y^2 - 6y - 9$

$$\begin{aligned} &= x^2 - (y^2 + 6y + 9) \\ &= x^2 - ((y^2) + 2(y)(3) + (3)^2) \\ &= x^2 - (y+3)^2 \\ &= (x+(y+3))(x-(y+3)) \\ &= (x+y+3)(x-y-3) \end{aligned}$$

**(ii)**  $x^2 - a^2 + 2a - 1$

$$\begin{aligned} &= x^2 - (a^2 - 2a + 1) \\ &= x^2 - ((a)^2 - 2(a)(1) + (1)^2) \\ &= x^2 - (a-1)^2 \\ &= (x)^2 - (a-1)^2 \\ &= (x+(a-1))(x-(a+1)) \\ &= (x+a-1)(x-a+1) \end{aligned}$$

**(iii)**  $4x^2 - y^2 - 4x - 2y + 3$

$$\begin{aligned} &= 4x^2 - (y^2 + 2y + 1) \\ &= (2x)^2 - (y+1)^2 \\ &= [2x+(y+1)][2x-(y+1)] \\ &= (2x+y-1)(2x-y-1) \end{aligned}$$

$$(iv) x^2 - y^2 - 4x - 2y + 3$$

$$= x^2 - 4x - y^2 - 2y + 3$$

$$= x^2 - 4x - y^2 - 2y + 3$$

$$= x^2 - 4x + 4 - y^2 - 2y - 1$$

$$= x^2 - 4x + 4 - (y + 1)^2$$

$$= ((x - 2) + (y + 1))(x - 2 - y - 1)$$

$$= (x + y - 1)(x - y - 3)$$

$$(v) 25x^2 - 10x + 1 - 36z^2$$

$$= (5x)^2 - 2(5x)(1) + (1)^2 - 36z^2$$

$$= (5x - 1)^2 - (6z)^2$$

$$= ((5x - 1) + 6z)((5x - 1) - 6z)$$

$$= (5x - 1 + 6z)(5x - 1 - 6z)$$

$$(vi) x^2 - y^2 - 4xz + 4z^2$$

$$= x^2 - 4xz + 4z^2 - y^2$$

$$= (x)^2 - 2(x)(2z) + (2z)^2 - y^2$$

$$= (x - 2z)^2 - (y)^2$$

$$= ((x - 2z) + y)((x - 2z) - y)$$

$$= (x - 2z + y)(x - y - 2z)$$

$$= (x + y - 2z)(x - y - 2z)$$

## Exercise 5.2

### Q.1 Factorize

$$(i) x^4 + \frac{1}{x^4} - 3$$

$$= x^4 + 1/x^4 - 2 - 1$$

$$= x^4 - 2 + 1/x^4 - 1$$

$$= (x^2 - 1/x^2)^2 - 1^2$$

$$= ((x^2 - 1/x^2) + 1)((x^2 - 1/x^2) - 1)$$

$$= (x^2 - 1/x^2 + 1)(x^2 - 1/x^2 - 1)$$

$$(ii) 3x^4 + 12y^4$$

$$= 3(x^4 + 4y^4)$$

$$= 3(x^4 + 4x^2y^2 + 4y^4 - 4x^2y^2)$$

$$= 3(x^2 + 2y^2)^2 - 4x^2y^2$$

$$= 3((x^2 + 2y^2) + (2xy))^2$$

$$= 3((x^2 + 2y^2) + 2xy)((x^2 + 2y^2) - 2xy)$$

$$= 3(x^2 + 2xy + 2y^2)(x^2 - 2xy + 2y^2)$$

$$(iii) a^4 + 3a^2b^2 + ab^4$$

$$= a^4 + 4a^2b^2 + 4b^2 - a^2b^2$$

$$= (a^2 + 2b^2)^2 - (ab)^2$$

$$= (a^2 + 2b^2 + ab)(a^2 + 2b^2 - ab)$$

$$= (a^2 + ab + 2b^2)(a^2 - ab + 2b^2)$$

$$(iv) 4x^4 + 81$$

$$= (2x^2)^2 + (9)^2 + 36x - 36x^2$$

$$\begin{aligned}
 &= (2x^2 + 9)^2 - (6x)^2 \\
 &= (2x^2 + 9 + 6x)(2x^2 + 9 - 6x) \\
 &= (2x^2 + 6x + 9)(2x^2 - 6x + 9)
 \end{aligned}$$

**(v)**  $x^4 + x^2 + 25$

$$\begin{aligned}
 &= x^4 + 10x^2 + 25 - 9x^2 \\
 &= (x^2)^2 + 2(x^2)5 - 9x^2 \\
 &= (x^2 + 5)^2 - (3x)^2 \\
 &= (x^2 + 5 + 3x)(x^2 + 5 - 3x) \\
 &= (x^2 + 2x + 4)(x^2 - 2x + 4)
 \end{aligned}$$

**(vi)**  $x^4 + 4x^2 + 16$

$$\begin{aligned}
 &= x^4 + 8x^2 + 16 - 4x^2 \\
 &= (x^2 + 4)^2 - (2x)^2 \\
 &= (x^2 + 4 + 2x)(x^2 + 4 - 2x) \\
 &= (x^2 + 2x + 4)(x^2 + 2x - 4)
 \end{aligned}$$

## Q.2

**(i)**  $x^2 + 14x + 48$

$$\begin{aligned}
 &= x^2 + 8x + 6x + 48 \\
 &= x(x + 8) + 6(x + 8) \\
 &= (x + 8)(x + 6)
 \end{aligned}$$

**(ii)**  $x^2 - 21x + 108$

$$\begin{aligned}
 &= x^2 - 12x - 9x + 108 \\
 &= x(x - 12) - 9(x - 12) \\
 &= (x - 12)(x - 9)
 \end{aligned}$$

$$\text{(iii)} x^2 - 11x - 42$$

$$= x^2 - 14x + 3x - 42$$

$$= x(x-14) + 3(x-14)$$

$$= (x-14)(x+3)$$

$$\text{(iv)} x^2 + x - 132$$

$$= x^2 - 12x - 11x - 132$$

$$= x(x+12)(x-11)$$

$$= (x+12)(2x+1)$$

### Q.3

$$\text{(i)} 4x^2 + 12x + 5$$

$$= 4x^2 + 10x + 2x + 5$$

$$= 2x(2x+5) + 1(2x+5)$$

$$= (2x+1)(2x+5)$$

$$\text{(ii)} 30x^2 + 7x - 15$$

$$= 30x^2 + 25x - 18x - 15$$

$$= 5x(6x+5) - 3(6x+5)$$

$$= (6x+5)(5x-3)$$

$$\text{(iii)} 24x^2 - 65x + 21$$

$$= 24x^2 - 56x - 9x + 21$$

$$= 8x(3x-7) - 3(3x-7)$$

$$= (3x-7)(8x-3)$$

$$\text{(iv)} 5x^2 - 16x - 21$$

$$\begin{aligned} &= 5x^2 - 21x + 5x - 21 \\ &= x(5x - 21) + 1(5x - 21) \\ &= (5x - 21)(x + 1) \end{aligned}$$

$$\text{(v)} 4x^2 - 17xy + 4y^2$$

$$\begin{aligned} &= 4x^2 - 16xy - y + 4y^2 \\ &= 4x(x - 4y) - y(x - 4y) \\ &= (x - 4y)(4x - y) \end{aligned}$$

$$\text{(vi)} 3x^2 - 38xy + 13y^2$$

$$\begin{aligned} &= 3x^2 - 39xy + xy - 13y^2 \\ &= 3x(x - 13y) + y(x - 13y) \\ &= (x - 13y)(3x + y) \end{aligned}$$

$$\text{(vii)} 5x^2 + 33xy - 14y^2$$

$$\begin{aligned} &= 5x^2 + 35xy - 2xy - 14y^2 \\ &= 5x(x + 7y) + y(x + 7y) \\ &= (x + 7y)(5x + y) \end{aligned}$$

$$\text{(viii)} (5x - 1/x)^2 + 4(5x - 1/x) + 4$$

$$\text{let } 5x - \frac{1}{x} = y$$

$$= y^2 + 4y + 4$$

$$(y + 2)^2 = (y + 2)(y + 2)$$

$$\begin{aligned} & \text{by putting value of } y = 5x - \frac{1}{x} \\ & = (5x - 1/x + 2)(5x - 1/x + 2) \end{aligned}$$

**Q.4**

$$(i) (x^2 + 5x + 4)(x^2 + 5x + 6) - 3$$

$$\begin{aligned} \text{let } x^2 + 5x &= y \\ (y + 4)(y + 6) - 3 \\ &= y^2 + 6y + 4y + 24 - 3 \\ &= y^2 + 10y + 21 \\ &= y^2 + 7y + 3y + 21 \\ &= y(y + 7) + 3(y + 7) \\ &= (y + 7)(y + 3) \end{aligned}$$

$$\begin{aligned} & \text{by putting value of } y = x^2 + 5x \\ & = (x^2 + 5x + 7)(x^2 + 5x + 3) \end{aligned}$$

$$(ii) (x^2 - 4x)(x^2 - 4x - 1) - 20$$

$$\begin{aligned} \text{let } x^2 - 4x &= y \\ &= y(y - 1) - 20 \\ &= y^2 - y - 20 \\ &= y^2 - 5y + 4y - 20 \\ &= y(y - 5) + 4(y - 5) \\ &= (y - 5)(y + 5) \end{aligned}$$

$$\begin{aligned} & \text{by putting value of } y = x^2 - 4x \\ & = (x^2 - 4x - 5)(x^2 - 4x + 4) \\ & = (x^2 - 5x + x - 5)(x^2 - 2(x)2 + 4) \\ & = ((x(x - 5) + 1(x - 5)))(x - 2)^2 \\ & = (x - 5)(x + 1)(x - 2)^2 \end{aligned}$$

$$\text{(iii)} (x+2)(x+3)(x+4)(x+5) - 15$$

By using commutative property of addition

$$\text{As } 2+5 = 3+4$$

$$= (x^2 + 7x + 10)(x^2 + 7x + 12) - 15$$

$$\text{let } x^2 + 7x = y$$

$$= (y+10)(y+12) - 15$$

$$= y^2 + 22y + 120 - 15$$

$$= y^2 + 22y + 105$$

$$= y^2 + 15y + 7y + 105$$

$$= y(y+15) + 7(y+15)$$

$$= (y+15)(y+7)$$

By putting value of  $y = x^2 + 7x$

$$= (x^2 + 7x + 15)(x^2 + 7x + 7)$$

$$\text{(iv)} (x+4)(x-5)(x+6)(x-7) - 504$$

By using commutative property of subtraction

$$\text{As } 4-5 = 6-7$$

$$= (x^2 - x - 20)(x^2 - x - 42) - 504$$

$$\text{let } x^2 - x = y$$

$$= (y-20)(y-42) - 504$$

$$= y^2 - 42y - 20y + 840 - 504$$

$$= y^2 - 62y + 336$$

$$= y(y-56)(y-6)$$

= by putting value of  $y = x^2 - x$

$$= (x^2 - x - 56)(x^2 - x - 6)$$

$$= (x^2 - 8x + 7x - 56)(x^2 - 3x + 2x - 6)$$

$$= (x(x-8) + 7(x-8))(x(x-3) + 2(x-3))$$

$$= (x-8)(x+7)(x-3)(x+2)$$

$$\text{(v)} (x+1)(x+2)(x+3)(x+6) - 3x^2$$

By using commutative property of multiplication

$$\begin{aligned} \text{As } (1)(6) &= (2)(3) \\ &= (x^2 + 7x + 6)(x^2 + 5x + 6) - 3x^2 \\ &= (x^2 + 6 + 7x)(x^2 + 6 + 5x) - 3x^2 \end{aligned}$$

$$\begin{aligned} \text{let } x^2 + 6 &= y \\ &= (y + 7x)(y + 5x) - 3x^2 \\ &= y^2 + 5xy + 7xy + 35x^2 - 3x^2 \\ &= y^2 + 12xy + 32x^2 \\ &= y^2 + 8xy + 4xy + 32x^2 \\ &= y(y + 8x) + 4x(y + 8x) \\ &= (y + 8x)(y + 4x) \end{aligned}$$

By putting value of  $y = x^2 + 6$

$$\begin{aligned} &= (x^2 + 6 + 8x)(x^2 + 6 + 4x) \\ &= \left(x + 8 + \frac{6}{x}\right) \cdot x \left(x + 4 + \frac{6}{x}\right) \\ &= x^2 \left(x + \frac{6}{x} + 8\right) \left(x + \frac{6}{x} + 4\right) \end{aligned}$$

### Q.5

$$\begin{aligned} \text{(i)} \quad x^3 + 48x - 12x^2 - 64 & \\ &= x^3 - 12x^2 + 48x - 64 \\ &= x^3 - 3 \cdot x^2 \cdot 4 + 3 \cdot x \cdot 4^2 - 4^3 \\ &= (x - 4)^3 \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad 8x^3 + 60x^2 + 150x + 125 & \\ &= (2x)^3 + 3 \cdot (2x)^2 \cdot 5 + 3 \cdot (2x) \cdot 5^2 + 5^3 \\ &= (2x + 5)^3 \end{aligned}$$

$$\text{(iii)} \quad x^3 - 18x^2 + 108x - 216$$

$$= x^{23} - 3x^2 \cdot 6 + 3 \cdot x \cdot 6^2 - 6^3$$

$$= (x - 6)^3$$

**(iv)**  $8x^3 - 125y^3 - 60x^2y + 150xy^2$

$$= 8x^3 - 60x^2y + 150xy^2 - 125y^3$$

$$= (2x)^3 - 3 \cdot (2x)^2 \cdot 5y + 3 \cdot (2x) \cdot (5y)^2 - (5y)^3$$

$$= (2x - 5y)^3$$

**Q.6**

**(i)**  $27 + 8x^3$

$$= (3)^3 + (2x)^3$$

$$= (3 + 2x)(3^2 - 3 \cdot 2x + 2(x)^2)$$

$$= (3 + 2x)(9 - 6x + 4x^2)$$

**(ii)**  $125x^3 - 216y^3$

$$= (5x)^3 - (6y)^3$$

$$= (5x - 6y)((5x)^2 + 5x \cdot 6y + (6y)^2)$$

$$= (5x - 6y)(25x^2 + 30xy + 36y^2)$$

**(iii)**  $64x^3 + 27y^3$

$$= (4x)^3 + (3y)^3$$

$$= (4x + 3y)((4x)^2 + 4x \cdot 3y + (3y)^2)$$

$$= (4x + 3y)(16x^2 + 12xy + 9y^2)$$

**(iv)**  $8x^3 + 125y^3$

$$\begin{aligned} &= (2x)^3 + (5y)^3 \\ &= (2x + 5y)((4x)^2 - 4x \cdot 5y + (5y)^2) \\ &= (2x + 5y)(4x^2 - 10xy + 25y^2) \end{aligned}$$

ClassNotes

## Exercise 5.3

**Q.1 Use Remainder theorem to find the remainder when**

(i)  $3x^3 - 10x^2 + 13x - 6$  is divided by  $(x - 2)$

**Solution**

$$\text{Let } p(x) = 3x^3 - 10x^2 + 13x - 6$$

When  $p(x)$  is divided by  $x - 2$

The remainder  $R = p(2)$

$$p(2) = 3(2)^3 - 10(2)^2 + 13(2) - 6$$

$$p(2) = 24 - 40 + 26 - 6 = 4$$

Therefore remainder = 4

(ii)  $4x^3 - 4x + 3$  is divided by  $(2x - 1)$

**Solution**

$$\text{Let } p(x) = 4x^3 - 4x + 3$$

When  $p(x)$  is divided by  $2x - 1$

The remainder  $R = p\left(\frac{1}{2}\right)$

$$p\left(\frac{1}{2}\right) = 4\left(\frac{1}{2}\right)^3 - 4\left(\frac{1}{2}\right) + 3$$

$$= 4\left(\frac{1}{8}\right) - 4\left(\frac{1}{2}\right) + 3 = \frac{1}{2} - \frac{4}{2} + 3 = \frac{1 - 4 + 6}{2} = \frac{3}{2}$$

(ii)  $6x^4 + 2x^3 - x + 2$  is divided by  $(x + 2)$

**Solution:**

$$\text{Let } p(x) = 6x^4 + 2x^3 - x + 2$$

when  $p(x)$  is divided by  $x + 2$  the remainder  $R = p(-2)$

$$p(-2) = 6(-2)^4 + 2(-2)^3 - 2 + 2$$

$$96 - 16 + 2 + 2 = 84$$

Therefore remainder = 84

**(iii)  $p(x) = (2x+1)^3 + 6(3+4x)^2 - 10$  is divided by  $(2x+1)$**

**Solution:**

$$\text{Let } p(x) = (2x+1)^3 + 6(3+4x)^2 - 10$$

When  $p(x)$  is divided by  $2x+1$  the remainder  $R = p\left(\frac{-1}{2}\right)$

$$\left[2\left(\frac{-1}{2}\right) - 1\right]^3 + 6\left[3 + 4\left(\frac{-1}{2}\right)\right]^2 - 10$$

$$= (-1-1)^3 + 6(3-2)^2 - 10$$

$$= (-2)^3 + 6(1)^2 - 10$$

$$= -8 + 6 - 10 = -12$$

Therefore remainder = -12

**(iv)  $x^3 - 3x^2 + 4x - 14$  is divided by  $(x+2)$**

$$\text{Let } p(x) = x^3 - 3x^2 + 4x - 14$$

when  $p(x)$  is divided by  $x+2$  the remainder  $R = p(-2)$

$$= (-2)^3 - 3(-2)^2 + 4(-2) - 14$$

$$= -8 - 12 - 8 - 14 = -42$$

Therefore remainder = -42

**Q2. If  $(x+2)$  is a factor of  $x^2 - 4kx - 4k^2$  then find the value(s) of  $k$ .**

**Solution:**

$$\text{Let } p(x) = x^2 - 4kx - 4k^2$$

As  $x+2 = x - (-2)$  is a factor of  $p(x)$

$$\text{So } p(-2) = 0$$

$$3(-2)^2 - 4k(-2) - 4k^2 = 0$$

$$12 + 8k - 4k^2 = 0$$

$$\text{or } 3 + 2k - k^2 = 0$$

$$3 + 3k - k - k^2 = 0$$

$$3(1+k) - k(1+k) = 0$$

$$(1+k)(3-k) = 0$$

$$1+k=0 : 3-k=0$$

$$k=-1 : k=3$$

$$\Rightarrow k = -1, 3$$

(ii) If  $(x-1)$  is a factor of  $x^3 - kx^2 + 11x - 6$ , then find the value(s) of  $k$ .

**Solution:**

$$\text{Let } p(x) = x^3 - kx^2 + 11x - 6$$

As  $x-1$  is a factor of  $p(x)$  we have  $p(1) = 0$

i.e.

$$(1)^3 - k(1)^2 + 11(1) - 6 = 0$$

$$1 - k + 11 - 6 = 0$$

$$-k + 6 = 0$$

$$\Rightarrow k = 6$$

**Q3. Without actual long division determine whether.**

1.  $(x-2)$  and  $(x-3)$  are factors of

$$P(x) = x^3 - 12x^2 + 44x - 48$$

**Solution:**

The remainder for  $x-2$  is

$$P(2) = (2)^3 - 12(2)^2 + 44(2) - 48$$

$$= 8 - 48 + 88 - 48$$

$$= 0$$

Since remainder = 0 therefore  $x-2$  is a factor of  $p(x)$

The remainder for  $x-3$  is

$$P(3) = (3)^3 - 12(3)^2 + 44(3) - 48$$

$$=3$$

Since remainder is not equal to zero therefore  $x-3$  is not a factor

**2.  $(x-2), (x+3)$  and  $(x-4)$  are factors of**

$$q(x) = x^3 + 2x^2 - 5x - 6$$

**Solution:**

$$q(x) = x^3 + 2x^2 - 5x - 6$$

The remainder for  $x-2$  is

$$p(2) = (2)^3 + 2(2)^2 - 5(2) - 6$$

$$P(2) = 8+8-10-6$$

Since remainder=0 therefore  $x-2$  is a factor of  $q(x)$

The remainder for  $x-4$  is

$$P(4) = 4^3 + 2(4)^2 - 5(4) - 6$$

$$=70$$

Not a factor as remainder is not equal to zero

**Q4. For what value of  $m$  is the polynomial  $p(x) = 4x^3 - 7x^2 + 6x - 3m$  exactly divisible by  $x+2$ :**

**Solution:**

$$P(x) = 4x^3 - 7x^2 + 6x - 3m$$

As  $p(x)$  is exactly divisible  $x+2$  therefore remainder=0

$$4(-2)^3 - 7(-2)^2 + 6(-2) - 3m = 0$$

$$-72 - 3m = 0$$

$$-24 - m = 0$$

$$m = -24$$

**Q5. Determine the value of  $k$  if  $p(x) = kx^3 + 4x^2 + 3x - 4$  And  $q(x) = x^3 - 4x + k$  leaves the same remainder when divided by  $x-3$ :**

**Solution:**

$$P(3) = k(3)^3 + 4(3)^2 + 3(3) - 4$$

$$=27k+41$$

$$Q(3) = (3)^2 - 4(3) + k$$

$$=15+k$$

According to given condition:

$$27k+41=15+k$$

$$K=-1$$

**Q6. The remainder after dividing the polynomial  $p(x) = x^3 + ax^2 + 7$  by  $(x+1)$  is 2b. Calculate the value of a and b if this expression leaves a remainder of  $(b+5)$  on being divided by  $(x-2)$**

**Solution:**

$$P(x) = x^3 + ax^2 + 7$$

When  $p(x)$  is divided by  $x+1$ , then the remainder  $p(-1)=0$

$$P(-1) = (-1)^3 + a(-1)^2 + 7$$

$$= -1 + a + 7$$

$$= a + 6$$

As given remainder = 2b

$$A + 6 = 2b$$

$$a - 2b = -6 \quad \dots\dots(i)$$

When  $p(x)$  is divided by  $x-2$ , then the remainder  $p(2)=0$

$$p(2) = (2)^3 + a(2)^2 + 7$$

$$= 4a + 15$$

As given remainder = b+15

Therefore, calculated remainder = given remainder

$$4a + 15 = b + 5$$

$$4a - b = -10 \quad \dots\dots(ii)$$

Multiply eq2 by 2 and subtract from eq1:

$$a - 2b = -6$$

$$-8a + 2b = -20$$

$$-7a = 14$$

Put  $a = -2$  in eq1, we get

$$-2 - 2b = -6$$

$$-2b = -4 \quad \text{or} \quad b = 2$$

$$a = -2, b = -2$$

**Q7. The polynomial  $x^3 + lx^2 + mx + 24$  has factor  $(x+4)$  and it leaves a remainder of 36 when divided by  $(x-2)$ . Find the value of  $l$  and  $m$ .**

$$\text{Let } P(x) = x^3 + lx^2 + mx + 24$$

As  $x+4$  is a factor of  $p(x)$

$$\text{i.e. } (-4)^3 + l(-4)^2 + m(-4) + 24 = 0$$

$$4l - m = 10 \quad \dots\dots\dots(i)$$

When  $p(x)$  is divided by  $x-2$

When remainder is  $p(2)$

$$\text{Then } P(2) = 36$$

$$x^3 + lx^2 + mx + 24 = 36$$

$$8 + 4l + 2m + 24 = 36$$

$$4l + 2m = 4$$

$$2l + 3m = 2 \quad \dots\dots\dots(ii)$$

By adding eq1 and eq2 we get:

$$6l = 12$$

$$l = 2$$

Putting  $l = 2$  in eq (i)

$$8 - m = 10$$

$$-m = 2$$

$$m = -2$$

So,  $l = 2, m = -2$

**Q8. The expression  $lx^3 + mx^2 - 4$  leaves remainder of -3 and 12 when divided by  $(x-1)$  and  $(x+2)$  respectively. Calculate the values of  $l$  and  $m$ .**

**Solution:**

When  $p(x)$  is divided by  $x-1$  the remainder

$$L(x)^3m(1)^2-4=-3$$

$$L+m-4=-3$$

$$L+m=1 \quad \dots\dots\dots(i)$$

When  $p(x)$  is divided by  $x+2$  the remainder

$$P(-2)=12$$

$$L(-2)^2+m(-2)^2-4=12$$

$$-8l+4m-4=12$$

$$-8l+4m=16$$

$$-2l+m=4 \quad \dots\dots\dots(ii)$$

Subtracting eq2 from eq1:

$$3l=-3$$

$$l=-1$$

Putting  $l = -1$  in eq1:

$$-l+m=1$$

$$m=2$$

So  $l=-1, m=2$

**Q9 The expression  $ax^3 - 9x^2 + bx + 3a$  is exactly divisible  $x^2 - 5x + 6$ . Find the values of  $a$  and  $b$ .**

**Solution:**

$$\text{Let } p(x) = ax^3 - 9x^2 + bx + 3a$$

$$q(x) = x^2 - 5x + 6$$

$$=x^2-3x-2x+6$$

$$=x(x-3)-2(x-3)$$

$$=(x-3)(x-2)$$

As  $p(x)$  is exactly divisible by  $q(x)$ . So,  $p(x)$  is exactly divisible by  $x-2$  and  $x-3$  [ $x=2$ ,  $x=3$ ]

Hence  $p(2)=0$

And  $p(3)=0$

$$P(2) = 2(2)^3 - 9(2)^2 + b(2) + 3a = 0$$

$$8a - 36 + 2b + 3a = 0$$

$$11a + 2b = 36$$

$$P(3) = 2(3)^3 - 9(3)^2 + b(3) + 3a = 0$$

$$27a - 81 + 3b + 3a = 0$$

$$30a + 3b = 81$$

$$10a + b = 27$$

By multiplying eq2 by 2 and subtracting from eq1:

$$11a + 2b = 36$$

$$\underline{\pm 20a \pm 2b = \pm 54}$$

$$-9a = -18$$

$$a = 2$$

Putting in eq2:

$$20 + b = 27$$

$$b = 7$$

So,  **$a=2$**  and  **$b=7$**

## Exercise 5.4

**Factorize each of the following cubic polynomials by factor theorem.**

**Q1.**  $x^3 - 2x^2 - x + 2$

**Solution:**

Let  $p(x) = x^3 - 2x^2 - x + 2$

Possible factors of constant zeros of  $p(x)$  are  $p = \pm 1, \pm 2$  and possible factors of leading coefficient 1 are  $q = \pm 1$  Thus the expected zeros of  $p(x)$  are

$$\frac{p}{q} = \pm 1, \pm 2$$

Now  $p(1) = 1^3 - 2(1)^2 - 1 + 2$   
 $= 1 - 2 - 1 + 2$

Hence  $x=1$  is a zero of  $p(x)$  are therefore  $x-1$  is a factor of  $p(x)$

$p(-1) = -1^3 - 2(-1)^2 - 1 + 2$   
 $= -1 - 2 + 1 + 2 = 0$

Hence  $x=-1$  is a zero of  $p(x)$  and

Therefore  $x-1$  and  $x+1$  is a factor of  $p(x)$

$p(2) = 2^3 - 2(2)^2 - 2 + 2$   
 $= 8 - 8 - 2 + 2 = 0$

Hence  $x=2$  is a zero of  $p(x)$  and therefore  $x-2$  is a factor of  $p(x)$

Hence required factors are  $(x-1)(x+1)(x-2)$

**Q2.**  $x^3 - x^2 - 22x + 40$

**Solution:**

Let  $p(x) = x^3 - x^2 - 22x + 40$

Possible factors of constant term 40 are

$$p = \pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 8, \pm 10, \pm 20, \pm 40$$

And those of leading coefficient 1 are Thus the possible zeros of  $p(x)$

$$\pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 8, \pm 10, \pm 20, \pm 40$$

Now  $p(1) = 1 - 1 - 22 + 44 = 18 \neq 0$

So  $x-1$  is not a factor of  $p(x)$

$$\begin{aligned} p(x) &= -1^3 - 1^2 - 22(-1) + 40 \\ &= 8 - 4 - 44 + 40 = 0 \\ &= -1 - 1 + 22 + 40 = 60 \neq 0 \end{aligned}$$

$x+1$  is not a factor of  $p(x)$

$$\begin{aligned} p(2) &= -2^3 - (-2)^2 - 22(2) + 40 \\ &= 8 - 4 - 44 + 40 = 0 \end{aligned}$$

$x-2$  is a factor of  $p(x)$

$$\begin{aligned} p(-2) &= (-2)^2 - 22(-2) + 40 \\ &= 8 - 4 + 44 + 40 = 72 \neq 0 \end{aligned}$$

$x+2$  is not a factor of  $p(x)$

$$\begin{aligned} p(4) &= p(4) = 4^3 - (4)^2 - 22(4) + 40 \\ &= 64 - 16 - 88 + 40 = 48 \neq 0 \end{aligned}$$

$x-4$  is not a factor of  $p(x)$

$$p(-4) = -4^3 - (4)^2 - 22(4) + 40$$

$x+4$  is not a factor of  $p(x)$

$$\begin{aligned} p(5) &= 5^3 - (5)^2 - 110 + 40 \\ &= 125 - 25 - 110 + 40 = 30 \neq 0 \end{aligned}$$

$x-5$  is not a factor of  $p(x)$

$$\begin{aligned} p(-5) &= -5^3 - (-5)^2 - 22(-5) + 40 \\ &= 125 - 25 + 110 + 40 = 0 \end{aligned}$$

So,  $x+5$  is a factor of  $p(x)$

Hence required factors are  $(x-2)(x-4)(x+5)$

**Q3.**  $x^3 - 6x^2 + 3x + 10$

**Solution:**

Let  $p(x) = x^3 - 6x^2 + 3x + 10$

Possible factors of constant term 10 are

$$\pm 1, \pm 2, \pm 5, \pm 10$$

$$p(-1) = -1^3 - (-1)^2 - 22(-1) + 40$$

Now  $= 8 - 4 - 44 + 40 = 0$

$$= -1 - 1 + 22 + 40 = 60 \neq 0$$

So,  $x+1$  is not a factor

$$p(2) = 2^3 - (2)^2 - 22(2) + 40$$

$$= 8 - 4 - 44 + 40 = 0$$

$x-2$  is not a factor

$$p(-2) = -2^3 - (-2)^2 - 22 + 40$$

$$= -8 - 4 - 44 + 40 = 72 \neq 0$$

$x+4$  is not a factor of  $p(x)$

$$p(5) = 5^3 - (5)^2 - 22(5) + 40$$

$$= 30 \neq 0$$

$x-5$  is not a factor of  $p(x)$

$$p(-5) = -5^3 - (5)^2 - 22(-5) + 40$$

$$= 125 - 25 + 110 + 40 = 0$$

So,  $x-5$  is a factor of  $p(x)$

Hence required factors are  $(x-2)(x-4)(x+5)$

**Q4.**  $x^3 + x^2 - 10x + 8$

**Solution:**

Let  $p(x) = x^3 + x^2 - 10x + 8$

Possible factors of constant term 8 are

$$p = \pm 1, \pm 2, \pm 4, \pm 8$$

Thus the expected zeros of  $p(x)$  are

$$\frac{p}{q} = \pm 1, \pm 2, \pm 4, \pm 8 \quad \frac{p}{q} = \pm 1, \pm 2, \pm 4, \pm 8$$

$$\begin{aligned} p(1) &= (1)^3 + (1)^2 - 10(1) + 8 \\ &= 1 + 1 - 10 + 8 = 0 \end{aligned}$$

So,  $x-1$  is a factor of  $p(x)$

$$\begin{aligned} p(-1) &= (-1)^3 + (-1)^2 - 10(-1) + 8 \\ &= -1 + 1 + 10 + 8 = 18 \neq 0 \end{aligned}$$

$x+1$  is not a factor of  $p(x)$

$$\begin{aligned} p(2) &= (2)^3 + (2)^2 - 10(2) + 8 \\ &= 8 + 4 - 20 + 8 = 0 \end{aligned}$$

$x+2$  is not a factor of  $p(x)$

$$\begin{aligned} p(-4) &= (-4)^3 + (4)^2 - 10(4) + 8 \\ &= -64 + 16 - 40 + 8 = 0 \end{aligned}$$

$x-4$  is not a factor of  $p(x)$

$$\begin{aligned} p(-4) &= (-4)^3 + (4)^2 - 10(4) + 8 \\ &= -64 + 16 - 40 + 8 = 0 \end{aligned}$$

So,  $x+4$  is a factor of  $p(x)$

Hence required factors are  $(x-1)(x-2)(x+4)$

**Q5.**  $x^3 - 2x^2 + 5x + 6$

**Solution:**

Let  $p(x) = x^3 - 2x^2 + 5x + 6$

Possible factors of constant term 6 are

$$p = \pm 1, \pm 2, \pm 3, \pm 6$$

Thus the possible zeros of  $p(x)$  are

$$\frac{p}{q} = \pm 1, \pm 2, \pm 3, \pm 6$$

$$P(1) = 1^3 - 2(1)^2 - 5(1) + 6$$

$$= -1 - 2 + 5 + 6 = 8 \neq 0$$

So,  $x-1$  is a factor of  $p(x)$

$$p(-1) = 1^3 - 2(1)^2 - 5(1) + 6$$

$$= -1 - 2 + 5 + 6 = 8 \neq 0$$

$x-2$  is not a factor of  $p(x)$

$$p(-2) = -2^3 - 2(2)^2 - 5(-2) + 6$$

$$= -8 - 8 + 10 + 6 = 0$$

$x+2$  is a factor of  $p(x)$

$$p(3) = 3^3 - 2(3)^2 - 5(3) + 6$$

$$= 27 - 18 + 15 + 6 = 0$$

So,  $x-3$  is a factor of  $p(x)$

Hence required factors are  $(x-1)(x-3)(x+2)$

**Q6.**  $x^3 + 5x^2 - 2x - 24$

**Solution:**

Let  $p(x) = x^3 - x^2 - 22x + 40$

Possible factors of constant term 40 are

$$p = \pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 8, \pm 10, \pm 20, \pm 40$$

And those of leading coefficient 1 are Thus the possible zeros of  $p(x)$

$$\pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 8, \pm 10, \pm 20, \pm 40$$

Now  $p(1) = 1 - 1 - 22 + 44 = 18 \neq 0$

So  $x-1$  is not a factor of  $p(x)$

$$\begin{aligned}
 p(x) &= -1^3 - 1^2 - 22(-1) + 40 \\
 &= 8 - 4 - 44 + 40 = 0 \\
 &= -1 - 1 + 22 + 40 = 60 \neq 0
 \end{aligned}$$

$x+1$  is not a factor of  $p(x)$

$$\begin{aligned}
 p(2) &= -2^3 - (-2)^2 - 22(2) + 40 \\
 &= 8 - 4 - 44 + 40 = 0
 \end{aligned}$$

$x-2$  is a factor of  $p(x)$

$$\begin{aligned}
 p(-2) &= (-2)^2 - 22(-2) + 40 \\
 &= 8 - 4 + 44 + 40 = 72 \neq 0
 \end{aligned}$$

$x+2$  is not a factor of  $p(x)$

$$\begin{aligned}
 p(4) &= p(4) = 4^3 - (4)^2 - 22(4) + 40 \\
 &= 64 - 16 - 88 + 40 = 48 \neq 0
 \end{aligned}$$

$x-4$  is not a factor of  $p(x)$

$$p(-4) = -4^3 - (4)^2 - 22(4) + 40$$

$x+4$  is not a factor of  $p(x)$

$$\begin{aligned}
 p(5) &= 5^3 - (5)^2 - 110 + 40 \\
 &= 125 - 25 - 110 + 40 = 30 \neq 0
 \end{aligned}$$

$x-5$  is not a factor of  $p(x)$

$$\begin{aligned}
 p(-5) &= -5^3 - (-5)^2 - 22(-5) + 40 \\
 &= 125 - 25 + 110 + 40 = 0
 \end{aligned}$$

So,  $x+5$  is a factor of  $p(x)$

Hence required factors are  $(x-2)(x-4)(x+5)$

**Q7.**  $3x^3 - x^2 - 12x + 4$

**Solution:**

Let  $p(x) = 3x^3 - x^2 - 12x + 4$

Possible factors of the constant term 4 are

$$P = \pm 1, \pm 2, \pm 4$$

And those of the leading coefficient 3 are  $q = \pm 1, \pm 3$

Thus the possible zeros of  $p(x)$

$$\begin{aligned} p(-1) &= 3(-1)^3 - (-1)^2 - 12(-1) + 4 \\ &= 3 - 1 + 12 + 4 = 12 \neq 0 \end{aligned}$$

So,  $x-1$  is not a factor of  $p(x)$

$$\begin{aligned} p(-1) &= 3(-1)^3 - (-1)^2 - 12(-1) + 4 \\ &= 3 - 1 + 12 + 4 = 12 \neq 0 \end{aligned}$$

$x-2$  is not a zero of  $p(x)$

$$\begin{aligned} p(-2) &= 3(-2)^3 - (-2)^2 - 12(-2) - 24 \\ &= -24 - 4 + 4 + 4 = 0 \end{aligned}$$

So,  $x+2$  is a zero of  $p(x)$

$$\begin{aligned} p\left(\frac{1}{3}\right) &= 3\left(\frac{1}{3}\right)^3 - \left(\frac{1}{3}\right)^2 - 12\left(\frac{1}{3}\right) + 4 \\ &= \frac{1}{9} - \frac{1}{9} - 4 + 4 = 0 \end{aligned}$$

So  $3x-1$  is zero of  $p(x)$

Hence  $(x-2), (x+2)$  and  $(3x-1)$  are factors of  $P(x)$

Hence required functions are  $(x-2)(x+2)(3x-1)$

**Q8.**  $2x^3 + x^2 - 2x - 1$

**Solution:**

Let  $p(x) = 2x^3 + x^2 - 2x - 1$

Possible factors of the constant term  $-1$  are  $p = \pm 1$  and those of leading coefficient 2 are  $q = \pm 1, \pm 2$

Thus the possible zeros  $p(x)$  are  $\frac{p}{q} = \pm 1, \pm \frac{1}{2}$

$$\begin{aligned}p(1) &= 2(1)^3 + (1)^2 - 2(1) - 1 \\ &= 2 + 1 - 2 - 1 = 0\end{aligned}$$

So,  $x-1$  is a zero of  $p(x)$

$$\begin{aligned}p\left(\frac{1}{2}\right) &= 2\left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^2 - 2\left(\frac{1}{2}\right) - 1 \\ &= \frac{1}{4} + \frac{1}{4} - 1 - 1 = 0\end{aligned}$$

So,  $x = -\frac{1}{2}$  is a zero of  $p(x)$

Hence  $x+1$  and  $2x+1$  are factors of  $p(x)$

Hence required factors are  $(x+1)(x-1)(2x+1)$

ClassNotes

## سردار کوڑے خان پبلک ہائر سیکنڈری سکول مظفر گڑھ

کلاس: نہم

یونٹ نمبر 01

مضمون: مطالعہ پاکستان

(حصہ معروضی)

مندرجہ ذیل سوالات کے درست جواب پر نشان لگائیں

- 1- کانگریسی وزارتوں کا دور رہا؟ (ا) 1935-33 (ب) 1939-41 (ج) 1941-43 (د) 1937-39
- 2- قرارداد لاہور 1940 میں خطبہ صدارت دیا۔ (ا) مولانا ظفر علی خان (ب) محمد علی جناح (ج) لیاقت علی خان (د) مولوی فضل الحق
- 3- ایم۔ اے۔ اسکول اور کالج قائم کیا؟ (ا) سر سید احمد خان (ب) چوہدری رحمت علی (ج) قاضی عیسیٰ (د) مولوی فضل الحق
- 4- نظریہ پاکستان کی بنیاد ہے۔ (ا) اجتماعی نظام (ب) دو قومی نظریہ (ج) ترقی پسندیت (د) اسلامی نظریہ حیات
- 5- 1930 میں مسلمانوں کو الگ ریاست کو تصور دینے والی شخصیت ہے۔ (ا) قائد اعظم (ب) علامہ محمد اقبال (ج) سر سید احمد خان (د) محمد علی جوہر
- 6- قیام پاکستان کا مطالبہ کرتے وقت مسلمانوں کی سوچ تھی کہ۔ (ا) اتحاد عالم اسلام ہو (ب) مسلم قوم بہتر تعلیم حاصل کرے (ج) ملک میں معاشی ترقی ہو (د) وہ اپنے مذہب اور عقائد کے مطابق زندگی بسر کر سکیں
- 7- 1867ء میں جب بنارس میں ہندوؤں کی مسلم دشمنی کھل کر سامنے آگئی جس پر سر سید احمد نے واضح اعلان کیا کہ (ا) مسلمان اور ہندو الگ الگ قومیں ہیں (ب) مسلمان ریاست سے الگ رہیں (ج) ہندو ہمارے دوست نہیں (د) مسلمان انگریزی تعلیم حاصل کریں
- 8- قطب الدین ایبک نے دہلی سلطنت کی بنیاد رکھی۔ (ا) 1106 (ب) 1206 (ج) 1306 (د) 1406
- 9- اردو ہندی تنازع کب شروع ہوا؟ (ا) 1864 (ب) 1865 (ج) 1866 (د) 1867
- 10- ظہیر الدین بابر نے مغلیہ سلطنت کی بنیاد رکھی؟ (ا) 1326 (ب) 1426 (ج) 1526 (د) 1626
- 11- پاکستان نیشنل موومنٹ کی بنیاد کس نے رکھی؟ (ا) قائد اعظم (ب) سر سید احمد خان (ج) چوہدری رحمت علی خان (د) سر آغا خان
- 12- سب سے پہلے مسلمانوں کو الگ قوم قرار دیا؟ (ا) قائد اعظم (ب) محمد علی جوہر (ج) سر سید احمد خان (د) عابدی بیگم
- 13- سر سید احمد خان کب پیدا ہوئے؟ (ا) 1816 (ب) 1817 (ج) 1818 (د) 1819
- 14- آخری مغل حکمران کون تھے؟ (ا) جلال الدین اکبر (ب) ظہیر الدین بابر (ج) ہمایوں (د) بہادر شاہ ظفر
- 15- انگریزوں نے ایسٹ انڈیا کمپنی کب قائم کی؟ (ا) 1500 (ب) 1550 (ج) 1600 (د) 1650
- 16- چوہدری رحمت علی کب پیدا ہوئے؟ (ا) 1867 (ب) 1877 (ج) 1887 (د) 1897
- 17- سر سید احمد خان نے کب وفات پائی؟ (ا) 1868 (ب) 1878 (ج) 1888 (د) 1898
- 18- کوئی بھی معاشرہ اس کے بغیر ترقی نہیں کر سکتا؟ (ا) حقوق (ب) فرائض (ج) عدل و انصاف (د) اخوت و بھائی چارہ
- 19- اونچ نیچ کا تصور کس مذہب میں نہیں ہے۔ (ا) ہندو ازم (ب) اسلام (ج) بدھ مت (د) پارسی
- 20- دین اسلام کو قائم کرنے کا نمونہ کیا ہے؟ (ا) نماز (ب) روزہ (ج) زکوٰۃ (د) حج
- 21- اللہ تعالیٰ اور بندے کے درمیان قربت کا ذریعہ ہے۔ (ا) نماز (ب) روزہ (ج) زکوٰۃ (د) حج
- 22- پاکستان ایک مذہبی نہیں اسلامی فلاحی ریاست ہوگی۔ کس نے کہا تھا؟ (ا) علامہ اقبال (ب) چوہدری رحمت علی (ج) قائد اعظم (د) سر سید احمد خان
- 23- اپنی روح میں ایک جمہوری نظم ہے۔ (ا) ہندو مت (ب) بدھ مت (ج) اسلام (د) عیسائیت
- 24- اردو کس اسم الخط میں لکھی جاتی ہے؟ (ا) دیوناگری (ب) عربی (ج) فارسی (د) سنسکرت
- 25- ہندی کس اسم الخط میں لکھی جاتی ہے؟ (ا) دیوناگری (ب) عربی (ج) فارسی (د) سنسکرت

## سردار کوڑے خان پبلک ہائر سیکنڈری سکول مظفر گڑھ

کلاس: نہم

یونٹ نمبر 01

مضمون: مطالعہ پاکستان

(حصہ انشائیہ)

مختصر سوالات کے جوابات تحریر کریں۔

- 1- قائد اعظم نے یکم جولائی 1948ء کو سٹیٹ بینک کا افتتاح کرتے ہوئے کیا فرمایا؟  
انہوں نے فرمایا "مغرب کا معاشی نظام انسانیت کیلئے ناقابل حل مسائل پیدا کر رہا ہے اور یہ لوگوں کے درمیان انصاف قائم کرنے میں ناکام رہا ہے۔ ہمیں دنیا کے سامنے ایک ایسا معاشی نظام پیش کرنا چاہیے جو اسلام کے صحیح تصور مساوات اور سماجی انصاف کے اصولوں پر مبنی ہو۔"
- 2- دو قومی نظریے سے کیا مراد ہے؟  
دو قومی نظریے سے مراد یہ ہے کہ برصغیر پاک و ہند میں دو بڑی قومیں ہندو اور مسلمان آباد ہیں۔ یہ دونوں قومیں صدیوں تک ایک دوسرے کے ساتھ رہنے کے باوجود آپس میں گھل مل نہ سکیں۔ دو قومی نظریہ کی بنیاد مسلمانوں کا علیحدہ تشخص ہے۔
- 3- نظریہ پاکستان کی تعریف کریں۔  
نظریہ پاکستان سے مراد ایک الگ خطہ زمین کا حصول ہے جس میں مسلمانان برصغیر قرآن و سنت کی روشنی میں اسلامی قدروں اور نظریات کو محفوظ کر سکیں اور اپنی زندگیاں اسلام کے روشن اصولوں کے تحت گزار سکیں۔
- 4- عقیدہ رسالت کی تعریف کریں۔  
عقیدہ رسالت کا مطلب تمام رسولوں پر ایمان لانا ہے۔ دائرہ اسلام میں آنے کیلئے لازم ہے کہ رسالت کو دل و جان سے تسلیم کیا جائے اور کسی اعتبار سے اس میں شک و شبہ نہ کیا جائے قرآن مجید اور اسوہ رسول ﷺ کو سرچشمہ ہدایت ماننا اور حضرت محمدؐ کو اللہ تعالیٰ کا آخری نبی ماننا اور یہ ایمان رکھنا کہ آپؐ کے بعد کوئی نبی نہیں آئے گا۔
- 5- ہندوستان میں ایسٹ انڈیا کمپنی قائم کرنے کا مقصد کیا تھی؟  
ایسٹ انڈیا کمپنی ہندوستان میں ایسی معاشی پالیسیاں بنانی تھے جس کا زیادہ سے زیادہ مالی فائدہ خود انگریزوں کو ہوتا تھا۔
- 6- "اب یا پھر کبھی نہیں Now or never" کے عنوان سے شہرہ آفاق کتا بچہ کب اور کس نے جاری کیا؟  
چوہدری رحمت علی نے 1933 میں جاری کیا
- 7- نظریہ کی تعریف کریں۔  
کسی شے کو وجود میں لانے کیلئے ذہن میں سوچ و فکر اور نقشہ ابھرتا اور قائم ہوتا ہے نظریہ کہلاتا ہے۔
- 8- چند مسلمان مصلحین کے نام لکھیں  
سر سید احمد خان، مولانا جمال الدین افغانی، مولانا عبدالحلیم شرر، مولانا مرتضیٰ میکیش اور علامہ اقبال
- 9- اقلیتوں کے حقوق کے تحفظ کے لیے قائد اعظم نے کیا فرمایا؟  
آپ نے فرمایا "آپ عبادت کے لیے اپنی مخصوص عبادت گاہوں میں جانے کیلئے آزاد ہیں۔ آپ کا تعلق چاہے کس عقیدے سے ہو" ریاست کا اس سے کوئی تعلق نہیں۔ پاکستان کا تمام شہری مساوی ہیں اور انہیں مساوی حقوق حاصل ہونگے۔
- 10- مسلم ملت کی اساس کے حوالے سے علامہ اقبال نے کیا فرمایا؟  
انہوں نے فرمایا کہ مسلمان اسلام کی وجہ سے ایک ملت ہیں انکی قوت کا انحصار اسلام پر ہے۔  
علامہ اقبال نے اس کا حقیقی تصور اپنے اشعار میں پیش کیا  
اپنی ملت پر قیاس اقوام مغرب سے نہ کر  
خاص ہے ترکیب میں قوم رسول ہاشمیؐ  
ان کی جمعیت کا ہے ملک و نصب پر انحصار  
قوت مذہب سے مستحکم ہے جمعیت تری

11- اسلام میں مساوات کا تصور بیان کریں

اسلام میں اونچ نیچ کا تصور نہیں ہے۔ اسلام نے ایسے معاشرے کی بنیاد رکھی ہے جس میں غریب اور امیر سب ایک جیسے ہیں۔ اللہ تعالیٰ کے نزدیک کوئی شخص برتر نہیں سوائے متقی اور پرہیزگار کے۔

12- حضور ﷺ نے مساوات کے بارے میں خطبہ حجۃ الوداع میں کیا فرمایا؟

آپ ﷺ فرمایا "اے لوگو! بے شک تمہارا رب ایک ہے اور تمہارا باپ بھی ایک۔ آگاہ رہو۔ کسی عربی کو عجمی پر، کسی عجمی کو عربی پر، کسی سفید کو کسی سیاہ فام پر اور کسی سیاہ فام کو کسی سفید پر کوئی فضیلت حاصل نہیں۔ فضیلت کا معیار صرف تقویٰ ہے۔

13- اسلام میں قانون کی بنیاد کیا ہے؟

اس کی بنیاد اس تصور پر ہے کہ قانون کا سرچشمہ اللہ تعالیٰ ہے قرآن اور اسوہ حسنہ۔ قانون کی بنیاد ہیں

14- عقائد سے کیا مراد ہے؟

عقائد میں توحید، رسالت، آخرت، ملائکہ اور الہامی کتابوں پر ایمان لانا شامل ہے عقائد کے مجموعے کو ایمان کہتے ہیں

15- عقیدہ توحید سے کیا مراد ہے؟

عقیدہ توحید سے مراد یہ ہے کہ اللہ تعالیٰ ساری کائنات کا مالک اور خالق ہے وہ واحد یکتا ہے اور اس کا کوئی شریک نہیں اور نہ ہی کوئی چیز اس کے علم سے باہر ہے۔

16- عدل و انصاف معاشرے کی ترقی کیوں ضروری ہے؟

عدل و انصاف کے بغیر کوئی بھی معاشرہ ترقی نہیں کر سکتا لہذا عدل و انصاف کا تقاضہ ہے کہ معاشرے میں ہر کسی کو اس کا حق ملے۔ جہاں انصاف پر مبنی معاشرہ ہوگا وہاں معاشرے کی دوسری خرابیاں خود بخود ٹھیک ہو جائیں گی۔

17- علامہ اقبال نے 1930 میں خطبہ الہ آباد میں کیا فرمایا؟

آپ نے فرمایا "مجھے ایسا نظر آتا ہے کہ اور نہیں تو شمال مغربی ہندوستان کے مسلمانوں کو بالآخر ایک اسلامی ریاست قائم کرنا پڑے گی۔ اگر ہم چاہتے ہیں کہ اس ملک میں اسلام بحیثیت تمدنی قوت زندہ رہے، تو اس کے لیے ضروری ہے کہ وہ ایک مخصوص علاقے میں اپنی مرکزیت قائم کریں۔ میں صرف ہندوستان میں اسلام کی فلاح و بہبود کے خیال سے ایک منظم اسلامی ریاست کے قیام کا مطالبہ کر رہا ہوں"

18- سر سید احمد خان نے دو قومی نظریے کی اصلاح کب استحصالی کی؟

1867 میں بنارس میں اردو ہندی تنازع کے موقع پر آپ نے واضح اعلان کیا کہ مسلمان اور ہندو الگ الگ قومیں ہیں۔

19- مغل حکمرانوں سے پہلے ہندوستان میں کن خاندان کی حکومت تھی۔

خاندان غلاماں، خاندان خلجی، خاندان تغلق، سادات اور لودھی خاندان نے حکومت کی۔

20- چند مشہور مغل حکمرانوں کے نام تحریر کریں۔

بابر، ہمایوں، اکبر، جہانگیر، شاہ جہاں اور اورنگزیب مشہور حکمران تھے

21- غزنوی دور حکومت کتنے عرصے پر محیط ہے۔

غزنوی دور حکومت 1003ء سے 1206ء تک محیط ہے

22- چند ہندو تحریکوں کے نام لکھیں۔ جس کا مقصد ہندو ازم کی اشاعت تھا۔

آریا سماج اور برہم سماج ان کا مقصد ہندو ازم کی اشاعت اور مسلمانوں کی بچا رکھنا تھا۔

23- نظریہ کی اہمیت بیان کریں۔

نظریہ لوگوں کی سوچ کی عکاسی کرتا ہے۔ اقوام اسی وجہ سے زندہ نظر آتی ہیں۔ نظریہ انسان کے ایک دوسرے کے ساتھ قومی حقوق و فرائض کی وضاحت کرتا ہے۔

24- نظریہ کے ماخذ تحریر کریں۔

مشترکہ مذہب، مشترکہ سیاسی مقاصد، مشترکہ تعلیمی مقاصد، مشترکہ معاشی مقاصد، مشترکہ ثقافتی مقاصد

25- اسلام کا تیسرا رکن کونسا ہے۔

اسلام کا تیسرا رکن زکوٰۃ ہے زکوٰۃ ایک مالی عبادت ہے اسلام کے معاشی نظام کی مضبوطی کا ذریعہ ہے۔

Sr	Week No.	No. of Periods	Topics/Chapter Unit
1	1	08-06-20	Ch.3 Dynamics, force, inertia, momentum
2	1	09-06-20	Newton's law of motion. 1 <sup>st</sup> law of motion, 2 <sup>nd</sup> law of motion, related problems.
3	1	10-06-20	Mass and weight, 3 <sup>rd</sup> law of motion
4	1	11-06-20	Tension in a string, vertical motion of bodies attached to the ends of a string + problems
5	1	12-06-20	Motion of two bodies attached to the ends of a string g that passes over a friction less pulley such that.
			One body moves horizontally and other vertically + problem
6	2	13-06-20	Force and momentum + related problem
7	2	15-06-20	Law of conservation of momentum
8	2	16-06-20	Friction, rolling friction, problem
9	2	17-06-20	Braking and skidding, advantages and disadvantages of friction methods of reducing friction.
10	2	18-06-20	Uniform circular motion, centripetal force centrifugal force + related problem
11	2	19-06-20	Applications of centripetal force.
12	2	20-06-20	Test ch.3

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PHYSICS

CLASS :9TH

# Unit 3 Dynamics

## LECTURE NO.1

08 -06- 2020

### DYNAMICS:

The branch of **mechanics** that deals with the study of motion of an object and the cause of its motion (**FORCE**) is called dynamics.

### FORCE:

**A force moves or tends to move, stops or tends to stop the motion of a body. The force can also change the direction of motion of a body.**

#### For Example

1. We can open a door either by pushing or pulling it.
2. The push on a cart may move the cart or change the direction of its motion or may stop the moving cart.
3. A batsman can change the direction of a moving ball by pushing it with his bat.
4. we can cut an apple with a knife by pushing its sharp edge into the apple. Thus a force can also change the shape or size of a body on which it acts.

### INERTIA:

**Inertia of a body is its property due to which it resists any change in its state of rest or motion.**

**Galileo** observed that it is easy to move or to stop light objects than heavier ones. Heavier objects are difficult to move or if moving then difficult to stop.

**Newton** concluded that every body resists to the change in its state of rest or of uniform motion in a straight line. He called this property of matter as inertia. He related the inertia of a body with its mass; **greater is the mass of a body greater is its inertia.**

#### EXPERIMENT 3.1

Take a glass and cover it with a piece of cardboard. Place a coin on the cardboard. Now flick the card horizontally with a jerk of your finger. The coin does not move with the cardboard due to inertia.

Consider another example of inertia. Cut a strip of paper. Place it on the table. Stack a few coins at its one end. Pull out the paper strip under the coins with a jerk. The coins do not move with the strip of paper due to inertia.

### MOMENTUM

**Momentum of a body is the quantity of motion it possesses due to its mass and velocity.**

The momentum  $P$  of a body is given by the product of its mass  $m$  and velocity  $v$ .

Thus 
$$P = mv \dots \dots \dots (3.1)$$

Momentum is a vector quantity. Its direction is along the direction of velocity.

Its SI unit is  $\text{kgms}^{-1}$  or  $\text{Ns}$ .

#### For Example

A bullet has a very small inertia due to its small mass. But its impact is so strong when it is fired from the gun due to its high velocity. Thus a fired bullet has a greater momentum than a bullet thrown with a hand.

On the other hand, the impact of a loaded truck on a body coming its way is very large even if the truck is moving slowly. Thus the slow moving truck has large momentum due to its large mass. So **momentum of a body depends upon its mass as well as its velocity.**

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# Unit 3 Dynamics

## LECTURE NO.2

09-06- 2020

### NEWTON'S LAWS OF MOTION

Newton was the first to formulate the laws of motion known as Newton's laws of motion.

#### NEWTON'S FIRST LAW OF MOTION

**A body continues its state of rest or of uniform motion in a straight line provided no net force (external force /unbalanced force) acts on it.**

##### **Explanation:**

First law of motion deals with bodies which are either at rest or moving with uniform speed in a straight line. According to Newton's first law of motion, a body at rest remains at rest provided no **net force** acts on it. This part of the law is true as we observe that objects do not move by themselves unless someone moves them. For example, a book lying on a table remains at rest as long as no **net force** (external force/unbalanced force) acts on it. Similarly, a moving object does not stop moving by itself.

A ball rolled on a rough ground stops earlier than that rolled on a smooth ground. It is because rough surfaces offer greater friction. If there would be no force (**friction**) to oppose the motion of a body then the moving body would never stop.

Since Newton's first law of motion deals with the inertial property of matter, therefore, Newton's first law of motion is also known as **law of inertia**. We have observed that the passengers standing in a bus fall forward when its driver applies brakes suddenly. It is because the upper parts of their bodies tend to continue their motion, while lower parts of their bodies in contact with the bus stop with it. Hence, they fall forward.

When a bus takes a sharp turn, passengers fall in the outward direction. It is due to inertia that they want to continue their motion in a straight line and thus fall outwards.

##### **NET FORCE:**

Net force is the resultant of all the forces acting on a body.

#### NEWTON'S SECOND LAW OF MOTION

Newton's second law of motion deals with situations when a net force is acting on a body.

It states that:

**When a net force acts on a body, it produces acceleration in the body in the direction of the net force. The magnitude of this acceleration is directly proportional to the net force acting on the body and inversely proportional to its mass.**

##### **Explanation:**

If a force produces an acceleration  $a$  in a body of mass  $m$ , then we can state mathematically that

$$a \propto F$$

and

$$a \propto 1/m$$

or

$$a \propto F/m$$

or

$$F \propto ma$$

Putting  $k$  as proportionality constant, we get

$$F = kma \dots\dots\dots 3.2$$

In SI units, the value of  $k$  comes out to be 1.

Thus Eq. 3.2 becomes

$$F = ma$$

**SI unit of force is newton (N).** According to Newton's second law of motion:

**One newton (1 N) is the force that produces an acceleration of  $1 \text{ ms}^{-2}$  in a body of mass of 1 kg.**

Thus, a force of one newton can be expressed as

$$1\text{N} = 1\text{kg} \times 1\text{ms}^{-2}$$

(continue to page -3)

## Problems on Newton's second Law of motion (lecture-2)

### 3.1

A force of 20 N moves a body with an acceleration of  $2 \text{ ms}^{-2}$ . What is its mass? (10 kg)

**Solution:**

$$F=20\text{N}$$

$$a=2 \text{ ms}^{-2}$$

$$m=?$$

$$F=ma$$

$$m=F/a$$

$$m=20\text{N}/2 \text{ ms}^{-2}$$

$$\mathbf{m=10\text{kg} \quad (\text{Ans})}$$

### 3.4

Find the acceleration produced by a force of 100 N in a mass of 50 kg. ( $2 \text{ ms}^{-2}$ )

**Solution:**

$$F=100\text{N}$$

$$m=50\text{kg}$$

$$a=?$$

$$F=ma$$

$$a=F/m$$

$$a=100\text{N}/50\text{kg}$$

$$\mathbf{a=2 \text{ ms}^{-2} \quad (\text{Ans})}$$

### 3.5

A body has weight 20 N. How much force is required to move it vertically upward with an acceleration of  $2 \text{ ms}^{-2}$ ? (24 N)

**Solution:**

$$W=20\text{N}$$

$$a=2 \text{ ms}^{-2}$$

$$w=mg$$

$$m=w/g$$

$$g=10 \text{ ms}^{-2}$$

$$m=20/10$$

$$m=2\text{kg}$$

Force needed to move the body vertically upward =F=?

$$F=w+ma$$

$$F=20\text{N}+2 \times 2 \text{ N}$$

$$\mathbf{F=24\text{N} \quad (\text{Ans})}$$

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CLASS :9TH

# Unit 3 Dynamics

## LECTURE NO.3

10 -06- 2020

### MASS AND WEIGHT

Generally, mass and weight are considered similar quantities, but it is not correct. They are two different quantities.

#### Mass:

1. Mass of a body is the quantity of matter possessed by the body.
2. It is a scalar quantity.
3. It does not change with change of place.
4. It is measured by comparison with standard masses using a beam balance.
5. Its SI unit is kg.
6. It is a base quantity.
7. It can be calculated by using formulas  $F=ma$  and  $w=mg$

#### Weight:

1. weight of a body is the force equal to the force with which Earth attracts it.
2. It varies from place to place depending upon the value of  $g$ , acceleration due to gravity.
3. Weight  $w$  of a body of mass  $m$  is related by the equation.  $w = mg$  ..... (3.5)
4. Weight is a force and thus it is a vector quantity.
5. Its SI unit is newton (N); the same as force.
6. Weight is measured by a spring balance.
7. It is a derived quantity.

### NEWTON'S THIRD LAW OF MOTION

**To every action there is always an equal but opposite reaction.**

#### Explanation:

According to this law, action is always accompanied by a reaction force and the two forces must always be equal and opposite. Note that action and reaction forces act on different bodies.

1. Consider a book lying on a table . The weight of the book is acting on the table in the downward direction. This is the action of book on the table . The reaction of the table acts on the book in the upward direction.
2. Consider another example. Take an air-filled balloon . When the balloon is set free, the air inside it rushes out and the balloon moves forward. In this example, the action is by the balloon that pushes the air out of it when set free. The reaction of the air which escapes out from the balloon acts on the balloon. It is due to this reaction of the escaping air that moves the balloon forward.
3. A rocket moves on the same principle. When its fuel burns, hot gases escape out from its tail with a very high speed. The reaction of these gases on the rocket causes it to move opposite to the gases rushing out of its tail.

#### Quick Quiz

Stretch out your palm and hold a book on it.

1. How much force you need to prevent the book from falling?  
***We need force equal to the weight of the book to prevent it from falling.***
2. Which is action?  
***The weight of the book acting downward on the hand is action.***
3. Is there any reaction? If yes, then what is its direction?  
***Yes, there is a reaction applied by the hand whose direction is upward.***

# Unit 3 Dynamics

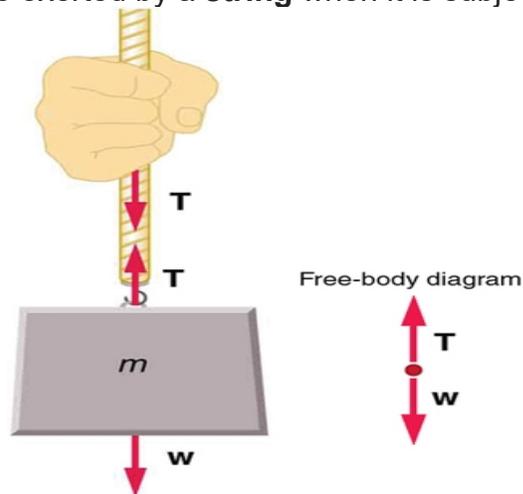
## LECTURE NO.4

11 -06- 2020

### TENSION AND ACCELERATION IN A STRING

#### Tension

The **tension** is defined as: "The force exerted by a **string** when it is subjected to pull"



Consider a block supported by a string.

The upper end of the string is fixed on a stand. Let  $w$  be the weight of the block. The block pulls the string downwards by its weight. This causes a tension  $T$  in the string. The tension  $T$  in the string is acting upwards at the block. As the block is at rest, therefore, the weight of the block acting downwards must be balanced by the upwards tension  $T$  in the string. Thus the tension  $T$  in the string must be equal and opposite to the weight  $w$  of the block.

#### **VERTICAL MOTION OF TWO BODIES ATTACHED TO THE ENDS OF A STRING THAT PASSES OVER A FRICTIONLESS PULLEY**

Consider two bodies A and B of masses  $m_1$  and  $m_2$  respectively. Let  $m_1$  is greater than  $m_2$ . The bodies are attached to the opposite ends of an inextensible string. The string passes over a frictionless pulley as shown in

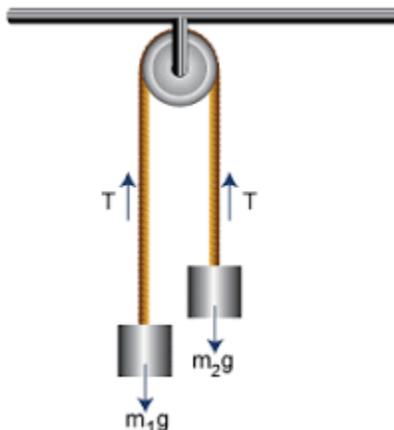


figure . The body *A* being heavier must be moving downwards with some acceleration. Let this acceleration be *a*. At the same time, the body *B* attached to the other end of the string moves up with the same acceleration *a*. As the pulley is frictionless, hence tension will be the same throughout the string. Let the tension in the string be *T*.

Since the body *A* moves downwards, hence its weight  $m_1g$  is greater than the tension *T* in the string.

$$\text{Net force acting on body A} = F_1 = m_1g - T$$

According to Newton's second law of motion;

$$F_1 = m_1a$$

$$\text{So, } m_1a = m_1g - T \dots \dots \dots (1)$$

As body *B* moves upwards, hence its weight  $m_2g$  is less than the tension *T* in the string.

$$\text{Net force acting on body B} = F_2 = T - m_2g$$

According to Newton's second law of motion;

$$F_2 = m_2a$$

$$\text{So, } m_2a = T - m_2g \dots \dots \dots (2)$$

Adding Eq. (1) and Eq.(2), we get acceleration *a*.

$$m_1a + m_2a = m_1g - T + T - m_2g$$

$$a(m_1 + m_2) = g(m_1 - m_2)$$

$$a = (m_1 - m_2)g / (m_1 + m_2) \dots \dots \dots (A)$$

Divide Eq. 2 by Eq. 1, to find tension *T* in the string.

$$T = 2m_1m_2g / (m_1 + m_2) \dots \dots \dots (B)$$

The above arrangement is also known as **Atwood machine**. It can be used to find the acceleration *g due* to gravity using Eq. **A**,

$$g = (m_1 + m_2)a / (m_1 - m_2)$$

An **Atwood machine** is an arrangement of two objects of unequal masses such as shown in figure .Both the objects are attached to the ends of a string. The string passes over a frictionless pulley. This arrangement is sometime used to find the acceleration due to gravity.

### problem 3.6:

Two masses 52 kg and 48 kg are attached to the ends of a string that passes over a frictionless pulley. Find the tension in the string and acceleration in the bodies when both the masses are moving vertically. (500 N, 0.4 ms<sup>-2</sup>)

**Solution:**

$$m_1 = 52 \text{ kg}$$

$$m_2 = 48 \text{ kg}$$

$$g = 10 \text{ ms}^{-2}$$

$$T = ?$$

$$a = ?$$

$$T = 2m_1m_2g / (m_1 + m_2)$$

$$T = 2 \times 52 \times 48 / (52 + 48)$$

$$T = 4992 / 100$$

$$\mathbf{T = 500N}$$

$$a = (m_1 - m_2)g / (m_1 + m_2)$$

$$a = (52 - 48) \times 10 / (52 + 48)$$

$$a = 40 / 100$$

$$\mathbf{a = 0.4 \text{ ms}^{-2}}$$

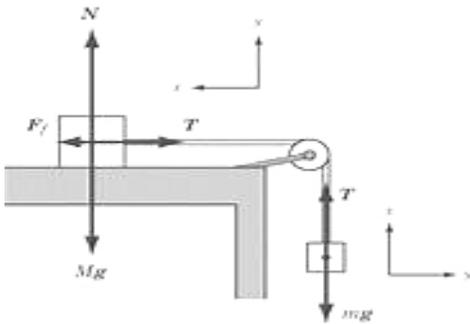
# Unit 3 Dynamics

## LECTURE NO.5

12 -06- 2020

### MOTION OF TWO BODIES ATTACHED TO THE ENDS OF A STRING THAT PASSES OVER A FRICTIONLESS PULLEY SUCH THAT ONE BODY MOVES VERTICALLY AND THE OTHER MOVES ON A SMOOTH HORIZONTAL SURFACE

Consider two bodies A and B of masses  $m_1$  and  $m_2$  respectively attached to the ends of an inextensible string as shown in figure . Let the body A moves downwards with an acceleration  $a$ . Since the string is inextensible, therefore, body B also moves over the horizontal surface with the same acceleration  $a$ . As the pulley is frictionless, hence tension  $T$  will be the same throughout the string.



Since body A moves downwards, therefore, its weight  $m_1g$  is greater than the tension  $T$  in the string.

$$\text{Net force acting on body A} = F_1 = m_1g - T$$

According to Newton's second law of motion;

$$F_1 = m_1a$$

$$\text{So } m_1a = m_1g - T \dots\dots\dots(1)$$

The forces acting on body B are:

- i. Weight  $m_2g$  of the body B acting downward.
  - ii. Reaction  $R$  of the horizontal surface acting on body B in the upwards direction.
  - iii. Tension  $T$  in the string pulling the body B horizontally over the smooth surface.
- As body B has no vertical motion, hence resultant of vertical forces ( $m_2g$  and  $R$ ) must be zero.

$$\text{Thus, the net force acting on body B is } F_2 = T$$

According to Newton's second law of motion;

$$F_2 = m_2a$$

$$m_2a = T \dots\dots\dots(2)$$

Adding Eqs. 3.10 and 3.11, we get acceleration  $a$  as

$$m_1a + m_2a = m_1g - T + T$$

$$a(m_1 + m_2) = m_1g$$

$$a = m_1g / (m_1 + m_2) \dots\dots\dots(A)$$

Putting the value of  $a$  in equation (2) to get tension  $T$  as

$$T = m_1m_2g / (m_1 + m_2) \dots\dots\dots(B)$$

**Problem:3.8**

Two masses 26 kg and 24 kg are attached to the ends of a string which passes over a frictionless pulley. 26 kg is lying over a smooth horizontal table. 24 kg mass is moving vertically downward. Find the tension in the string and the acceleration in the bodies. (125 N, 4.8 ms<sup>-2</sup>)

**Solution:**

$$m_1=24\text{kg}$$

$$m_2=26\text{kg}$$

$$g = 10\text{ms}^{-2}$$

$$T=?$$

$$a=?$$

$$T=m_1m_2g/(m_1+m_2)$$

$$T=24 \times 26 \times 10 / (24+26)$$

$$T=6240/50$$

$$\mathbf{T=125N}$$

$$a=(m_1)g/(m_1+m_2)$$

$$a=(24) \times 10 / (24+26)$$

$$a=240/50$$

$$\mathbf{a=4.8 \text{ ms}^{-2}}$$

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# Unit 3 Dynamics

## LECTURE NO.6

13 -06- 2020

### FORCE AND THE MOMENTUM

Consider a body of mass  $m$  moving with initial velocity  $v_i$ . Let a force  $F$  acts on the body which produces an acceleration  $a$  in it. This changes the velocity of the body. Let its final velocity after time becomes  $v_f$ . If  $P_i$  and  $P_f$  be the initial momentum and final momentum of the body related to initial and final velocities respectively, then

$$P_i = mv_i$$

$$P_f = mv_f$$

change of momentum

$$P_f - P_i = mv_f - mv_i$$

Thus the rate of change in momentum is given by:

$$(P_f - P_i)/t = (mv_f - mv_i)/t$$

$$= m(v_f - v_i)/t$$

$$\text{since } a = (v_f - v_i)/t$$

$$\text{so } (P_f - P_i)/t = ma$$

$$(P_f - P_i)/t = F$$

since the rate of change of velocity equal to the acceleration  $a$  produced by the force  $F$ .

According to Newton's second law of motion, above equation also defines force and states

Newton's second law of motion as

**When a force acts on a body, it produces an acceleration in the body and will be equal to the rate of change of momentum of the body.**

SI unit of momentum is newton-second (Ns) which is the same as  $\text{kgms}^{-1}$ .

#### problem 3.8:

How much time is required to change 22 Ns momentum by a force of 20 N? (1.1s)

#### Solution:

change of momentum  $P_f - P_i = 22\text{Ns}$

Applied force  $F = 20\text{N}$

Time Required  $t = ?$

Rate of change of momentum  $= F$

$$(P_f - P_i)/t = F$$

$$22/t = 20$$

$$t = 22/20$$

$$t = 1.1\text{s}$$

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PHYSICS

CLASS :9TH

# Unit 3 Dynamics

## LECTURE NO.7

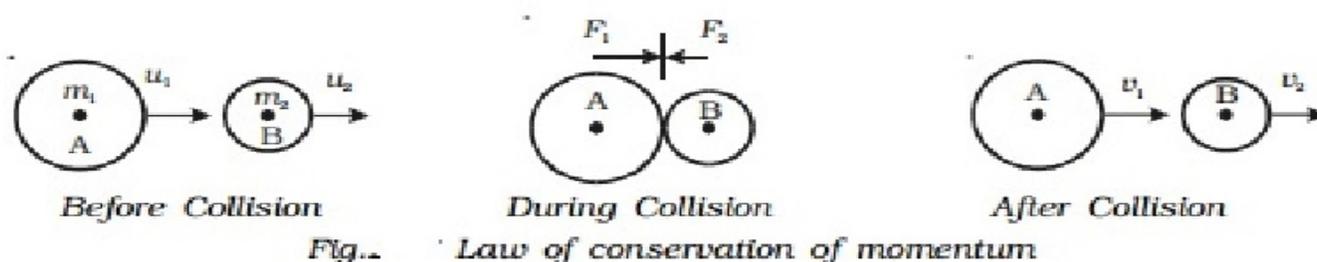
15 -06- 2020

### LAW OF CONSERVATION OF MOMENTUM:

Momentum of a system depends on its mass and velocity. A system is a group of bodies within certain boundaries. An **isolated system** is a group of interacting bodies on which no external force is acting. If no unbalanced or net force acts on a system, then its momentum remains constant. Thus the momentum of an isolated system is always conserved. This is the Law of Conservation of Momentum. It states that:

**The momentum of an isolated system of two or more than two interacting bodies remains constant.**

Consider an isolated system of two spheres of masses  $m_1$  and  $m_2$  as shown in figure.



They are moving in a straight line with initial velocities  $u_1$  and  $u_2$  respectively, such that  $u_1$  is greater than  $u_2$ . Sphere of mass  $m_1$  approaches the sphere of mass  $m_2$  as they move.

Initial momentum of mass  $m_1 = m_1 u_1$

Initial momentum of mass  $m_2 = m_2 u_2$

Total initial momentum of the system before collision =  $m_1 u_1 + m_2 u_2 \dots (1)$

After sometime mass  $m_1$  hits  $m_2$  with some force. According to Newton's third law of motion,  $m_2$  exerts an equal and opposite reaction force on  $m_1$ . Let their velocities become  $v_1$  and  $v_2$  respectively after collision.

Then Final momentum of mass  $m_1 = m_1 v_1$

Final momentum of mass  $m_2 = m_2 v_2$

Total final momentum of the system after collision =  $m_1 v_1 + m_2 v_2 \dots (2)$

According to the law of conservation of momentum

Total initial momentum of the system before collision = Total final momentum the system after collision.

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2 \dots (3)$$

Equation 3 shows that the momentum of an isolated system before and after collisions remains the same which is the law of conservation of momentum. Law of conservation of momentum is an important law and has vast applications.

**Consider a system of gun and a bullet.** Before firing the gun, both the gun and bullet are at rest, so the total momentum of the system is zero. As the gun is fired, bullet shoots out of the gun and acquires momentum.

To conserve momentum of the system, the gun recoils. According to the law of conservation of momentum, the total momentum of the gun and the bullet will also be zero after the gun is fired.

Let  $m$  be the mass of the bullet and  $v$  be its velocity on firing the gun;  $M$  be the mass of the gun and  $V$  be the velocity

Total initial momentum of the system before the gun is fired = 0

Total final momentum of the system after the gun is fired =  $m v + M V \dots (4)$

According to the law of conservation of momentum

Total momentum of the gun and the bullet after the gun is fired = Total momentum of the gun and the bullet before the gun is fired.

$$m v + M V = 0$$

or

$$M V = -m v$$

$$V = -m v / M \dots (5)$$

Hence

Equation (5) gives the velocity  $V$  of the gun. Negative sign indicates that velocity of the gun is opposite to the velocity of the bullet, i.e., the gun recoils. Since mass of the gun is much larger than the bullet, therefore, the recoil is much smaller than the velocity of the bullet.

**Rockets and jet engines** also work on the same principle. In these machines, hot gases produced by burning of fuel rush out with large momentum. The machines gain an equal and opposite momentum. This enables them to move with very high velocities.

# Unit 3 Dynamics

## LECTURE NO.8

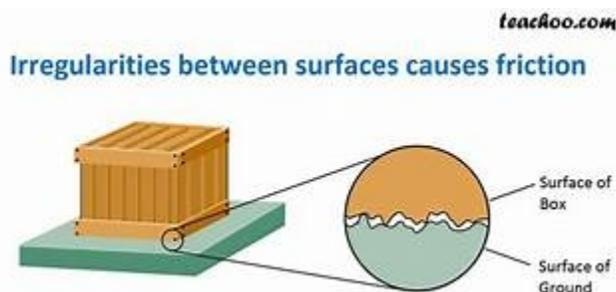
16 -06- 2020

### FRICTION :

*The force that opposes the motion of moving objects is called friction.*

Friction is a force that comes into action as soon as a body is pushed or pulled over a surface. In case of solids, the force of friction between two bodies depends upon many factors such as **nature of the two surfaces** in contact and the **pressing force** between them. Rub your palm over different surfaces such as table, carpet, polished marble surface, brick, etc. You will find smoother is the surface, easier it is to move over the surface. Moreover, harder you press your palm over the surface, more difficult would it be to move.

**Cause of Friction:** No surface is perfectly smooth. A surface that appears smooth has pits and bumps that can be seen under a microscope. Figure shows two wooden blocks with their polished surfaces in contact.



A magnified view of two smooth surfaces in contact shows the gaps and contacts between them. The contact points between the two surfaces form a sort of **cold welds**. These cold welds resist the surfaces from sliding over each other. Adding weight over the upper block increases the force pressing the surfaces together and hence, increases the resistance. Thus, **greater is the pressing force greater will be the friction** between the sliding surfaces.

Friction is equal to the applied force that tends to move a body at rest. It increases with the applied force.

Friction can be increased to certain maximum value. It does not increase beyond this. The maximum value of friction is known as the **force of limiting friction ( $F_s$ )**. It depends on the normal reaction (pressing force) between the two surfaces in contact. The ratio between the force of limiting friction  $F_s$  and the normal reaction  $R$  is constant. This constant is called the **coefficient of friction** and is represented by  $\mu$ .

$$\text{Thus } \mu = F_s/R$$

$$F_s = \mu R$$

If  $m$  is the mass of the block, then for horizontal surface;  $R = mg$

$$\text{Hence } F_s = \mu mg$$

Friction is needed to walk on the ground. It is risky to run on wet floor with shoes that have smooth soles. Athletes use special shoes that have extraordinary ground grip. Such shoes prevent them from slipping while running fast. To stop our bicycle We will apply brakes. The rubber pads pressed against the rims provide friction. It is the friction that stops the bicycle.

**problem:3.9**

How much is the force of friction between a wooden block of mass 5 kg and the horizontal marble floor? The coefficient of friction between wood and the marble is 0.6. (30 N).

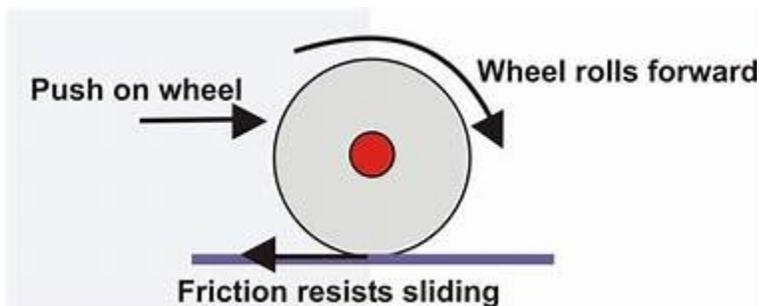
**Solution:**

$$\begin{aligned} m &= 5\text{kg} \\ \mu &= 0.6 \\ g &= 10\text{ms}^{-2} \\ F_s &= \mu mg \\ F_s &= 0.6 \times 5 \times 10\text{N} \\ \mathbf{F_s} &= \mathbf{30\text{N}} \end{aligned}$$

**Rolling friction:**

***Rolling friction is the force of friction between a rolling body and a surface over which it rolls. Rolling friction is lesser than the sliding friction.***

Wheel is one of the most important inventions in the history of mankind. The first thing about a wheel is that it rolls as it moves rather than to slide. This greatly reduces friction. When the axle of a wheel is pushed, the force of friction between the wheel and the ground at the point of contact provides the reaction force. The reaction force acts at the contact points of the wheel in a direction opposite to the applied force. The wheel rolls without rupturing the cold welds. That is why the rolling friction is extremely small than sliding friction. The fact that **rolling friction is less than sliding friction** is applied in ball bearings or roller bearings to reduce losses due to friction. The wheel would not roll on pushing it if there would be no friction between the wheel and the ground. Thus, friction is desirable for wheels to roll over a surface. It is dangerous to drive on a wet road because the friction between the road and the tyres is very small. This increases the chance of slipping the tyres from the road. The threading on tyres is designed to increase friction. Thus, threading improves road grip and make it safer to drive even on wet road. A cyclist applies brakes to stop his/her bicycle. As soon as brakes are applied, the wheels stop rolling and begin to slide over the road. Since sliding friction much greater than rolling friction. Therefore, the cycle stops very quickly.



**<sup>1</sup>BALL BEARING**



**<sup>2</sup>THREADED TYRES**

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# Unit 3 Dynamics

## LECTURE NO.9

17 -06- 2020

### **BRAKING AND SKIDDING:**

The wheels of a moving vehicle have two velocity components:

(i) motion of wheels along the road. (ii) rotation of wheels about their axis.

To move a vehicle on the road as well as to stop a moving vehicle requires friction between its tyres and the road. For example, if the road is slippery or the tyres are worn out then the tyres instead of rolling, slip over the road. The vehicle will not move if the wheels start slipping at the same point on the slippery road. Thus for the wheels to roll, the force of friction (gripping force) between the tyres and the road must be enough that prevents them from slipping. Similarly, to stop a car quickly, a large force of friction between the tyres and the road is needed. But there is a limit to this force of friction that tyres can provide. If the brakes are applied too strongly, the wheels of the car will lock up (stop turning) and the car will skid due to its large momentum. It will lose its directional control that may result in an accident. In order to reduce the chance of skidding, it is advisable not to apply brakes too hard that lock up their rolling motion especially at high speeds. Moreover, it is unsafe to drive a vehicle with worn out tyres.

### **ADVANTAGES AND DISADVANTAGES OF FRICTION:**

#### **ADVANTAGES:**

1. We cannot write if there would be no friction between paper and the pencil.
2. Friction enables us to walk on the ground.
3. We cannot run on a slippery ground. A slippery ground offers very little friction. Hence, anybody who tries to run on a slippery ground may meet an accident.
4. It is dangerous to apply brakes with full force to stop a fast moving vehicle on a slippery road
5. . Birds could not fly, if there is no air resistance. The reaction of pushed air enables the birds to fly.
6. Friction is required to erase a pencil work.
7. friction is needed to stop a moving vehicle.
8. friction is highly desirable when climbing up a hill.

#### **DISADVANTAGES:**

1. Friction is undesirable when moving at high speeds because it opposes the motion and thus limits the speed of moving objects.
2. Most of our useful energy is lost as heat and sound due to the friction between various moving parts of machines.
3. In machines, friction also causes wear and tear of their moving parts..

### **METHODS OF REDUCING FRICTION:** The friction can be reduced by:

- (i) making the sliding surfaces smooth.
- (ii) making the fast moving objects a streamline shape (fish shape) such as cars, aero planes etc. This causes the smooth flow of air and thus minimizes air resistance at high speeds.
- (iii) Lubricating the sliding surfaces.
- (iv) Using ball bearings or roller bearings .Because the rolling friction is lesser than the sliding friction.

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# Unit 3 Dynamics

## LECTURE NO.10

18 -06- 2020

### UNIFORM CIRCULAR MOTION:

*The motion of an object in a circular path with uniform speed is known as circular motion.*

We come across many things in our daily life that are moving along circular path. Take a small stone. Tie it at one end of a string and keep the other end of the string in your hand as shown in figure.

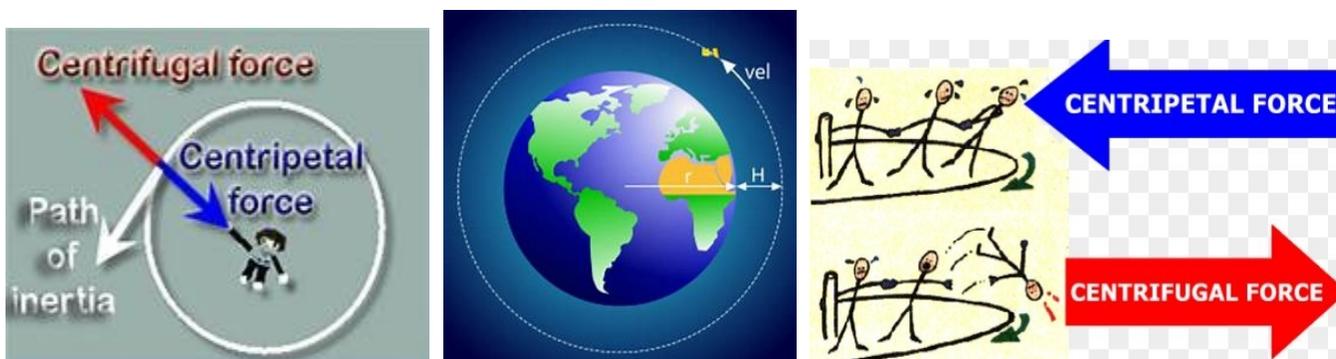


Now rotate the stone holding the string. The stone will move in a circular path. The motion of stone will be called as circular motion. Similarly, motion of the moon around the Earth is circular motion.

### CENTRIPETAL FORCE :

*Centripetal force is a force that keeps a body to move in a circle.*

Consider a body tied at the end of a string moving with uniform speed in a circular path. A body has the tendency to move in a straight line due to inertia. The string to which the body is tied keeps it to move in a circle by pulling the body towards the centre of the circle. The string pulls the body perpendicular to its motion as shown in figure .



This pulling force continuously changes the direction of motion and remains towards the centre of the circle. This centre seeking force is called the centripetal force. It keeps the body to move in a circle. Centripetal force always acts perpendicular to the motion of the body.

Let us study the centripetal forces in the following examples:

- (i) Figure (1) shows a stone tied to one end of a string rotating in a circle. The tension in the string provides the necessary centripetal force. It keeps the stone to remain in the circle. If the string is not strong enough to provide the necessary tension, it breaks and the stone moves away along a tangent to the circle .
- (ii) (ii) The moon revolves around the Earth. The gravitational force of the Earth provides the necessary centripetal force.

Let a body of mass  $m$  moves with uniform speed  $v$  in a circle of radius  $r$ . The acceleration  $a_c$  produced by the centripetal force  $F_c$  is given by

$$\text{centripetal acceleration } a_c = mv^2/r$$

According to Newton's second law of motion, the centripetal force  $F_c$  is given by

$$F_c = ma_c$$

$$F_c = mv^2/r$$

Equation shows that the centripetal force needed by a body moving in a circle depends on the mass  $m$  of the body, square of its velocity  $v$  and reciprocal to the radius  $r$  of the circle.

### **CENTRIFUGAL FORCE:**

According to Newton's third law of motion, there exists a reaction to the centripetal force. Centripetal reaction that pulls the bodies moving along a circular path outward is sometimes called the centrifugal force.

Consider a stone shown in above figure tied to a string moving in a circle. The necessary centripetal force acts on the stone through the string that keeps it to move in a circle. According to Newton's third law of motion, there exists a reaction to this centripetal force that pulls the string outward is sometimes called the centrifugal force.

#### **Problem3.10**

How much centripetal force is needed to make a body of mass 0.5 kg to move in a circle of radius 50 cm with a speed 3 ms<sup>-1</sup>?

**Solution:**

$$m = 0.5 \text{ kg}$$

$$v = 3 \text{ ms}^{-1}$$

$$r = 50 \text{ cm} = 0.5 \text{ m}$$

$$F_c = ?$$

$$F_c = mv^2/r$$

$$F_c = 0.5 \times (3)^2 / 0.5$$

$$F_c = 9 \text{ N}$$

# Unit 3 Dynamics

## LECTURE NO.11

19 -06- 2020

### APPLICATIONS OF CENTRIPITAL FORCE:

#### 1.BANKING OF THE ROADS

When a car takes a turn, centripetal force is needed to keep it in its curved track. The friction between the tyres and the road provides the necessary centripetal force. The car would skid if the force of friction between the tyres and the road is not sufficient enough particularly when the roads are wet. This problem is solved by banking of curved roads. Banking of a road means that the outer edge of a road is raised. Imagine a vehicle on a curved road. Banking causes a component of vehicle's weight to provide the necessary centripetal force while taking a turn. Thus banking of roads prevents skidding of vehicle and thus makes the driving safe.

#### 2.WASHING MACHINE DRYER

The dryer of a washing machine is basket spinners. They have a perforated wall having large numbers of fine holes in the cylindrical rotor. The lid of the cylindrical container is closed after putting wet clothes in it. When it spins at high speed, the water from wet clothes is forced out through these holes due to lack of centripetal force.

#### 3.CREAM SEPARATOR

Most modern plants use a separator to control the fat contents of various products. A separator is a high-speed spinner. It acts on the same principle of centrifuge machines. The bowl spins at very high speed causing the heavier contents of milk to move outward in the bowl pushing the lighter contents inward

towards the spinning axis. Cream or butterfat is lighter than other components in milk. Therefore, skimmed milk, which is denser than cream is collected at the outer wall of the bowl. The lighter part (cream) is pushed towards the centre from where it is collected through a pipe

