KVPY PAPER – 2012
CLASS-XI

PART–I
ONE – MARKS QUESTIONS

MATHEMATICS

1. Let f(x) be a quadratic polynomial with f(2) = 10 and f(–2) = – 2. Then the coefficient of x in f(x) is :

(A) 1 (B) 2 (C) 3 (D) 4

Sol. **(C)**

$f(2) = 10,\ f(-2) = -2$

$f(x) = ax^2 + bx + c$

$10 = 4a + 2b + c$

$-2 = 4a - 2b + c$

$-\quad -\quad +\quad -$

$12 = 4b \Rightarrow b = 3$

2. The square-root of $\frac{(0.75)^3}{1-(0.75)} + (0.75 + (0.75)^2 + 1)$ is :

(A) 1 (B) 2 (C) 3 (D) 4

Sol. **(B)**

$$x = 0.75$$

$$= \frac{x^3}{1-x} + (1 + x + x^2)$$

$$= \frac{x^3}{1-x} + x^2 + 1 + x$$

$$= \frac{x^3 + x^2 - x^3}{1-x} + x + 1$$

$$= \frac{x^2 + x - x^2}{1-x} + 1 = \frac{x + 1 - x}{1-x} = \frac{1}{1-x} = \frac{1}{1-\frac{3}{4}} = 4$$

Sq. root = 2

3. The sides of a triangle are distinct positive integers in an arithmetic progression. If he smallest side is 10, the number of such triangle is :

(A) 8 (B) 9 (C) 10 (D) infinitely many

Sol. **(C)**

10, 10 + d, 10 + 2d

(i) $10 + 10 + d > 10 + 2d$

$20 + d > 10 + 2d$

$10 > d \Rightarrow d < 10$

(ii) $10 + 10 + 2d > 10 + d$

$10 + d > 0 \Rightarrow d > -10$

(iii) $10 + d + 10 + 2d > 10$

$3d + 10 > 0$

$d > -\frac{10}{3}$

Possible value of d is (d > 0) 1, 2, 3, ..., 10

4. If a, b, c, d are positive real numbers such that $\frac{a}{3}=\frac{a+b}{4}=\frac{a+b+c}{5}=\frac{a+b+c+d}{6}$, then $\frac{a}{b+2c+3d}$ is :

(A) $\frac{1}{2}$ (B) 1 (C) 2 (D) not determinable

Sol. (A)

a, b, c, d > 0

$\frac{a}{3}=\frac{a+b}{4}=\frac{a+b+c}{5}=\frac{a+b+c+d}{6}=K$

$a = 3K,\ a + b = 4K \Rightarrow b = K$

$a + b + c = 5K \Rightarrow c = 5K - 4K = K$

$a + b + c + d = 6K \Rightarrow d = 6K - 5K = K$

$$\frac{a}{b+2c+3d} = \frac{3K}{K+2K+3K}=\frac{1}{2}$$

5. For $\frac{2^2+4^2+6^2+...+(2n)^2}{1^2+3^2+5^2+...+(2n-1)^2}$ to exceed 1.01, then maximum value of n is :

(A) 99 (B) 100 (C) 101 (D) 150

Sol. (D)

$\frac{2^2(1^2+2^2+3^2+.....+n^2)}{1^2+3^2+5^2+.....+(2n-1)^2}>1.01$

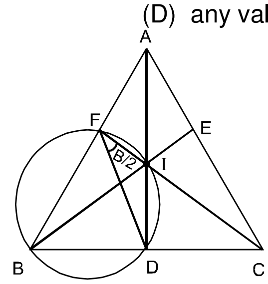
$\frac{2(n+1)}{(2n-1)}>\frac{101}{100}\Rightarrow n<\frac{301}{2}$

6. In triangle ABC, let AD, BE and CF be the internal angle bisectors with D, E and F on the sides BC, CA and AB respectively. Suppose AD, BE and CF concur at I and B, D, I, F are concyclic, then $\angle IFD$ has measure :

(A) 15º (B) 30º (C) 45º (D) any value ≤ 90º

Sol. **(D)**

$\angle IFD = \frac{B}{2}=\frac{\pi}{2}-\left(\frac{A+c}{2}\right)\le 90°$



7. A regular octagon is formed by cutting congruent isosceles right-angled triangles from the corners of a square. If the square has side-length 1, the side-length of the octagon is :

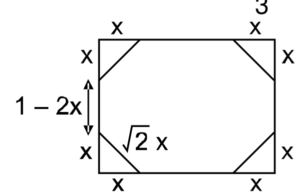
(A) $\frac{\sqrt{2}-1}{2}$ (B) $\sqrt{2}-1$ (C) $\frac{\sqrt{5}-1}{4}$ (D) $\frac{\sqrt{5}-1}{3}$

Sol. **(B)**

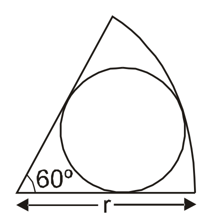
$1 - 2x = \sqrt{2}x$

$x=\frac{(\sqrt{2}-1)}{\sqrt{2}}$

Side length of octagon = $(\sqrt{2}-1)$



8. A circle is drawn in a sector of a larger circle of radius r, as shown in the adjacent figure. The smaller circle is tangent to the two bounding radii and the arc of the sector. The radius of the small circle is :



(A) $\frac{r}{2}$ (B) $\frac{r}{3}$

(C) $\frac{2\sqrt{3}\,r}{5}$ (D) $\frac{r}{\sqrt{2}}$

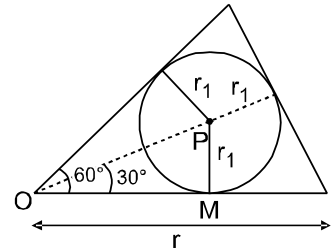
Sol. **(B)**

ΔOPM $\qquad \sin 30° = \dfrac{r_1}{OP}$

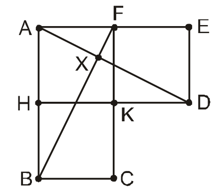
$OP = 2r_1$

$2r_1 + r_1 = r$

$r_1 = \dfrac{r}{3}$



9. In the figure, AHKF, FKDE and HBCK are unit squares; AD and BF intersect in X. Then the ratio of the areas of triangle AXF and ABF is :



(A) $\dfrac{1}{4}$ $\qquad$ (B) $\dfrac{1}{5}$

(C) $\dfrac{1}{6}$ $\qquad$ (D) $\dfrac{1}{8}$

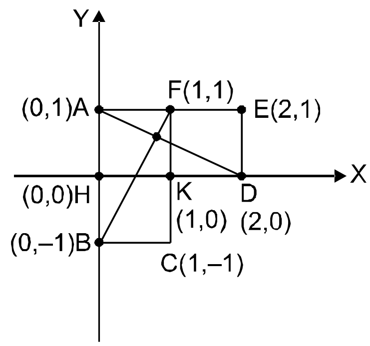
Sol. **(B)**

Coordinate of X is $\left(\dfrac{4}{5}, \dfrac{3}{5}\right)$

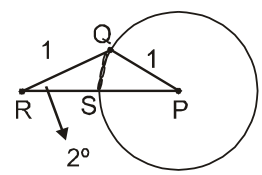
Area of AXF = $\dfrac{1}{5}$sq.unit

Area of ABF = $\dfrac{1}{2} \times 2 \times 1 = 1$

Ratio is = $\dfrac{1}{5}$



10. Suppose Q is a point on the circle with centre P and radius 1, as shown in the figure; R is a point outside the circle such that QR = 1 and $\angle QRP = 2^{\circ}$. Let S be the point where the segment RP intersects the given circle. Then measure of $\angle RQS$ equals :



(A) 86º $\qquad$ (B) 87º

(C) 88º $\qquad$ (D) 89º

Sol. **(B)**

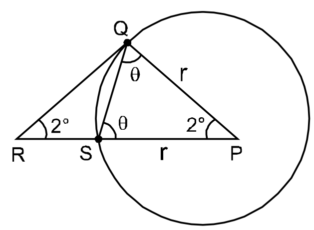
$2\theta + 2° = 180°$

$\theta + 1° = 90°$

$\theta = 89°$

$\angle RSQ = 90°$

$\angle RQS = 87°$



11. Observe that, at any instant, the minute and hour hands of a clock make two angles between them whose sum is 360º. At 6 : 15 the difference between these two angles is :

(A) 165º $\qquad$ (B) 170º $\qquad$ (C) 175º $\qquad$ (D) 180º

Sol. **(A)**

Angle between them at 6:15 will be = 97.5

Other angle = 360 – 97.5 = 262.5

So difference = 262.5 – 97.5 = 165.0 = 165°

12. Two workers A and B are engaged to do a piece of work. Working alone, A takes 8 hours more to complete the work than if both worked together. On the other hand, working alone, B would need $4\dfrac{1}{2}$ hours more to complete the work than if both worked together. How much time would they take to complete the job working together ?

(A) 4 hours $\qquad$ (B) 5 hours $\qquad$ (C) 6 hours $\qquad$ (D) 7 hours

Sol. **(C)**

Let they finish work together in x hours

A alone finish work = (x + 8) hours

B alone finish work = $\left(x+\frac{9}{2}\right)$ hours

So $\frac{1}{x+8}+\frac{1}{x+\frac{9}{2}}=\frac{1}{x}$

So on solving x = 6 hours

13. When a bucket is half full, the weight of the bucket and the water is 10 kg. When the bucket is two-thirds full, the total weight is 11 kg. What is the total weight, in kg, when the bucket is completely full ?

(A) 12 (B) $12\frac{1}{2}$ (C) $12\frac{2}{3}$ (D) 13

Sol. **(D)**

Let the weight of water when bucket is fall = 2x kg

weight of bucket = x kg

So, x + y = 0

$\frac{2}{3}(2x)+y = 11$

So, on solving x = 3, y = 7

So weight of bucket when totally filled with water

= 2x + y

= 2 · 3 + 7 = 13 kg

14. How many ordered pairs of (m, n) integers satisfy $\frac{m}{12}=\frac{12}{n}$?

(A) 30 (B) 15 (C) 12 (D) 10

Sol. **(A)**

$m \times n = 12 \times 12$

$= 144 \times 1 \rightarrow$ 4 cases (taking positive and negative)

$= 2 \times 72 \rightarrow$ 4 cases

$= 4 \times 36 \rightarrow$ 4 cases

$= 8 \times 18 \rightarrow$ 4 cases

$= 16 \times 9 \rightarrow$ 4 cases

$= 48 \times 3 \rightarrow$ 4 cases

$= 6 \times 24 \rightarrow$ 4 cases

$= 12 \times 12 \rightarrow$ 2 cases

So Total = 30

15. Let S = {1, 2, 3,…, 40} and let A be a subset of S such that no two elements n A have their sum divisible by 5. What is the maximum number of elements possible in A ?

(A) 10 (B) 13 (C) 17 (D) 20

Sol. **(C)**

Take all numbers leaving remainder 4, 3 & 0.

Max. no. 17.

PHYSICS

16. A clay ball of mass m and speed v strikes another metal ball of same mass m, which is at rest. They stick together after collision. The kinetic energy of the system after collision is :

(A) $mv^2/2$ (B) $mv^2/4$ (C) mv^2 (D) mv^2

Sol. **(B)**

By cons. of momentum

$mv = 2m\,v'$

$v' = \frac{v}{2}$

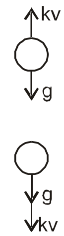
$KE_f = \frac{1}{2}(2m)(v')^2 = \frac{mv^2}{4}$.

17. A ball falls vertically downward and bounces off a horizontal floor. The speed of the ball just before reaching the floor (u_1) is equal to the speed just after leaving contact with the floor (u_2); $u_1 = u_2$. The corresponding magnitudes of accelerations are denoted respectively by a_1 and a_2. The air resistance during motion is proportional to speed and is not negligible. If g is acceleration due to gravity, then :

(A) $a_1 < a_2$ (B) $a_1 = a_2 \neq g$ (C) $a_1 > a_2$ (D) $a_1 = a_2 = g$

Sol. **(A)**

Let Before reaching the ground speed is v.



$\therefore$ $a_1 = |g - kv|$

And after bouncing

$a_2 = |g + kv|$

$\therefore$ $a_2 > a_1$

18. Which of the following statements is true about the flow of electrons in an electric circuit ?

(A) Electrons always flow from lower to higher potential

(B) Electrons always flow from higher to lower potential

(C) Electrons flow from lower to higher potential except through power sources

(D) Electrons flow from higher to lower potential, except through power sources

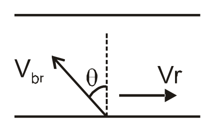
Sol. **(A)**

Electrons always moves in direction opposite to that of direction of electric field. And potential drops in the direction of electric field. Hence, electron moves from lower to higher potential.

19. A boat crossing a river moves with a velocity v relative to still water. The river is flowing with a velocity v/2 with respect to the bank. The angle with respect to the flow direction with which the boat should move to minimize the drift is :

(A) 30º (B) 60º (C) 150º (D) 120º

Sol. **(D)**



$$\theta = \sin^{-1}\left(\frac{v/2}{v}\right)$$

$$\theta = 30^\circ$$

So angle with direction of flow of river is 90º + 30º = 120º.

20. In the Arctic region hemispherical houses called Igloss are made of ice. It is possible to maintain a temperature inside an Igloo as high as 20ºC because :

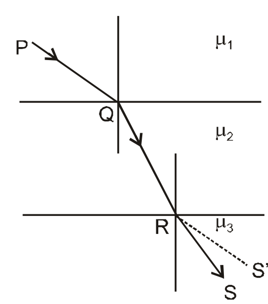
(A) ice has high thermal conductivity (B) ice has low thermal conductivity

(C) ice has high specific heat (D) ice has higher density than water

Sol. **(B)**

Ice has low thermal conductivity so it do not transfer heat easily.

21. In the figure below, PQRS denotes the path followed by a ray of light as it travels through three media in succession. The absolute refractive indices of the media are μ_1, μ_2 and μ_3 respectively. (The line segment RS' in the figure is parallel to PQ). Then



(A) $\mu_1 > \mu_2 > \mu_3$ (B) $\mu_1 < \mu_2 < \mu_3$

(C) $\mu_1 = \mu_3 < \mu_2$ (D) $\mu_1 < \mu_2 < \mu_3$

Sol. **(D)**

From figure we can analyse

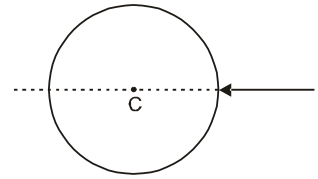
$\mu_2 > \mu_1$

$\mu_3 < \mu_2$

$\mu_1 < \mu_3$

$\therefore$ $\mu_1 < \mu_3 < \mu_2$.

22. A ray of white light is incident on a spherical water droop whose center is C as shown below. When observed from the opposite side, the emergent light :

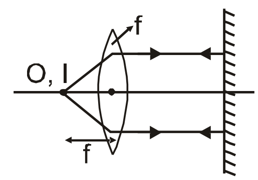


(A) will be white and will emerge without deviating
(B) will be internally reflected
(C) will split into different colors such that the angle of deviation will be different for different colors
(D) will split into different colors such that the angles of deviation will be same for all colors

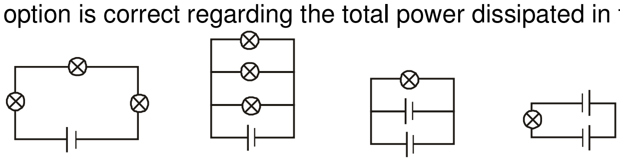
Sol. **(A)**
The light ray is incident normally hence it will not show refraction.

23. A convex lens of focal length 15 cm is placed in front of a plane mirror at a distance 25 cm from the mirror. Where on the optical axis and from the centre of the lens should a small object be placed such that the final image coincides with the object ?
(A) 15 cm and on the opposite side of the mirror (B) 15 cm and between the mirror and the lens
(C) 7.5 cm and on the opposite side of the mirror (D) 7.5 cm and between the mirror and the lens

Sol. **(A)**
Object must be placed at focus.



24. Following figures show different combinations of identical bulb(s) connected to identical battery(ies). Which option is correct regarding the total power dissipated in the circuit ?



(A) P < Q < R < S (B) R < Q < P < S (C) P < Q < R = S (D) P < R < Q < S

Sol. **(D)**

Power in circuit $P = \frac{V^2}{3R}$

Power in circuit $Q = \frac{3V^2}{R}$

Power in circuit $R = \frac{V^2}{R}$

Power in circuit $S = \frac{4V^2}{R}$

So, order is S > Q > R > P.

25. A circular metallic ring of radius R has a small gap of width d. The coefficient of thermal expansion of the metal is α in appropriate units. If we increase the temperature of the ring by an amount ΔT, then width of the gap :
(A) will increase by an amount $d\alpha\Delta T$ (B) will not change
(C) will increase by an amount $(2\pi R- d)\ \alpha\Delta T$ (D) will decrease by an amount $d\alpha\Delta T$

Sol. **(A)**
Gap will increase by amount.

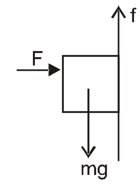
$$\Delta d = d\alpha\Delta T.$$

26. A girl holds a book of mass m against a vertical wall with a horizontal force F using her finger so that the book does not move. The frictional force on the book by the wall is :
(A) F and along the finger but pointing towards the girl
(B) μF upwards where μ is the coefficient of static friction
(C) mg and upwards
(D) equal and opposite to the resultant of F and mg

Sol. **(C)**

For balancing of block.

$$f = mg.$$



27. A solid cube and a solid sphere both made of same material are completely submerged in water but to different depths. The sphere and the cube have same surface area. The buoyant force is :

(A) greater for the cube than the sphere (B) greater for the sphere than the cube
(C) same for the sphere and the cube (D) greater for the object that is submerged deeper

Sol. (B)

For a given area, volume of sphere is more then volume of a cube.
Hence Buoyant force on sphere will be maximum.

28. $^{238}_{92}U$ atom disintegrates to $^{214}_{84}Po$ with a half life of 4.5×10^9 years by emitting six alpha particles and n electrons. Here n is :

(A) 6 (B) 4 (C) 10 (D) 7

Sol. (B)

$^{238}_{92}U \rightarrow ^{214}_{84}Po + 6\alpha$

To conserve charge 4 electrons must be released.

29. Which statement about the Rutherford model of the atom is NOT true ?

(A) There is a positively charged center in an atom called the nucleus
(B) Nearly all the mass of an atom resides in the nucleus
(C) Size of the nucleus is comparable to the atom
(D) Electrons occupy the space surrounding the nucleus

Sol. (C)

Size of nucleus is lesser than size of atom. Most space of atom is vacant.

30. A girl brings a positively charged rod near a thin neutral stream of water from a tap. She observes that the water stream bends towards her. Instead, if she were to bring a negatively charged rod near to the stream, it will :

(A) bend in the same direction
(B) bend in the opposite direction
(C) not bend at all
(D) bend in the opposite direction above the below the rod

Sol. (A)

Here stream of water gets deflected due to induction hence in both cases it will bend toward the girl.

CHEMISTRY

31. The weight of calcium oxide formed by burning 20 g of calcium in excess oxygen is :

(A) 36 g (B) 56 g (C) 28 g (D) 72 g

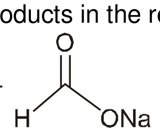
Sol. (C)

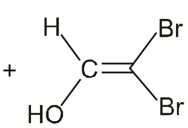
$$2Ca + O_2 \longrightarrow 2CaO$$

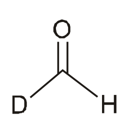
$$n_{Ca} = \frac{20}{40} = \frac{1}{2}$$

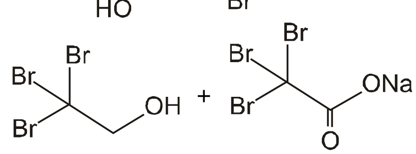
$$n_{CaO} = \frac{1}{2} \times 56 = 28$$

32. The major products in the reaction $Br_3CCHO \xrightarrow{NaOH}$ are :

(A) $CHBr_3$ + 

(B) NaBr + 

(C) NaOBr + 

(D) 

Sol. **(A)**

$$Br_3CCHO \xrightarrow{NaOH} CHBr_3 + H-\overset{\overset{\displaystyle O}{\|}}{C}-ONa$$

33. The number of electrons plus neutrons in ${}^{40}_{19}K^{+}$ is :

(A) 38 (B) 59 (C) 39 (D) 40

Sol. **(C)**

$n_e = 18$ & $n_n = 40 - 19 = 21$

Hence $n_e + n_n = 18 + 21 = 39$

34. Among the following, the most basic oxide is :

(A) Al_2O_3 (B) P_2O_5 (C) SiO_2 (D) Na_2O

Sol. **(D)**

Na_2O (alkali metal oxides are most basic in its period)

35. By dissolving 0.35 mole of sodium chloride in water, 1.30 L of salt solution is obtained. The molarity of the resulting solution should be reported as :

(A) 0.3 (B) 0.269 (C) 0.27 (D) 0.2692

Sol. **(D)**

$$M = \frac{\text{mole}}{\text{volume}} = \frac{0.35}{1.3} = 0.2692$$

36. Among the quantities, density (ρ), temperature (T), enthalpy (H), heat capacity (C_p), volume (V) and pressure (P), a set of intensive variables are :

(A) (ρ, T, H) (B) (H, T, V) (C) (V, T, C_p) (D) (ρ, T, P)

Sol. **(D)**

Intensive variables are density (ρ), temperature (T) & pressure (P).

37. The value of 'x' in $KAl(SO_4)_x.12H_2O$ is :

(A) 1 (B) 2 (C) 3 (D) 4

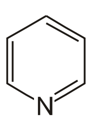
Sol. **(B)**

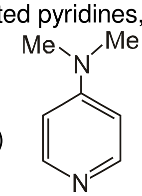
Formula is $K_2SO_4 . Al_2(SO_4)_3 . 24H_2O$

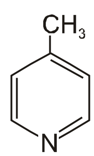
Empirical formula is $KAl(SO_4)_2 . 12H_2O$

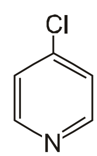
So x = 2

38. Among the following substituted pyridines, the most basic compound is :

(A) 

(B) 

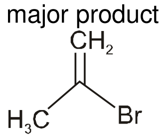
(C) 

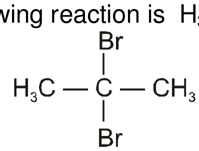
(D) 

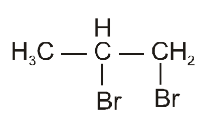
Sol. **(B)**

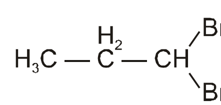
Because conjugate acid is stabilised by resonance with complete octate.

39. The major product in the following reaction is $H_3C - C \equiv C - H + HBr$ (excess)

(A) 

(B) 

(C) 

(D) 

Sol. **(B)**

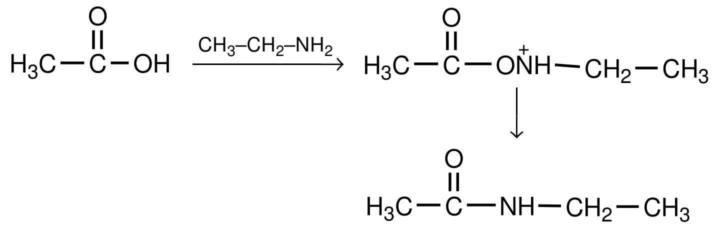
$$H_3C-C\equiv C-H + \underset{\text{(excess)}}{HBr} \longrightarrow H_3C-\underset{\underset{\displaystyle Br}{|}}{\overset{\overset{\displaystyle Br}{|}}{C}}-CH_3$$

40. The major product in the following reaction at 25ºC is

$$CH_3COOH \xrightarrow{CH_3CH_2NH_2}$$

(A) $CH_3CONHCH_2CH_3$ (B) $CH_3CH{=}NCH_2CH_3$ (C) $NH_3^+CH_2CH_3.CH_3COO^-$ (D) $CH_3CON{=}CHCH_3$

Sol. **(A)**

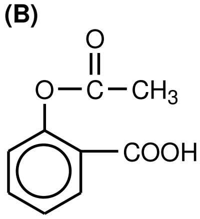


41. A reaction with reaction quotient Q_C and equilibrium constant K_C, will proceed in the direction of the products when :
(A) $Q_C = K_C$ (B) $Q_C < K_C$ (C) $Q_C > K_C$ (D) $Q_C = 0$

Sol. **(B)**
$Q_c < K_c$

42. Acetylsalicylic acid is a pain killer and is commonly known as :
(A) paracetamol (B) aspirin (C) ibuprofen (D) penicillin

Sol. **(B)**

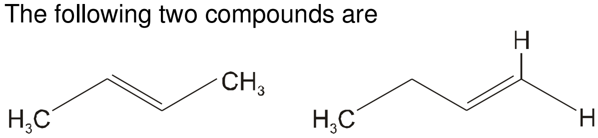


Aspirin

43. The molecule which does not exhibit strong hydrogen bonding is :
(A) methyl amine (B) acetic acid (C) diethyl ether (D) glucose

Sol. **(C)**
$CH_3–CH_2–O–CH_2–CH_3$

44. The following two compounds are



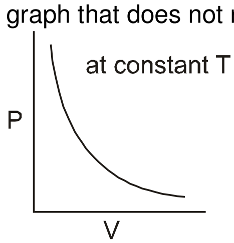
(A) geometrical isomers (B) positional isomers
(C) functional group isomers (D) optical isoers

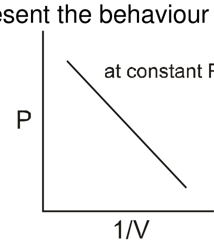
Sol. **(B)**

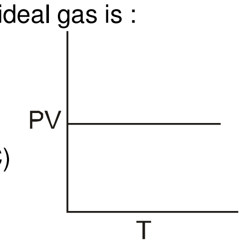
 are position isomer

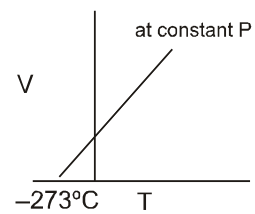
2-butene 1-butene

45. The graph that does not represent the behaviour of an ideal gas is :

(A) 

(B) 

(C) 

(D) 

Sol. **(B, C)**
B & C both are incorrect.

BIOLOGY

46. A smear of blood from a healthy individual is stained with a nuclear stain called hematoxylin and then observed under a light microscope. Which of the following cell type would be highest in number ?
(A) neutrophils (B) lymphocytes (C) eosinophils (D) monocytes

Sol. **(A)**
Neutrophils are type of granulocyte WBC which can stain with either acidic or basic dye.
Haematoxylin is a basic dye can be used to stain neutrophils while eosinophils can be stain with acidic dye like eosin.

47. Which of the following biological phenomenon involves a bacteriophage ?
(A) transformation (B) conjugation (C) translocation (D) transduction
Sol. **(D)**
Bacterial virus “bacteriophage” mediated transfer of DNA is called transduction.

48. In which compartment of a cell does the process of glycolysis takes place ?
(A) Golgi complex (B) cytoplasm (C) mitochondria (D) ribosomes
Sol. **(C)**
Glycolysis is an aerobic degradation of glucose which takes place in cytoplasm.

49. Huntington’s disease is a disease of the :
(A) nervous system (B) circulatory system (C) respiratory system (D) excretory system
Sol. **(A)**
Huntington’s disease is a disorder passed down through families in which nerve cells in certain parts of the brain waste away or degenerate.

50. A cell will experience the highest level of endosmosis when it is kept in
(A) distilled water (B) sugar solution (C) salt solution (D) protein solution
Sol. **(A)**
Endosmosis takes place from hypotonic medium or high water potential to hypertonic medium or low water potential. As distilled (pure water) has highest water potential so a cell will experience highest level of endosmosis when kept in distilled water.

51. When the leaf of the ‘touch-me-not’ (chui-mui, *Mimosa pudica*) plant is touched, the leaf drops because :
(A) a nerve signal passes through the plant (B) the temperature of the plant increases
(C) water is lost from the cells at the base of the leaf (D) the plant dies
Sol. **(C)**
Mimosa pudica show siesmonasty i.e. it’s leaf droops on touch due to water los from the cells at the base of the leaf.

52. If you are seeing mangroves around you, which part of India are you visiting ?
(A) Western Ghats (B) Thar desert (C) Sunderbans (D) Himalayas
Sol. **(B)**
The sundarbans comprises the principal portion of Mangrove in India.

53. Myeloid tissue is a type of :
(A) haematopoietic tissue (B) cartilage tissue (C) muscular tissue (D) areolar tissue
Sol. **(A)**
Myeloid tissue is a biological tissue with the ability to perform hematopoiesis. It is mainly found a the red bone marrow.

54. The heart of an amphibian is usually :
(A) two chambered (B) three chambered
(C) four chambered (D) three and half chambered
Sol. **(C)**
Heart in vertebrate show evolutionary advancement. In fishes heart is two chambered, in amphibians and reptiles three chambered and in birds and mammales heart is four chambered.

55. Gigantism and acromegaly are due to defects in the function of the following gland:
(A) adrenals (B) thyroid (C) pancreas (D) pituitary
Sol. **(D)**
Gigantism and acromegaly are hypersecretion disorders of growth hormone which is secreted from pituitary gland.

56. The pH of 10^{-8} M HCl solution is :
(A) 8 (B) close to 7 (C) 1 (D) 0
Sol. **(B)**
The pH of 10^{-8} MHCl solution is close to 7.

57. Which one of the following organelles can synthesize some of its own proteins ?
(A) lysozome (B) Golgi apparatus (C) vacuole (D) mitochondrion
Sol. **(D)**
Mitochondrion and chloroplast are semiautonomous organs, both can synthesize some of their own proteins.

58. Maltose is a polymer of :

(A) one glucose and one fructose molecule
(B) one glucose and one galactose molecule
(C) two glucose molecules
(D) two fructose molecules

Sol. **(C)**

Maltose also known as Maltobiose or malt sugar, is a disaccharide formed from two units of glucose joined with and $\alpha(1 \rightarrow 4)$ bond.

59. The roots of some higher plants get associated with a fungal partner. The roots provide food to the fungus while the fungus supplies water to the roots. The structure so formed is known as :

(A) lichen (B) anabaena (C) mycorrhiza (D) rhizobium

Sol. **(B)**

Symbiotic association of fungi and roots of higher plants is called mycorrhiza.

60. Prehistoric forms of life are found in fossils. The probability of finding fossils of more complex organisms :

(A) increases from lower to upper strata
(B) decreases from lower to upper strata
(C) remains constant in each stratum
(D) uncertain

Sol. **(A)**

Life originated in simple form and then evolved to complex form. So probability of finding fossils of more complex organisms will increase from lower to upper strata.

PART – II
TWO MARK QUESTIONS

MATHEMATICS

61. Let a, b, c be positive integers such that $\frac{a\sqrt{2}+b}{b\sqrt{2}+c}$ is a rational number, then which of the following is always an integer ?

(A) $\frac{2a^2+b^2}{2b^2+c^2}$ (B) $\frac{a^2+2b^2}{b^2+2c^2}$ (C) $\frac{a^2+b^2-c^2}{a+b-c}$ (D) $\frac{a^2+b^2+c^2}{a+c-b}$

Sol. **(D)**

$$\frac{a\sqrt{2}\times b}{b\sqrt{2}+c}\times\frac{c-b\sqrt{2}}{c-b\sqrt{2}} = \frac{ac\sqrt{2}+bc-2ab-b^2\sqrt{2}}{c^2-2b}$$

is a rational number

So $ac - b^2 = 0$

$ac = b^2 \Rightarrow b = \sqrt{ac}$

So $$\frac{a^2+b^2+c^2}{a+c-b} = \frac{a^2+c^2+ac}{a+c-\sqrt{ac}} = \frac{(a+c)^2-ac}{a+c-\sqrt{ac}}$$

$$= \frac{(a+c-\sqrt{ac})(a+c+\sqrt{ac})}{a+c-\sqrt{ac}}$$

$$= a+c+\sqrt{ac} = a + c + b$$

So option (D) is correct.

62. The number of solutions (x, y, z) to the system of equations x + 2y + 4z = 9, 4yz + 2xz + xy = 13, xyz = 3, such that at least two of x, y, z are integers is :

(A) 3 (B) 5 (C) 6 (D) 4

Sol. (B)

x = 2 then y = 3/2, z = 1
y = 2, z = 3/4   2

x = 3 then y = 2, z = 1/2
y = 1, z = 1   2

x = 4 then y = 3/2, z = 1/2
y = 1, z = 3/4   1

Solution is 5

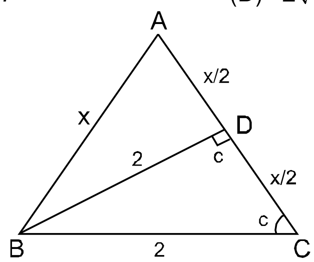
63. In a triangle ABC, it is known that AB = AC. Suppose D is the mid-point of AC and BD = BC = 2. Then the area of the triangle ABC is :

(A) 2 (B) $2\sqrt{2}$ (C) $\sqrt{7}$ (D) $2\sqrt{7}$

Sol. **(C)**

Value of x = $2\sqrt{2}$

Area of ΔABC = $\sqrt{7}$



64. A train leaves Pune at 7:30 am and reaches Mumbai at 11:30 am. Another train leaves Mumbai at 9:30 am and reaches Pune at 1:00 pm. Assuming that the two trains travel at constant speeds, at what time do the two trains cross each other ?

(A) 10 : 20 am (B) 10 : 26 am (C) 11 : 30 am (D) data not sufficient

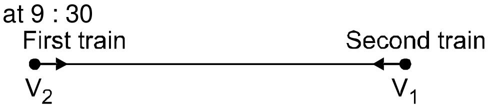
Sol. **(B)**

Let speed of first train = V_1

Speed of second train = V_2

Distance between Mumbai and Pune = x

So at 9 : 30



Let they meet t hours after 9 : 30

So $\qquad V_1 + V_2 = \frac{x/2}{t}$

$$\frac{x}{4} + \frac{x}{7/2} = \frac{x}{2t} \Rightarrow t = \frac{28}{30}\text{hr} = 56\,\text{min.}$$

So they meet at 9 : 30 + 56 min. = 10 : 26 am

65. In the adjacent figures, which has the shortest path ?

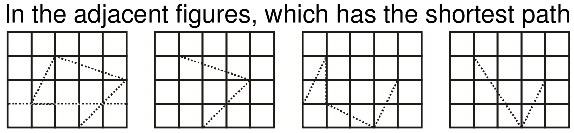


Fig. 1 Fig. 2 Fig. 3 Fig. 4

(A) Fig. 1 (B) Fig. 2 (C) Fig. 3 (D) Fig. 4

Sol. **(C)**

Figure 3 has shortest path.

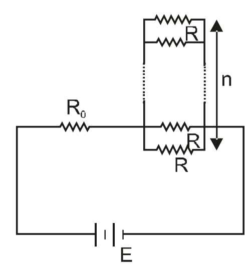
PHYSICS

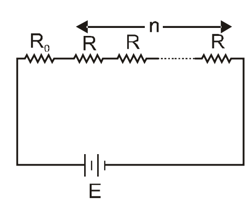
66. In the circuit shown, n identical resistors R are connected in parallel (n > 1) and the combination is connected in series to another resistor R_0. In the adjoining circuit n resistors of resistance R are all connected in series along with R_0.

The batteries in both circuits are identical and net power dissipated in the n resistors in both circuits is same. The ratio R_0/R is :

(A) 1 (B) n

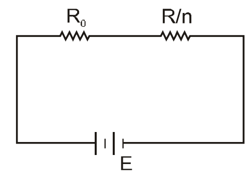
(C) n^2 (D) 1/n





Sol. **(A)**

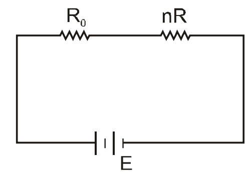
Power dissipated in resistance $\left(\frac{R}{n}\right)$ is



for CKt (1)

$$P_1 = \left(\frac{E}{R_0 + R/n}\right)^2 \times \frac{R}{n}$$

Power dissipated in resistance nR is



for CKt (2)

$$P_2 = \left(\frac{E}{R_0 + nR}\right)^2 \times nR$$

$$P_1 = P_2$$

$$\Rightarrow \quad \frac{n^2}{(nR_0 + R)^2} \times \frac{R}{n} = \frac{nR}{(R_0 + nR)^2}$$

$$(nR_0 + R)^2 = (R_0 + nR)^2$$

$$nR_0 + R = R_0 + nR$$

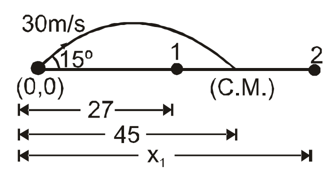
$$(n - 1)R_0 = (n - 1)R$$

$$\frac{R_0}{R} = 1$$

67. A firecracker is thrown with velocity of 30 m.s.$^{-1}$ in a direction which makes an angle of 75º with the vertical axis. At some point on its trajectory, the firecracker splits into two identical pieces in such a way that one piece falls 27 m far from the shooting point. Assuming that all trajectories are contained in the same plane, how far will the other piece fall from the shooting point ? (Take g = 10 m.s.$^{-2}$ and neglect air resistance)

(A) 63 m or 144 m (B) 28 m or 72 m (C) 72 m or 99 m (D) 63 m or 117 m

Sol. **(D)**



$$R = \frac{(30)^2 \times \sin 2 \times 15º}{g} = \frac{900}{10 \times 2} = 45$$

Case I $\quad \frac{27 \times m + x_1 m}{2m} = 45 \text{ m}$

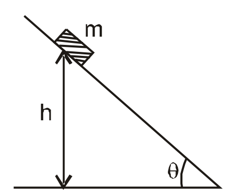
$$27m + xm = 90 \text{ m}$$

$$x = 90 - 27 = 63$$

Case II $\quad \frac{-27 \times m + x_2 m}{2m} = 45$

$$x_2 = 90 + 27 = 117 \text{ m}$$

68. A block of mass m is sliding down an inclined plane with constant speed. At a certain instant t_0, its height above the ground is h. The coefficient of kinetic friction between the block and the plane is μ. If the block reaches the ground at a later instant t_g, then the energy dissipated by friction in the time interval $(t_g - t_o)$ is :



(A) μmgh (B) mgh

(C) μmgh/sinθ (D) μmgh/cosθ

Sol. **(B)**

As block slide down with constant velocity

$$\Delta K.E = 0$$

$$W_{friction} + W_{mg} = 0$$

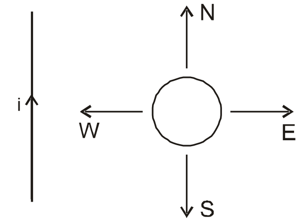
$$W_{friction} = - W_{mg} = - mgh$$

So, Energy dissipated by friction = – W_{frict}

$$\Rightarrow + mgh$$

69. A circular loop of wire is in the same plane as an infinitely long wire carrying i. Four possible motions of the loop are marked by N, E, W, and S as shown.

A clockwise current is induced in the loop when loop is pulled towards :

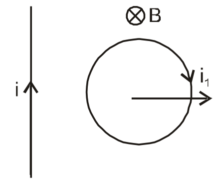


(A) N (B) E

(C) W (D) S

Sol. **(B)**

According to len'z law the direction of induced current is such that it opposes the change of flux.



70. 150 g of ice is mixed with 100 g of water at temperature 80ºC. The latent heat of ice is 80 cal/g and the specific heat of water is 1 cal/g-ºC. Assuming no heat loss to the environment, the amount of ice which does not melt is :

(A) 100 g (B) 0 g (C) 150 g (D) 50 g

Sol. **(D)**

Let m ⇒ mass of ice melt in water. Let find temperature of mixture is 0ºC.

Heat released by water $= 100 \times 80 \times 1$

$= 8000$ cal.

Heat required by ice to melt $= m \times 80$

$m \times 80 = 100 \times 80 \Rightarrow m = 100$ g

So, remaining mass of Ice $= (150 - 100)$ g

$= 50$ gm

CHEMISTRY

71. Upon fully dissolving 2.0 g of a metal in sulfuric acid, 6.8 g of the metal sulfate is formed. The equivalent weight of the metal is :

(A) 13.6 g (B) 20.0 g (C) 4.0 g (D) 10.0 g

Sol. **(B)**

$$e_M = eSO_4^{2-}$$

$$\frac{2}{E_M} = \frac{4.8}{48}$$

$$E_M = \mathbf{20}$$

Mass of metal sulphate = 6.86

Mass of metal = 2g

Mass of sulphate ion = (6.8 – 2) = 4.8 g

72. Upon mixing equal volumes of aqueous solutions of 0.1 M HCl and 0.2 M H_2SO_4, the concentration of H^+ in the resulting solution is :

(A) 0.30 mol/L (B) 0.25 mol/L (C) 0.15 mol/L (D) 0.10 mol/L

Sol. **(B)**

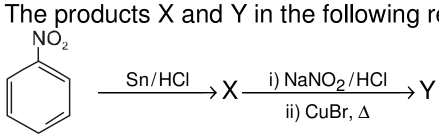
$$n_{H^+(HCl)} = 0.1\ V$$

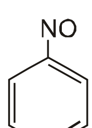
$$n_{H^+\ (H_2SO_4)} = 0.2 \times 2V$$

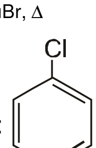
$$[H^+] = \frac{n_{H^+(HCl)} + n_{H^+(H_2SO_4)}}{2V}$$

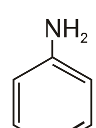
$$= \frac{0.1V + 0.4V}{2V} = \frac{0.5V}{2V} = 0.25\,\text{mol/L}$$

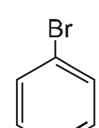
73. The products X and Y in the following reaction sequence are

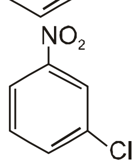


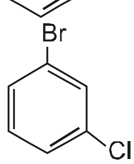
(A) X : 

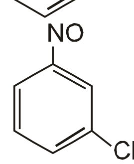
Y : 

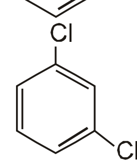
(B) X : 

Y : 

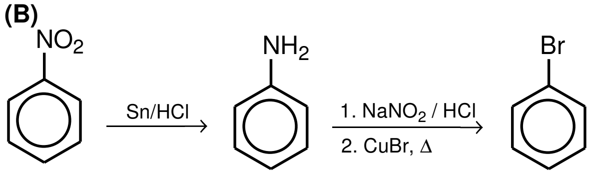
(C) X : 

Y : 

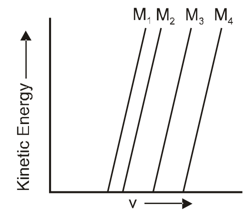
(D) X : 

Y : 

Sol. **(B)**



74. A plot of the kinetic energy ($1/2\ mv^2$) of ejected electrons as a function of the frequency (v) of incident radiation for four alkali metals (M_1, M_2, M_3, M_4) is shown below.
The alkali metals M_1, M_2, M_3 and M_4 are, respectively :



(A) Li, Na, K, and Rb (B) Rb, K, Na, and Li
(C) Na, K, Li, and Rb (D) Rb, Li, Na, and K

Sol. **(B)**

Intercept on υ-axis denotes υ^0 & $\upsilon^0 = \dfrac{\phi}{n}$ where ϕ = work function of metal.

75. The number of moles of Br_2 produced when two moles of potassium permanganate are treated with excess potassium bromide in aqueous acid medium is :
(A) 1 (B) 3 (C) 2 (D) 4

Sol. (No option is correct)

$$MnO_4^- + 5Br^- \longrightarrow \frac{5}{2} Br_2 + Mn^{2+}$$

Ans. (5 mole Br_2)

BIOLOGY

76. A baby is born with the normal number and distribution of rods, but no cones in his eyes. We would expect that the baby would be :
(A) color blind (B) night blind (C) blind in both eyes (D) blind in one eye

Sol. **(A)**
Cone cells are responsible for colour differentiation while rod cells help in bright and dark differentiation. If newly born baby's eye retina devoid cone cells baby would be color blind.

77. In mammals, pleural membranes cover the lungs as well as insides of the rib cage. The pleural fluid in between the two membranes :
(A) dissolves oxygen for transfer to the alveoli (B) dissolves CO_2 for transfer to the blood
(C) provides partial pressure (D) reduces the friction between the ribs and the lungs

Sol. **(D)**
Fluid called pleural fluid present in double walled pleural membrane covering surround lungs reduces the friction between the ribs and the lungs.

78. At which phase of the cell cycle, DNA polymerase activity is at its highest ?
(A) Gap 1 (G1) (B) Mitotic (M) (C) Synthetic (S) (D) Gap 2 (G2)

Sol. **(B)**
DNA polymerase catalyze DNA synthesis. Which takes place during synthetic (s) phase of the cell cycle.

79. Usain Bolt, an Olympic runner, at the end of a 100 meter sprint, will have more of which of the following in his muscles ?
(A) ATP (B) Pyruvic acid (C) Lactic acid (D) Carbon dioxide

Sol. **(B)**
During vigorous muscular activity muscles perform anaerobic respiration due to scarcity of O_2. During anaerobic respiration is Muscles Lactic acid is produced as by product.

80. Desert temperature often varies between 0 to 50 °C. The DNA polymerase isolated from a camel living in the desert will be able to synthesize DNA most efficiently at :
(A) 0°C (B) 37°C (C) 50°C (D) 25°C

Sol. **(B)**
Camel belong to class Mammalia. Both birds and Mammales are hot bloodes or Homeothermic. Mammales have a fixed 37°C body temp. So the DNA polymerase isolated from a camel will work efficiently at temperature near it's body temperature.

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