

Physics Section-A

1. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Net dipole moment of a polar linear isotropic dielectric substance is not zero even in the absence of an external electric field.

Reason (R) : In absence of an external electric field, the different permanent dipoles of a polar dielectric substance are oriented in random directions.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (a) (A) is correct but (R) is not correct
- (b) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (c) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (d) (A) is not correct but (R) is correct

2. In a moving coil galvanometer, two moving coils M_1 and M_2 have the following particulars:

$$R_1 = 5\Omega, N_1 = 15, A_1 = 3.6 \times 10^{-3} \text{ m}^2, B_1 = 0.25 \text{ T}$$

$$R_2 = 7\Omega, N_2 = 21, A_2 = 1.8 \times 10^{-3} \text{ m}^2, B_2 = 0.50 \text{ T}$$

Assuming that torsional constant of the springs are same for both coils, what will be the ratio of voltage sensitivity of M_1 and M_2 ?

- (a) 1:1
- (b) 1:4
- (c) 1:3
- (d) 1:2

3. The moment of inertia of a circular ring of mass M and diameter r about a tangential axis lying in the plane of the ring is :

- (a) $\frac{1}{2} Mr^2$
- (b) $\frac{3}{8} Mr^2$
- (c) $\frac{3}{2} Mr^2$
- (d) $2Mr^2$

4. Two water drops each of radius ' r ' coalesce to form a bigger drop. If ' T ' is the surface tension, the surface energy released in this process is :

- (a) $4\pi r^2 T \left[2 - 2^{\frac{2}{3}} \right]$
- (b) $4\pi r^2 T \left[2 - 2^{\frac{1}{3}} \right]$
- (c) $4\pi r^2 T [1 + \sqrt{2}]$
- (d) $4\pi r^2 T [\sqrt{2} - 1]$

5. An electron with mass ' m ' with an initial velocity ($t = 0$) $\vec{v} = v_0 \hat{i}$ ($v_0 > 0$) enters a magnetic field $\vec{B} = B_0 \hat{j}$. If the initial de-Broglie wavelength at $t = 0$ is λ_0 then its value after time ' t ' would be :

- (a) $\frac{\lambda_0}{\sqrt{1 - \frac{e^2 B_0^2 t^2}{m^2}}}$
- (b) $\frac{\lambda_0}{\sqrt{1 + \frac{e^2 B_0^2 t^2}{m^2}}}$
- (c) $\lambda_0 \sqrt{1 + \frac{e^2 B_0^2 t^2}{m^2}}$
- (d) λ_0

6. A sinusoidal wave of wavelength 7.5 cm travels a distance of 1.2 cm along the x -direction in 0.3 sec. The crest P is at $x = 0$ at $t = 0$ sec and maximum displacement of the wave is 2 cm. Which equation correctly represents this wave ?

- (a) $y = 2\cos(0.83x - 3.35t)$ cm
- (b) $y = 2\sin(0.83x - 3.5t)$ cm
- (c) $y = 2\cos(3.35x - 0.83t)$ cm
- (d) $y = 2\cos(0.13x - 0.5t)$ cm

7. Given a charge q , current I and permeability of vacuum μ_0 . Which of the following quantity has the dimension of momentum?

- (a) qI/μ_0
- (b) $q\mu_0 I$
- (c) $q^2 \mu_0 I$
- (d) $q\mu_0/I$

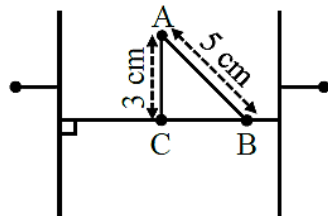
8. A solenoid having area A and length ' l ' is filled with a material having

relative permeability 2. The magnetic energy stored in the solenoid is :

- (a) $\frac{B^2 Al}{\mu_0}$ (b) $\frac{B^2 Al}{2\mu_0}$
(c) $B^2 Al$ (d) $\frac{B^2 Al}{4\mu_0}$

9. Two large plane parallel conducting plates are kept 10 cm apart as shown in figure.

The potential difference between them is V. The potential difference between the points A and B (shown in the figure) is :



- (a) $\frac{1}{4} V$ (b) $\frac{2}{5} V$
(c) $\frac{3}{4} V$ (d) 1 V

10. Identify the characteristics of an adiabatic process in a monoatomic gas.

- (A) Internal energy is constant.
(B) Work done in the process is equal to the change in internal energy.
(C) The product of temperature and volume is a constant.
(D) The product of pressure and volume is a constant.
(E) The work done to change the temperature from T_1 to T_2 is proportional to $(T_2 - T_1)$

Choose the correct answer from the options given below :

- (a) (A), (C), (D) only (b) (A), (C), (E) only
(c) (B), (E) only (d) (B), (D) only

11. Assuming the validity of Bohr's atomic model for hydrogen like ions

the radius of Li^{++} ion in its ground state is given by $\frac{1}{X} a_0$, where $X =$. (Where a_0 is the first Bohr's radius.)

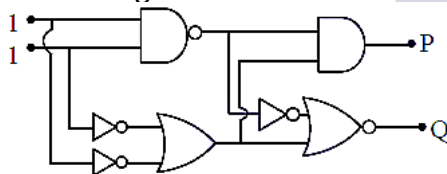
- (a) 2 (b) 1
(c) 3 (d) 9

12. Energy released when two deuterons (${}_1\text{H}^2$) fuse to form a helium nucleus (${}_2\text{He}^4$) is :

(Given : Binding energy per nucleon of ${}_1\text{H}^2 = 1.1\text{MeV}$ and binding energy per nucleon of ${}_2\text{He}^4 = 7.0\text{MeV}$)

- (a) 8.1 MeV (b) 5.9 MeV
(c) 23.6 MeV (d) 26.8 MeV

13. In the digital circuit shown in the figure, for the given inputs the P and Q values are.



- (a) $P = 1, Q = 1$
(b) $P = 0, Q = 0$
(c) $P = 0, Q = 1$
(d) $P = 1, Q = 0$

14. Two identical objects are placed in front of convex mirror and concave mirror having

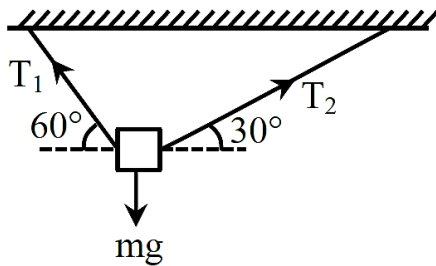
same radii of curvature of 12 cm, at same distance of 18 cm from the respective mirrors. The ratio of sizes of the images formed by convex mirror and by concave mirror is :

- (a) $\frac{1}{2}$ (b) 2
(c) 3 (d) $\frac{1}{3}$

15. A sportsman runs around a circular track of radius r such that he traverses the path $ABAB$. The distance travelled and displacement, respectively, are

- (a) $2r, 3\pi r$ (b) $3\pi r, \pi r$
(c) $\pi r, 3r$ (d) $3\pi r, 2r$

16. A body of mass 1 kg is suspended with the help of two strings making angles as shown in figure. Magnitude of tensions T_1 and T_2 , respectively, are (in N) :



- (a) $5, 5\sqrt{3}$ (b) $5\sqrt{3}, 5$
(c) $5\sqrt{3}, 5\sqrt{3}$ (d) $5, 5$

17. A bi-convex lens has radius of curvature of both the surfaces same as $1/6$ cm. If this lens is required to be replaced by another convex lens having different radii of curvatures on both sides ($R_1 \neq R_2$), without any change in lens power then possible combination of R_1 and R_2 is :

- (a) $\frac{1}{3}$ cm and $\frac{1}{3}$ cm (b) $\frac{1}{5}$ cm and $\frac{1}{7}$ cm
(c) $\frac{1}{3}$ cm and $\frac{1}{7}$ cm (d) $\frac{1}{6}$ cm and $\frac{1}{9}$ cm

18. If μ_0 and ϵ_0 are the permeability and permittivity of free space, respectively, then the dimension of $\left(\frac{1}{\mu_0 \epsilon_0}\right)$ is :

- (a) L/T^2 (b) L^2/T^2
(c) T^2/L (d) T^2/L^2

19. Match List-I with List-II.

List-I		List-II	
(A)	Heat capacity of body	(I)	Jkg^{-1}
(B)	Specific heat capacity of body	(II)	JK^{-1}
(C)	Latent heat	(III)	$\text{Jkg}^{-1} \text{K}^{-1}$
(D)	Thermal conductivity	(IV)	$\text{Jm}^{-1} \text{K}^{-1} \text{s}^{-1}$

Choose the correct answer from the options given below:

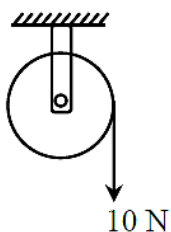
- (a) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
(b) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(c) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
(d) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

20. Consider a circular loop that is uniformly charged and has a radius $a\sqrt{2}$. Find the position along the positive z-axis of the cartesian coordinate system where the electric field is maximum if the ring was assumed to be placed in xy-plane at the origin :

- (a) $\frac{a}{\sqrt{2}}$ (b) $\frac{a}{2}$
(c) a (d) 0

SECTION-B

21. A wheel of radius 0.2 m rotates freely about its center when a string that is wrapped over its



rim is pulled by force of 10 N as shown in figure. The established torque produces an angular acceleration of 2rad/s^2 . Moment of inertia of the wheel is kgm^2 .

(Acceleration due to gravity = 10 m/s^2)

22. The internal energy of air in

a $4 \text{ m} \times 4 \text{ m} \times 3 \text{ m}$ sized room at 1 atmospheric pressure will be $\times 10^6 \text{ J}$. (Consider air as diatomic molecule)

23. A ray of light suffers minimum deviation when incident on a prism having angle of the prism equal to 60° . The refractive index of the prism material is $\sqrt{2}$. The angle of incidence (in degrees) is .
24. The length of a light string is 1.4 m when the tension on it is 5 N . If the tension increases to 7 N , the length of the string is 1.56 m . The original length of the string is m .
25. A satellite of mass 1000 kg is launched to revolve around the earth in an orbit at a height of 270 km from the earth's surface. Kinetic energy of the satellite in this orbit is $\times 10^{10}$ J. (Mass of earth = 6×10^{24} kg, Radius of earth = 6.4×10^6 m, Gravitational constant = $6.67 \times 10^{-11} \text{Nm}^2 \text{kg}^{-2}$)

Chemistry

Section-A

26. When a concentrated solution of sulphanilic acid and 1-naphthylamine is treated with nitrous acid (273 K) and acidified with acetic acid, the mass (g) of 0.1 mole of product formed is : (Given molar mass in gmol^{-1} H: 1, C: 12, N: 14, O : 16, S : 32)

- (a) 343 (b) 330
(c) 33 (d) 66

27. The d-orbital electronic configuration of the complex among $[\text{Co}(\text{en})_3]^{3+}$, $[\text{CoF}_6]^{3-}$, $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$ that has the highest CFSE is :

- (a) $t_{2g}^6 e_g^0$ (b) $t_{2g}^6 e_g^4$
(c) $t_{2g}^3 e_g^2$ (d) $t_{2g}^4 e_g^2$

28. Given below are two statements:

Statement (I) : Neopentane forms only one monosubstituted derivative.

Statement (II) : Melting point of neopentane is higher than n-pentane

In the light of the above statements, choose the most appropriate answer from the options given below :

- (a) Statement I is correct but Statement II is incorrect
(b) Both Statement I and Statement II are correct
(c) Both Statement I and Statement II are incorrect
(d) Statement I is incorrect but Statement II is correct

29. Which among the following molecules is (a) involved in $sp^3 d$ hybridization, (b) has different bond lengths and (c) has lone pair of electrons on the central atom?

- (a) PF_5 (b) XeF_4
(c) SF_4 (d) XeF_2

30. Formation of $\text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$, a purple coloured complex formed by addition of sodium nitroprusside in sodium carbonate extract of salt indicates the presence of :

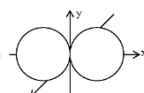
- (a) Sodium ion
(b) Sulphate ion
(c) Sulphide ion
(d) Sulphide ion

31. In 3,3-dimethylhex-1-ene-4-yne, there are sp^3 __, sp^2 and __ sp hybridised carbon atoms respectively:

- (a) 4,2,2 (b) 3,3,2
(c) 2,4,2 (d) 2,2,4

32. Which of the following statements are true ?

(A) The subsidiary quantum number l describes the shape of the orbital occupied by the electron.

(B)  is the boundary surface diagram of the $2p_x$ orbital.

(C) The + and - signs in the wave function of the $2p_x$ orbital refer to charge.

(D) The wave function of $2p_x$ orbital is zero everywhere in the xy plane.

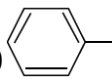
- (a) (B) and (D) only
(b) (A), (B) and (C) only
(c) (C) and (D) only
(d) (A) and (B) only

33. The type of hybridization and the magnetic property of $[\text{MnCl}_6]^{3-}$ are :

- (a) d^2sp^3 , paramagnetic with four unpaired electrons
(b) $sp^3 d^2$, paramagnetic with four unpaired electrons

- (c) d^2sp^3 , paramagnetic with two unpaired electrons
 (d) sp^3d^2 , paramagnetic with two unpaired electrons

34. Consider the following reactions. From these reactions which reaction will give carboxylic acid as a major product ?

- (A) $R-C \equiv N \xrightarrow[\text{mild Condition}]{(i) H^+ \setminus H_2O}$
 (B) $R-MgX \xrightarrow[(ii) H_3O^+]{(i) CO_2}$
 (C) $R-C \equiv N \xrightarrow[(ii) H_3O^+]{(i) SnCl_2/HCl}$
 (D) $R-CH_2-OH \xrightarrow{PCC}$
 (E)  $-COCl \xrightarrow[(ii) Br_2, \text{ water}]{(i) H_2/Pd-BaSO_4}$

Choose the correct answer from the options given below :

- (a) A and D only
 (b) A, B and E only
 (c) B, C and E only
 (d) B and E only

35. Electronic configuration of four elements A, B, C and D are given below

- (A) $1s^2 2s^2 2p^3$
 (B) $1s^2 2s^2 2p^4$
 (C) $1s^2 2s^2 2p^5$
 (D) $1s^2 2s^2 2p^2$

Which of the following is the correct order of increasing electronegativity (Pauling's scale) ?

- (a) $A < D < B < C$
 (b) $A < C < B < D$
 (c) $A < B < C < D$
 (d) $D < A < B < C$

36. Match List-I with List-II

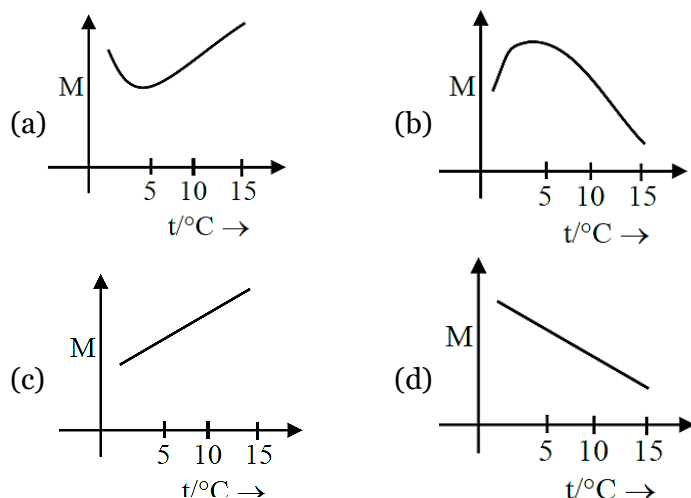
List-I (Purification technique)		List-II (Mixture of organic compounds)	
(A)	Distillation (simple)	(I)	Diesel + Petrol
(B)	Fractional distillation	(II)	Aniline + Water
(C)	Distillation under reduced pressure	(III)	Chloroform + Aniline
(D)	Steam distillation	(IV)	Glycerol + Spent-lye

Choose the correct answer from the options given below:

- (a) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
 (b) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
 (c) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (d) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

37. 'x' g of NaCl is added to water in a beaker with a lid. The temperature

of the system is raised from 1°C to 25°C . Which out of the following plots, is best suited for the change in the molarity (M) of the solution with respect to temperature ? [Consider the solubility of NaCl remains unchanged over the temperature range]



38. Arrange the following in order of magnitude of work done by the system / on the system at constant temperature :

- (a) $|w_{\text{reversible}}|$ for expansion in infinite stage.
- (b) $|w_{\text{irreversible}}|$ for expansion in single stage.
- (c) $|w_{\text{reversible}}|$ for compression in infinite stage.
- (d) $|w_{\text{irreversible}}|$ for compression in single stage.

Choose the correct answer from the options given below:

- (a) $a > b > c > d$
- (b) $d > c = a > b$
- (c) $c = a > d > b$
- (d) $a > c > b > d$

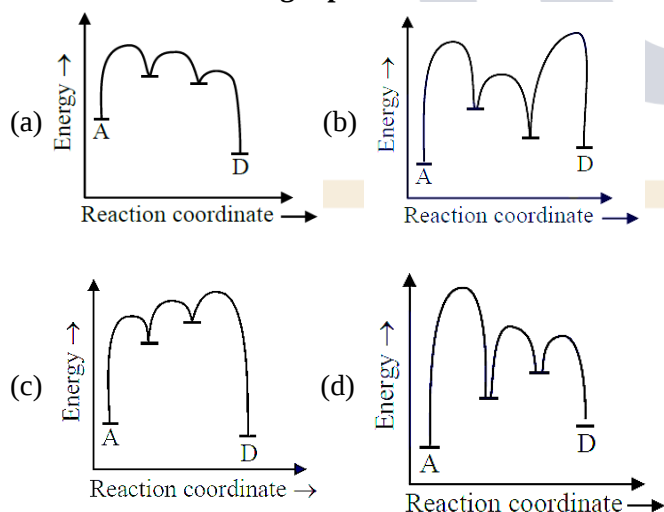
39. Reactant A converts to product D through the given mechanism (with the net evolution of heat) :

$A \rightarrow B$ slow; $\Delta H = +ve$

$B \rightarrow C$ fast; $\Delta H = -ve$

$C \rightarrow D$ fast; $\Delta H = -ve$

Which of the following represents the above reaction mechanism?



40. The nature of oxide (TeO_2) and hydride (TeH_2) formed by Te, respectively are :

- (a) Oxidising and acidic
- (b) Reducing and basic
- (c) Reducing and acidic
- (d) Oxidising and basic

41. Match List-I With List-II.

List -I (Reaction)		List-II (Name Of Reaction)	
(A)	$2 \text{C}_6\text{H}_5\text{X} + 2\text{Na} \xrightarrow[\text{Ether}]{\text{Dry}} \text{C}_6\text{H}_5\text{C}_6\text{H}_5 + 2\text{NaX}$	(I)	Lucas reaction
(B)	$\text{ArN}_2^+\text{X}^- \xrightarrow[\text{HCl}]{\text{Cu}} \text{ArCl} + \text{N}_2 \uparrow + \text{CuX}$	(II)	Finkelstein reaction
(C)	$\text{C}_2\text{H}_5\text{Br} + \text{NaI} \xrightarrow[\text{Acetone}]{\text{Dry}} \text{C}_2\text{H}_5\text{I} + \text{NaBr}$	(III)	Fittig reaction
(D)	$\begin{array}{l} \text{CH}_3\text{C}(\text{OH})(\text{CH}_3)\text{CH}_3 \xrightarrow[\text{ZnCl}_2]{\text{HCl}} \\ \text{CH}_3\text{C}(\text{Cl})(\text{CH}_3)\text{CH}_3 \end{array}$	(IV)	Gattermann reaction

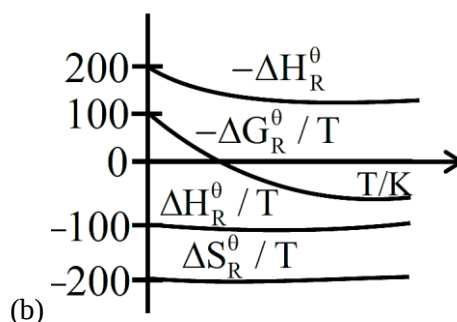
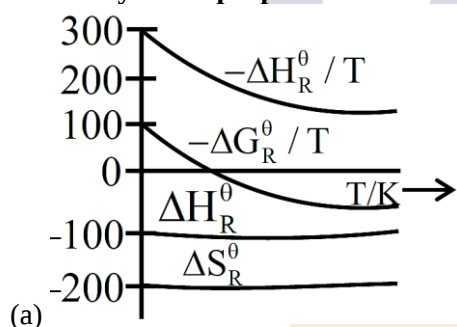
Choose the correct answer from the options given below:
 (a) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

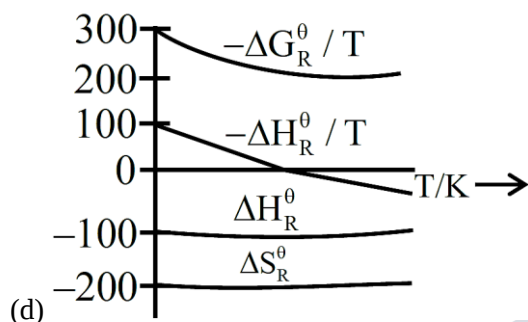
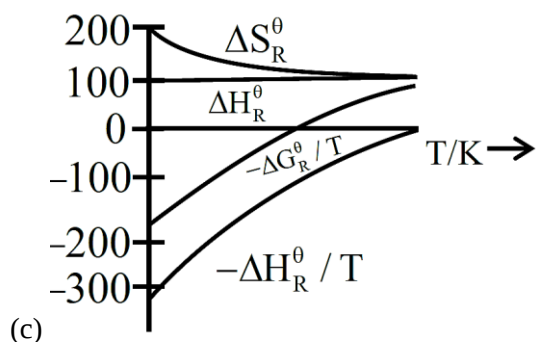
- (b) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (c) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
 (d) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

42. Consider the following chemical equilibrium of the gas phase reaction at a constant temperature : $\text{A}(\text{g}) \rightleftharpoons \text{B}(\text{g}) + \text{C}(\text{g})$. If p being the total pressure, K_p is the pressure equilibrium constant and α is the degree of dissociation, then which of the following is true at equilibrium ?

- (a) If p value is extremely high compared to K_p , $\alpha \approx 1$
 (b) When p increases α decreases
 (c) If K_p value is extremely high compared to p , α becomes much less than unity
 (d) When p increases α increases

43. Which of the following graphs correctly represents the variation of thermodynamic properties of Haber's process?





44. A tetrapeptide "x" on complete hydrolysis produced glycine (Gly), alanine (Ala), valine (Val), leucine (Leu) in equimolar proportion each. The number of tetrapeptides (sequences) possible involving each of these amino acids is.

- (a) 16 (b) 32
(c) 8 (d) 24

45. In Dumas' method for estimation of nitrogen, 0.5 gram of an organic compound gave 60 mL of nitrogen collected at 300 K temperature and 715 mm Hg pressure. The percentage composition of nitrogen in the compound (Aqueous tension at 300 K = 15 mmHg) is.

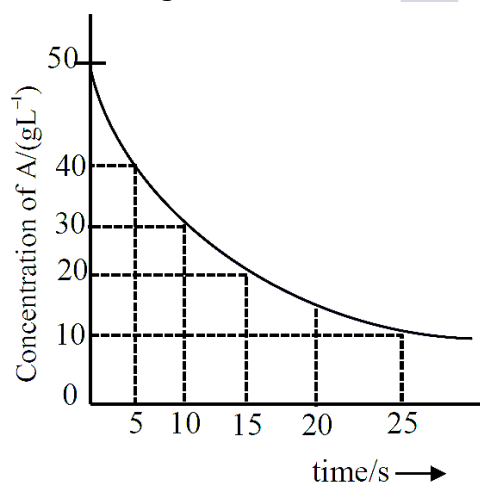
- (a) 1.257 (b) 20.87
(c) 18.67 (d) 12.57

Section-B

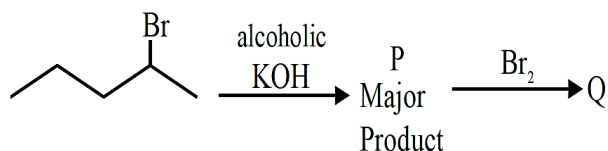
46. For the reaction $A \rightarrow B$ the following graph was obtained. The time required (in seconds) for the concentration of A to reduce to 2.5 g L^{-1} (if the initial concentration of A was 50 g L^{-1}) is .

(Nearest integer)

Given : $\log 2 = 0.3010$



47. 0.2%(w/v) solution of NaOH is measured to have resistivity $870.0 \text{ m}\Omega \text{ m}$. The molar conductivity of the solution will be _____ $\times 10^2 \text{ mS cm}^2 \text{ mol}^{-1}$. (Nearest integer)



48.

Consider the above sequence of reactions. 151 g of 2-bromopentane is made to react. Yield of major product P is 80% whereas Q is 100%.

Mass of product Q obtained is g.

(Given molar mass in gmol^{-1} : H: 1, C: 12, O: 16, Br: 80)

49. When 1 g each of compounds AB and AB_2 are dissolved in 15 g of water separately, they

increased the boiling point of water by 2.7 K and 1.5 K respectively. The atomic mass of A (in amu) is $\times 10^{-1}$

(Nearest integer). (Given : Molal boiling point elevation constant is $0.5 \text{ K kg mol}^{-1}$)

50. The spin-only magnetic moment value of M^{n+} ion formed among Ni, ZnMn and Cu that has the

least enthalpy of atomisation is . (in nearest integer)

Here n is equal to the number of diamagnetic complexes among $\text{K}_2[\text{NiCl}_4]$, $[\text{Zn}(\text{H}_2\text{O})_6]\text{Cl}_2$, $\text{K}_3[\text{Mn}(\text{CN})_6]$ and $[\text{Cu}(\text{PPh}_3)_3]\text{I}$

Mathematics

Section-A

51. If the image of the point $P(1, 0, 3)$ in the line joining the points $A(4, 7, 1)$ and

$B(3, 5, 3)$ is $Q(\alpha, \beta, \gamma)$, then $\alpha + \beta + \gamma$ is equal to.

- (a) $\frac{47}{3}$ (b) $\frac{46}{3}$
(c) 18 (d) 13

52. Let $f: [1, \infty) \rightarrow [2, \infty)$ be a differentiable function, If $10 \int_1^x f(t) dt = 5xf(x) - x^5 - 9$ for all $x \geq 1$, then the value of $f(3)$ is :

- (a) 18 (b) 32
(c) 22 (d) 26

53. The number of terms of an A.P. is even; the sum of all the odd terms is

24, the sum of all the even terms is 30 and the last term exceeds the first by $\frac{21}{2}$. Then the number of terms which are integers in the A.P. is :

- (a) 4 (b) 10
(c) 6 (d) 8

54. Let $A = \{1, 2, 3, \dots, 10\}$ and R be a relation on A such that $R = \{(a, b): a = 2b + 1\}$.

Let $(a_1, a_2), (a_2, a_3), (a_3, a_4), \dots, (a_k, a_{k+1})$ be a sequence of k elements of R such that the second entry of an ordered pair is equal to the first entry of the next ordered pair. Then the largest integer k, for which such a sequence exists, is equal to :

- (a) 6 (b) 7
(c) 5 (d) 8

55. If the length of the minor axis of an ellipse is equal to one fourth of the distance between the foci, then the eccentricity of the ellipse is :

- (a) $\frac{4}{\sqrt{17}}$ (b) $\frac{\sqrt{3}}{16}$
(c) $\frac{3}{\sqrt{19}}$ (d) $\frac{\sqrt{5}}{7}$

56. The line L_1 is parallel to the vector $\vec{a} = -3\hat{i} + 2\hat{j} + 4\hat{k}$ and passes through the point

$(7, 6, 2)$ and the line L_2 is parallel to the vector $\vec{b} = 2\hat{i} + \hat{j} + 3\hat{k}$ and passes through the point $(5, 3, 4)$. The shortest distance between the lines L_1 and L_2 is :

- (a) $\frac{23}{\sqrt{38}}$ (b) $\frac{21}{\sqrt{57}}$
(c) $\frac{23}{\sqrt{57}}$ (d) $\frac{21}{\sqrt{38}}$

57. Let (a, b) be the point of intersection of the curve $x^2 = 2y$ and the straight line $y -$

$2x - 6 = 0$ in the second quadrant. Then the integral $I = \int_a^b \frac{9x^2}{1+5^x} dx$ is equal to:

- (a) 24 (b) 27
(c) 18 (d) 21

58. If the system of equation

$$2x + \lambda y + 3z = 5$$

$$3x + 2y - z = 7$$

$$4x + 5y + \mu z = 9$$

has infinitely many solutions, then $(\lambda^2 + \mu^2)$ is equal to :

(a) 22 (b) 18

(c) 26 (d) 30

59. If $\theta \in \left[-\frac{7\pi}{6}, \frac{4\pi}{3}\right]$, then the number of solutions of $\sqrt{3}\operatorname{cosec}^2\theta - 2(\sqrt{3} - 1)\operatorname{cosec}\theta - 4 = 0$, is equal to.

(a) 6 (b) 8

(c) 10 (d) 7

60. Given three identical bags each containing 10 balls, whose colours are as follows :

	Red	Blue	Green
Bag I	3	2	5
Bag II	4	3	3
Bag III	5	1	4

A person chooses a bag at random and takes out a ball. If the ball is Red, the probability that it is from bag I is p and if the balls is Green, the probability that it is from bag III is q , then the value of $\left(\frac{1}{p} + \frac{1}{q}\right)$ is :

(a) 6 (b) 9

(c) 7 (d) 8

61. If the mean and the variance of 6, 4, a , 8, b , 12, 10, 13 are 9 and 9.25 respectively, then $a + b + ab$ is equal to :

(a) 105 (b) 103

(c) 100 (d) 106

62. If the domain of the function $f(x) = \frac{1}{\sqrt{10+3x-x^2}} + \frac{1}{\sqrt{x+|x|}}$ is (a, b) , then

$(1+a)^2 + b^2$ is equal to :

(a) 26 (b) 29

(c) 25 (d) 30

63. $4 \int_0^1 \left(\frac{1}{\sqrt{3+x^2} + \sqrt{1+x^2}} \right) dx - 3 \log_e(\sqrt{3})$ is equal to:

(a) $2 + \sqrt{2} + \log_e(1 + \sqrt{2})$

(b) $2 - \sqrt{2} - \log_e(1 + \sqrt{2})$

(c) $2 + \sqrt{2} - \log_e(1 + \sqrt{2})$

(d) $2 - \sqrt{2} + \log_e(1 + \sqrt{2})$

64. If $\lim_{x \rightarrow 0} \frac{\cos(2x) + a \cos(4x) - b}{x^4}$ is finite, then $(a + b)$ is equal to:

(a) $\frac{1}{2}$ (b) 0

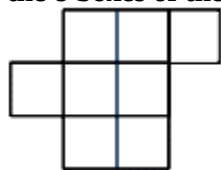
(c) $\frac{3}{4}$ (d) -1

65. If $\sum_{r=0}^{10} \left(\frac{10^{r+1}-1}{10^r} \right) \cdot {}^{11}C_{r+1} = \frac{\alpha^{11}-11^{11}}{10^{10}}$, then α is equal to :

(a) 15 (b) 11

(c) 24 (d) 20

66. The number of ways, in which the letters A, B, C, D, E can be placed in the 8 boxes of the figure below so that no row remains empty and at most one letter can be placed in a box, is :



(a) 5880 (b) 960

(c) 840 (d) 5760

67. Let the point P of the focal chord PQ of the parabola $y^2 = 16x$ be

(1, -4). If the focus of the parabola divides the chord PQ in the ratio m: n, $\gcd(m, n) = 1$, then $m^2 + n^2$ is equal to :

- (a) 17 (b) 10
(c) 37 (d) 26

68. Let $\vec{a} = 2\hat{i} - 3\hat{j} + \hat{k}$, $\vec{b} = 3\hat{i} + 2\hat{j} + 5\hat{k}$ and a vector $\vec{c}$ be such that

$(\vec{a} - \vec{c}) \times \vec{b} = -18\hat{i} - 3\hat{j} + 12\hat{k}$ and $\vec{a} \cdot \vec{c} = 3$. If $\vec{b} \times \vec{c} = \vec{d}$, then $|\vec{a} \cdot \vec{d}|$ is equal to :

- (a) 18 (b) 12
(c) 9 (d) 15

69. Let the area of the triangle formed by a straight Line $L: x + by + c = 0$

with co-ordinate axes be 48 square units. If the perpendicular drawn from the origin to the line L makes an angle of 45° with the positive x -axis, then the value of $b^2 + c^2$ is:

- (a) 90 (b) 93
(c) 97 (d) 83

70. Let A be a 3×3 real matrix such that $A^2(A - 2I) - 4(A - I) = O$, where I

and O are the identity and null matrices, respectively. If $A^5 = \alpha A^2 + \beta A + \gamma I$, where α, β and γ are real constants, then $\alpha + \beta + \gamma$ is equal to:

- (a) 12 (b) 20
(c) 76 (d) 4

Section-B

71. Let $y = y(x)$ be the solution of the differential equation $\frac{dy}{dx} + 2y \sec^2 x = 2 \sec^2 x + 3 \tan x \cdot \sec^2 x$ such that

$y(0) = \frac{5}{4}$. Then $12 \left(y \left(\frac{\pi}{4} \right) - e^{-2} \right)$ is equal to _____ .

72. If the sum of the first 10 terms of the series $\frac{4.1}{1+4.1^4} + \frac{4.2}{1+4.2^4} + \frac{4.3}{1+4.3^4} + \dots$ is

$\frac{m}{n}$, where $\gcd(m, n) = 1$, then $m + n$ is equal to. ____

73. If $y = \cos \left(\frac{\pi}{3} + \cos^{-1} \frac{x}{2} \right)$, then $(x - y)^2 + 3y^2$ is equal to _____ .

74. Let $A(4, -2)$, $B(1, 1)$ and $C(9, -3)$ be the vertices of a triangle ABC . Then the maximum area of the parallelogram $AFDE$, formed with vertices D, E and F on the sides BC, CA and AB of the triangle ABC respectively, is _____ .

75. If the set of all $a \in \mathbb{R} - \{1\}$, for which the roots of the equation

$(1 - a)x^2 + 2(a - 3)x + 9 = 0$ are positive is $(-\infty, -\alpha] \cup [\beta, \gamma)$, then $2\alpha + \beta + \gamma$ is equal to _____ .