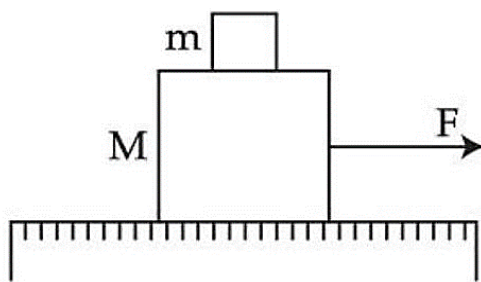


PART-I PHYSICS

SECTION-A

- A projectile is launched at an angle ' α ' with the horizontal with a velocity 20 ms^{-1} . After 10 s, its inclination with horizontal is ' β '. The value of $\tan \beta$ will be : ($g = 10 \text{ ms}^{-2}$)
 (a) $\tan \alpha + 5 \sec \alpha$ (b) $\tan \alpha - 5 \sec \alpha$
 (c) $2 \tan \alpha - 5 \sec \alpha$ (d) $2 \tan \alpha + 5 \sec \alpha$
- A girl standing on road holds her umbrella at 45° with the vertical to keep the rain away. If she starts running without umbrella with a speed of $15\sqrt{2} \text{ kmh}^{-1}$, the rain drops hit her head vertically. The speed of rain drops with respect to the moving girl is:
 (a) 30 kmh^{-1} (b) $\frac{25}{\sqrt{2}} \text{ kmh}^{-1}$
 (c) $\frac{30}{\sqrt{2}} \text{ kmh}^{-1}$ (d) 25 kmh^{-1}
- A sliver wire has mass $(0.6 \pm 0.006) \text{ g}$, radius $(0.5 \pm 0.005) \text{ mm}$ and length $(4 \pm 0.04) \text{ cm}$. The maximum percentage error in the measurement of its density will be:
 (a) 4% (b) 3%
 (c) 6% (d) 7%
- A system of two blocks of masses $m = 2 \text{ kg}$ and $M = 8 \text{ kg}$ is placed on a smooth table as shown in figure. The coefficient of static friction between two blocks is 0.5. The maximum horizontal force F that can be applied to the block of mass M so that the blocks move together will be:



- Two blocks of masses 10 kg and 30 kg are placed on the same straight line with coordinates $(0, 0) \text{ cm}$ and $(x, 0) \text{ cm}$ respectively. The block of 10 kg is moved on the same line through a distance of 6 cm towards the other block. The distance through which the block of 30 kg must be moved to keep the position of centre of mass of the system unchanged is:
 (a) 4 cm towards the 10 kg block
 (b) 2 cm away from the 10 kg block
 (c) 2 cm towards the 10 kg block
 (d) 4 cm away from the 10 kg block
- A 72Ω galvanometer is shunted by a resistance of 8Ω . The percentage of the total current which passes through the galvanometer is:
 (a) 0.1% (b) 10%
 (c) 25% (d) 0.25%
- Given below are two statements:

Statement I: The law of gravitation holds good for any pair of bodies in the universe.

Statement II: The weight of any person becomes zero when the person is at the centre of the earth. In the light of the above statements, choose the correct answer from the options given below.

- Both statement I and Statement II are true

- (b) Both statement I and Statement II are false
- (c) Statement I is true but Statement II are false
- (d) Statement I is false but Statement II is true
8. What percentage of kinetic energy of a moving particle is transferred to a stationary particle when it strikes the stationary particle of 5 times its mass? (Assume the collision to be head-on elastic collision)
- (a) 50.0% (b) 66.6%
(c) 55.5% (d) 33.3%
9. The velocity of a small ball of mass 'm' and density d_1 , when dropped in a container filled with glycerine, becomes constant after some time. If the density of glycerine is d_2 , then the viscous force acting on the ball, will be:
- (a) $mg\left(1 - \frac{d_1}{d_2}\right)$ (b) $mg\left(1 - \frac{d_2}{d_1}\right)$
(c) $mg\left(\frac{d_1}{d_2} - 1\right)$ (d) $mg\left(\frac{d_2}{d_1} - 1\right)$
10. The susceptibility of a paramagnetic material is 99. The permeability of the material in Wb/A – m is : [Permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ Wb/A – m]
- (a) $4\pi \times 10^{-7}$ (b) $4\pi \times 10^{-4}$
(c) $4\pi \times 10^{-5}$ (d) $4\pi \times 10^{-6}$
11. The current flowing through an ac circuit is given by
- $$I = 5\sin(120\pi t)A$$

How long will the current take to reach the peak value starting from zero?

- (a) $\frac{1}{60}$ s (b) 60 s
(c) $\frac{1}{120}$ s (d) $\frac{1}{240}$ s

12. Match List-I with List - II:

	List-I		List-II
(A)	Ultraviolet rays	(i)	Study crystal structure
(B)	Microwaves	(ii)	Greenhouse effect
(C)	Infrared waves	(iii)	Sterilizing surgical instrument
(D)	X-rays	(iv)	Radar system

Choose the correct answer from the options given below:

- (a) (A) - (iii), (B) - (iv), (C) - (ii), (D) - (i)
- (b) (A) - (iii), (B) - (i), (C) - (ii), (D) - (iv)

(c) (A) - (iv), (B) - (iii), (C) - (ii), (D) - (i)

(d) (A) - (iii), (B) - (iv), (C) - (i), (D) - (ii)

13. An α particle and a carbon 12 atom has same kinetic energy K . The ratio of their de-Broglie wavelength ($\lambda_\alpha : \lambda_{C12}$) is:

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

14. A force of 10 N acts on a charged particle placed between two plates of a charged capacitor. If one plate of capacitor is removed, then the force acting on that particle will be:

- (a) 5 N (b) 10 N
(c) 20 N (d) Zero

15. The displacement of simple harmonic oscillator after 3 seconds starting from its mean position is equal to half of its amplitude. The time period of harmonic motion is:

- (a) 6 s (b) 8 s
(c) 12 s (d) 36 s

16. An observer moves towards a stationary source of sound with a velocity equal to one-fifth of the velocity of sound. The percentage change in the frequency will be:

- (a) 20% (b) 10%
(c) 5% (d) 0%

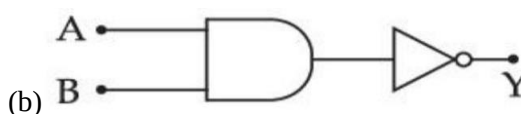
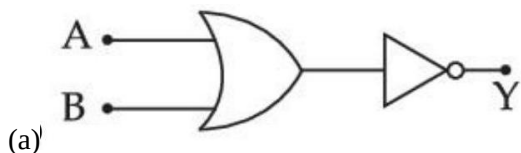
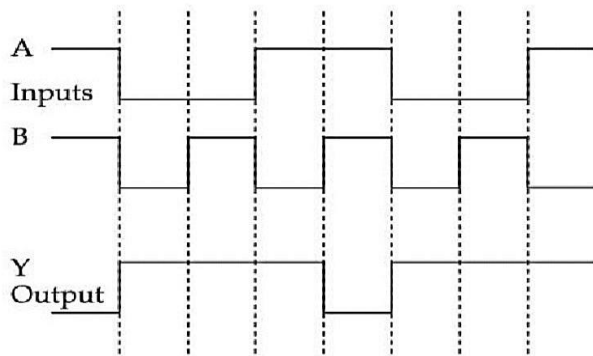
17. Consider a light ray travelling in air is incident into a medium of refractive index $\sqrt{2}n$. The incident angle is twice that of refracting angle. Then, the angle of incidence will be:

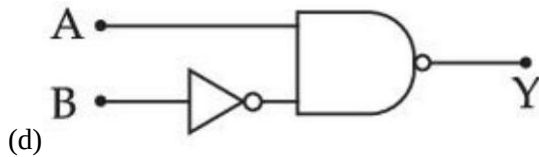
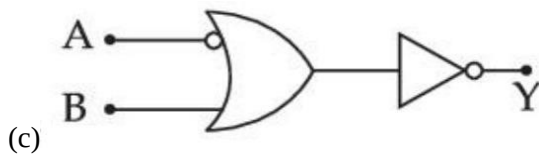
- (a) $\sin^{-1}(\sqrt{n})$ (b) $\cos^{-1}\left(\sqrt{\frac{n}{2}}\right)$
(c) $\sin^{-1}(\sqrt{2}n)$ (d) $2\cos^{-1}\left(\sqrt{\frac{n}{2}}\right)$

18. A hydrogen atom in its ground state absorbs 10.2 eV of energy. The angular momentum of electron of the hydrogen atom will increase by the value of : (Given, Planck's constant = 6.6×10^{-34} Js)

- (a) 2.10×10^{-34} Js (b) 1.05×10^{-34} Js
(c) 3.15×10^{-34} Js (d) 4.2×10^{-34} Js

19. Identify the correct Logic Gate for the following output (Y) of two inputs A and B.





20. A mixture of hydrogen and oxygen has volume 2000 cm^3 , temperature 300 K , pressure 100 kPa and mass 0.76 g . The ratio of number of moles of hydrogen to number of moles of oxygen in the mixture will be:

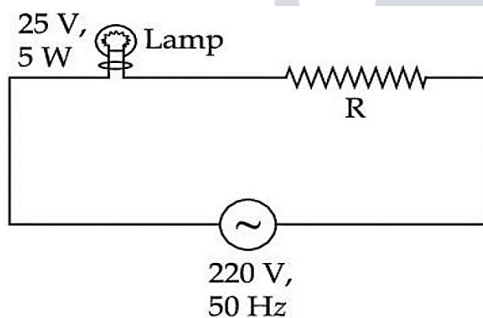
- (a) $\frac{1}{3}$ (b) $\frac{3}{1}$
(c) $\frac{1}{16}$ (d) $\frac{16}{1}$

SECTION-B

21. In a Carnot engine, the temperature of reservoir is 527°C and that of sink is 200 K . If the workdone by the engine when it transfers heat from reservoir to sink is 12000 kJ , the quantity of heat absorbed by the engine from reservoir is $\times 10^6 \text{ J}$.

22. A 220 V , 50 Hz AC source is connected to a 25 V ,

5 W lamp and an additional resistance R in series (as shown in figure) to run the lamp at its peak brightness, then the value of R (in ohm) will be



23. In Young's double slit experiment the two slits are 0.6 mm distance apart. Interference pattern is observed on a screen at a distance 80 cm from the slits. The first dark fringe is observed on the screen directly opposite to one of the slits. The wavelength of light will be nm .

24. A beam of monochromatic light is used to excite the electron in Li^{++} from the first orbit to the third orbit. The wavelength of monochromatic light is found to be $x \times 10^{-10} \text{ m}$. The value of x is

25. A cell, shunted by a 8Ω resistance, is balanced across a potentiometer wire of length 3 m . The balancing length is 2 m when the cell is shunted by 4Ω resistance. The value of internal resistance of the cell will be Ω .

26. The current density in a cylindrical wire of radius 4 mm is $4 \times 10^6 \text{ Am}^{-2}$. The current through the outer portion of the wire between radial distance $\frac{R}{2}$ and R is πA .

27. A capacitor of capacitance 50 pF is charged by 100 V source. It is then connected to another uncharged identical capacitor. Electrostatic energy loss in the process is nJ .

28. The height of a transmitting antenna at the top of a tower is 25 m and that of receiving antenna is, 49 m. The maximum distance between them, for satisfactory communication in LOS (Line-OfSight) is $K\sqrt{5} \times 10^2$ m. The value of K is [Assume radius of Earth is 64×10^5 m] (Calculate upto nearest integer value)
29. The area of cross-section of a large tank is 0.5 m^2 . It has a narrow opening near the bottom having area of cross-section 1 cm^2 . A load of 25 kg is applied on the water at the top in the tank. Neglecting the speed of water in the tank, the velocity of the water, coming out of the opening at the time when the height of water level in the tank is 40 cm above the bottom, will be cms^{-1} . [Take $g = 10 \text{ ms}^{-2}$]
30. A pendulum of length 2 m consists of a wooden bob of mass 50 g. A bullet of mass 75 g is fired towards the stationary bob with a speed v. The bullet emerges out of the bob with a speed $\frac{v}{3}$ and the bob just completes the vertical circle. The value of v is ms^{-1} . (if $g = 10 \text{ m/s}^2$)

PART-II CHEMISTRY

SECTION-A

31. Given below are two statements: one is labelled as Assertion (a) and the other is labelled as Reason (R)
 Assertion (a): At 10°C , the density of a 5M solution of KCl [atomic masses of K and Cl are 39 & 35.5 g mol^{-1}]. The solution is cooled to -21°C . The molality of the solution will remain unchanged.

Reason (R): The molality of a solution does not change with temperature as mass remains unaffected with temperature.

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

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

32. Based upon VSEPR theory, match the shape (geometry) of the molecules in List-I with the molecules in List-II and select the most appropriate option

List-I

LIST-II

Shape

Molecules

- | | |
|---------------------|----------------------|
| (A) T-shaped | (I) XeF_4 |
| (B) Trigonal planar | (II) SF_4 |
| (C) Square planar | (III) ClF_3 |
| (D) See-saw | (IV) BF_3 |

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

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

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

33. Match List-I with List-II

	List-I	List-II
(A)	Spontaneous process	(I) $\Delta H < 0$
(B)	Process with $\Delta P = 0$, $\Delta T = 0$	(II) $\Delta G_{T,P} < 0$
(C)	$\Delta H_{\text{reaction}}$	(III) Isothermal and isobaric process
(D)	Exothermic process	(IV) [Bond energies of molecules in reactants] - [Bond energies of product molecules]

Choose the correct answer from the options given below:

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

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

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

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

34. Match List-I with List-II

List-I

List-II

(A) Lyophilic colloid

(I) Liquid-liquid colloid

(B) Emulsion

(II) protective colloid

(C) Positively charged

(III) $\text{FeCl}_3 + \text{NaOH}$

(D) Negatively charged colloid (IV) $\text{FeCl}_3 + \text{hot water}$

Choose the correct answer from the options given below:

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

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

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

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

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

Assertion (a): The ionic radii of O^{2-} and Mg^{2+} are same.

Reason (R) : Both O^{2-} and Mg^{2+} are isoelectronic species

In the light of the above statements, choose the correct answer from the options given below

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

36. Match List-I with List-II

List-I

(A) Concentration of gold ore

(B) Leaching of alumina

(C) Froth stabiliser

(D) Blister copper

List-II

(I) Aniline

(II) NaOH

(III) SO_2

(IV) NaCN

Choose the correct answer from the options given below.

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

37. Addition of H_2SO_4 to BaO_2 produces:

- (a) BaO , SO_2 and H_2O
- (b) $BaHSO_4$ and O_2
- (c) $BaSO_4$, H_2 and O_2
- (d) $BaSO_4$ and H_2O_2

38. $BeCl_2$ reacts with $LiAlH_4$ to give

- (a) $Be + Li[AlCl_4] + H_2$
- (b) $Be + AlH_3 + LiCl + HCl$
- (c) $BeH_2 + LiCl + AlCl_3$
- (d) $BeH_2 + Li[AlCl_4]$

39. Match List-I with List-II

List-I

List-II

(Si-Compounds)

(Si-Polymeric/other products)

(a) $(\text{CH}_3)_4\text{Si}$

(I) Chain silicone

(b) $(\text{CH}_3)\text{Si}(\text{OH})_3$

(II) Dimeric silicone

(c) $(\text{CH}_3)_2\text{Si}(\text{OH})_2$

(III) Silane

(d) $(\text{CH}_3)_3\text{Si}(\text{OH})$

(IV) 2D - Silicone

Choose the correct answer from the options given below:

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

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

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

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

40. Heating white phosphorus with conc. NaOH solution gives mainly

(a) Na_3P and H_2O

(b) H_3PO and NaH

(c) $\text{P}(\text{OH})_3$ and NaH_2PO_4

(d) PH_3 and NaH_2PO_2

41. Which of the following will have maximum stabilization due to crystal field?

(a) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$

(b) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$

(c) $[\text{Co}(\text{CN})_6]^{3-}$

(d) $[\text{Cu}(\text{NH}_3)_4]^{2+}$

42. Given below are two statements:

Statement I: Classical smog occurs in cool humid climate. It is a reducing mixture of smoke, fog and sulphur dioxide

Statement II: Photochemical smog has components, ozone, nitric oxide, acrolein, formaldehyde, PAN etc.

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

(a) Both Statement I and Statement II are correct

(b) Both Statement I and Statement II are incorrect

(c) Statement I is correct but statement II is incorrect

(d) Statement I is incorrect but Statement II is correct

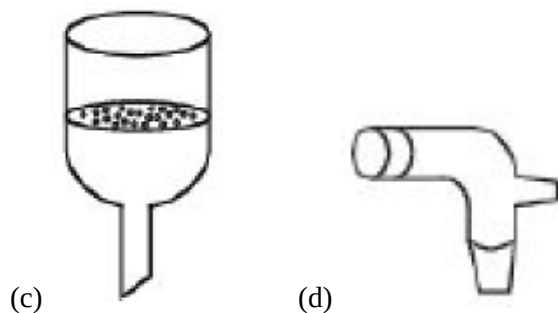
43. Which of the following is structure of a separating funnel?



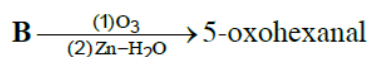
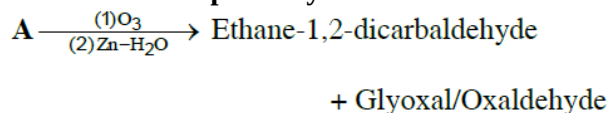
(a)



(b)

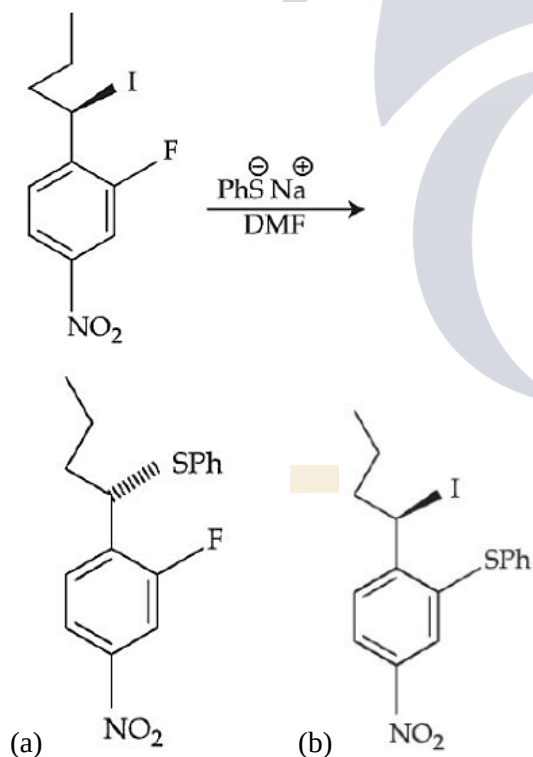


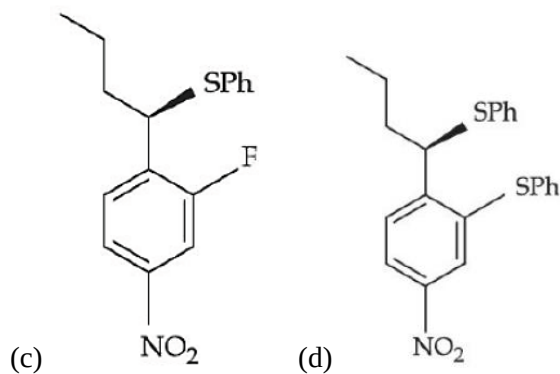
44. 'A' and 'B' respectively are:



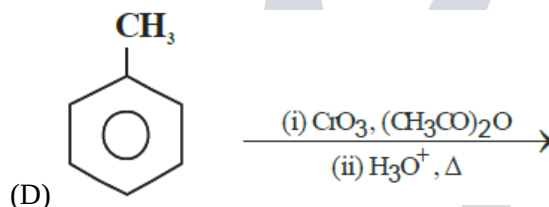
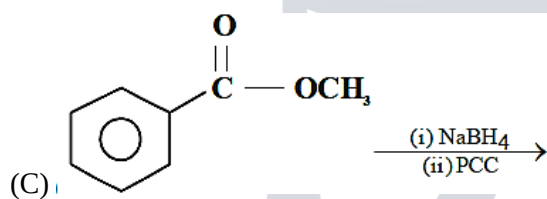
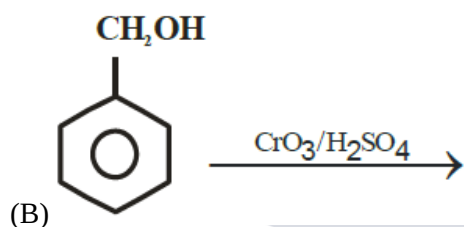
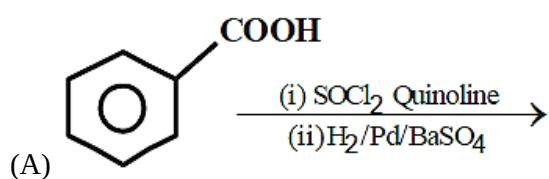
- (a) 1-methylcyclohex-1, 3-diene & cyclopentene
 (b) Cyclohex-1, 3-diene & cyclopentene
 (c) 1-methylcyclohex-1,4-diene & 1-methylcyclopent-1-ene
 (d) Cyclohex-1,3-diene & 1-methylcyclopent-1-ene

45. The major product of the following reaction is:





46. Which of the following reactions will yield benzaldehyde as a product?



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

47. Given below are two statements:

Statements-I: In Hofmann degradation reaction, the migration of only an alkyl group takes place from carbonyl carbon of the amide to the nitrogen atom.

Statement-II: The group is migrated in Hofmann degradation reaction to electron deficient atom.

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

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

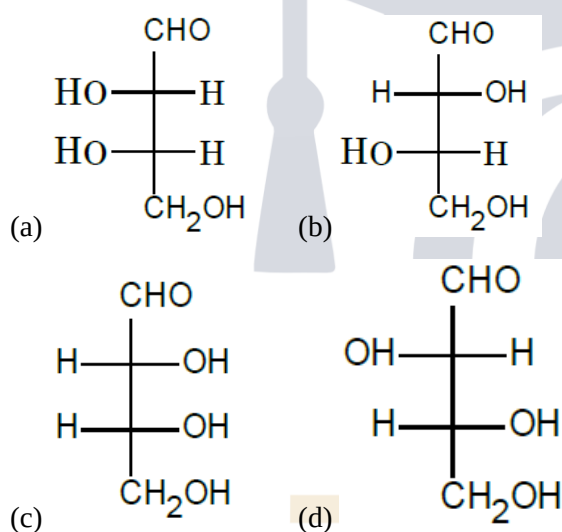
48. Match List-I with List-II

List-I	List-II
(Polymer)	(Used in)
(A) Bakelite	(I) Radio and television Cabinets
(B) Glyptal	(II) Electrical switches
(C) PVC	(III) Paints and Lacquers
(D) Polystyrene	(IV) Water pipes

Choose the correct answer from the options given below:

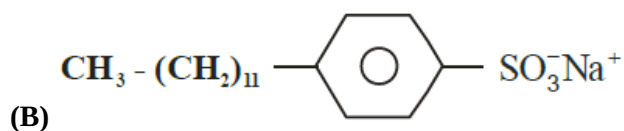
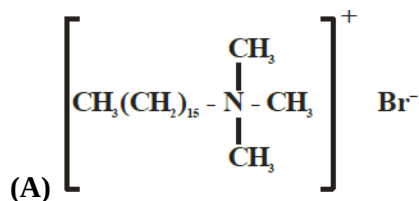
- (a) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)
 (b) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
 (c) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)
 (d) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)

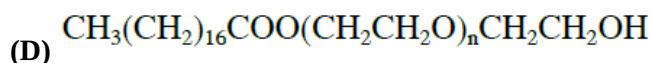
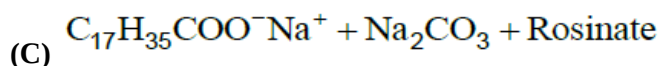
49. L-isomer of a compound 'A' ($C_4H_8O_4$) gives a positive test with $[Ag(NH_3)_2]^+$. Treatment of 'A' with acetic anhydride yield triacetate derivative. Compound 'A' produces an optically active compound (b) and an optically inactive compound (c) on treatment with bromine water and HNO_3 respectively, compound (a) is



50. Match List-I with List-II

LIST-I





List-II

(I) Dishwashing powder

(II) Toothpaste

(III) Laundry soap

(IV) Hair conditioner

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

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

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

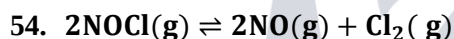
(d) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

SECTION-B

51. Metal deficiency defect is shown by $\text{Fe}_{0.93}\text{O}$. In the crystal, some Fe^{2+} cations are missing and loss of positive charge is compensated by the presence of Fe^{3+} ions. The percentage of Fe^{2+} ions in the $\text{Fe}_{0.93}\text{O}$ crystals is (Nearest integer)

52. If the uncertainty in velocity and position of a minute particle in space are, $2.4 \times 10^{-26} (\text{ms}^{-1})$ and $10^{-7} (\text{m})$ respectively. The mass of the particle in g is (Nearest integer) (Given: $h = 6.626 \times 10^{-34} \text{Js}$)

53. 2 g of a non-volatile non-electrolyte solute is dissolved in 200 g of two different solvents A and B whose ebullioscopic constants are in the ratio of 1: 8. The elevation in boiling points of A and B are in the ratio $\frac{x}{y}$ (x: y). The value of y is (Nearest integer)



In an experiment, 2.0 moles of NOCl was placed in a one-litre flask and the concentration of NO after equilibrium established, was found to be 0.4 mol/L. The equilibrium constant at 30°C is $\times 10^{-4}$.

55. The limiting molar conductivities of NaI, NaNO_3 and AgNO_3 are 12.7, 12.0 and 13.3mSmmol^{-1} , respectively (all at 25°C). The limiting molar conductivity of AgI at this temperature is mSmmol^{-1}

56. The rate constant for a first order reaction is given by the following equation:

$$\ln k = 33.24 - \frac{2.0 \times 10^4 \text{ K}}{T}$$

The Activation energy for the reaction is given by kJmol^{-1} . (In Nearest integer) (Given: $R = 8.3 \text{ J K}^{-1} \text{mol}^{-1}$)

57. The number of statement(s) correct from the following for copper (at no. 29) is/are

(a) Cu (II) complexes are always paramagnetic

(b) Cu(I) complexes are generally colourless

(c) Cu(I) is easily oxidized

(d) In Fehling solution, the active reagent has Cu(I)

58. Acidified potassium permanganate solution oxidises oxalic acid. The spin-only magnetic moment of the manganese product formed from the above reaction is B.M. (Nearest Integer)

59. Two elements A and B which form 0.15 moles of A_2B and AB_3 type compounds. If both A_2B and AB_3 weigh equally, then the atomic weight of A is times of atomic weight of B.
60. Total number of possible stereoisomers of dimethyl cyclopentane is

PART-III MATHEMATICS

SECTION-A

61. The area of the polygon, whose vertices are the non-real roots of the equation $\bar{Z} = iz^2$ is :
- (a) $\frac{3\sqrt{3}}{4}$ (b) $\frac{3\sqrt{3}}{2}$
 (c) $\frac{3}{2}$ (d) $\frac{3}{4}$
62. Let the system of linear equations $x + 2y + z = 2$, $ax + 3y - z = \alpha$, $-\alpha x + y + 2z = -\alpha$ be inconsistent. Then α is equal to:
- (a) $\frac{5}{2}$ (b) $-\frac{5}{2}$
 (c) $\frac{7}{2}$ (d) $-\frac{7}{2}$
63. If $x = \sum_{n=0}^{\infty} a^n$, $y = \sum_{n=0}^{\infty} b^n$, $z = \sum_{n=0}^{\infty} c^n$, where a, b, c are in A.P. and $|a| < 1$, $|b| < 1$, $|c| < 1$, $abc \neq 0$, then
- (a) x, y, z are in A.P.
 (b) x, y, z are in G.P.
 (c) $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$ are in A.P.
 (d) $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1 - (a + b + c)$
64. Let $\frac{dy}{dx} = \frac{ax - by + a}{bx + cy + a}$, where a, b, c are constants, represent a circle passing through the point (2, 5). Then the shortest distance of the point (11, 6) from this circle is:
- (a) 10 (b) 8
 (c) 7 (d) 5
65. Let a be an integer such that $\lim_{x \rightarrow 7} \frac{18 - [1-x]}{[x-3a]}$ exists, where $[t]$ is greatest integer $\leq t$. Then a is equal to:
- (a) -6 (b) -2
 (c) 2 (d) 6
66. The number of distinct real roots of $x^4 - 4x + 1 = 0$ is:
- (a) 4 (b) 2
 (c) 1 (d) 0
67. The lengths of the sides of a triangle are $10 + x^2$, $10 + x^2$ and $20 - 2x^2$. If for $x = k$, the area of the triangle is maximum, then $3k^2$ is equal to:
- (a) 5 (b) 8
 (c) 10 (d) 12
68. If $\cos^{-1}\left(\frac{y}{2}\right) = \log_e\left(\frac{x}{5}\right)^5$, $|y| < 2$, then :
- (a) $x^2y'' + xy' - 25y = 0$
 (b) $x^2y'' - xy' - 25y = 0$
 (c) $x^2y'' - xy' + 25y = 0$
 (d) $x^2y'' + xy' + 25y = 0$

69. $\int \frac{(x^2+1)e^x}{(x+1)^2} dx = f(x)e^x + C$, Where C is a constant, then $\frac{d^3f}{dx^3}$ at $x = 1$ is equal to:
- (a) $-\frac{3}{4}$ (b) $\frac{3}{4}$
(c) $-\frac{3}{2}$ (d) $\frac{3}{2}$
70. The value of the integral $\int_{-2}^2 \frac{|x^3+x|}{(e^{|x|}+1)} dx$ is equal to :
- (a) $5e^2$ (b) $3e^{-2}$
(c) 4 (d) 6
71. If $\frac{dy}{dx} + \frac{2^{x-y}(2^y-1)}{2^x-1} = 0$, $x, y > 0$, $y(1) = 1$, then $y(2)$ is equal to :
- (a) $2 + \log_2 3$ (b) $2 + \log_2 2$
(c) $2 - \log_2 3$ (d) $2 - \log_2 2$
72. In an isosceles triangle ABC, the vertex A is (6, 1) and the equation of the base BC is $2x + y = 4$. Let the point B lie on the line $x + 3y = 7$. If (α, β) is the centroid $\triangle ABC$, then $15(\alpha + \beta)$ is equal to:
- (a) 39 (b) 41
(c) 51 (d) 63
73. Let the eccentricity of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$, be $\frac{1}{4}$. If this ellipse passes through the point $\left(-4\sqrt{\frac{2}{5}}, 3\right)$, then $a^2 + b^2$ is equal to:
- (a) 29 (b) 31
(c) 32 (d) 34
74. If two straight lines whose direction cosines are given by the relations $1 + m - n = 0$, $3l^2 + m^2 + cnl = 0$ are parallel, then the positive value of c is:
- (a) 6 (b) 4
(c) 3 (d) 2
75. Let $\vec{a} = \hat{i} + \hat{j} - \hat{k}$ and $\vec{c} = 2\hat{i} - 3\hat{j} + 2\hat{k}$. Then the number of vectors $\vec{b}$ such that $\vec{b} \times \vec{c} = \vec{a}$ and $|\vec{b}| \in \{1, 2, \dots, 10\}$ is:
- (a) 0 (b) 1
(c) 2 (d) 3
76. Five numbers x_1, x_2, x_3, x_4, x_5 are randomly selected from the numbers 1, 2, 3, 18 and are arranged in the increasing order ($x_1 < x_2 < x_3 < x_4 < x_5$). The probability that $x_2 = 7$ and $x_4 = 11$ is:
- (a) $\frac{1}{136}$ (b) $\frac{1}{72}$
(c) $\frac{1}{68}$ (d) $\frac{1}{34}$
77. Let X be a random variable having binomial distribution $B(7, p)$. If $P(X = 3) = 5P(X = 4)$, then the sum of the mean and the variance of X is:
- (a) $\frac{105}{16}$ (b) $\frac{7}{16}$
(c) $\frac{77}{36}$ (d) $\frac{49}{16}$
78. The value of $\cos\left(\frac{2\pi}{7}\right) + \cos\left(\frac{4\pi}{7}\right) + \cos\left(\frac{6\pi}{7}\right)$ is equal to :
- (a) -1 (b) $-\frac{1}{2}$
(c) $-\frac{1}{3}$ (d) $-\frac{1}{4}$
79. $\sin^{-1}\left(\sin\frac{2\pi}{3}\right) + \cos^{-1}\left(\cos\frac{7\pi}{6}\right) + \tan^{-1}\left(\tan\frac{3\pi}{4}\right)$ is equal to:
- (a) $\frac{11\pi}{12}$ (b) $\frac{17\pi}{12}$
(c) $\frac{31\pi}{12}$ (d) $-\frac{3\pi}{4}$
80. The Boolean expression $(\sim (p \wedge q)) \vee q$ is equivalent to:
- (a) $q \rightarrow (p \wedge q)$ (b) $p \rightarrow q$
(c) $p \rightarrow (p \rightarrow q)$ (d) $p \rightarrow (p \vee q)$

SECTION-B

81. Let $f: R \rightarrow R$ be a function defined $f(x) = \frac{2e^{2x}}{e^{2x}+e}$. Then $f\left(\frac{1}{100}\right) + f\left(\frac{2}{100}\right) + f\left(\frac{3}{100}\right) + \dots + f\left(\frac{99}{100}\right)$ is equal to
82. If the sum of all the roots of the equation $e^{2x} - 11e^x - 45e^{-x} + \frac{81}{2} = 0$ is $\log_e P$, then p is equal to
83. The positive value of the determinant of the matrix A , whose $\text{Adj}(\text{Adj}(A)) = \begin{pmatrix} 14 & 28 & -14 \\ -14 & 14 & 28 \\ 28 & -14 & 14 \end{pmatrix}$, is
84. The number of ways, 16 identical cubes, of which 11 are blue and rest are red, can be placed in a row so that between any two red cubes there should be at least 2 blue cubes, is
85. If the coefficient of x^{10} in the binomial expansion of $\left(\frac{\sqrt{x}}{5^{\frac{1}{4}}} + \frac{\sqrt{5}}{x^{\frac{1}{3}}}\right)^{60}$ is $5^k l$, where $l, k \in \mathbb{N}$ and l is coprime to 5, then k is equal to
86. Let $A_1 = \{(x, y): |x| \leq y^2, |x| + 2y \leq 8\}$ and $A_2 = \{(x, y): |x| + |y| \leq k\}$. If $27(\text{Area } A_1) = 5(\text{Area } A_2)$, then k is equal to:
87. If the sum of the first ten terms of the series $\frac{1}{5} + \frac{2}{65} + \frac{3}{325} + \frac{4}{1025} + \frac{5}{2501} + \dots$ is $\frac{m}{n}$, where m and n are co-prime numbers, then $m + n$ is equal to
88. A rectangle R with end points of the one of its sides as $(1, 2)$ and $(3, 6)$ is inscribed in a circle. If the equation of a diameter of the circle is $2x - y + 4 = 0$, then the area of R is
89. A circle of radius 2 unit passes through the vertex and the focus of the parabola $y^2 = 2x$ and touches the parabola $y = \left(x - \frac{1}{4}\right)^2 + \alpha$, where $\alpha > 0$. Then $(4\alpha - 8)^2$ is equal to
90. Let the mirror image of the point (a, b, c) with respect to the plane $3x - 4y + 12z + 19 = 0$ be $(a - 6, \beta, \gamma)$. If $a + b + c = 5$, then $7\beta - 9\gamma$ is equal to