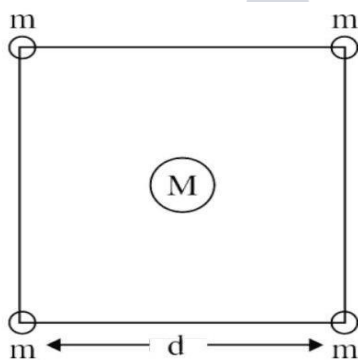


PART-I PHYSICS

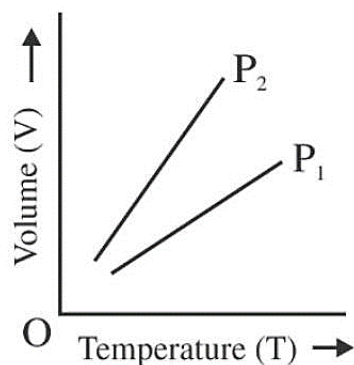
SECTION-A

- The SI unit of a physical quantity is pascal-second. The dimensional formula of this quantity will be
 (a) $[ML^{-1} T^{-1}]$ (b) $[ML^{-1} T^{-2}]$
 (c) $[ML^2 T^{-1}]$ (d) $[M^{-1} L^3 T^0]$
- The distance of the Sun from earth is 1.5×10^{11} m and its angular diameter is (2000) s when observed from the earth. The diameter of the Sun will be:
 (a) 2.45×10^{10} m (b) 1.45×10^{10} m
 (c) 1.45×10^9 m (d) 0.14×10^9 m
- When a ball is dropped into a lake from a height 4.9 m above the water level, it hits the water with a velocity v and then sinks to the bottom with the constant velocity v . It reaches the bottom of the lake 4.0 s after it is dropped. The approximate depth of the lake is:
 (a) 19.6 m (b) 29.4 m
 (c) 39.2 m (d) 73.5 m
- One end of a massless spring of spring constant k and natural length l_0 is fixed while the other end is connected to a small object of mass m lying on a frictionless table. The spring remains horizontal on the table. If the object is made to rotate at an angular velocity ω about an axis passing through fixed end, then the elongation of the spring will be:
 (a) $\frac{k-m\omega^2 l_0}{m\omega^2}$ (b) $\frac{m\omega l_0}{k+m\omega^2}$
 (c) $\frac{m\omega^2 l_0}{k-m\omega^2}$ (d) $\frac{k+m\omega^2 l_0}{m\omega^2}$
- A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed u . The magnitude of change in its velocity, as it reaches a position where the string is horizontal, is $\sqrt{x(u^2 - gL)}$. The value of x is
 (a) 3 (b) 2
 (c) 1 (d) 5
- Four spheres each of mass m form a square of side d (as shown in figure). A fifth sphere of mass M is situated at the centre of square. The total gravitational potential energy of the system is:



- $-\frac{Gm}{d} [(4 + \sqrt{2})m + 4\sqrt{2}M]$
- $-\frac{Gm}{d} [(4 + \sqrt{2})M + 4\sqrt{2}m]$
- $-\frac{Gm}{d} [3m^2 + 4\sqrt{2}M]$
- $-\frac{Gm}{d} [6m^2 + 4\sqrt{2}M]$

- For a perfect gas, two pressures P_1 and P_2 are shown in figure. The graph shows:



- (a) $P_1 > P_2$
- (b) $P_1 < P_2$
- (c) $P_1 = P_2$
- (d) Insufficient data to draw any conclusion

8. According to kinetic theory of gases,

- A. The motion of the gas molecules freezes at 0°C
- B. The mean free path of gas molecules decreases if the density of molecules is increased.
- C. The mean free path of gas molecules increases if temperature is increased keeping pressure constant.
- D. Average kinetic energy per molecule per degree of freedom is $\frac{3}{2}k_B T$ (for monoatomic gases)

Choose the most appropriate answer from the options given below:

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

9. A lead bullet penetrates into a solid object and melts. Assuming that 40% of its kinetic energy is used to heat it, the initial speed of bullet is:

(Given, initial temperature of the bullet = 127°C ,

Melting point of the bullet = 327°C ,

Latent heat of fusion of lead = $2.5 \times 10^4 \text{ J Kg}^{-1}$,

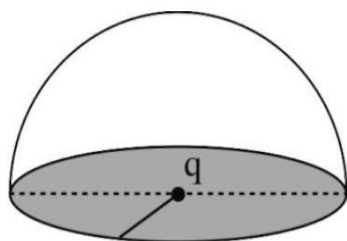
Specific heat capacity of lead = 125 J/kgK)

- (a) 125 ms^{-1}
- (b) 500 ms^{-1}
- (c) 250 ms^{-1}
- (d) 600 ms^{-1}

10. The equation of a particle executing simple harmonic motion is given by $x = \sin \pi \left(t + \frac{1}{3} \right) \text{ m}$. At $t = 1 \text{ s}$, the speed of particle will be (Given: $\pi = 3.14$)

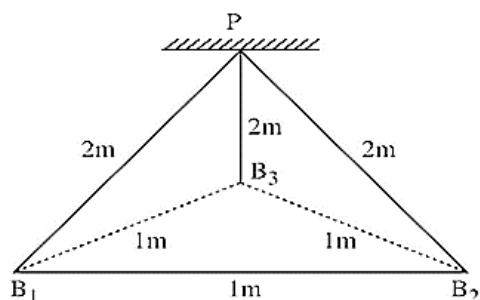
- (a) 0 cm s^{-1}
- (b) 157 cm s^{-1}
- (c) 272 cm s^{-1}
- (d) 314 cm s^{-1}

11. If a charge q is placed at the centre of a closed hemispherical non-conducting surface, the total flux passing through the flat surface would be:



- (a) $\frac{q}{\epsilon_0}$ (b) $\frac{q}{2\epsilon_0}$
(c) $\frac{q}{4\epsilon_0}$ (d) $\frac{q}{2\pi\epsilon_0}$

12. Three identical charged balls each of charge $2C$ are suspended from a common point P by silk threads of 2 m each (as shown in figure). They form an equilateral triangle of side 1 m . The ratio of net force on a charged ball to the force between any two charged balls will be:



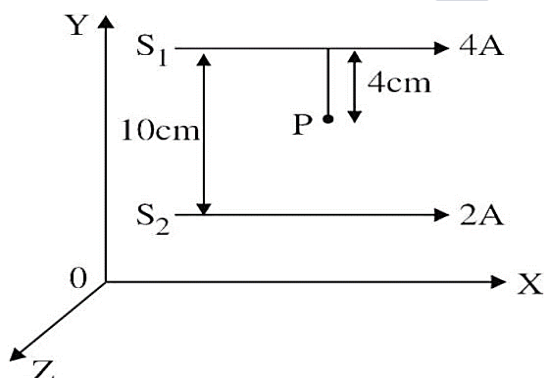
- (a) 1:1 (b) 1:4
(c) $\sqrt{3}:2$ (d) $\sqrt{3}:1$

13. Two long parallel conductors S_1 and S_2 are separated by a distance 10 cm and carrying currents of 4 A and 2 A respectively. The conductors are placed along X -axis in $X - Y$ plane. There is a point P located between the conductors (as shown in figure).

A charge particle of 3π coulomb is passing through the point P with velocity

$\vec{v} = (2\hat{i} + 3\hat{j})\text{ m/s}$; where $\hat{i}$ & $\hat{j}$ represents unit vector along x & y axis respectively.

The force acting on the charge particle is $4\pi \times 10^{-5}(-x\hat{i} + 2\hat{j})\text{ N}$. The value of x is:



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

14. If L , C and R are the self inductance, capacitance and resistance respectively, which of the following does not have the dimension of time?

- (a) RC (b) $\frac{L}{R}$
(c) $\sqrt{LC}$ (d) $\frac{L}{C}$

15. Given below are two statements:

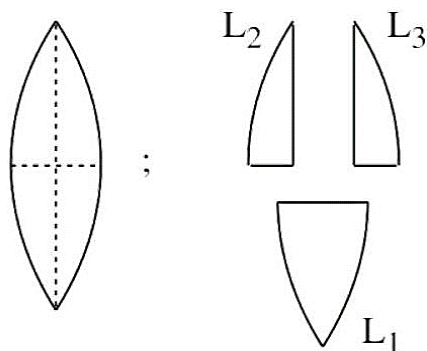
Statement I: A time varying electric field is a source of changing magnetic field and vice-versa. Thus a disturbance in electric or magnetic field creates EM waves.

Statement II: In a material medium. The EM wave travels with speed $v = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$.

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

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

16. A convex lens has power P . It is cut into two halves along its principal axis. Further one piece (out of the two halves) is cut into two halves perpendicular to the principal axis (as shown in figure). Choose the incorrect option for the reported pieces.



- (a) Power of $L_1 = \frac{P}{2}$
- (b) Power of $L_2 = \frac{P}{2}$
- (c) Power of $L_3 = \frac{P}{2}$
- (d) Power of $L_1 = P$

17. If a wave gets refracted into a denser medium, then which of the following is true?

- (a) wavelength speed and frequency decreases.
- (b) wavelength increases, speed decreases and frequency remains constant.
- (c) wavelength and speed decreases but frequency remains constant.
- (d) wavelength, speed and frequency increases.

18. Given below are two statements:

Statement I : In hydrogen atom, the frequency of radiation emitted when an electron jumps from lower energy orbit (E_1) to higher energy orbit (E_2), is given as $hf = E_1 - E_2$.

Statement-II: The jumping of electron from higher energy orbit (E_2) to lower energy orbit (E_1) is associated with frequency of radiation given as $f = (E_2 - E_1)/h$

This condition is Bohr's frequency condition.

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

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

19. For a transistor to act as a switch, it must be operated in

- (a) Active region
- (b) Saturation state only
- (c) Cut-off state only
- (d) Saturation and cut-off state

20. We do not transmit low frequency signal to long distances because

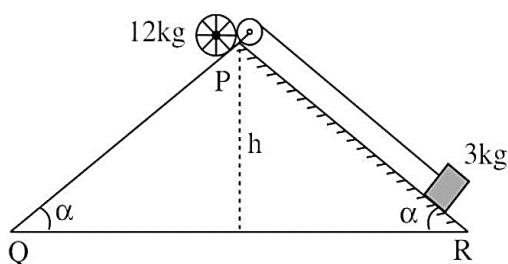
- (A) The size of the antenna should be comparable to signal wavelength which is unreal solution for a signal of longer wavelength.
- (B) Effective power radiated by a long wavelength baseband signal would be high.
- (C) We want to avoid mixing up signals transmitted by different transmitter simultaneously.
- (D) Low frequency signal can be sent to long distances by superimposing with a high frequency wave as well.

Therefore, the most suitable options will be:

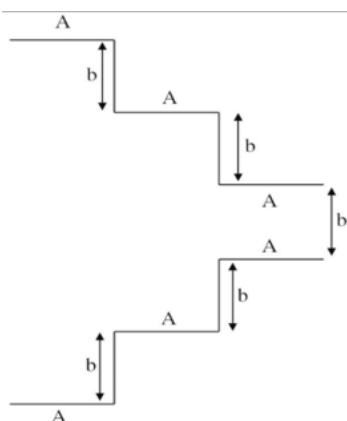
- (a) All statements are true
- (b) (A), (b) and (C) are true only
- (c) (A), (C) and (D) are true only
- (d) (B), (C) and (D) are true only

SECTION-B

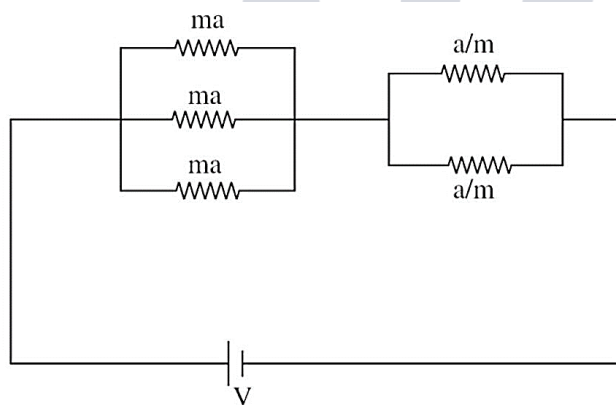
- 21. A mass of 10 kg is suspended vertically by a rope of length 5 m from the roof. A force of 30 N is applied at the middle point of rope in horizontal direction. The angle made by upper half of the rope with vertical is $\theta = \tan^{-1}(x \times 10^{-1})$. The value of x is (Given $g = 10 \text{ m/s}^2$)**
- 22. A rolling wheel of 12 kg is on an inclined plane at position P and connected to a mass of 3 kg through a string of fixed length and pulley as shown in figure. Consider PR as friction free surface. The velocity of centre of mass of the wheel when it reaches at the bottom Q of the inclined plane PQ will be $\frac{1}{2}\sqrt{xgh}\text{m/s}$. The value of x is**



23. A diatomic gas ($\gamma = 1.4$) does 400 J of work when it is expanded isobarically. The heat given to the gas in the process is J.
24. A particle executes simple harmonic motion. Its amplitude is 8 cm and time period is 6 s. The time it will take to travel from its position of maximum displacement to the point corresponding to half of its amplitude, is s.
25. A parallel plate capacitor is made up of stair like structure with a plate area A of each stair and that is connected with a wire of length b , as shown in the figure. The capacitance of the arrangement is $\frac{x \epsilon_0 A}{15 b}$. The value of x is

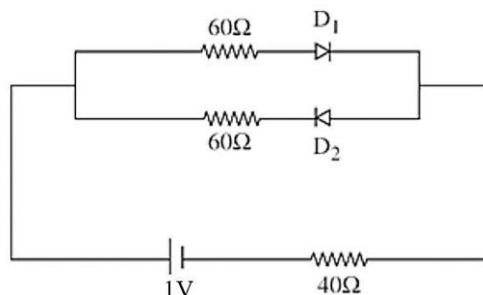


26. The current density in a cylindrical wire of radius $r = 4.0$ mm is 1.0×10^6 A/m². The current through the outer portion of the wire between radial distances $r/2$ and r is $x\pi A$; where x is
27. In the given circuit ' a ' is an arbitrary constant. The value of m for which the equivalent circuit resistance is minimum, will be $\sqrt{\frac{x}{2}}$. The value of x is



28. A deuteron and a proton moving with equal kinetic energy enter into a uniform magnetic field at right angle to the field. If r_d and r_p are the radii of their circular paths respectively, then the ratio $\frac{r_d}{r_p}$ will be $\sqrt{x}:1$ where x is
29. A metallic rod of length 20 cm is placed in North-South direction and is moved at a constant speed of 20 m/s towards East. The horizontal component of the Earth's magnetic field at that place is 4×10^{-3} T and the angle of dip is 45° . The emf induced in the rod is mV.

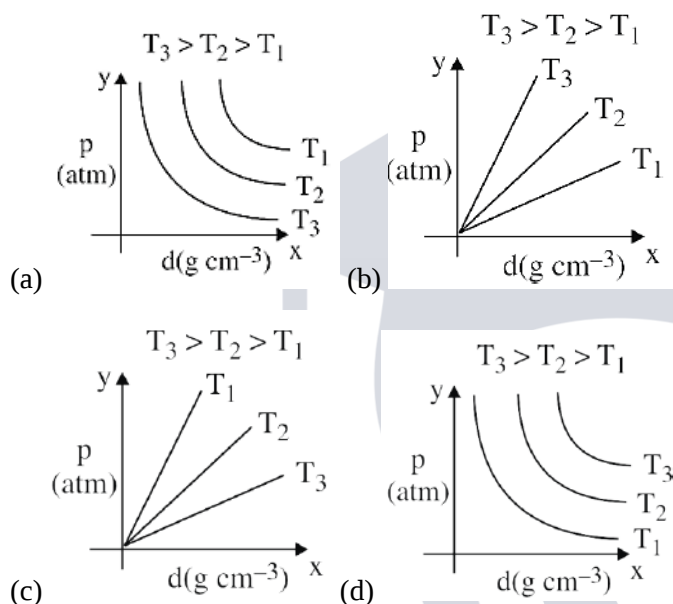
30. The cut-off voltage of the diodes (shown in figure) in forward bias is 0.6 V. The current through the resistor of 40Ω is mA.



PART-II CHEMISTRY

SECTION-A

31. Which amongst the given plots is the correct plot for pressure (p) vs density (d) for an ideal gas?



32. Identify the incorrect statement for PCl_5 from the following.

- (a) In this molecule, orbitals of phosphorous are assumed to undergo $sp^3 d$ hybridization.
- (b) The geometry of PCl_5 is trigonal bipyramidal.
- (c) PCl_5 has two axial bonds stronger than three equatorial bonds.
- (d) The three equatorial bonds of PCl_5 lie in a plane.

33. Statement I: Leaching of gold with cyanide ion in absence of air / O_2 leads to cyano complex of Au(III).

Statement II: Zinc is oxidized during the displacement reaction carried out for gold extraction.

In the light of the above statements, choose the correct 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

34. The correct order of increasing intermolecular hydrogen bond strength is

- (a) $\text{HCN} < \text{H}_2\text{O} < \text{NH}_3$ (b) $\text{HCN} < \text{CH}_4 < \text{NH}_3$
(c) $\text{CH}_4 < \text{HCN} < \text{NH}_3$ (d) $\text{CH}_4 < \text{NH}_3 < \text{HCN}$

35. The correct order of increasing ionic radii is

- (a) $\text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-} < \text{N}^{3-}$
(b) $\text{N}^{3-} < \text{O}^{2-} < \text{F}^- < \text{Na}^+ < \text{Mg}^{2+}$
(c) $\text{F}^- < \text{Na}^+ < \text{O}^{2-} < \text{Mg}^{2+} < \text{N}^{3-}$
(d) $\text{Na}^+ < \text{F}^- < \text{Mg}^{2+} < \text{O}^{2-} < \text{N}^{3-}$

36. The gas produced by treating an aqueous solution of ammonium chloride with sodium nitrite is

- (a) NH_3 (b) N_2
(c) N_2O (d) Cl_2

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

Assertion A: Fluorine forms one oxoacid.

Reason R: Fluorine has smallest size amongst all halogens and is highly electronegative

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

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

38. In 3d series, the metal having the highest M^{2+}/M standard electrode potential is

- (a) Cr (b) Fe
(c) Cu (d) Zn

39. The 'f' orbitals are half and completely filled, respectively in lanthanide ions

(Given: Atomic no. Eu, 63; Sm, 62; Tm, 69; Tb, 65; Yb, 70; Dy, 66)

- (a) Eu^{2+} and Tm^{2+} (b) Sm^{2+} and Tm^{3+}
(c) Tb^{4+} and Yb^{2+} (d) Dy^{3+} and Yb^{3+}

40. Arrange the following coordination compounds in the increasing order of magnetic moments.

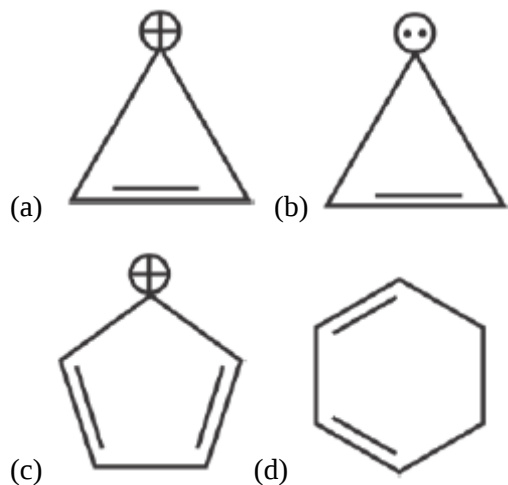
(Atomic numbers: Mn = 25; Fe = 26)

- (A) $[\text{FeF}_6]^{3-}$ (B) $[\text{Fe}(\text{CN})_6]^{3-}$
(C) $[\text{MnCl}_6]^{3-}$ (high spin) (D) $[\text{Mn}(\text{CN})_6]^{3-}$
(a) $A < B < D < C$ (b) $B < D < C < A$
(c) $A < C < D < B$ (d) $B < D < A < C$

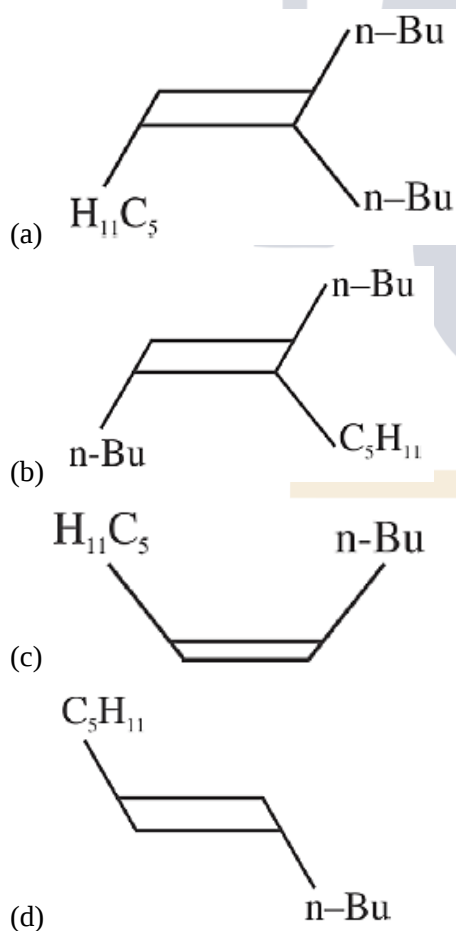
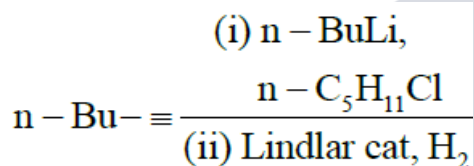
41. On the surface of polar stratospheric clouds, hydrolysis of chlorine nitrate gives A and B while its reaction with HCl produces B and C. A, B and C are, respectively

- (a) $\text{HOCl}, \text{HNO}_3, \text{Cl}_2$ (b) $\text{Cl}_2, \text{HNO}_3, \text{HOCl}$
(c) $\text{HClO}_2, \text{HNO}_2, \text{HOCl}$ (d) $\text{HOCl}, \text{HNO}_2, \text{Cl}_2\text{O}$

42. Which of the following is most stable?

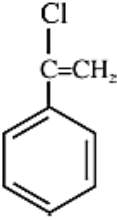
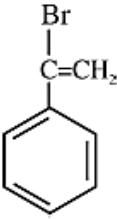
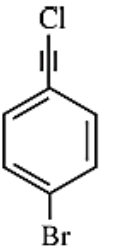
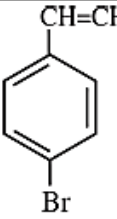


43. What will be the major product of following sequence of reactions?

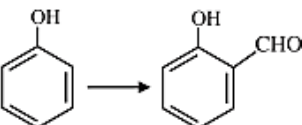
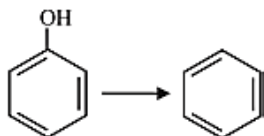
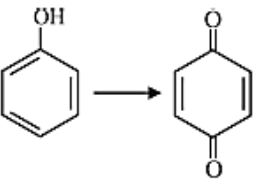
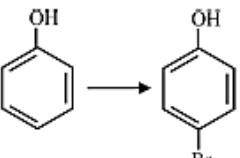


44. Product 'A' of following sequence of reactions is

Ethylbenzene $\xrightarrow[\text{(c) alc. KOH}]{\text{(a) Br}_2, \text{Fe}}$ 'A' (Major product)

(A)	
(B)	
(C)	
(D)	

45. Match List I with List II

List I	List II
A. 	I. Br_2 in CS_2
B. 	II. $\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$
C. 	III. Zn
D. 	IV. $\text{CHCl}_3/\text{NaOH}$

Choose the correct answer from the options given below:

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

46. Decarboxylation of all six possible forms of diaminobenzoic acids $\text{C}_6\text{H}_3(\text{NH}_2)_2\text{COOH}$ yields three products A, B and C. Three acids give a product 'A', two acids give a product 'B' and one acid gives a product 'C'.

The melting point of product 'C' is

- (a) 63°C (b) 90°C
(c) 104°C (d) 142°C

47. Which is true about Buna-N?

- (a) It is a linear polymer of 1, 3-butadiene.
(b) It is obtained by copolymerization of 1, 3butadiene and styrene.
(c) It is obtained by copolymerization of 1, 3butadiene and acrylonitrile.
(d) The suffix N in Buna- N stands for its natural occurrence

48. Given below are two statements.

Statements I: Maltose has two α -D-glucose units linked at C_1 and C_4 and is a reducing sugar.

Statement II: Maltose has two monosaccharides: α -D-glucose and β -D-glucose linked at C_1 and C_6 and it is a non-reducing sugar.

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

- (a) 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 is false
- (d) Statement I is false but Statement II is true

49. Match List I with List II

List I	List II
A. Antipyretic	I. Reduces pain
B. Analgesic	II. Reduces stress
C. Tranquilizer	III. Reduces fever
D. Antacid	IV. Reduces acidity (Stomach)

Choose the correct answer from the options given below:

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

50. Match List I with List II

List I (Anion)	List II (Gas evolved on reaction with dil. H ₂ SO ₄)
A. CO ₃ ²⁻	I. Colourless gas which turns lead acetate paper black
B. S ²⁻	II. Colourless gas which turns acidified potassium dichromate solution green.
C. SO ₃ ²⁻	III. Brown fumes which turns acidified KI solution containing starch blue.
D. NO ₂ ⁻	IV. Colourless gas evolved with brisk effervescence, which turns lime water milky.

Choose the correct answer from the options given below:

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

SECTION-B

51. 116 g of a substance upon dissociation reaction, yields 7.5 g of hydrogen, 60 g of oxygen and 48.5 g of carbon. Given that the atomic masses of H, O and C are 1, 16 and 12 respectively. The data agrees with how many formulae of the following?

- (a) CH_3COOH (b) HCHO
(c) CH_3OOCH_3 (d) CH_3CHO

52. Consider the following set of quantum numbers

	n	l	m_l
A.	3	3	-3
B.	3	2	-2
C.	2	1	+1
D.	2	2	+2

The number of correct sets of quantum numbers is

53. BeO reacts with HF in presence of ammonia to give [A] which on thermal decomposition produces [B] and ammonium fluoride. Oxidation state of Be in [A] is

54. When 5 moles of He gas expand isothermally and reversibly at 300 K from 10 litre to 20 litre, the magnitude of the maximum work obtained is J. [nearest integer] (Given: $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ and $\log 2 = 0.3010$)

55. A solution containing $2.5 \times 10^{-3} \text{ kg}$ of a solute dissolved in $75 \times 10^{-3} \text{ kg}$ of water boils at 373.535 K. The molar mass of the solute is g mol^{-1} . [nearest integer] (Given: $K_b(\text{H}_2\text{O}) = 0.52 \text{ K Kg mol}^{-1}$, boiling point of water = 373.15 K)

56. pH value of 0.001MNaOH solution is

57. For the reaction taking place in the cell:

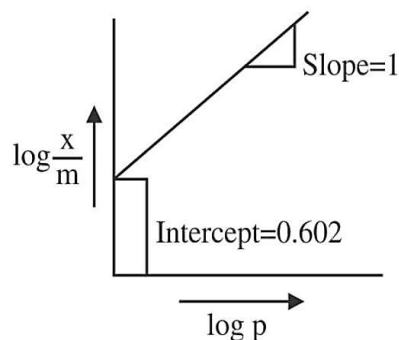


$$E_{\text{Cell}}^{\circ} = +0.5332 \text{ V.}$$

The value of $\Delta_f G^{\circ}$ is kJ mol^{-1} . (in nearest integer)

58. It has been found that for a chemical reaction with rise in temperature by 9 K the rate constant gets doubled. Assuming a reaction to be occurring at 300 K, the value of activation energy is found to be kJ mol^{-1} . [nearest integer] (Given $\ln 10 = 2.3$, $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$, $\log 2 = 0.30$)

59.



If the initial pressure of a gas is 0.03 atm, the mass of the gas adsorbed per gram of the adsorbent is $\times 10^{-2}$ g.

60. 0.25 g of an organic compound containing chlorine gave 0.40 g of silver chloride in Carius estimation. The percentage of chlorine present in the compound is [in nearest integer] (Given: Molar mass of Ag is 108 g mol^{-1} and that of Cl is 35.5 g mol^{-1})

PART-III MATHEMATICS

SECTION-A

61. The number of points of intersection of $|z - (4 + 3i)| = 2$ and $|z| + |z - 4| = 6, z \in \mathbb{C}$ is :
 (a) 0 (b) 1
 (c) 2 (d) 3
62. Let $f(x) = \begin{vmatrix} a & -1 & 0 \\ ax & a & -1 \\ ax^2 & ax & a \end{vmatrix}, a \in \mathbb{R}$. Then the sum of which the squares of all the values of a for $2f'(10) - f'(5) + 100 = 0$ is:
 (a) 117 (b) 106
 (c) 125 (d) 136
63. Let for some real numbers α and $\beta, a = \alpha - i\beta$. If the system of equations $4ix + (1 + i)y = 0$ and $8\left(\cos \frac{2\pi}{3} + i\sin \frac{2\pi}{3}\right)x + \bar{a}y = 0$ has more than one solution then $\frac{\alpha}{\beta}$ is equal to:
 (a) $-2 + \sqrt{3}$ (b) $2 - \sqrt{3}$
 (c) $2 + \sqrt{3}$ (d) $-2 - \sqrt{3}$
64. Let A and B be two 3×3 matrices such that $AB = I$ and $|A| = \frac{1}{8}$ then $|\text{adj}(\text{Badj}(2A))|$ is equal to
 (a) 16 (b) 32
 (c) 64 (d) 128
65. Let $S = 2 + \frac{6}{7} + \frac{12}{7^2} + \frac{20}{7^3} + \frac{30}{7^4} + \dots$, then $4S$ is equal to
 (a) $\left(\frac{7}{3}\right)^2$ (b) $\frac{7^3}{3^2}$
 (c) $\left(\frac{7}{3}\right)^3$ (d) $\frac{7^2}{3^3}$
66. If $a_1, a_2, a_3 \dots$ and $b_1, b_2, b_3 \dots$ are A.P. and $a_1 = 2, a_{10} = 3, a_1 b_1 = 1 = a_{10} b_{10}$ then $a_4 b_4$ is equal to
 (a) $\frac{35}{27}$ (b) 1
 (c) $\frac{27}{28}$ (d) $\frac{28}{27}$
67. If m and n respectively are the number of local maximum and local minimum points of the function $f(x) = \int_0^{x^2} \frac{t^2 - 5t + 4}{2 + e^t} dt$, then the ordered pair (m, n) is equal to
 (a) (3, 2) (b) (2, 3)
 (c) (2, 2) (d) (3, 4)

68. Let f be a differentiable function in $(0, \frac{\pi}{2})$. If $\int_{\cos x}^1 t^2 f(t) dt = \sin^3 x + \cos x$ then $\frac{1}{\sqrt{3}} f'(\frac{1}{\sqrt{3}})$ is equal to:
- (a) $6 - 9\sqrt{2}$ (b) $6 - \frac{9}{\sqrt{2}}$
(c) $\frac{9}{2} - 6\sqrt{2}$ (d) $\frac{9}{\sqrt{2}} - 6$
69. The integral $\int_0^1 \frac{1}{7^{\lfloor x \rfloor}} dx$, where $\lfloor \cdot \rfloor$ denotes the greatest integer function is equal to
- (a) $1 + 6\log_e\left(\frac{6}{7}\right)$ (b) $1 - 6\log_e\left(\frac{6}{7}\right)$
(c) $\log_e\left(\frac{7}{6}\right)$ (d) $1 - 7\log_e\left(\frac{6}{7}\right)$
70. If the solution curve of the differential equation $((\tan^{-1} y) - x) dy = (1 + y^2) dx$ passes through the point $(1, 0)$ then the abscissa of the point on the curve whose ordinate is $\tan(1)$ is:
- (a) $2e$ (b) $\frac{2}{e}$
(c) 2 (d) $\frac{1}{e}$
71. If the equation of the parabola, whose vertex is at $(5, 4)$ and the directrix is $3x + y - 29 = 0$, is $x^2 + ay^2 + bxy + cx + dy + k = 0$ then $a + b + c + d + k$ is equal to
- (a) 575 (b) -575
(c) 576 (d) -576
72. The set of values of k for which the circle $C : 4x^2 + 4y^2 - 12x + 8y + k = 0$ lies inside the fourth quadrant and the point $(1, -\frac{1}{3})$ lies on or inside the circle C is :
- (a) An empty set (b) $(6, \frac{95}{9}]$
(c) $[\frac{80}{9}, 10)$ (d) $(9, \frac{92}{9}]$
73. Let the foot of the perpendicular from the point $(1, 2, 4)$ on the line $\frac{x+2}{4} = \frac{y-1}{2} = \frac{z+1}{3}$ be P . Then the distance of P from the plane $3x + 4y + 12z + 23 = 0$
- (a) 5 (b) $\frac{50}{13}$
(c) 4 (d) $\frac{63}{13}$
74. The shortest distance between the lines $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-1}{-1}$ and $\frac{x+3}{2} = \frac{y-6}{1} = \frac{z-5}{3}$ is :
- (a) $\frac{18}{\sqrt{5}}$ (b) $\frac{22}{3\sqrt{5}}$
(c) $\frac{46}{3\sqrt{5}}$ (d) $6\sqrt{3}$
75. Let $\vec{a}$ and $\vec{b}$ be the vectors along the diagonal of a parallelogram having area $2\sqrt{2}$. Let the angle between $\vec{a}$ and $\vec{b}$ be acute. $|\vec{a}| = 1$ and $|\vec{a} \cdot \vec{b}| = |\vec{a} \times \vec{b}|$. If $\vec{c} = 2\sqrt{2}(\vec{a} \times \vec{b}) - 2\vec{b}$, then an angle between $\vec{b}$ and $\vec{c}$ is:
- (a) $\frac{\pi}{4}$ (b) $-\frac{\pi}{4}$
(c) $\frac{5\pi}{6}$ (d) $\frac{3\pi}{4}$
76. The mean and variance of the data 4, 5, 6, 6, 7, 8, x , y where $x < y$ are 6, and $\frac{9}{4}$ respectively. Then $x^4 + y^2$ is equal to
- (a) 162 (b) 320
(c) 674 (d) 420
77. If a point $A(x, y)$ lies in the region bounded by the y -axis, straight lines $2y + x = 6$ and $5x - 6y = 30$, then the probability that $y < 1$ is:
- (a) $\frac{1}{6}$ (b) $\frac{5}{6}$
(c) $\frac{2}{3}$ (d) $\frac{6}{7}$

78. The value of $\cot \left(\sum_{n=1}^{50} \tan^{-1} \left(\frac{1}{1+n+n^2} \right) \right)$ is

- (a) $\frac{26}{25}$ (b) $\frac{25}{26}$
(c) $\frac{50}{51}$ (d) $\frac{52}{51}$

79. $\alpha = \sin 36^\circ$ is a root of which of the following equation

- (a) $10x^4 - 10x^2 - 5 = 0$
(b) $16x^4 + 20x^2 - 5 = 0$
(c) $16x^4 - 20x^2 + 5 = 0$
(d) $16x^4 - 10x^2 + 5 = 0$

80. Which of the following statement is a tautology?

- (a) $((\sim q) \wedge p) \wedge q$
(b) $((\sim q) \wedge p) \wedge (p \wedge (\sim p))$
(c) $((\sim q) \wedge p) \vee (p \vee (\sim p))$
(d) $(p \wedge q) \wedge (\sim (p \wedge q))$

SECTION-B

81. Let $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$. Define

$$f: S \rightarrow S \text{ as } f(n) = \begin{cases} 2n, & \text{if } n = 1, 2, 3, 4, 5 \\ 2n - 11 & \text{if } n = 6, 7, 8, 9, 10 \end{cases}$$

Let $g: S \rightarrow S$ be a function such that $f \circ g(n) = \begin{cases} n + 1, & \text{if } n \text{ is odd} \\ n - 1, & \text{if } n \text{ is even} \end{cases}$, then

$g(10)((g(1) + g(2) + g(3) + g(4) + g(5)))$ is equal to:

82. Let α, β be the roots of the equation $x^2 - 4\lambda x + 5 = 0$ and α, γ be the roots of the equation $x^2 - (3\sqrt{2} + 2\sqrt{3})x + 7 + 3\lambda\sqrt{3} = 0$. If $\beta + \gamma = 3\sqrt{2}$, then $(\alpha + 2\beta + \gamma)^2$ is equal to:

83. Let A be a matrix of order 2×2 , whose entries are from the set $\{0, 1, 2, 3, 4, 5\}$. If the sum of all the entries of A is a prime number $p, 2 < p < 8$, then the number of such matrices A is:

84. If the sum of the coefficients of all the positive powers of x , in the binomial expansion of $\left(x^n + \frac{2}{x^5}\right)^7$ is 939, then the sum of all the possible integral values of n is:

85. Let $[t]$ denote the greatest integer $\leq t$ and $\{t\}$ denote the fractional part of t . Then integral value of α for which the left hand limit of the function $f(x) = [1 + x] + \frac{\alpha^{2[x] + \{x\}} + [x] - 1}{2[x] + \{x\}}$ at $x = 0$ is equal to $\alpha - \frac{4}{3}$ is

86. If $y(x) = (x^{x^x}), x > 0$ then $\frac{d^2y}{dx^2} + 20$ at $x = 1$ is equal to:

87. If the area of the region $\{(x, y): x^{\frac{2}{3}} + y^{\frac{2}{3}} \leq 1, x + y \geq 0, y \geq 0\}$ is A , then $\frac{256A}{\pi}$ is

88. Let v be the solution of the differential equation $(1 - x^2)dy = (xy + (x^3 + 2)\sqrt{1 - x^2})dx, -1 < x < 1$ and $y(0) = 0$ if $\int_{-\frac{1}{2}}^{\frac{1}{2}} \sqrt{1 - x^2} y(x) dx = k$ then k^{-1} is equal to:

89. Let a circle C of radius 5 lie below the x -axis. The line $L_1 = 4x + 3y - 2$ passes through the centre P of the circle C and intersects the line $L_2: 3x - 4y - 11 = 0$ at Q . The line L_2 touches C at the point Q . Then the distance of P from the line $5x - 12y + 51 = 0$ is
90. Let $S = \{E_1, E_2, \dots, E_8\}$ be a sample space of random experiment such that $P(E_n) = \frac{n}{36}$ for every $n = 1, 2, \dots, 8$. Then the number of elements in the set $\{A \subset S: P(A) \geq \frac{4}{5}\}$ is

