

Physics

Section-A

1. Two harmonic waves moving in the same direction superimpose to form a wave $x = a \cos(1.5t) \cos(50.5t)$ where t is in seconds. Find the period with which they beat (close to nearest integer)

- (a) 6 s (b) 4 s
(c) 1 s (d) 2 s

2. Two plane polarized light waves combine at a certain point whose electric field

$$E_1 = E_0 \sin \omega t$$

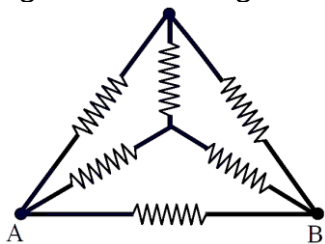
components are

$$E_2 = E_0 \sin \left(\omega t + \frac{\pi}{3} \right)$$

Find the amplitude of the resultant wave.

- (a) 0.9 E_0 (b) E_0
(c) 1.7 E_0 (d) 3.4 E_0

3. A wire of resistance R is bent into a triangular pyramid as shown in figure with each segment having same length. The resistance between points A and B is R/n . The value of n is :



- (a) 16 (b) 14
(c) 10 (d) 12

4. Uniform magnetic fields of different strengths (B_1 and B_2), both normal to the plane of the paper exist as shown in the figure. A charged particle of mass m and charge q , at the interface at an instant, moves into the region 2 with velocity v and returns to the interface. It continues to move into region 1 and finally reaches the interface. What is the displacement of the particle during this movement along the interface ?

(Consider the velocity of the particle to be normal to the magnetic field and $B_2 > B_1$)

$\times \times \times \times \times \times \times \times$

B_1 $\times \times \times \times$ Region 1

Interface

$\times \times \times \times \times \times \times \times$

B_2 $\times \times \times \times$ Region 2

$\times \times \times \times \times \times \times \times$

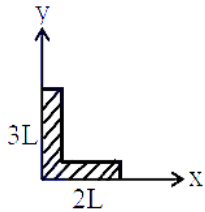
- (a) $\frac{mv}{qB_1} \left(1 - \frac{B_2}{B_1} \right) \times 2$ (b) $\frac{mv}{qB_1} \left(1 - \frac{B_1}{B_2} \right)$
(c) $\frac{mv}{qB_1} \left(1 - \frac{B_2}{B_1} \right)$ (d) $\frac{mv}{qB_1} \left(1 - \frac{B_1}{B_2} \right) \times 2$

5. If ϵ_0 denotes the permittivity of free space and Φ_E is the flux of the electric field through the area bounded by the closed surface, then dimension of $\left(\epsilon_0 \frac{d\Phi_E}{dt} \right)$ are that of :

- (a) Electric field
(b) Electric potential
(c) Electric charge
(d) Electric current

6. A rod of length $5L$ is bent right angle keeping one side length as $2L$.

The position of the center of mass of the system: (Consider $L = 10 \text{ cm}$)



- (a) $2\hat{i} + 3\hat{j}$ (b) $3\hat{i} + 7\hat{j}$
(c) $5\hat{i} + 8\hat{j}$ (d) $4\hat{i} + 9\hat{j}$

7. The percentage increase in magnetic field (B) when space within a current carrying solenoid is filled with magnesium (magnetic susceptibility $\chi_{mg} = 1.2 \times 10^{-5}$) is :

- (a) $\frac{6}{5} \times 10^{-3}\%$ (b) $\frac{5}{6} \times 10^{-5}\%$
(c) $\frac{5}{6} \times 10^{-4}\%$ (d) $\frac{5}{3} \times 10^{-5}\%$

8. A lens having refractive index 1.6 has focal length of 12 cm, when it is in air. Find the focal length of the lens when it is placed in water.

(Take refractive index of water as 1.28)

- (a) 355 mm (b) 288 mm
(c) 555 mm (d) 655 mm

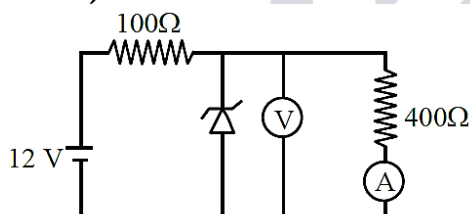
9. An ac current is represented as $i = 5\sqrt{2} + 10\cos\left(650\pi t + \frac{\pi}{6}\right)$ Amp The r.m.s value of the current is.

- (a) 50 Amp (b) 100 Amp
(c) 10 Amp (d) $5\sqrt{2}$ Amp

10. Two thin convex lenses of focal lengths 30 cm and 10 cm are placed coaxially, 10 cm apart. The power of this combination is :

- (a) 5 D (b) 1 D
(c) 20 D (d) 10 D

11. In the following circuit, the reading of the ammeter will be (Take Zener breakdown voltage = 4 V).



- (a) 24 mA (b) 80 mA
(c) 10 mA (d) 60 mA

12. Two projectiles are fired from ground with same initial speeds from same point at angles $(45^\circ + \alpha)$ and $(45^\circ - \alpha)$ with horizontal direction. The ratio of their times of flights is.

- (a) 1 (b) $\frac{1 - \tan \alpha}{1 + \tan \alpha}$
(c) $\frac{1 + \sin 2\alpha}{1 - \sin 2\alpha}$ (d) $\frac{1 + \tan \alpha}{1 - \tan \alpha}$

13. Match the List-I with List-II

List-I		List-II	
A.	Triatomic rigid gas	I.	$\frac{C_P}{C_V} = \frac{5}{3}$
B.	Diatomic non-rigid gas	II.	$\frac{C_P}{C_V} = \frac{7}{5}$
C.	Monoatomic gas	III.	$\frac{C_P}{C_V} = \frac{4}{3}$

D.	Diatomic rigid gas	IV	$\frac{C_P}{C_V} = \frac{9}{7}$
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Choose the correct answer from the options given below :

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

14. A cubic block of mass m is sliding down on an inclined plane at 60° with an acceleration of $\frac{g}{2}$, the value of coefficient of kinetic friction is.

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

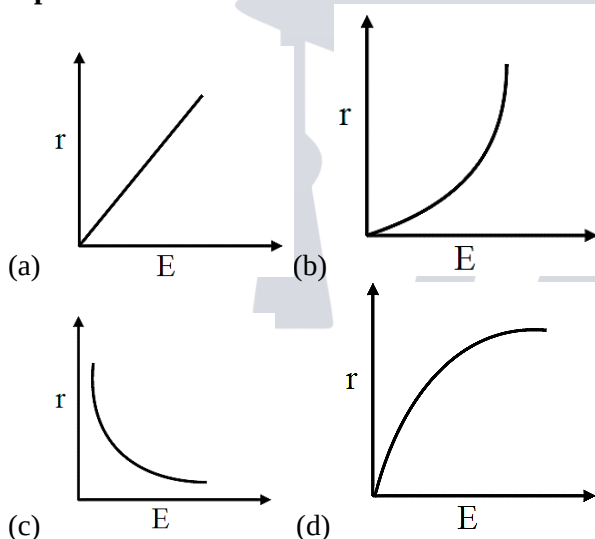
15. In a hydrogen like ion, the energy difference between the 2nd excitation energy state and ground is 108.8 eV . The atomic number of the ion is

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

16. For a hydrogen atom, the ratio of the largest wavelength of Lyman series to that of the Balmer series is.

- (a) 5:36 (b) 5:27
 (c) 3:4 (d) 27:5

17. A particle of charge q , mass m and kinetic energy E enters in magnetic field perpendicular to its velocity and undergoes a circular arc of radius(r). Which of the following curves represents the variation of r with E ?



18. An object of mass 1000 g experiences a time dependent force $\vec{F} = (2t\hat{i} + 3t^2\hat{j})N$.

The power generated by the force at time t is :

- (a) $(2t^2 + 3t^3)W$
 (b) $(2t^2 + 18t^3)W$
 (c) $(3t^3 + 5t^5)W$
 (d) $(2t^3 + 3t^5)W$

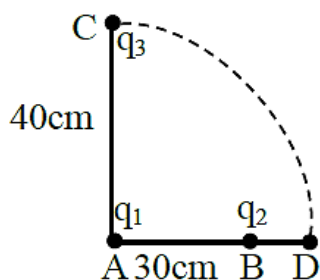
19. Two wires A and B are made of same material having ratio of lengths

$\frac{L_A}{L_B} = \frac{1}{3}$ and their diameters ratio $\frac{d_A}{d_B} = 2$. If both the wires are stretched using same force, what would be the ratio of their respective elongations?

- (a) 1:6 (b) 1:12
 (c) 3:4 (d) 1:3

20. Two charges q_1 and q_2 are separated by a distance of 30 cm . A third charge q_3 initially at ' C ' as shown in the figure, is moved along the circular path of radius 40 cm from C to D.

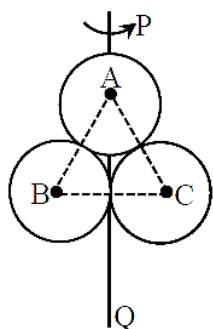
If the difference in potential energy due to movement of q_3 from C to D is given by $\frac{q_3 K}{4\pi\epsilon_0}$, the value of K is :



- (a) $8q_2$ (b) $6q_2$
(c) $8q_1$ (d) $6q_1$

Section-B

21. A, B and C are disc, solid sphere and spherical shell respectively with same radii and masses. These masses are placed as shown in figure.



The moment of inertia of the given system about PQ is $\frac{x}{15}I$, where I is the moment of inertia of the disc about its diameter. The value of x is .

22. For ac circuit shown in figure, $R = 100\text{k}\Omega$ and $C = 100\text{pF}$ and the phase difference between V_{in} and $(V_B - V_A)$ is 90° . The input signal frequency is 10^xrad/sec , where 'x' is.

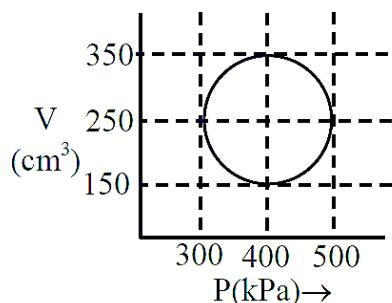
23. A container contains a liquid with refractive index of 1.2 up to a height of 60 cm and another liquid having refractive index 1.6 is added to height H above first liquid. If viewed from above, the apparent shift in the position of bottom of container is 40 cm. The value of H is cm. (Consider liquids are immisible)

24. A wire of length 10 cm and diameter 0.5 mm is used in a bulb. The temperature of the wire is 1727°C and power radiated by the wire is 94.2 W. Its emissivity is $\frac{x}{8}$ where $x =$ (Given $\sigma = 6.0 \times 10^{-8}\text{ W m}^{-2}\text{ K}^{-4}$, $\pi = 3.14$ and assume that the emissivity of wire material is same at all wavelength.)

25. An ideal gas has undergone through the cyclic process as shown in the figure.

Work done by the gas in the entire cycle is $\times 10^{-1}\text{ J}$.

(Take $\pi = 3.14$)



Chemistry Section-A

26. Given below are two statements :

Statement I : Ozonolysis followed by treatment with Zn , H_2O of cis-2-butene gives ethanal.

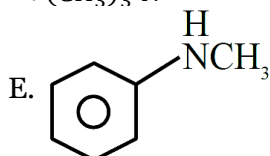
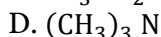
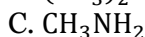
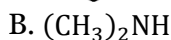
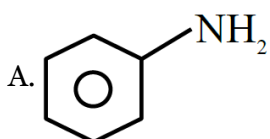
Statement II : The production obtained by ozonolysis followed by treatment with Zn , H_2O of 3, 6-dimethyloct-4-ene has no chiral carbon atom.

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) Statement I is false but Statement II are true
 (c) Statement I is true but Statement II is false
 (d) Both Statement I and Statement II are false

27. Which of the following amine (s) show (s) positive carbylamines test ?



Choose the correct answer from the options given below:

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

28. Reaction $\text{A(g)} \rightarrow 2 \text{B(g)} + \text{C(g)}$ is a first order reaction. It was started with pure A

t/min	Pressure of system at time t/mm Hg
10	160
∞	240

Which of the following option is incorrect ?

- (a) Initial pressure of A is 80 mm Hg
 (b) The reaction never goes to completion
 (c) Rate constant of the reaction is 1.693 min^{-1}
 (d) Partial pressure of A after 10 minute is 40 mm Hg

29. Total enthalpy change for freezing of 1 mol of water at 10°C to ice at -10°C is (Given : $\Delta_{\text{fus}}H = x \text{ kJ/mol}$)

$$C_p[\text{H}_2\text{O(l)}] = y \text{ J mol}^{-1} \text{ K}^{-1}$$

$$C_p[\text{H}_2\text{O(s)}] = z \text{ J mol}^{-1} \text{ K}^{-1}$$

- (a) $-x - 10y - 10z$
 (b) $-10(100x + y + z)$
 (c) $10(100x + y + z)$
 (d) $x - 10y - 10z$

30. An aqueous solution of HCl with pH 1.0 is diluted by adding equal volume of water (ignoring dissociation of water). The pH of HCl solution would. (Given $\log 2 = 0.30$)

- (a) reduce to 0.5
 (b) increase to 1.3
 (c) remain same
 (d) increase to 2

31. Given below are two statements:

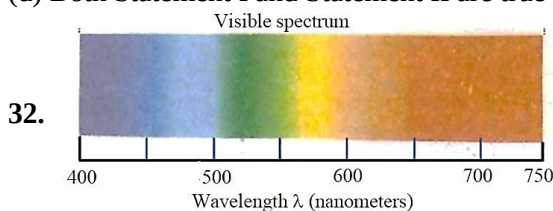
Statement I : Dimethyl ether is completely soluble in water. However, diethyl ether is soluble in water to a very small extent.

Statement II : Sodium metal can be used to dry diethyl ether and not ethyl alcohol.

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

- (a) Statement I is false but Statement II are true
 (b) Both Statement I and Statement II are false

- (c) Statement I is true but Statement II is false
(d) Both Statement I and Statement II are true

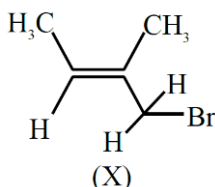


- A. When Cs is placed inside a vacuum chamber with an ammeter connected to it and yellow light is focused on Cs the ammeter shows the presence of current.
B. When the brightness of the yellow light is dimmed, the value of the current in the ammeter is reduced.
C. When a red light is used instead to the yellow light, the current produced is higher with respect to the yellow light.
D. When a blue light is used, the ammeter shows the formation of current.
E. When a white light is used, the ammeter shows formation of current.

Choose the correct answer from the options given below:

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

33. Which of the following is the correct IUPAC name of given organic compound (X) ?



- (a) 2-Bromo-2-methylbut-2-ene
(b) 3-Bromo-3-methylprop-2-ene
(c) 1-Bromo-2-methylbut-2-ene
(d) 4-Bromo-3-methylbut-2-ene

34. At the sea level, the dry air mass percentage composition is given as nitrogen gas :

70.0, oxygen gas : 27.0 and argon gas : 3.0. If total pressure is 1.15 atm , then calculate the ratio of followings respectively :

(i) partial pressure of nitrogen gas to partial pressure of oxygen gas

(ii) partial pressure of oxygen gas to partial pressure of argon gas

(Given : Molar mass of N, O and Ar are 14, 16, and 40 g mol⁻¹ respectively)

- (a) 4.26,19.3 (b) 2.59,11.85
(c) 5.46,17.8 (d) 2.96,11.2

35. Given below are two statements:

Statement I : Mohr's salt is composed of only three types of ions-ferrous, ammonium and sulphate.

Statement II : If the molar conductance at infinite dilution of ferrous, ammonium and sulphate ions are x_1 , x_2 and x_3 S cm² mol⁻¹, respectively then the molar conductance for Mohr's salt solution at infinite dilution would be given by $x_1 + x_2 + 2x_3$

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

- (a) Both statements I and Statement II are false
(b) Statement I is false but Statement II is true
(c) Statement I is true but Statement II are false
(d) Both statements I and Statement II are true

36. The number of valence electrons present in the metal among Cr, Co, Fe and Ni which has the lowest enthalpy of atomisation is.

- (a) 8 (b) 9
(c) 6 (d) 10

37. When a salt is treated with sodium hydroxide solution it gives gas X . On passing gas X through reagent Y a brown coloured precipitate is formed. X and Y respectively, are.

- (a) X = NH₃ and Y = HgO

(b) $X = \text{NH}_3$ and $Y = \text{K}_2\text{HgI}_4 + \text{KOH}$

(c) $X = \text{NH}_4\text{Cl}$ and $Y = \text{KOH}$

(d) $X = \text{HCl}$ and $Y = \text{NH}_4\text{Cl}$

38. The group 14 elements A and B have the first ionisation enthalpy values of 708 and 715 kJ mol^{-1} respectively. The above values are lowest among their group members. The nature of their ions A^{2+} B^{4+} respectively is.

(a) both reducing

(b) both oxidising

(c) reducing and oxidising

(d) oxidising and reducing

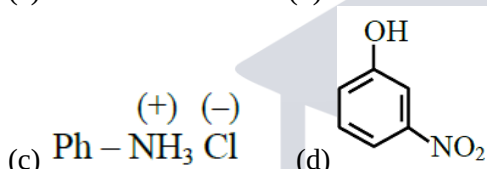
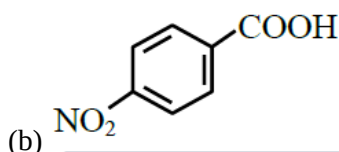
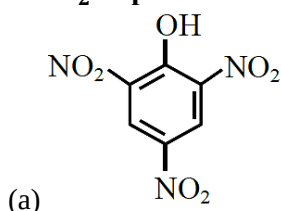
39. The first transition series metal 'M' has the highest enthalpy of atomisation in its series.

One of its aquated ion (M^{n+}) exists in green colour. The nature of the oxide formed by the above M^{n+} ion is :

(a) neutral (b) acidic

(c) basic (d) amphoteric

40. Which of the following compounds is least likely to give effervescence of CO_2 in presence of aq. NaHCO_3 ?



41. Match the LIST-I with LIST-II.

LIST-I Molecule/ion		LIST-II Bond pair : lone pair (on the central atom)	
A.	ICl_2^-	I.	4:2
B.	H_2O	II.	4:1
C.	SO_2	III.	2 : 3
D.	XeF_4	IV.	2 : 2

Choose the correct answer from the options given below:

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

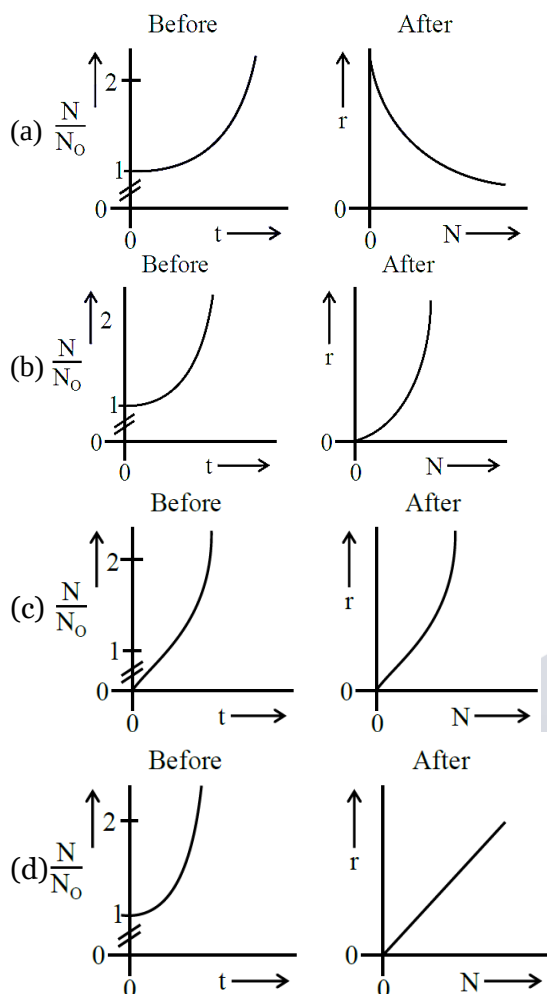
(b) A-III, B-IV, C-II, D-I

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

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

42. A person's wound was exposed to some bacteria and then bacteria growth started to happen at the same place. The wound was later treated with some antibacterial medicine and the rate of bacterial decay (r) was found to be proportional with the square of the existing number of bacteria at any instance. Which of the following set of graphs correctly represents the 'before' and 'after' situation of the application of the medicine?

[Given : N = No. of bacteria, t = time, bacterial growth follows 1st order kinetics.]



43. Given below are two statements :

Statement I: D-(+)-glucose + D-(+) fructose $\xrightarrow{-H_2O}$ sucrose
sucrose $\xrightarrow{\text{Hydrolysis}}$ D-(+)-glucose + D-(+) fructose

Statement II : Invert sugar is formed during sucrose hydrolysis.

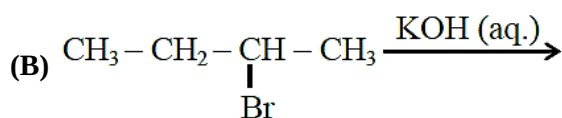
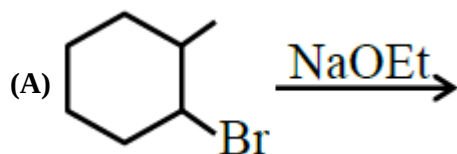
In the light of the above statements, choose the correct answer from the options given below

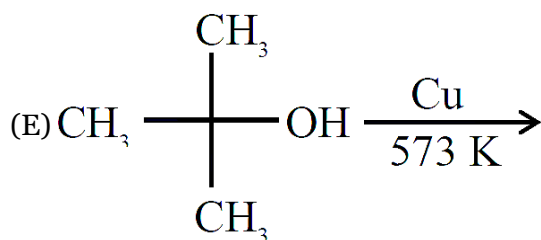
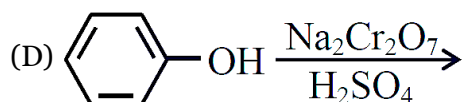
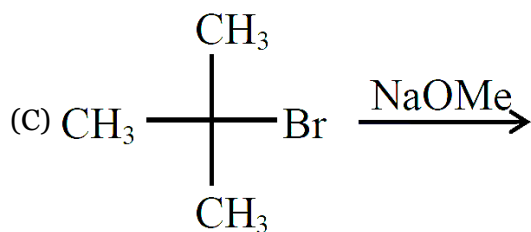
- (a) Both Statement I and Statement II are true.
(b) Statement I is false but Statement II are true.
(c) Statement I is true but Statement II is false.
(d) Both Statement I and Statement II are false.

44. An octahedral complex having molecular composition $\text{Co} \cdot 5\text{NH}_3 \cdot \text{Cl}_2 \cdot \text{SO}_4$ has two isomers A and B . The solution of A gives a white precipitate with AgNO_3 solution and the solution of B gives white precipitate with BaCl_2 solution. The type of isomerism exhibited by the complex is,

- (a) Co-ordinate isomerism
(b) Linkage isomerism
(c) Ionisation isomerism
(d) Geometrical isomerism

45. The reactions which cannot be applied to prepare an alkene by elimination, are.





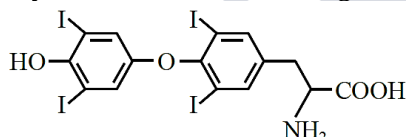
Choose the correct answer from the option given below :

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

Section-B

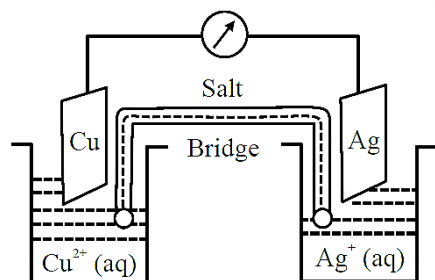
46. An organic compound weighing 500 mg, produced 220 mg of CO_2 on complete combustion. The percentage composition of carbon in the compound is %. (nearest integer)
(Given molar mass in gmol^{-1} of C: 12, O: 16)

47. Thyroxine, the hormone has given below structure



The percentage of iodine in thyroxine is %. (nearest integer)
(Given molar mass in gmol^{-1} C: 12, H: 1, O: 16, N: 14, I: 127)

48. 1 Faraday electricity was passed through Cu^{2+} (1.5 M, 1 L)/Cu and 0.1 Faraday was passed through Ag^+ (0.2 M, 1 L)/Ag electrolytic cells. After this the two cells were connected as shown below to make an electrochemical cell. The emf of the cell thus formed at 298 K is-



Given : $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34\text{ V}$

$E^\circ_{\text{Ag}^+/\text{Ag}} = 0.8\text{ V}$

$\frac{2.303RT}{F} = 0.06\text{ V}$

49. The percentage dissociation of a salt (MX_3) solution at given temperature (van't Hoff factor $i = 2$) is % (Nearest integer)

50. The number of paramagnetic complex among $[\text{FeF}_6]^{3-}$, $[\text{Fe}(\text{CN})_6]^{3-}$, $[\text{Mn}(\text{CN})_6]^{3-}$, $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, $[\text{MnCl}_6]^{3-}$ and $[\text{CoF}_6]^{3-}$, which involved d^2sp^3 hybridization is

Mathematics
Section-A

51. $\lim_{x \rightarrow 0^+} \frac{\tan\left(5(x)^{\frac{1}{3}}\right) \log_e(1+3x^2)}{(\tan^{-1} 3\sqrt{x})^2 \left(e^{5(x)^{\frac{4}{3}}}-1\right)}$ is equal to.

- (a) $\frac{1}{15}$ (b) 1
(c) $\frac{1}{3}$ (d) $\frac{5}{3}$

52. If the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x}{1} = \frac{y}{\alpha} = \frac{z-5}{1}$ is $\frac{5}{\sqrt{6}}$, then the sum of all possible values of α is.

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

53. Let $x = -1$ and $x = 2$ be the critical points of the function $f(x) = x^3 + ax^2 + b \log_e |x| + 1$, $x \neq 0$. Let m and M respectively be the absolute minimum and the absolute maximum values of f in the interval $\left[-2, -\frac{1}{2}\right]$. Then $|M + m|$ is equal to

(Take $\log_e 2 = 0.7$):

- (a) 21.1 (b) 19.8
(c) 22.1 (d) 20.9

54. The remainder when $((64)^{(64)})^{(64)}$ is divided by 7 is equal to.

- (a) 4 (b) 1
(c) 3 (d) 6

55. Let P be the parabola, whose focus is $(-2, 1)$ and directrix is $2x + y + 2 = 0$. Then the sum of the ordinates of the points on P , whose abscissa is -2, is.

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

56. Let $y = y(x)$ be the solution curve of the differential equation $x(x^2 + e^x)dy + (e^x(x - 2)y - x^3)dx = 0$, $x > 0$ passing through the point $(1, 0)$. Then $y(2)$ is equal to :

- (a) $\frac{4}{4-e^2}$ (b) $\frac{2}{2+e^2}$
(c) $\frac{2}{2-e^2}$ (d) $\frac{4}{4+e^2}$

57. From a group of 7 batsmen and 6 bowlers, 10 players are to be chosen for a team, which should include atleast 4 batsmen and atleast 4 bowlers. One batsmen and one bowler who are captain and vice-captain respectively of the team should be included. Then the total number of ways such a selection can be made, is.

- (a) 165 (b) 155
(c) 145 (d) 135

58. If for $\theta \in \left[-\frac{\pi}{3}, 0\right]$, the points $(x, y) = \left(3 \tan\left(\theta + \frac{\pi}{3}\right), 2 \tan\left(\theta + \frac{\pi}{6}\right)\right)$ lie on $xy + \alpha x + \beta y + \gamma = 0$, then $\alpha^2 + \beta^2 + \gamma^2$ is equal to :

- (a) 80 (b) 72
(c) 96 (d) 75

59. Let C_1 be the circle in the third quadrant of radius 3, that touches

both coordinate axes. Let C_2 be the circle with centre $(1, 3)$ that touches C_1 externally at the point (α, β) . If $(\beta - \alpha)^2 = \frac{m}{n}$, $\gcd(m, n) = 1$, then $m + n$ is equal to :

- (a) 9 (b) 13
(c) 22 (d) 31

60. The integral $\int_0^{\pi} \frac{(x+3)\sin x}{1+3\cos^2 x} dx$ is equal to :

- (a) $\frac{\pi}{\sqrt{3}}(\pi + 1)$
(b) $\frac{\pi}{\sqrt{3}}(\pi + 2)$

(c) $\frac{\pi}{3\sqrt{3}}(\pi + 6)$

(d) $\frac{\pi}{2\sqrt{3}}(\pi + 4)$

61. Among the statements

(S1) : The set $\{z \in \mathbb{C} - \{-i\} : |z| = 1 \text{ and } \frac{z-i}{z+i} \text{ is purely real}\}$ contains exactly two elements, and

(S2) : The set $\{z \in \mathbb{C} - \{-1\} : |z| = 1 \text{ and } \frac{z-1}{z+1} \text{ is purely imaginary}\}$ contains infinitely many elements.

(a) both are incorrect

(b) only (S1) is correct

(c) only (S2) is correct

(d) both are correct

62. The mean and standard deviation of 100 observations are 40 and 5.1,

respectively, By mistake one observation is taken as 50 instead of 40. If the correct mean and the correct standard deviation are μ and σ respectively, then $10(\mu + \sigma)$ is equal to.

(a) 445

(b) 451

(c) 447

(d) 449

63. Let x_1, x_2, x_3, x_4 be in a geometric progression. If 2, 7, 9, 5 are subtracted

respectively from x_1, x_2, x_3, x_4 then the resulting numbers are in an arithmetic progression. Then the value of

$\frac{1}{24}(x_1 x_2 x_3 x_4)$ is :

(a) 72

(b) 18

(c) 36

(d) 216

64. Let the set of all values of $p \in \mathbb{R}$, for which both the roots of the

equation $x^2 - (p+2)x + (2p+9) = 0$ are negative real numbers, be the interval $(\alpha, \beta]$. Then $\beta - 2\alpha$ is equal to.

(a) 0

(b) 9

(c) 5

(d) 20

65. Let A be a 3×3 matrix such that $|\text{adj}(\text{adj}(\text{adj}A))| = 81$. If

$$S = \left\{ n \in \mathbb{Z} : (|\text{adj}(\text{adj}A)|)^{\frac{(n-1)^2}{2}} = |A|^{(3n^2-5n-4)} \right\}$$

then $\sum_{n \in S} |A^{(n^2+n)}|$ is equal to.

(a) 866

(b) 750

(c) 820

(d) 732

66. If the area of the region bounded by the curves $y = 4 - \frac{x^2}{4}$ and $y = \frac{x-4}{2}$ is equal to α , then 6α equals.

(a) 250

(b) 210

(c) 240

(d) 220

67. Let the system of equations:

$$2x + 3y + 5z = 9$$

$$7x + 3y - 2z = 8$$

$$12x + 3y - (4 + \lambda)z = 16 - \mu$$

have infinitely many solutions. Then the radius of the circle centred at (λ, μ) and touching the line $4x = 3y$ is.

(a) $\frac{17}{5}$

(b) $\frac{7}{5}$

(c) 7

(d) $\frac{21}{5}$

68. Let the line L pass through $(1, 1, 1)$ and intersect the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$

and $\frac{x-3}{1} = \frac{y-4}{2} = \frac{z}{1}$. Then, which of the following points lies on the line L ?

(a) (4, 22, 7)

(b) (5, 4, 3)

(c) (10, -29, -50)

(d) (7, 15, 13)

69. Let the angle θ , $0 < \theta < \frac{\pi}{2}$ between two unit vectors $\hat{a}$ and $\hat{b}$ be $\sin^{-1}\left(\frac{\sqrt{65}}{9}\right)$. If the

vector $\vec{c} = 3\hat{a} + 6\hat{b} + 9(\hat{a} \times \hat{b})$, then the value of $9(\vec{c} \cdot \hat{a}) - 3(\vec{c} \cdot \hat{b})$ is.

- (a) 31 (b) 27
(c) 29 (d) 24

70. Let ABC be the triangle such that the equations of lines AB and AC be $3y - x = 2$ and $x + y = 2$, respectively, and the points B and C lie on x -axis. If P is the orthocentre of the triangle ABC , then the area of the triangle PBC is equal to.

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

Section-B

71. The number of points of discontinuity of the function $f(x) = \left[\frac{x^2}{2}\right] - [\sqrt{x}]$, $x \in [0, 4]$,

where $[\cdot]$ denotes the greatest integer function is

72. The number of relations on the set $A = \{1, 2, 3\}$ containing at most 6 elements including $(1, 2)$, which are reflexive and transitive but not symmetric, is .

73. Consider the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ having one of its focus at $P(-3, 0)$. If the latus rectum

through its other focus subtends a right angle at P and $a^2 b^2 = \alpha\sqrt{2} - \beta$, $\alpha, \beta \in \mathbb{N}$.

74. The number of singular matrices of order 2, whose elements are from the set $\{2, 3, 6, 9\}$ is.

75. For $n \geq 2$, let S_n denote the set of all subsets of $\{1, 2, \dots, n\}$ with no two consecutive numbers. For example $\{1, 3, 5\} \in S_6$, but $\{1, 2, 4\} \notin S_6$. Then $n(S_5)$ is equal to

