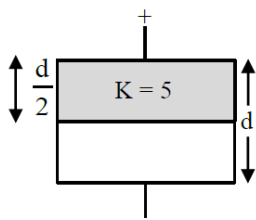


PHYSICS

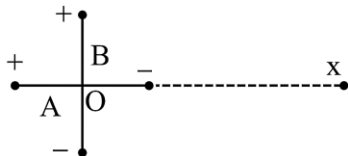
SECTION-A

1. The dimensional formula of $\frac{1}{2} \epsilon_0 E^2$ (ϵ_0 = permittivity of vacuum and E = electric field) is $M^a L^b T^c$. The value of $2a - b + c =$ ____ .
 (a) 0 (b) 1
 (c) -1 (d) 2
2. The diameter of a wire measured by a screw gauge of least count 0.001 cm is 0.08 cm . The length measured by a scale of least count 0.1 cm is 150 cm . When a weight of 100 N is applied to the wire, the extension in length is 0.5 cm , measured by a micrometer of least count 0.001 cm . The error in the measured Young's modulus is $\alpha \times 10^9$ N/m². The value of α is ____ . (Ignore the contribution of the load to Young's modulus error calculation)
 (a) 1.3 (b) 1.65
 (c) 0.13 (d) 0.25
3. The velocity of a particle is given as $\vec{v} = -x\hat{i} + 2y\hat{j} - z\hat{k}$ m/s. The magnitude of acceleration at point (1, 2, 4) is ____ m/s².
 (a) $\sqrt{6}$ (b) 9
 (c) $\sqrt{33}$ (d) 0
4. The position of an object having mass 0.1 kg as a function of time t is given as $\vec{r} = (10t^2\hat{i} + 5t^3\hat{j})$ m. At $t = 1$ s, which of the following statements are correct?
 (A) The linear momentum $\vec{p} = (2\hat{i} + 1.5\hat{j})$ kg · m/s.
 (B) The force acting on the object $\vec{F} = (2\hat{i} + 3\hat{j})$ N.
 (C) The angular momentum of the object about its origin $\vec{L} = 15\hat{k}$ Js.
 (D) The torque acting on the object about its origin $\vec{\tau} = 20\hat{k}$ Nm.
 Choose the correct answer from the option given below.
 (a) (A), (B) and (C) only
 (b) (B), (C) and (D) only
 (c) (A), (C) and (D) only
 (d) (A), (B) and (D) only
5. A planet (P_1) is moving around the star of mass $2M$ in the orbit of radius R . Another planet (P_2) is moving around another star of mass $4M$ in a orbit of radius $2R$. Ratio of time periods of revolution of P_2 and P_1 is ____ .
 (a) $\frac{1}{2}$ (b) 2
 (c) 4 (d) $\frac{1}{4}$
6. A particle is rotating in a circular path and at any instant its motion can be described as $\theta = \frac{5t^4}{40} - \frac{t^3}{3}$. The angular acceleration of the particle after 10 seconds is ____ rad/s².
 (a) 150 (b) 120
 (c) 130 (d) 170
7. A parallel plate air capacitor has a capacitance C . When it is half filled as show in figure with a dielectric constant $K = 5$, the percentage increase in the capacitance is ____ .



- (a) 33.34 (b) 66.67
 (c) 200 (d) 400

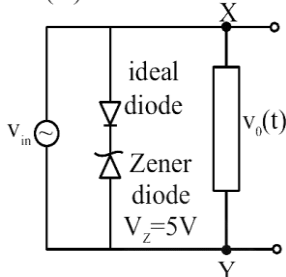
8. Heat is supplied to a diatomic gas at constant pressure. Then the ratio of $\Delta Q : \Delta U : \Delta W$ is ____ .
 (a) 2:3:5 (b) 5:3:2
 (c) 2:5:7 (d) 7:5:2
9. Two charged conducting spheres S_1 and S_2 of radii 8 cm and 18 cm are connected to each other by a wire. After equilibrium is established, the ratio of electric fields on S_1 and S_2 spheres are E_{S1} and E_{S2} respectively. The value of $\frac{E_{S1}}{E_{S2}}$ is ____ .
 (a) $\frac{3}{2}$ (b) $\frac{2}{3}$
 (c) $\frac{4}{9}$ (d) $\frac{9}{4}$
10. The equation of a plane progressive wave is given by $y = 5\cos\pi\left(200t - \frac{x}{150}\right)$ where x and y are in cm and t is in second. The velocity of the wave is ____ m/s
 (a) 120 (b) 150
 (c) 200 (d) 300
11. Two short electric dipoles A and B having dipole moment p_1 and p_2 respectively are placed with their axis mutually perpendicular as shown in the figure. The resultant electric field at a point x is making an angle of 60° with the line joining points O and x. The ratio of the dipole moments p_2/p_1 is ____ .



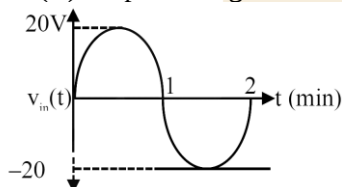
- (a) $\frac{\sqrt{3}}{2}$ (b) $2\sqrt{3}$
 (c) $\frac{1}{\sqrt{3}}$ (d) $\sqrt{3}$

12. For the given circuit (shown in part (A)) the time dependent input voltage $v_{in}(t)$ and corresponding output $v_0(t)$ are shown in part (B) and part (C), respectively. Identify the components that are used in the circuit between points X and Y .

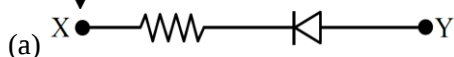
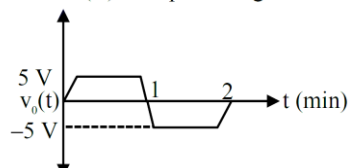
(A) Circuit used

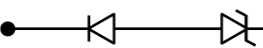
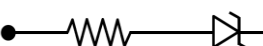
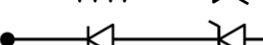


Part(B) : Input voltage



Part(C) : Output voltage

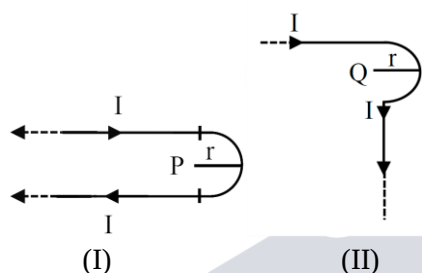


- (b) X  Y
- (c) X  Y
- (d) X  Y

13. When a coil is placed in a time dependent magnetic field the power dissipated in it is P . The number of turns, area of the coil and radius of the coil wire are N , A and r respectively. For a second coils number of turns, area of the coil and radius of the coil wire are $2N$, $2A$ and $3r$ respectively. When the first coil is replaced with second coil the power dissipated in it is $\sqrt{2}\alpha P$. The value of α is ____.

- (a) 36 (b) $128\sqrt{2}$
(c) 16 (d) 64

14. Two identical long current carrying wires are bent into the shapes shown in the following figures. If the magnitude of magnetic fields at the centers P and Q of a semicircular arc are B_1 and B_2 respectively, then the ratio $\frac{B_1}{B_2}$ is ____.

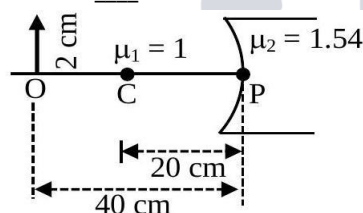


- (a) $\frac{2+\pi}{1+\pi}$ (b) $\frac{1+\pi}{1-\pi}$
(c) $\frac{2+\pi}{1-\pi}$ (d) $\frac{1+\pi}{2-\pi}$

15. For a thin symmetric prism made of glass (refractive index 1.5), the ratio of incident angle and minimum deviation will be ____.

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

16. Refer the figure given below. μ_1 and μ_2 are refractive indices of air and lens material. The height of image will be ____ cm.



- (a) 1 (b) 0.5
(c) 1.2 (d) 0.25

17. For a certain metal, when monochromatic light of wavelength λ is incident, the stopping potential for photoelectrons is $3V_0$. When the same metal is illuminated by light of wavelength 2λ , then the stopping potential becomes V_0 . The threshold wavelength for photoelectric emission for the given metal is $\alpha\lambda$. The value of α is ____.

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

18. An electromagnetic wave travelling in x -direction is described by field equation $E_y = 300\sin\omega\left(t - \frac{x}{c}\right)$. If the electron is restricted to move in y -direction only with speed of 1.5×10^6 m/s then ratio of maximum electric and magnetic forces acting on the electron is ____.

- (a) 200 (b) 150
(c) 400 (d) 300

19. Angular momentum of an electron in a hydrogen atom is $\frac{3h}{\pi}$, then the energy of the electron is ____ eV .
 (a) -1.51 (b) -0.85
 (c) -0.38 (d) -0.28
20. A liquid drop of diameter 2 mm breaks into 512 droplets. The change in surface energy is $\alpha \times 10^{-6}$ J. The value of α is ____ . (Take surface tension of liquid = 0.08 N/m)
 (a) 10 (b) 7
 (c) 8 (d) 11

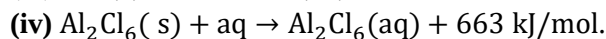
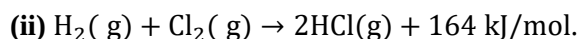
SECTION-B

21. In single slit diffraction pattern, the wavelength of light used is 628 nm and slit width is 0.2 mm , the angular width of central maximum is $\alpha \times 10^{-2}$ degrees. The value of α is ____ .
22. A vessel contains 0.15 m³ of a gas at pressure 8 bar and temperature 140°C with $c_p = 3R$ and $c_v = 2R$. It is expanded adiabatically till pressure falls to 1 bar. The work done during this process is ____ k J . (R is gas constant)
23. 1 μ C charge moving with velocity $\vec{v} = (\hat{i} - 2\hat{j} + 3\hat{k})$ m/s in the region of magnetic field $\vec{B} = (2\hat{i} + 3\hat{j} - 5\hat{k})$ T. The magnitude of force acting on it is $\sqrt{\alpha} \times 10^{-6}$ N. The value of α is ____ .
24. A uniform wire of length l of weight w is suspended from the roof with a weight of W at the other end. The stress in the wire at $\frac{l}{3}$ distance from the top is $\left(\frac{W}{A} + \frac{2w}{\gamma A}\right)$, where, A is the cross-sectional area of the wire. The value of γ is ____ .
25. A tube is filled with water and a wooden cube 10 cm $\times$ 10 cm $\times$ 10 cm is placed in the water. The wooden cube is found to float on the water with a part of it submerged in water. When a metal coin is placed on the wooden cube, the submerged part is increased by 3.87 cm . The mass of the metal coin is ____ gram. (Take water density as 1 g/cm³ and density of wood as 0.4 g/cm³)

CHEMISTRY

SECTION-A

26. The mass of iron converted into Fe₃O₄ by the action of 18 g of steam is :
 (Given : Molar mass of H, O and Fe are 1, 16 and 56 g mol⁻¹ respectively)
 Assume iron is present in excess :
 (a) 2.1 g (b) 4.2 g
 (c) 21 g (d) 42 g
27. What is the energy (in J atom⁻¹) required for the following process?
 $\text{Li}^{2+}(\text{g}) \rightarrow \text{Li}^{3+}(\text{g}) + \text{e}^-$ (Take the ionization energy for the H atom in the ground state as 2.18×10^{-18} J⁻¹ atom⁻¹)
 (a) 8.72×10^{-18}
 (b) 1.962×10^{-18}
 (c) 1.962×10^{-17}
 (d) 6.54×10^{-17}
28. Given below are two statements :
Statement (I) : The correct sequence of bond lengths in the following species is :
 $\text{O}_2^+ < \text{O}_2 < \text{O}_2^- < \text{O}_2^{2-}$
Statement (II) : The correct sequence of number of unpaired electrons in the following species is :
 $\text{O}_2 > \text{O}_2^+ > \text{O}_2^- > \text{O}_2^{2-}$
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
29. Consider the following data
 (i) $2\text{Al}(\text{s}) + 6\text{HCl}(\text{aq}) \rightarrow \text{Al}_2\text{Cl}_6(\text{aq}) + 3\text{H}_2(\text{g}) + 1200 \text{ kJ/mol}$.



The enthalpy of formation of anhydrous solid Al_2Cl_6 is :

- (a) -648 kJ mol^{-1}
 (b) $-1350 \text{ kJ mol}^{-1}$
 (c) $-2002 \text{ kJ mol}^{-1}$
 (d) $-1527 \text{ kJ mol}^{-1}$

30. 19.5 g of fluoro acetic acid (molar mass = 78 g mol^{-1}) is dissolved in 500 g of water at 298 K. The depression in the freezing point of water was 1°C . What is K_a of fluoro acetic acid ?

(For water, $K_f = 1.86 \text{ K kg mol}^{-1}$). Assume molarity and molality to have same values.

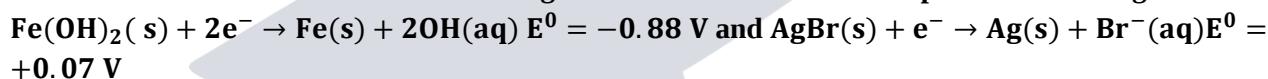
- (a) 10^{-6} (b) 4×10^{-4}
 (c) 3×10^{-5} (d) 3×10^{-3}

31. The solubility product constants of Ag_2CrO_4 and AgBr are $32x$ and $4y$ respectively at 298 K.

The value of $\left(\frac{\text{molarity of } \text{Ag}_2\text{CrO}_4}{\text{molarity of } \text{AgBr}}\right)$ can be expressed as :

- (a) $\frac{2\sqrt[3]{x}}{y}$ (b) $2\sqrt{\frac{x}{y}}$
 (c) $\sqrt{\frac{x}{y}}$ (d) $\frac{\sqrt[3]{x}}{\sqrt{y}}$

32. An electrochemical cell is constructed using half cells in the direction of spontaneous change



Which of the following option is correct?

- (a) Overall reaction $\text{Fe}(\text{s}) + 2\text{OH}^-(\text{aq}) + 2\text{AgBr}(\text{s}) \rightleftharpoons \text{Fe}(\text{OH})_2(\text{s}) + 2\text{Ag}(\text{s}) + 2\text{Br}^-(\text{aq})$
 (b) $E_{\text{cell}}^0 = -0.95 \text{ V}$
 (c) Fe is reduced in the electrochemical cell
 (d) E_{cell}^0 is an extensive property

33. $t_{100\%}$ is the time required for the 100% completion of the reaction while $t_{1/2}$ is the time required for 50% of the reaction to be completed. Which of the following option correctly represents the relation between $t_{100\%}$ and $t_{1/2}$ for zero and first order reactions respectively?

- (a) $t_{100\%} = (t_{1/2})^2$ and $t_{100\%} = (t_{1/2})^{-\infty}$
 (b) $t_{100\%} = 2t_{1/2}$ and $t_{100\%} = (t_{1/2})^{\infty}$
 (c) $t_{100\%} = 2t_{1/2}$ and $t_{100\%} = (2t_{1/2})^2$
 (d) $t_{100\%} = (t_{1/2})^{\infty}$ and $t_{100\%} = 2t_{1/2}$

34. Given below are two statements :

Statement (I) : The first ionisation enthalpy of the elements Na, Mg, Cl and Ar follows the order $\text{Na} > \text{Mg} > \text{Cl} > \text{Ar}$

Statement (II) : Among Ca, Al, Fe and B, the third ionisation enthalpy is very high for Ca.

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

35. Given below are two statements :

Statement (I) : Oxidising power of halogens decreases in the order $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$, which is the basis of "Layer test".

Statement (II) : "Layer test" to identify Br_2 and I_2 in aqueous solution involves the oxidation of bromide or iodide into Br_2 or I_2 respectively with Cl_2 , which is a type of displacement redox reaction.

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

36. Which of the following sets includes all the species that will change the orange colour of $K_2Cr_2O_7$ in acidic medium?

- (a) Fe^{2+} , Sn^{2+} , I^- , S^{2-}
- (b) S^{2-} , Fe^{3+} , I^- , $C_2O_4^{2-}$
- (c) Fe^{2+} , NO_2^- , SO_2 , Sn^{4+}
- (d) Fe^{3+} , SO_4^{2-} , S^{2-} , Sn^{4+}

37. Match List - I with List - II.

List - I	List - II
Chromium (III) Complexes (en = ethylene diamine)	$\Delta_0 (cm^{-1})$
(A) $[Cr(CN)_6]^{3-}$	(I) 15,060
(B) $[CrF_6]^{3-}$	(II) 17,400
(C) $[Cr(H_2O)_6]^{3+}$	(III) 22,300
(D) $[Cr(en)_3]^{3+}$	(IV) 26,600

Choose the correct answer from the options given below :

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

38. Given below are two statements :

Statement (I) : 1,2,3-Trihydroxypropane can be separated from water by simple distillation.

Statement (II) : An azeotropic mixture cannot be separated by fractional distillation.

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

39. Given below are two statements :

Statement (I) : Benzyl chloride reacts faster in S_N1 mechanism than ethyl chloride.

Statement (II) : Ethyl carbocation intermediate is less stabilized by hyperconjugation than benzyl carbocation by resonance.

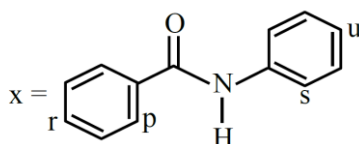
In the light of the above statements, choose the correct answer from the options given below :

- (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

40. In IUPAC nomenclature, the correct order of decreasing priority of functional group is :

- (a) $-CONH_2$, $>C=O$, $-CHO$, $-NH_2$, $-C \equiv C-$
- (b) $-CONH_2$, $-COOCH_3$, $-CHO$, $-NH_2$, $-OH$
- (c) $-CONH_2$, $-CHO$, $>C=O$, $-NH_2$, $-C \equiv C-$
- (d) $-CONH_2$, $-CHO$, $-CN$, $-NH_2$, $-C \equiv C-$

41. For the given molecule, "x", the preferred site for the attack of the electrophile is :



- (a) Predominantly at "r"
- (b) "r" and "u"

- (c) "p" and "s"
(d) Predominantly at "u"

42. Match List-I with List-II.

List-I

Mixture of Compounds

- (A) Diethyl amine + Ethyl amine
(B) Acetaldehyde + Acetone
(C) Ethanol + Phenol
(D) Benzoic acid + Cinnamic acid

List-II

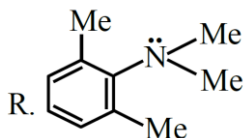
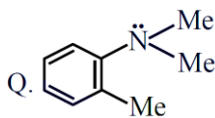
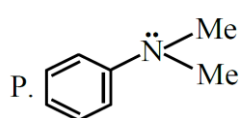
Reagent used to distinguish

- (I) Bromine water
(II) $\text{CHCl}_3 + \text{KOH}, \Delta$
(III) Neutral FeCl_3
(IV) Ammoniacal silver nitrate

Choose the correct answer from the options given below :

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

43. Consider the three aromatic molecules (P, Q and R) whose structures have been given below :



The correct order regarding the reactivity of these compounds with $\text{Ph} - \text{N} \equiv \text{NCl}^{(-)}$ under optimum but (+) slightly acidic medium is :

- (a) $P > Q > R$
(b) $R > P > Q$
(c) $R > Q > P$
(d) $P > R > Q$

44. Match List-I with List-II.

List-I

Vitamin

- (A) Vitamin B_1
(B) Vitamin B_2
(C) Vitamin B_6
(D) Vitamin C

List-II

Name

- (I) Pyridoxine
(II) Ascorbic acid
(III) Thiamine
(IV) Riboflavin

Choose the correct answer from the options given below :

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

45. A salt with few drops of conc. HCl gives apple green colour in flame test. The group precipitate of the salt is dissolved in acetic acid and treated with K_2CrO_4 to give yellow precipitate. When the sodium carbonate extract of the salt solution is heated with conc. HNO_3 and ammonium molybdate, it resulted a canary yellow precipitate. The cation and anion present in the salt are respectively.

- (a) Ca^{2+} and SO_4^{2-}
(b) Ba^{2+} and PO_4^{3-}
(c) Mn^{2+} and PO_4^{3-}
(d) Ba^{2+} and SO_4^{2-}

SECTION-B

46. 5.33 g of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$, which is a 1:3 electrolyte, is dissolved in water and is passed through a cation exchanger. The chloride ions in the eluted solution, on treatment with AgNO_3 , results in 8.61 g of AgCl . The ratio of moles of complex reacted and moles of AgCl formed is $___ \times 10^{-2}$. (Nearest integer) [Molar mass in gmol^{-1} : Cr: 52, Ag: 108, Cl: 35.5, H: 1, O: 16]

47. Consider the isomers of hydrocarbon with molecular formula C_5H_{10} . These isomers do not decolourise $KMnO_4$ solution. These isomers are subjected to chlorination with chlorine in presence of light to give monochloro compounds. The total number of monochloro compounds (structural isomers only) formed is ____.
48. One mole of an alkane (x) requires 8 mole oxygen for complete combustion. Sum of number of carbon and hydrogen atoms in the alkane (x) is ____.
49. For reaction $A \rightarrow P$, rate constant $k = 1.5 \times 10^3 s^{-1}$ at $27^\circ C$. If activation energy for the above reaction is $60 kJ mol^{-1}$, then the temperature (in $^\circ C$) at which rate constant, $k = 4.5 \times 10^3 s^{-1}$ is ____ . (Nearest integer)
Given : $\log 2 = 0.30, \log 3 = 0.48, R = 8.3 J K^{-1} mol^{-1}, \ln 10 = 2.3$
50. At the transition temperature $T, A \rightleftharpoons B$ and $\Delta G^0 = 105 - 35 \log T$ where A and B are two states of substance X. The transition temperature in $^\circ C$ when pressure is 1 atm is ____ . (Nearest integer)

MATHEMATICS

SECTION-A

51. Let $\alpha, \alpha + 2, \alpha \in \mathbb{Z}$, be the roots of the quadratic equation $x(x + 2) + (x + 1)(x + 3) + (x + 2)(x + 4) + \dots + (x + n - 1)(x + n + 1) = 4n$ for some $n \in \mathbb{N}$. Then $(n + \alpha)$ is equal to :
- (a) 0 (b) 1
(c) 2 (d) 3
52. Let x and y be real number such that $50 \left(\frac{2x}{1+3i} - \frac{y}{1-2i} \right) = 31 + 17i, i = \sqrt{-1}$. Then the value of $10(x - 3y)$ is :
- (a) 20 (b) 31
(c) 35 (d) 75
53. Let $\alpha, \beta \in \mathbb{R}$ be such that the system of linear equations
- $$\begin{aligned} x + 2y + z &= 5 \\ 2x + y + \alpha z &= 5 \\ 8x + 4y + \beta z &= 18 \end{aligned}$$
- has no solution. Then $\frac{\beta}{\alpha}$ is equal to :
- (a) -4 (b) 4
(c) 8 (d) -8
54. Let $A = \begin{bmatrix} 1 & 2 \\ 1 & \alpha \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 3 \\ \beta & 2 \end{bmatrix}$.
If $A^2 - 4A + I = 0$ and $B^2 - 5B - 6I = 0$, then among the two statements :
- (S1) : $[(B - A)(B + A)]^T = \begin{bmatrix} 13 & 15 \\ 7 & 10 \end{bmatrix}$ and (S2) : $\det(\text{adj}(A + B)) = -5$,
- (a) only (S1) is correct
(b) only (S2) is correct
(c) both (S1) and (S2) are correct
(d) both (S1) and (S2) are wrong
55. Let A be the set of first 101 terms of an A.P., whose first term is 1 and the common difference is 5 and let B be the set of first 71 terms of an A.P., whose first term is 9 and the common difference is 6. Then the number of elements is $A \cap B$, which are divisible by 3, is :
- (a) 4 (b) 5
(c) 6 (d) 7
56. The number of seven-digit numbers, that can be formed by using the digits 1, 2, 3, 5 and 7 such that each digit is used at least once, is ;
- (a) 15400 (b) 17800
(c) 16800 (d) 29400
57. The number of elements in the set $S = \{(r, k) : k \in \mathbb{Z} \text{ and } {}^{36}C_{r+1} = \frac{6({}^{35}C_r)}{(k^2 - 3)}\}$, is
- (a) 2 (b) 4
(c) 8 (d) 16

58. If the mean of the data is 21, then k is one of the roots of the equation :

Class	Frequency
5 – 10	2
10 – 15	k
15 – 20	28
20 – 25	54
25 – 30	$k + 1$
30 – 35	5

- (a) $2x^2 - 23x - 10 = 0$
 (b) $4x^2 - 35x + 24 = 0$
 (c) $2x^2 - 19x - 10 = 0$
 (d) $2x^2 - 35x + 98 = 0$

59. Let the mid points of the sides of a triangle ABC be $(\frac{5}{2}, 7)$, $(\frac{5}{2}, 3)$ and $(4, 5)$. If its incentre is (h, k) , then $3h + k$ is equal to :

- (a) 11 (b) 12
 (c) 13 (d) 14

60. Let an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a < b$, pass through the point $(4, 3)$ and have eccentricity $\frac{\sqrt{5}}{3}$. Then the length of its latus rectum is :

- (a) $\frac{4\sqrt{5}}{3}$ (b) $2\sqrt{5}$
 (c) $\frac{7\sqrt{5}}{3}$ (d) $\frac{8\sqrt{5}}{3}$

61. If $\sin\left(\frac{\pi}{18}\right) \sin\left(\frac{5\pi}{18}\right) \sin\left(\frac{7\pi}{18}\right) = K$, then the value of $\sin\left(\frac{10K\pi}{3}\right)$ is :

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

62. Let $S = \{x \in [-\pi, \pi] : \sin x(\sin x + \cos x) = a, a \in \mathbb{Z}\}$. Then $n(S)$ is equal to :

- (a) 3 (b) 6
 (c) 7 (d) 9

63. If the point of intersection of the lines $\frac{x+1}{3} = \frac{y+a}{5} = \frac{z+b+1}{7}$ and $\frac{x-2}{1} = \frac{y-b}{4} = \frac{z-2a}{7}$ lies on xy -plane, then the value of $a + b$ is :

- (a) 2 (b) 5
 (c) 7 (d) 9

64. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}| = 2$ and $|\vec{b}| = 3$, then the maximum value of $3|(3\vec{a} + 2\vec{b})| + 4|(3\vec{a} - 2\vec{b})|$ is :

- (a) 30 (b) 36
 (c) 60 (d) 72

65. Let a line L passing through the point $(1, 1, 1)$ be perpendicular to both the vectors $2\hat{i} + 2\hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + \hat{k}$. If $P(a, b, c)$ is the foot of perpendicular from the origin on the line L , then the value of $34(a + b + c)$ is :

- (a) 50 (b) 80
 (c) 100 (d) 120

66. If $\lim_{x \rightarrow 2} \frac{\sin(x^3 - 5x^2 + ax + b)}{(\sqrt{x} - 1)\log_e(x - 1)} = m$, then $a + b + m$ is equal to:

- (a) 5 (b) 6
 (c) 8 (d) 10

67. If the curve $y = f(x)$ passes through the point $(1, e)$ and satisfies the differential equation $dy = y(2 + \log_e x)dx$, $x > 0$, then $f(e)$ is equal to :

- (a) e^e (b) e^{e^2}
(c) e^{2e} (d) e^{2^e}

68. The number of critical points of the function $f(x) = \begin{cases} \left| \frac{\sin x}{x} \right|, & x \neq 0 \\ 1, & x = 0 \end{cases}$ in the interval $(-2\pi, 2\pi)$ is equal to:

- (a) 1 (b) 3
(c) 5 (d) 7

69. Let $[.]$ denote the greatest integer function. Then the value of $\int_0^3 \left(\frac{e^x + e^{-x}}{[x]!} \right) dx$ is:

- (a) $e^2 + e^3 - \frac{1}{e^2} - \frac{1}{e^3}$
(b) $\frac{1}{2} \left(e^2 + e^3 - \frac{1}{e^2} - \frac{1}{e^3} \right)$
(c) $e^2 + e^3 - \frac{1}{2e^2} - \frac{1}{2e^3}$
(d) $\frac{1}{2} (e^2 + e^3) - \frac{1}{e^2} - \frac{1}{e^3}$

70. Let $y = y(x)$ be the solution curve of the differential equation $(1 + \sin x) \frac{dy}{dx} + (y + 1) \cos x = 0, y(0) = 0$.

If the curve $y = y(x)$ passes through the point $\left(\alpha, \frac{-1}{2} \right)$, then a value of α is :

- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

SECTION-B

71. If the domain of the function $f(x) = \sqrt{\log_{(0.6)} \left(\left| \frac{2x-5}{x^2-4} \right| \right)}$ is $(-\infty, a] \cup \{b\} \cup [c, d) \cup (e, \infty)$, then the value of $a + b + c + d + e$ is ____.

72. If $\sum_{k=1}^n a_k = 6n^3$, then $\sum_{k=1}^6 \left(\frac{a_{k+1} - a_k}{36} \right)^2$ is equal to ____.

73. Let $a, b, c \in \{1, 2, 3, 4\}$. If the probability, that $ax^2 + 2\sqrt{2}bx + c > 0$ for all $x \in \mathbb{R}$, is $\frac{m}{n}$, $\gcd(m, n) = 1$, then $m + n$ is equal to ____.

74. Let a circle C have its center in the first quadrant, intersect the coordinate axes at exactly three points and cut off equal intercepts from the coordinate axes. If the length of the chord of C on the line $x + y = 1$ is $\sqrt{14}$, then the square of the radius of C is ____.

75. If $\alpha = \int_0^{2\sqrt{3}} \log_2(x^2 + 4) dx + \int_2^4 \sqrt{2x - 4} dx$, then α^2 is equal to ____.