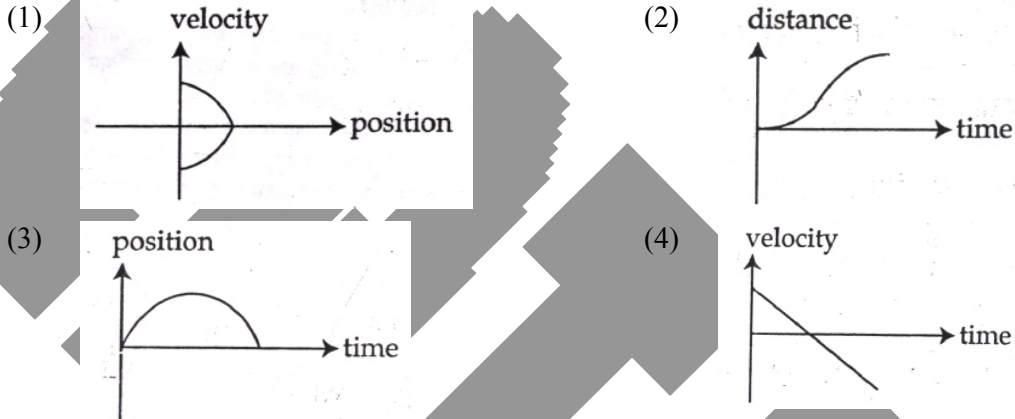


PHYSICS

1. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1%, the maximum error in determining the density is:
- (1) 2.5% (2) 3.5% (3) 4.5% (4) 6%

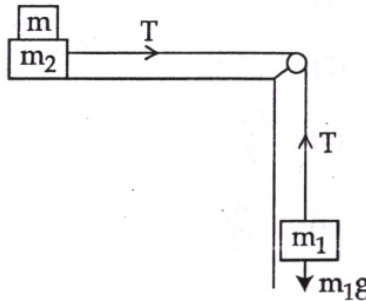
Answer key : (3)

2. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up.



Answer key : (2)

3. Two masses $m_1 = 5$ kg and $m_2 = 10$ kg, connected by an inextensible string over a frictionless pulley, are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. the minimum weight m that should be put on top of m_2 to stop the motion is:



- (1) 18.3 kg (2) 27.3 kg (3) 43.3 kg (4) 10.3 kg

Answer key : (No option correct. Correct answer = 23.33 kg)

4. A particle is moving in a circular path of radius a under the action of an attractive potential $U = -\frac{k}{2r^2}$. Its total energy is:
- (1) $-\frac{k}{4a^2}$ (2) $\frac{k}{2a^2}$ (3) Zero (4) $-\frac{3k}{2a^2}$

Answer key : (3)

5. In a collinear collision, a particle with an initial speed v_0 strikes a stationary particle of the same mass. If the final total kinetic energy is 50% greater than the original kinetic energy, the magnitude of the relative velocity between the two particles, after collision, is:

(1) $\frac{v_0}{4}$

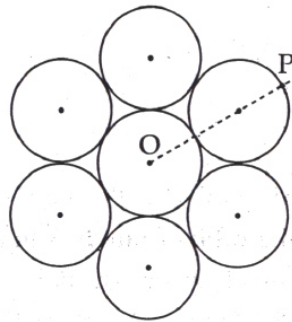
(2) $\sqrt{2} v_0$

(3) $\frac{v_0}{2}$

(4) $\frac{v_0}{\sqrt{2}}$

Answer key : (2)

6. Seven identical circular planar disks, each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point is:



(1) $\frac{19}{2}MR^2$

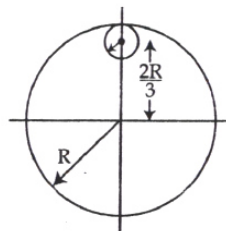
(2) $\frac{55}{2}MR^2$

(3) $\frac{73}{2}MR^2$

(4) $\frac{181}{2}MR^2$

Answer key : (4)

7. From a uniform circular disc of radius R and mass $9M$, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is:



(1) $4MR^2$

(2) $\frac{40}{9}MR^2$

(3) $10MR^2$

(4) $\frac{37}{9}MR^2$

Answer key : (1)

8. A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the n^{th} power of R . If the period of rotation of the particle is T , then:

(1) $T \propto R^{3/2}$ for any n

(2) $T \propto R^{\frac{n}{2}+1}$

(3) $T \propto R^{(n+1)/2}$

(4) $T \propto R^{n/2}$

Answer key : (3)

9. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\frac{dr}{r}\right)$, is:

(1) $\frac{Ka}{mg}$

(2) $\frac{Ka}{3mg}$

(3) $\frac{mg}{3Ka}$

(4) $\frac{mg}{Ka}$

Answer key : (3)

10. Two moles of an ideal monoatomic gas occupies a volume V at 27°C . The gas expands adiabatically to a volume $2V$. Calculate (a) the final temperature of the gas and (b) change in its internal energy.

- (1) (a) 189 K (b) 2.7 KJ (2) (a) 195 K (b) -2.7 KJ
 (3) (a) 189 K (b) -2.7 KJ (4) (a) 195 K (b) 2.7 KJ

Answer key : (3)

11. The mass of a hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} hydrogen molecule strike, per second, a fixed wall of area 2 cm^2 at an angle of 45° to the normal, and rebound elastically with a speed of 10^3 m/s , then the pressure on the wall is nearly:

- (1) $2.35 \times 10^3 \text{ N/m}^2$ (2) $4.70 \times 10^3 \text{ N/m}^2$ (3) $2.35 \times 10^2 \text{ N/m}^2$ (4) $4.70 \times 10^2 \text{ N/m}^2$

Answer key : (1)

12. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of $10^{12} / \text{sec}$. What is the force constant of the bonds connecting one atom with the other? (Mole wt. of silver = 108 and Avagadro number = $6.02 \times 10^{23} \text{ gm mole}^{-1}$)

- (1) 6.4 N/m (2) 7.1 N/m (3) 2.2 N/m (4) 5.5 N/m

Answer key : (2)

13. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is $2.7 \times 10^3 \text{ kg/m}^3$ and its Young's modulus is $9.27 \times 10^{10} \text{ Pa}$. What will be the fundamental frequency of the longitudinal vibrations?

- (1) 5 kHz (2) 2.5 kHz (3) 10 kHz (4) 7.5 kHz

Answer key : (1)

14. Three concentric metal shells A, B and C of respective radii a , b and c ($a < b < c$) have surface charge densities $+\sigma$, $-\sigma$ and $+\sigma$ respectively. The potential of shell B is:

- (1) $\frac{\sigma}{\epsilon_0} \left[\frac{a^2 - b^2}{a} + c \right]$ (2) $\frac{\sigma}{\epsilon_0} \left[\frac{a^2 - b^2}{b} + c \right]$ (3) $\frac{\sigma}{\epsilon_0} \left[\frac{b^2 - c^2}{b} + a \right]$ (4) $\frac{\sigma}{\epsilon_0} \left[\frac{b^2 - c^2}{c} + a \right]$

Answer key : (2)

15. A parallel plate capacitor of capacitance 90 pF is connected to a battery of emf 20 V. If a dielectric material of dielectric constant $K = \frac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be:

- (1) 1.2 nC (2) 0.3 nC (3) 2.4 nC (4) 0.9 nC

Answer key : (1)

16. In an a.c. circuit, the instantaneous e.m.f. and current are given by

$$e = 100 \sin 30 t$$

$$i = 20 \sin \left(30 t - \frac{\pi}{4} \right)$$

In one cycle of a.c., the average power consumed by the circuit and the wattles current are, respectively.

- (1) 50, 100 (2) $\frac{1000}{\sqrt{2}}, 10$ (3) $\frac{50}{\sqrt{2}}, 0$ (4) 50, 0

Answer key : (2)

17. Two batteries with e.m.f. 12 V and 13 V are connected in parallel across a load resistor of 10 Ω . The internal resistances of the two batteries are 1 Ω and 2 Ω respectively. The voltage across the load lies between:

- (1) 11.6 V and 11.7 V (2) 11.5 V and 11.6 V (3) 11.4 V and 11.5 V (4) 11.7 V and 11.8 V

Answer key : (2)

18. An electron, a proton and an alpha particle having the same kinetic energy and moving in circular orbits or radii r_e, r_p, r_α respectively in a uniform magnetic field B. The relation between r_e, r_p, r_α is:

- (1) $r_e > r_p = r_\alpha$ (2) $r_e < r_p = r_\alpha$ (3) $r_e < r_p < r_\alpha$ (4) $r_e < r_\alpha < r_p$

Answer key : (2)

19. The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is B_1 . When the dipole moment is doubled by keeping the current constant, the magnetic field at the centre of the loop is B_2 . The ratio $\frac{B_1}{B_2}$ is:

- (1) 2 (2) $\sqrt{3}$ (3) $\sqrt{2}$ (4) $\frac{1}{\sqrt{2}}$

Answer key : (3)

20. For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exhibits resonance. The quality factor, Q is given by:

- (1) $\frac{\omega_0 L}{R}$ (2) $\frac{\omega_0 R}{L}$ (3) $\frac{R}{(\omega_0 C)}$ (4) $\frac{CR}{\omega_0}$

Answer key : (1)

21. An EM wave from air enters a medium. The electric fields are $\vec{E}_1 = E_{01} \hat{x} \cos\left[2\pi\nu\left(\frac{z}{c} - t\right)\right]$ in air and $\vec{E}_2 = E_{02} \hat{x} \cos[k(2z - ct)]$ in medium, where the wave number k and frequency ν refer to their values in air. The medium is non-magnetic. If ϵ_{r1} and ϵ_{r2} refer to relative permittivities of air and medium respectively, which of the following options is correct?

- (1) $\frac{\epsilon_{r1}}{\epsilon_{r2}} = 4$ (2) $\frac{\epsilon_{r1}}{\epsilon_{r2}} = 2$ (3) $\frac{\epsilon_{r1}}{\epsilon_{r2}} = \frac{1}{4}$ (4) $\frac{\epsilon_{r1}}{\epsilon_{r2}} = \frac{1}{2}$

Answer key : (3)

22. Unpolarized light of intensity I passes through an ideal polarizer A. Another identical polarizer B is placed behind A. The intensity of light beyond B is found to be $\frac{I}{2}$. Now another identical polarizer C is placed between A and B. The intensity beyond B is now found to be $\frac{I}{8}$. The angle between polarizer A and C is:

- (1) 0° (2) 30° (3) 45° (4) 60°

Answer key : (3)

23. The angular width of the central maximum in a single slit diffraction pattern is 60° . The width of the slit is $1\mu\text{m}$. The slit is illuminated by monochromatic plane waves. If another slit of same width is made near it, Young's fringes can be observed on a screen placed at a distance 50 cm from the slits. If the observed fringe width is 1 cm, what is the slit separation distance?

(i.e. distance between the centres of each slit).

- (1) $25\mu\text{m}$ (2) $50\mu\text{m}$ (3) $75\mu\text{m}$ (4) $100\mu\text{m}$

Answer key : (1)

24. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively.

Let Λ_n be the wavelength of the emitted photon in the transition from the n^{th} state to the ground state.

For large n , (A, B are constants)

- (1) $\Lambda_n \approx A + \frac{B}{\lambda_n^2}$ (2) $\Lambda_n \approx A + B\lambda_n$ (3) $\Lambda_n^2 \approx A + B\lambda_n^2$ (4) $\Lambda_n^2 \approx \lambda$

Answer key : (1)

25. If the series limit frequency of Lyman series is ν_L , then the series limit frequency of the Pfund series is:

- (1) $25\nu_L$ (2) $16\nu_L$ (3) $\nu_L/16$ (4) $\nu_L/25$

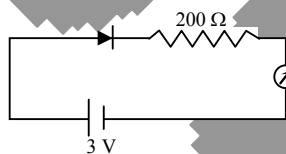
Answer key : (4)

26. It is found that a neutron suffers an elastic collinear collision with deuterium at rest, fractional loss of its energy is p_d , while for its similar collision with carbon nucleus at rest, fractional loss of energy is p_c . The values of p_d and p_c are respectively:

- (1) $(.89, .28)$ (2) $(.28, .89)$ (3) $(0, 0)$ (4) $(0, 1)$

Answer key : (1)

27. The reading of the ammeter of a silicon diode in the given circuit is:



- (1) 0 (2) 15 mA (3) 11.5 mA (4) 13.5 mA

Answer key : (3)

28. A telephonic communication service is working at carrier frequency of 10 GHz. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5 kHz?

- (1) 2×10^3 (2) 2×10^4 (3) 2×10^5 (4) 2×10^6

Answer key : (3)

29. In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across 52 cm of the potentiometer wire. If the cell is shunted by a resistance of 5Ω , a balance is found when the cell is connected across 40 cm of the wire. Find the internal resistance of the cell.

- (1) 1Ω (2) 1.5Ω (3) 2Ω (4) 2.5Ω

Answer key : (2)

30. On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10 cm. The resistance of their series combination is 1 k Ω . How much was the resistance on the left slot before interchanging the resistances?

- (1) 990 Ω (2) 505 Ω (3) 550 Ω (4) 910 Ω

Answer key : (3)

CHEMISTRY

31. The ratio of mass percent of C and H of an organic compound ($C_xH_yO_z$) is 6 : 1. If one molecule of the above compound ($C_xH_yO_z$) contains half as much oxygen as required to burn one molecule of compound C_xH_y completely to CO_2 and H_2O . The empirical formula of compound $C_xH_yO_z$ is

- (1) $C_3H_6O_3$ (2) C_2H_4O (3) $C_3H_4O_2$ (4) $C_2H_4O_3$

Answer Key[4]

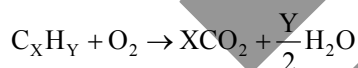
$$C_x \rightarrow 12x$$

$$H_y \rightarrow Y$$

$$O_z \rightarrow 16z$$

$$\frac{12x}{Y} = \frac{6}{1}$$

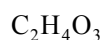
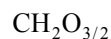
$$\Rightarrow Y = 2X$$



$$x + \frac{y}{4} \quad \text{O total} \quad \frac{2x + \frac{y}{2}}{2} = x + \frac{y}{4}$$

$$z = \frac{x + y}{4}$$

$$\therefore Y = 2X \Rightarrow z = x + \frac{x}{2} = \frac{3}{2}x$$



32. Which type of 'defect' has the presence of cation in the interstitial sites?

- (1) Schottky defect (2) Vacancy defect
(3) Frenkel defect (4) Metal deficiency defect

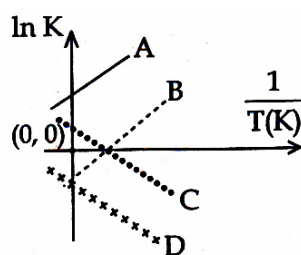
Answer Key[3]

33. According to molecular orbital theory, which of the following will not be a viable molecule?

- (1) He_2^{2+} (2) He_2^+ (3) H_2^- (4) H_2^{2-}

Answer Key[4]

34. Which of the following lines correctly show the temperature dependence of equilibrium constant, K for an exothermic reaction?



- (1) A and B (2) B and C (3) C and D (4) A and D

Answer Key[1]

35. The combustion of benzene(ℓ) gives $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\ell)$. Given that heat of combustion of benzene at constant volume is $-3263.9 \text{ kJ mol}^{-1}$ at 25°C ; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be [$R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$]

- (1) 4152.6 (2) -452.46 (3) 3260 (4) -3267.6

Answer Key[4]

36. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point?

- (1) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$ (2) $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$
 (3) $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}_2 \cdot 2\text{H}_2\text{O}$ (4) $[\text{Co}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$

Answer Key[4]

37. An aqueous solution contains $0.10 \text{ M H}_2\text{S}$ and 0.20 M HCl . If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is

- (1) 5×10^{-8} (2) 3×10^{-20} (3) 6×10^{-21} (4) 5×10^{-19}

Answer Key[2]

38. An aqueous solution contains an unknown concentration of Ba^{2+} . When 50 mL of a 1 M solution of Na_2SO_4 is added, BaSO_4 just begins to precipitate. The final volume is 500 mL . The solubility product of BaSO_4 is 1×10^{-10} . What is the original concentration of Ba^{2+} ?

- (1) $5 \times 10^{-9} \text{ M}$ (2) $2 \times 10^{-9} \text{ M}$ (3) $1.1 \times 10^{-9} \text{ M}$ (4) $1.0 \times 10^{-10} \text{ M}$

Answer Key[3]

39. At 518°C , the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 Torr , was 1.00 Torr s^{-1} when 5% had reacted and 0.5 Torr s^{-1} when 33% had reacted. The order of the reaction is

- (1) 2 (2) 3 (3) 1 (4) 0

Answer Key[1]

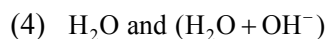
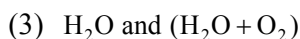
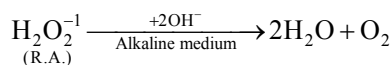
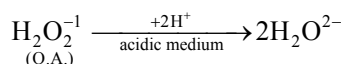
$$r = K[A]^n \rightarrow \text{Rate expression}$$

$$1 = K[0.95a]^n$$

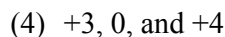
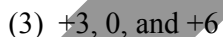
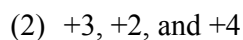
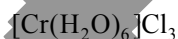
$$0.5 = K[0.67a]^n$$

$$\frac{1}{0.5} = \frac{K[0.95a]^n}{K[0.67a]^n}$$

$$\frac{10}{5} = \left(\frac{95}{67}\right)^n = (1.417)^n$$

**Answer Key [3]**

47. The oxidation states of Cr in $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$, $[\text{Cr}(\text{C}_6\text{H}_6)_2]$ and $\text{K}_2[\text{Cr}(\text{CN})_2(\text{O})_2(\text{O}_2)(\text{NH}_3)]$ respectively are

**Answer Key [3]**

$$x + 6 \times 0 - 3 = 0$$

$$x = +3$$



$$x + 2 \times 0 = 0$$

$$x = 0$$

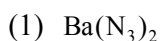
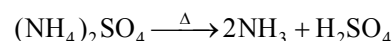


$$+2 + x - 2 - 4 - 2 + 0 = 0$$

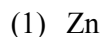
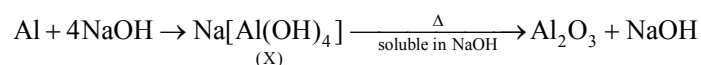
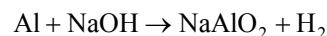
$$2 + x = 8$$

$$x = 8 - 2 = +6$$

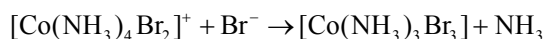
48. The compound that does not produce nitrogen gas by the thermal decomposition is

**Answer Key [4]**

49. When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is :

**Answer Key [3]**

50. Consider the following reaction and statements :



(I) Two isomers are produced if the reactant complex ion is a *cis*-isomer.

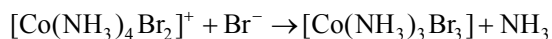
(II) Two isomers are produced if the reactant complex ion is a *trans*-isomer.

(III) Only one isomer is produced if the reactant complex ion is a *trans*-isomer.

(IV) Only one isomer is produced if the reactant complex ion is a *cis*-isomer.

The correct statements are :

- (1) (I) and (II) (2) (I) and (III) (3) (III) and (IV) (4) (II) and (IV)

Answer Key[2]

51. Glucose on prolonged heating with HI gives :

- (1) n-Hexane (2) 1-Hexene (3) Hexanoic acid (4) 6-iodohexanal

Answer Key[1]

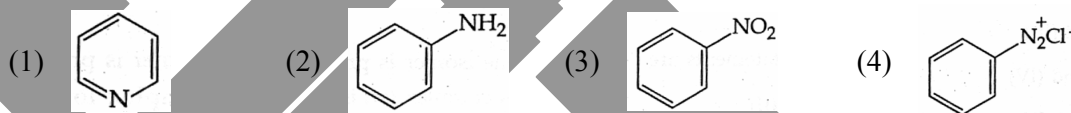
Glucose on prolonged heating with hydroiodic acid (HI)

52. The *trans*-alkenes are formed by the reduction of alkynes with :

- (1) H_2 -Pd / C, BaSO_4 (2) NaBH_4 (3) Na / liq. NH_3 (4) Sn-HCl

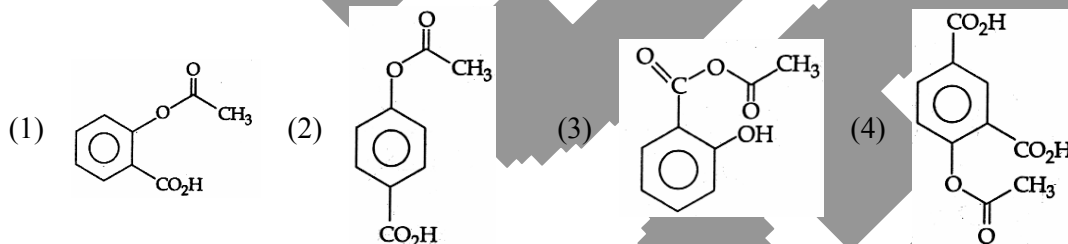
Answer Key[3]

53. Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimation?

**Answer Key[2]**

Kjeldahl method is not applicable to compounds containing nitrogen in nitro and azo groups and nitrogen present in the ring (e.g. pyridine) as nitrogen of the compounds does not change to ammonium sulphate under these conditions.

54. Phenol on treatment with CO_2 in the presence of NaOH followed by acidification produces compound X as the major product. X on treatment with $(\text{CH}_3\text{CO})_2\text{O}$ in the presence of catalytic amount of H_2SO_4 produces :

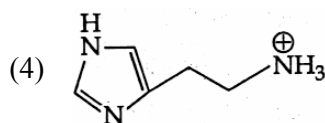
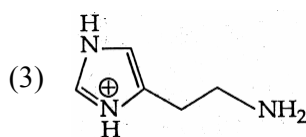
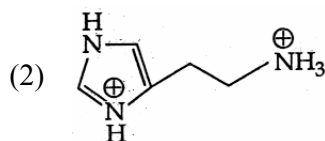
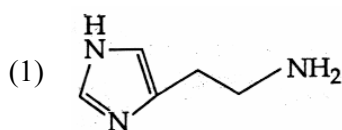
**Answer Key[1]**

55. An alkali is titrated against an acid with methyl orange as indicator, which of the following is a correct combination?

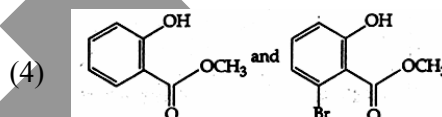
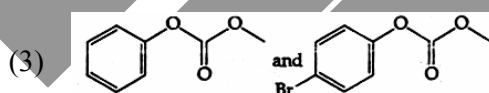
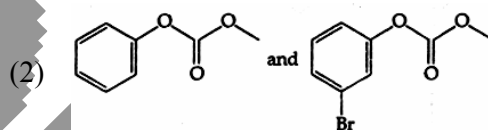
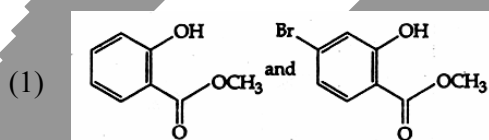
	Base	Acid	End point
(1)	Weak	Strong	Colourless to pink
(2)	Strong	Strong	Pinkish red to yellow
(3)	Weak	Strong	Yellow to pinkish red
(4)	Strong	Strong	Pink to colourless

Answer Key[3]

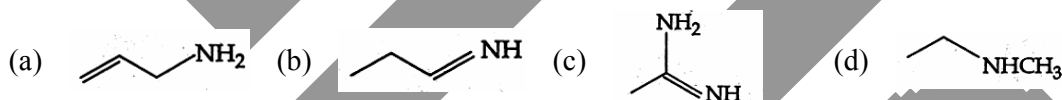
56. The predominant form of histamine present in human blood is (pK_a , Histidine = 6.0)

**Answer Key[4]**

57. Phenol reacts with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br_2 to form product B. A and B respectively :

**Answer Key[3]**

58. The increasing order of basicity of the following compounds is :



(1) (a) < (b) < (c) < (d)

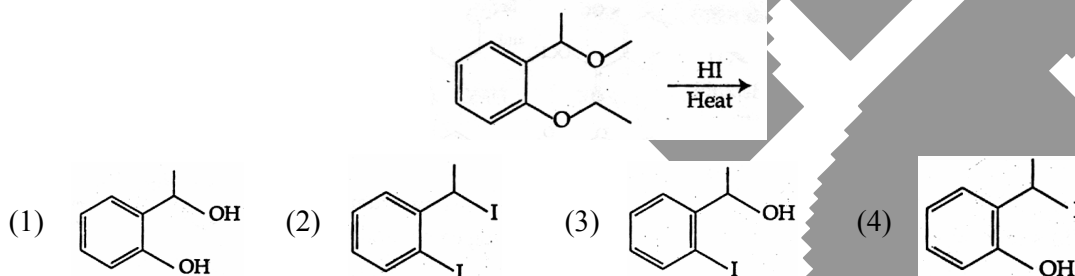
(2) (b) < (a) < (c) < (d)

(3) (b) < (a) < (d) < (c)

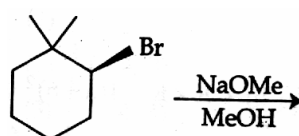
(3) (d) < (b) < (a) < (c)

Answer Key[3]

59. The major product formed in the following reaction is :

**Answer Key[4]**

60. The major product of the following reaction is :





Answer Key[2]

MATHEMATICS

61. Two sets A and B are as under $A = \{(a, b) \in \mathbb{R} \times \mathbb{R} : |a - 5| < 1 \text{ and } |b - 5| < 1\}$, $B = \{(a, b) \in \mathbb{R} \times \mathbb{R} : 4(a - 6)^2 + 9(b - 5)^2 \leq 36\}$. Then

- (1) $B \subset A$ (2) $A \subset B$
 (3) $A \cap B = \phi$ (an empty set) (4) neither $A \subset B$ nor $B \subset A$

Answer key (2)

62. Let $S = \{x \in \mathbb{R} : x \geq 0 \text{ and } 2|\sqrt{x} - 3| + \sqrt{x}(\sqrt{x} - 6) + 6 = 0\}$. Then S :

- (1) is an empty set. (2) contains exactly one element.
 (3) contains exactly two elements. (4) contains exactly four elements.

Answer key (3)

63. If $\alpha, \beta \in \mathbb{C}$ are the distinct roots, of the equation $x^2 - x + 1 = 0$, then $\alpha^{101} + \beta^{107}$ is equal to

- (1) -1 (2) 0 (3) 1 (4) 2

Answer key (3)

64. If $\begin{vmatrix} x-4 & 2x & 2x \\ 2x & x-4 & 2x \\ 2x & 2x & x-4 \end{vmatrix} = (A+Bx)(x-A)^2$, then the ordered (A, B) is equal to

- (1) (-4, -5) (2) (-4, 3) (3) (-4, 5) (4) (4, 5)

Answer key (3)

65. If the system of linear equations

$$x + ky + 3z = 0$$

$$3x + ky - 2z = 0$$

$$2x + 4y - 3z = 0$$

has a non-zero solution (x, y, z), then $\frac{xz}{y^2}$ is equal to

- (1) -10 (2) 10 (3) -30 (4) 30

Answer key (2)

66. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. The number of such arrangements is

- (1) at least 1000 (2) less than 500
 (3) at least 500- but less than 750 (4) at least 750 but less than 1000

Answer key (1)

67. The sum of the coefficients of all odd degree terms in the expansion of $(x + \sqrt{x^3 - 1})^5 + (x - \sqrt{x^3 - 1})^5$, ($x > 1$) is
- (1) -1 (2) 0 (3) 1 (4) 2

Answer key (4)

68. Let $a_1, a_2, a_3, \dots, a_{49}$ be in AP such that $\sum_{k=0}^{12} a_{4k+1} = 416$ and $a_9 + a_{43} = 66$. If $a_1^2 + a_2^2 + \dots + a_{17}^2 = 140m$, then m is equal to
- (1) 66 (2) 68 (3) 34 (4) 33

Answer key (3)

69. Let A be the sum of the first 20 terms and B be the sum of the first 40 terms of the series $1^2 + 2 \cdot 2^2 + 3^2 + 2 \cdot 4^2 + 5^2 + 2 \cdot 6^2 + \dots$. If $B - 2A = 100\lambda$, then λ is equal to
- (1) 232 (2) 248 (3) 464 (4) 496

Answer key (2)

70. For each $t \in \mathbb{R}$, let $[t]$ be the greatest integer less than or equal to t . Then $\lim_{x \rightarrow 0^+} x \left(\left[\frac{1}{x} \right] + \left[\frac{2}{x} \right] + \dots + \left[\frac{15}{x} \right] \right)$
- (1) is equal to 0. (2) is equal to 15. (3) is equal to 120 (4) does not exist (in \mathbb{R}).

Answer key (3)

71. Let $S = \{t \in \mathbb{R} : f(x) = |x - \pi| \cdot (e^{|x|} - 1) \sin |x| \text{ is not differentiable at } t\}$. Then the set S is equal to
- (1) ϕ (an empty set) (2) $\{0\}$ (3) $\{\pi\}$ (4) $\{0, \pi\}$

Answer key (1)

72. If the curves $y^2 = 6x$, $9x^2 + by^2 = 16$ intersect each other at right angles, then the value of b is
- (1) 6 (2) $\frac{7}{2}$ (3) 4 (4) $\frac{9}{2}$

Answer key (4)

73. Let $f(x) = x^2 + \frac{1}{x^2}$ and $g(x) = x - \frac{1}{x}$, $x \in \mathbb{R} - \{-1, 0, 1\}$. If $h(x) = \frac{f(x)}{g(x)}$, then the local minimum value of $h(x)$ is
- (1) 3 (2) -3 (3) $-2\sqrt{2}$ (4) $2\sqrt{2}$

Answer key (4)

74. The integral $\int \frac{\sin^2 x \cos^2 x}{(\sin^5 x + \cos^3 x \sin^2 x + \sin^3 x \cos^2 x + \cos^5 x)^2} dx$ is equal to

(1) $\frac{1}{3(1 + \tan^3 x)} + C$ (2) $\frac{-1}{3(1 + \tan^3 x)} + C$ (3) $\frac{1}{1 + \cot^3 x} + C$ (4) $\frac{-1}{1 + \cot^3 x} + C$

(where C is a constant of integration)

Answer key (2)

75. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^2 x}{1+2^x} dx$ is

- (1) $\frac{\pi}{8}$ (2) $\frac{\pi}{2}$ (3) 4π (4) $\frac{\pi}{4}$

Answer key (4)

76. Let $g(x) = \cos x^2$, $f(x) = \sqrt{x}$, and α, β ($\alpha < \beta$) be the roots of the quadratic equation $18x^2 - 9\pi x + \pi^2 = 0$. Then the area (in sq. units) bounded by the curve $y = (g \circ f)(x)$ and the lines $x = \alpha$, $x = \beta$ and $y = 0$, is

- (1) $\frac{1}{2}(\sqrt{3}-1)$ (2) $\frac{1}{2}(\sqrt{3}+1)$ (3) $\frac{1}{2}(\sqrt{3}-\sqrt{2})$ (4) $\frac{1}{2}(\sqrt{2}-1)$

Answer key (1)

77. Let $y = y(x)$ be the solution of the differential equation $\sin x \frac{dy}{dx} + y \cos x = 4x$, $x \in (0, \pi)$. If $y\left(\frac{\pi}{2}\right) = 0$, then $y\left(\frac{\pi}{6}\right)$ is equal to

- (1) $\frac{4}{9\sqrt{3}}\pi^2$ (2) $\frac{-8}{9\sqrt{3}}\pi^2$ (3) $-\frac{8}{9}\pi^2$ (4) $-\frac{4}{9}\pi^2$

Answer key (3)

78. A straight line through a fixed point (2, 3) intersects the coordinate axes at distinct points P and Q. If O is the origin and the rectangle OPRQ is completed, then the locus of R is

- (1) $3x + 2y = 6$ (2) $2x + 3y = xy$ (3) $3x + 2y = xy$ (4) $3x + 2y = 6xy$

Answer key (3)

79. Let the orthocentre and centroid of a triangle be A(-3, 5) and B(3, 3) respectively. If C is the circumcentre of this triangle, then the radius of the circle having the segment AC as diameter, is

- (1) $\sqrt{10}$ (2) $2\sqrt{10}$ (3) $3\sqrt{\frac{5}{2}}$ (4) $\frac{3\sqrt{5}}{2}$

Answer key (3)

80. If the tangent at (1, 7) to the curve $x^2 = y - 6$ touches the circle $x^2 + y^2 + 16x + 12y + c = 0$ then the value of c is

- (1) 195 (2) 185 (3) 85 (4) 95

Answer key (4)

81. Tangent and normal are drawn at P(16, 16) on the parabola $y^2 = 16x$, which intersect the axis of the parabola at A and B, respectively. If C is the centre of the circle through the points P, A and B and $\angle CPB = \theta$, then a value of $\tan \theta$ is

- (1) $\frac{1}{2}$ (2) 2 (3) 3 (4) $\frac{4}{3}$

Answer key (2)

82. Tangents are drawn to the hyperbola $4x^2 - y^2 = 36$ at the points P and Q. If these tangents intersect at the point T(0, 3) then the area (in sq. units) of ΔPTQ is

- (1) $45\sqrt{5}$ (2) $54\sqrt{3}$ (3) $60\sqrt{3}$ (4) $36\sqrt{5}$

Answer key (1)

83. If L_1 is the line of intersection of the planes $2x - 2y + 3z - 2 = 0$, $x - y + z + 1 = 0$ and L_2 is the line of intersection of the planes $x + 2y - z - 3 = 0$, $3x - y + 2z - 1 = 0$, then the distance of the origin from the plane, containing the lines L_1 and L_2 , is

- (1) $\frac{1}{4\sqrt{2}}$ (2) $\frac{1}{3\sqrt{2}}$ (3) $\frac{1}{2\sqrt{2}}$ (4) $\frac{1}{\sqrt{2}}$

Answer key (2)

84. The length of the projection of the line segment joining the points $(5, -1, 4)$ and $(4, -1, 3)$ on the plane, $x + y + z = 7$ is

- (1) $\frac{2}{\sqrt{3}}$ (2) $\frac{2}{3}$ (3) $\frac{1}{3}$ (4) $\frac{\sqrt{2}}{3}$

Answer key (4)

85. Let \vec{u} be a vector coplanar with the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. If \vec{u} is perpendicular to \vec{a} and $\vec{u} \cdot \vec{b} = 24$, then $|\vec{u}|^2$ is equal to

- (1) 336 (2) 315 (3) 256 (4) 84

Answer key (1)

86. A bag contains 4 red and 6 black balls. A ball is drawn at random from the bag, its colour is observed and this ball along with two additional balls of the same colour are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red, is

- (1) $\frac{3}{10}$ (2) $\frac{2}{5}$ (3) $\frac{1}{5}$ (4) $\frac{3}{4}$

Answer key (2)

87. If $\sum_{i=1}^9 (x_i - 5) = 9$ and $\sum_{i=1}^9 (x_i - 5)^2 = 45$, then the standard deviation of the 9 items x_1, x_2, \dots, x_9 is

- (1) 9 (2) 4 (3) 2 (4) 3

Answer key (3)

88. If sum of all the solutions of the equation $8\cos x \cdot \left(\cos\left(\frac{\pi}{6} + x\right) \cdot \cos\left(\frac{\pi}{6} - x\right) - \frac{1}{2} \right) = 1$ in $[0, \pi]$ is $k\pi$, then k is equal to

- (1) $\frac{2}{3}$ (2) $\frac{13}{9}$ (3) $\frac{8}{9}$ (4) $\frac{20}{9}$

Answer key (2)

89. PQR is a triangular park with $PQ = PR = 200$ m. A T.V. tower stands at the mid-point of QR. If the angles of elevation of the top of the tower at P, Q and R are respectively 45° , 30° and 30° , then the height of the tower (in m) is

- (1) 100 (2) 50 (3) $100\sqrt{3}$ (4) $50\sqrt{2}$

Answer key (1)

90. The Boolean expression $\sim(p \vee q) \vee (\sim p \wedge q)$ is equivalent to

- (1) $\sim p$ (2) p (3) q (4) $\sim q$

Answer key (1)

