MHT CET 2020 PCM Oct 12 Shift 1 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

Time Allowed: 180 Minutes **Total Questions: 150** **Maximum Marks: 200**

General Instructions

(i) This **PCM** paper is from **MHT CET 2020**, conducted by the **State Common Entrance Test Cell, Maharashtra**.

(ii) Answer all **150 multiple choice questions**: **50 Physics**, **50 Chemistry** and **50 Mathematics**.

(iii) Each question offers **four choices**, with **one correct answer**.

(iv) Allow **90 minutes for Physics and Chemistry together**, followed by **90 minutes for Mathematics**. The first group closes before the second opens.

(v) Correct answers earn **1 mark in Physics and Chemistry** and **2 marks in Mathematics**.

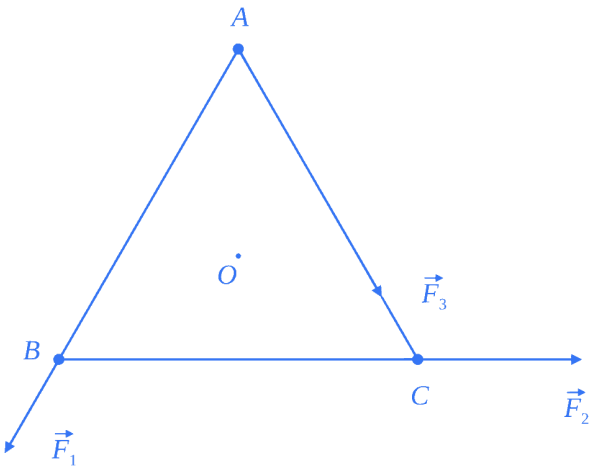
(vi) There is **no negative marking**. Unanswered questions score zero.

1. Resultant of two vectors $\vec{P}$ and $\vec{Q}$ is of magnitude R_1. If direction of $\vec{Q}$ is reversed, the resultant is of magnitude R_2. The value of $\left(R_1^2 + R_2^2\right)$ is $[\cos(\pi - \theta) = -\cos\theta]$

(A) $\left(P^2 + Q^2\right)$ (B) $2\left(P^2 + Q^2\right)$

(C) $2\left(P^2 - Q^2\right)$ (D) $\left(P^2 - Q^2\right)$

2. Figure shows three forces $\vec{F}_1, \vec{F}_2$ and $\vec{F}_3$ acting along the sides of an equilateral triangle. If the total torque acting at point ' 0 ' (centre of the triangle) is zero then the magnitude of $\vec{F}_3$ is



(A) $\frac{F_1 - F_2}{2}$ (B) $F_1 - F_2$

(C) $F_1 + F_2$ (D) $\frac{F_1}{F_2}$

3. The unit vector $(a\hat{\imath} + b\hat{\jmath})$ is perpendicular to $(\hat{\imath} + \hat{\jmath})$. The value of $'b'$ is

(A) $+\frac{1}{\sqrt{3}}$ (B) $-\frac{1}{\sqrt{3}}$

(C) $+\frac{1}{2}$ (D) $-\frac{1}{\sqrt{2}}$

4. If the dimensions of a physical quantity are given by $\left[L^a M^b T^c\right]$ then the physical quantity is

(A) velocity if $a = -1, b = 0, c = +1$

(B) force if $a = -1, b = 1, c = -2$

(C) pressure if $a = -1, b = 1, c = -2$

(D) acceleration if a $= 1$, b $= 1$, c $= -2$

5. Two cars of masses ' m_1 ', and ' m_2 ' are moving in the circles of radii ' r_1 ' and ' r_2 ' respectively. Their angular speeds ' ω_1 ' and ' ω_2 ' are such that they both complete one revolution in the same time ' t'. The ratio of linear speed of ' m_1 ' to the linear speed of ' m_2 ' is

(A) $r_1 : r_2$ (B) $T_1^2 : T_2^2$

(C) $\omega_1^2 : \omega_2^2$ (D) $m_1 : m_2$

6. A heavy mass is attached at one end of a thin wire and whirled in a vertical circle. The chances of breaking the wire are maximum when

(A) the wire is horizontal.

(B) the mass is at the lowest point of the circle.

(C) the wire makes an angle of 60° with the horizontal.

(D) the mass is at the highest point of the circle.

7. A ball of mass 'm' is attached to the free end of an inextensible string of length ' ℓ '. Let 'T' be the tension in the string. The ball is moving in horizontal circular path about the vertical axis. The angular velocity of the ball at any particular instant will be

(A) $\sqrt{\frac{T}{m\ell}}$ (B) $\sqrt{\frac{T\ell}{m}}$

(C) $\sqrt{\frac{m\ell}{T}}$ (D) $\sqrt{\frac{Tm}{\ell}}$

8. A metal ball of mass 2 kg moving with a speed of 10 ms^{-1} had a head-on collision with a stationary ball of mass 3 kg. If after collision, both the balls move together, then the loss in kinetic energy due to collision is

(A) 60 J. (B) 100 J.

(C) 140 J. (D) 40 J.

9. A stationary body explodes into two parts of masses ' M_1 ' and $'M_2'$. They move in opposite directions with velocities ' v_1 ' and ' v_2 '. The ratio of their kinetic energies is

(A) $\left[\frac{M_2}{M_1}\right]$ (B) $\left[\frac{M_2}{M_1}\right]^{\frac{1}{2}}$

(C) $\left[\frac{M_1}{M_2}\right]^2$ (D) $\left[\frac{M_2}{M_1}\right]^2$

10. A wheel is at rest in horizontal position. Its M.I. about vertical axis passing through its centre is 'I'. A constant torque ' ' 'acts on it for ' t ' second. The change in rotational kinetic energy is

(A) $\frac{\tau^2 t^2}{2I}$ (B) $\left[\frac{\tau t}{2I}\right]$

(C) $\left[\frac{\tau t}{2I}\right]^{\frac{1}{2}}$ (D) $\left[\frac{\tau t}{2I}\right]^2$

11. A solid cylinder of mass 'M' and radius 'R' rolls down a smooth inclined plane about its own axis and reaches the bottom with velocity ' v'. The height of the inclined plane is (g = acceleration due to gravity)

(A) $\frac{3v^2}{4g}$ (B) $\frac{4v^2}{5g}$

(C) $\frac{7v^2}{9g}$ (D) $\frac{2v^2}{3g}$

12. Two satellites 'A' and 'B' are revolving with critical velocities ' v_A ' and ' v_B ' around the earth, in circular orbits of radii ' R ' and ' 2R', respectively. The ratio $\frac{V'_A}{V_B}$ is

(A) 2 : 1 (B) $\sqrt{2}$: 1

(C) 1 : 2 (D) 1 : $\sqrt{2}$

13. A body is projected vertically upwards from earth's surface with velocity $2v_e$, where v_e is escape velocity from earth's surface. The velocity when body escapes the gravitational pull is

(A) $\sqrt{7}v_e$ (B) $\sqrt{3}v_e$

(C) $\sqrt{5}v_e$ (D) $2v_e$

14. A constant force is applied to a metal wire of length 'L'. Volume of the wire is constant. The extension produced is proportional to

(A) L^2 (B) L^3

(C) L (D) L^{-2}

15. A wire of length 10 cm is gently placed horizontally on the surface of water having surface tension of 75×10^{-3} N/m. What force is required to just pull up the wire from the water surface?

(A) 15×10^{-2} N (B) $7 \cdot 5 \times 10^{-2}$ N

(C) $1 \cdot 5 \times 10^{-2}$ N (D) 75×10^{-2} N

16. Two rain drops falling through air have radii in the ratio 1 : 2. They will have terminal velocity in the ratio

(A) 1 : 2 (B) 4 : 1

(C) 1 : 4 (D) 2 : 1

17. Two small drops of mercury each of radius 'R' coalesce to form a large single drop. The ratio of the total surface energies before and after the change is

(A) $\sqrt{2}$: 1 (B) $2^{1/3}$: 1

(C) 2 : 1 (D) $2^{2/3}$: 1

18. Ordinary bodies 'A' and 'B' radiate maximum energy with wavelength difference 4μm. The absolute temperature of body 'A' is 3 times that of ' B '. The wavelength at which body 'B' radiates maximum energy is

(A) 12μm (B) 6μm

(C) 4μm (D) 8μm.

19. Two spheres ' S_1 ' and ' S_2 ' have same radii but temperatures T_1 and T_2 respectively. Their emissive power is same and emissivity is in the ratio 1 : 4. Then the ratio of T_1 to T_2 is

(A) $\sqrt{2}$: 1 (B) 1 : 2

(C) 2 : 1 (D) 1 : $\sqrt{2}$

20. The weight suspended from a spring oscillates up and down. The acceleration of weight will be zero at

(A) mean position. (B) highest position.

(C) half of the amplitude. (D) lowest position.

21. A pendulum has length of 0.4 m and maximum speed 4 m/s. When the length makes an angle 30° with the horizontal, its speed will be [$\sin\frac{\pi}{6} = \cos\frac{\pi}{3} = 0 \cdot 5$ and $g = 10$ m/s^2]

(A) $2\sqrt{2}$ m/s (B) $\sqrt{3}$ m/s

(C) $2\sqrt{5}$ m/s (D) $2\sqrt{3}$ m/s

22. A mass 'M' is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes S.H.M. of period T. If the mass is increased by 'm', the time period becomes $\frac{5\,T'}{3}$. What is the ratio $\left(\frac{M}{m}\right)$?

(A) $\frac{25}{9}$ (B) $\frac{16}{9}$

(C) $\frac{9}{25}$ (D) $\frac{9}{16}$

23. On closing an open organ pipe from one end, it is noticed that the frequency of third harmonic is 50 Hz more than the fundamental frequency of vibration in open organ pipe. The fundamental frequency of open organ pipe is

(A) 250 Hz (B) 100 Hz

(C) 50 Hz (D) 200 Hz

24. Two identical wires are vibrating in unison. If the tension in one of the wires is increased by 2%, five beats are produced per second by the two vibrating wires. The initial frequency of each wire is $(\sqrt{1 \cdot 02} \doteq 1 \cdot 01)$

(A) 1000 Hz (B) 500 Hz

(C) 400 Hz (D) 200 Hz

25. The frequency of two tuning forks A and B are $1 \cdot 5\%$ more and $2 \cdot 5\%$ less than that of the tuning fork C. When A and B are sounded together, 12 beats are produced in 1 second. The frequency of tuning fork C is

(A) 200 Hz (B) 300 Hz

(C) 240 Hz (D) 360 Hz

26. A pipe open at one end has length 0.8 m. At the open end of the tube a string 0.5 m long is vibrating in its 1^{st} overtone and resonates with fundamental frequency of pipe. If tension in the string is 50 N, the mass of string is (speed of sound $= 320\ m/s$)

(A) 25 gram (B) 15 gram

(C) 20 gram (D) 10 gram

27. The earth's atmosphere is divided into different layers. Out of these layers, ionosphere consists of

(A) only positive ions. (B) only neutral particles.

(C) only electrons. (D) electrons and positive ions.

28. In a parallel plate capacitor, the capacity can be increased by decreasing

(A) permeability of the medium. (B) value of dielectric constant.

(C) area of the plates. (D) the distance between plates.

29. The potential differences that must be applied across the parallel and series combination of 3 identical capacitors is such that the energy stored in them becomes the same. The ratio of potential difference in parallel to series combination is

(A) $\frac{1}{4}$ (B) $\frac{1}{6}$

(C) $\frac{1}{3}$ (D) $\frac{1}{8}$

30. The deflection in a moving coil galvanometer is reduced to half when it is shunted with ' $X'\Omega$ coil. The relation between ' X′ and resistance of galvanometer ' G′ is

(A) $2X = G$ (B) $4X = G$

(C) $X = 2G$ (D) $X = G$

31. In meter bridge experiment, to minimize an error due to contact resistance,

(A) use non-uniform meter bridge wire. (B) repeat the experiment by interchanging the resistance in gaps.

(C) increase the current flowing through meter bridge wire. (D) changing the value of known resistance in the gap.

32. Two wires 'A' and 'B' of equal lengths are connected in left and right gaps, of meter bridge, respectively. The null point is obtained at 40 cm from left end. Diameters of the wires 'A' and 'B' are in the ratio 3 : 1, the ratio of specific resistance of 'A' to that of 'B' is

(A) 3: 1 (B) 1: 1

(C) 6: 1 (D) 9: 1

33. A charge ' $q_\circ'$ moving with velocity ' $\vec{v}$ 'in a magnetic field of induction $\vec{B}$, experiences force $\vec{F}$ '. The angle between $\vec{v}$ and $\vec{B}$ is θ. The speed of ' $q_\circ$ ' after one second will be

(A) v/B (B) v

(C) $v \times B$ (D) B/v

34. Two short bar magnets 'A and 'B' (having magnetic moments ' M_1 ' and ' M_2 ' respectively) are kept one above the other with their magnetic axis perpendicular to each other. If their resultant at a point on the axis of magnet ' A ' is inclined at 45° with the axis of magnet A then the ratio of magnetic moments $\frac{M_2}{M_1}$ is $[\tan 45^\circ = 1]$

(A) 2 : 1 (B) 2 : 3

(C) 1 : 2 (D) 3 : 2

35. In cyclotron, the time taken by an ion to describe semicircular path in a dee is

(A) dependent on speed of ion. (B) independent of mass of ion.

(C) independent of speed of ion and radius of circular path. (D) dependent on radius of circular path.

36. Magnetic field at the centre of a circular loop of area 'A' is ' B' '. The magnetic moment of the loop will be (μ_0 = permeability of free space)

(A) $\frac{BA^{\frac{3}{2}}}{\mu_0\pi}$ (B) $\frac{2\,BA^{\frac{3}{2}}}{\mu_0\pi^{\frac{1}{2}}}$

(C) $\frac{2BA^2}{\mu_0\pi}$ (D) $\frac{BA^{\frac{3}{2}}}{\mu_0\pi^{\frac{1}{2}}}$

37. Above the curie temperature the susceptibility of a ferromagnetic substance varies

(A) directly as the absolute temperature. (B) inversely as the absolute temperature.

(C) inversely as the square root of absolute temperature. (D) directly as the square root of absolute temperature.

38. Two coaxial coils A and B of radii 'R ' and 'Rz' are placed in the same plane. ($R_2 > R_1$). If a current is passed through coil B, the coefficient of mutual inductance between the coils is proportional to

(A) $\frac{1}{R_1R_2}$ (B) $\frac{R_2^2}{R_1}$

(C) R_1R_2 (D) $\frac{R_1^2}{R_2}$

39. A parallel combination of pure inductor and capacitor is connected across a source of alternating e.m.f. 'e'. The currents flowing through an inductor and capacitor are i_L and i_C respectively. In this parallel resonant circuit, the condition for currents i, i_L and i_C is (i = net r.m.s. current in the circuit)

(A) $i \doteq 0, i_L = i_C \neq 0$ (B) $i \neq 0, i_L = i_C = 0$

(C) $i \doteq i_L = i_C$ (D) $i \doteq 0, i_L \neq i_C$

40. A thin prism P_1 with angle 4° and made from glass of refractive index $1 \cdot 54$ is combined with another thin prism P_2 made from glass of refractive index $1 \cdot 72$ to produce dispersion without deviation. The angle of prism for P_2 is

(A) 4° (B) $5 \cdot 33^\circ$

(C) $2 \cdot 6^\circ$ (D) 3°

41. What is the magnifying power of a simple microscope of focal length 5 cm, if the image is formed at the distance of distinct vision?

(A) 4 (B) 7

(C) 6 (D) 5

42. In Young's double slit experiment, the intensity of light at a point on the screen is 'K' unit for path difference 'λ'. What would be the intensity at a point if path difference is $\frac{\lambda'}{4}$?

(A) zero (B) $\frac{K}{4}$

(C) K (D) $\frac{K}{2}$

43. A parallel beam of monochromatic light falls normally on a single narrow slit. The angular width of the central maximum in the resulting diffraction pattern

(A) decreases with increase of slitwidth. (B) increases with increase of slitwidth.

(C) decreases with decrease of slitwidth. (D) may increase or decrease.

44. A ray of unpolarised light is incident on the glass surface of refractive index $1 \cdot 73$ at polarizing angle. The angle of refraction will be [Take $\tan 60^\circ = 1 \cdot 73$]

(A) 45°. (B) 15°.

(C) 35°. (D) 30°.

45. If intensity of incident radiation in a photocell is increased, the stopping potential

(A) first increases and then decreases. (B) remains unchanged.

(C) decreases. (D) increases.

46. The maximum velocity of the photoelectron emitted by the metal surface is 'v'. Charge and mass of the photoelectron is denoted by 'e' and 'm' respectively. The stopping potential in volt is

(A) $\frac{v^2}{\left(\frac{m}{e}\right)}$ (B) $\frac{v^2}{\left(\frac{e}{m}\right)}$

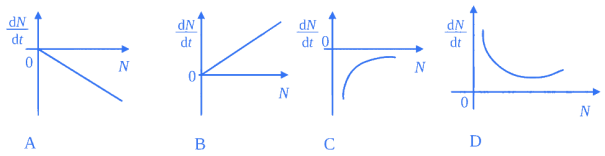
(C) $\frac{v^2}{2\left(\frac{m}{e}\right)}$ (D) $\frac{v^2}{2\left(\frac{e}{m}\right)}$

47. Electron in Hydrogen atom first jumps from third excited state to second excited state and then from second excited state to first excited state. The ratio of the wavelengths $\lambda_1 : \lambda_2$ emitted in the two cases respectively is

(A) $\frac{7}{5}$ (B) $\frac{27}{20}$

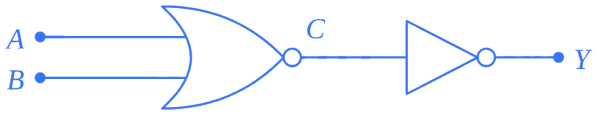
(C) $\frac{27}{5}$ (D) $\frac{20}{7}$

48. The variation of decay rate with number of active nuclei is correctly shown in graph



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

49. The resultant gate and its Boolean expression for the given circuit is



(A) OR, $A + B$
(B) NOR, $\overline{A + B}$
(C) NAND, $\overline{A \cdot B}$
(D) $AND, A \cdot B$

50. Choose the correct statement. In conductors

(A) valence band and conduction band overlap each other.
(B) valence band and conduction band are separated by a large energy gap.
(C) very small number of electrons are available for electrical conduction.
(D) valence band and conduction band are separated by a small energy gap.

51. The unit of atomic mass, amu is replaced by u, here u stands for

(A) unified mass
(B) united mass
(C) unique mass
(D) universal mass

52. In the reaction $2KClO_{3(s)} \longrightarrow 2KCl_{(s)} + 3O_{2(g)} \Delta H^{\circ} = -78$ kJ. If $33 \cdot 6$ L of oxygen gas is liberated at S.T.P. What is the mass of $KCl_{(s)}$ produced ? (at. mass $K = 39$, $Cl = 35 \cdot 5$ g mol^{-1})

(A) $48 \cdot 0$ g
(B) 7.45 g
(C) $24 \cdot 0$ g
(D) 74.5 g

53. H_2 molecule is more stable than Li_2 molecule, because

(A) In H_2 molecule σ_{15} molecular orbitals are shielded by electrons.
(B) In H_2 bond order is one.
(C) In Li_2 molecule σ_{1s} molecular orbitals are shielded by electrons.
(D) In Li_2 molecule, outer σ_{2s} molecular orbitals are shielded by the inner electrons.

54. In resonance hybrid of ozone molecule, $0 - 0$ bond length is

(A) 128pm
(B) $134 \cdot 5$pm
(C) 121pm
(D) 148pm

55. According to Andrews isothermals at what temperature the carbondioxide gas starts to condense at 73 atmosphere?

(A) $21 \cdot 5^{\circ}$C
(B) $30 \cdot 98^{\circ}$C
(C) $13 \cdot 1^{\circ}$C
(D) $48 \cdot 1^{\circ}$C

56. For the following reaction

$Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe_{(s)} + 3CO_{2(g)} \Delta H^{\circ} = -29 \cdot 8$ kJ

and $\Delta S^{\circ} = 15 JK^{-1}$. What is the value of $\Delta S_{(total)}$ at 298 K ?

(A) 29.8 J
(B) $100 \cdot 0$ J
(C) $298 \cdot 0$ J
(D) $115 \cdot 0$ J

57. Enthalpy of fusion and enthalpy of vaporization for water respectively are $6 \cdot 01$ kJ mol^{-1} and $45 \cdot 07$ kJ mol^{-1} at 0°C what is enthalpy of sublimation at 0°C ?

(A) $27 \cdot 50$ kJ mol^{-1}
(B) $48 \cdot 07$ kJ mol^{-1}
(C) $51 \cdot 08$ kJ mol^{-1}
(D) $39 \cdot 06$ kJ mol^{-1}

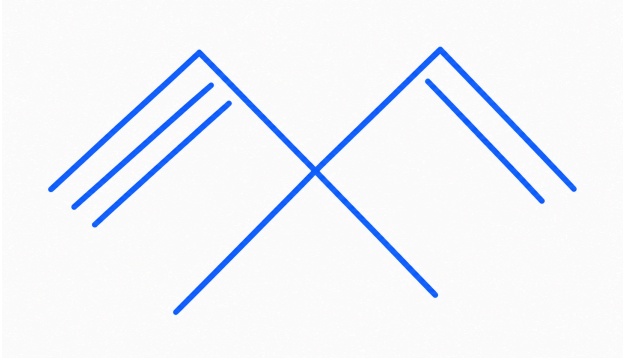
58. What is the boiling point of heavy water?

(A) $100 \cdot 4^{\circ}$C
(B) $101 \cdot 4^{\circ}$C
(C) 273°C
(D) 100°C

59. Which among the following gas is bubbled through the brine solution during the preparation of sodium carbonate in Solvay's process?

(A) $CO_{2(g)}$
(B) $N_{2(g)}$
(C) $NO_{2(g)}$
(D) $O_{2(g)}$

60. How many pi bonds and sigma bond are present in following molecule?



(A) $5\pi, 14\sigma$ - bonds
(B) $3\pi, 17\sigma$ - bonds
(C) $3\pi, 16\sigma$ - bonds
(D) $2\pi, 17\sigma$ - bonds

61. Identify the decreasing order of boiling point of alkanes (i) n-pentane (ii) Isopentane (iii) Neopentane

(A) Isopentane > n-pentane > Neopentane
(B) Neopentane > Isopentane > n - pentane
(C) n-pentane > Isopentane > Neopentane
(D) Isopentane > Neopentane > n - pentane

62. Calculate the number of unit cells in 38.6 g of noble metal haven density $19 \cdot 3$ g cm^{-3} and volume of one unit cell is $6 \cdot 18 \times 10^{-23}$ cm^3 ?

(A) $3 \cdot 236 \times 10^{22}$
(B) $6 \cdot 180 \times 10^{23}$
(C) $6 \cdot 236 \times 10^{20}$
(D) $3 \cdot 236 \times 10^{23}$

63. What is the value of radius ratio of ionic crystal having coordination number six?

(A) Greater than 0.732
(B) In between 0.414 to 0.732
(C) In between $0 \cdot 225$ to $0 \cdot 414$
(D) Less than 0.225

64. Calcite crystals used in Nicol's prism are formed of

(A) CaC_2
(B) $CaCO_3$
(C) $CaCl_2$
(D) Ca0

65. Sodium crystallizes in bcc structure with radius $1 \cdot 86 \times 10^{-8}$ cm. What is the edge length of unit cell of sodium?

(A) $4 \cdot 3 \times 10^{-8}$ cm
(B) $3 \cdot 72 \times 10^{-8}$ cm
(C) $7 \cdot 44 \times 10^{-8}$ cm
(D) $5 \cdot 26 \times 10^{-8}$ cm

66. Which of the following changes will cause increase in vapour pressure of 1 molal aqueous KI solution at same temperature?

(A) addition of $0 \cdot 1$ molal solution of NaCl
(B) addition of 0.5 molal solution of Na_2SO_4
(C) addition of water
(D) addition of 1 molal KI solution

67. Which of the following statement is NOT correct about solution?

(A) The three states of matter solid, liquid and gas may play the role of either solute or solvent.
(B) The component of solution which constitute smaller part is called solute.
(C) When water is solvent, the process of solvation is known as hydration.
(D) True solution is a heterogenous mixture of two or more substances with fixed composition.

68. Which of the following pairs of solution is isotonic? (molar mass. urea $= 60$, sucrose $= 342$ g mol^{-1})

(A) $3 \cdot 0$ g L^{-1} urea and $17 \cdot 19$gL^{-1} sucrose
(B) $0 \cdot 3$gL^{-1} urea and $1 \cdot 719$gL^{-1} sucrose
(C) $3 \cdot 0$gL^{-1} urea and $1 \cdot 719$gL^{-1} sucrose
(D) $0 \cdot 3$ g L^{-1} urea and $17 \cdot 19$gL^{-1} sucrose

69. What is the molar conductivity of $0 \cdot 1$ M NaCl if it's conductivity is $1 \cdot 06 \times 10^{-2} \Omega^{-1}$ cm^{-1} ?

(A) $1 \cdot 06 \times 10^{2} \Omega^{-1}$ cm^2 mol^{-1}
(B) $1 \cdot 06 \times 10^{-2} \Omega^{-1}$ cm^2 mol^{-1}
(C) $9 \cdot 4 \times 10^{-2} \Omega^{-1}$ cm^2 mol^{-1}
(D) $5 \cdot 3 \times 10^{3} \Omega^{-1}$ cm^2 mol^{-1}

70. What is the common unit of conductivity if the dimensions are expressed in centimeter?

(A) Ωcm^{-1}
(B) Ω^{-1} cm^{-1}
(C) Ωcm
(D) Ω^{-1} cm

71. The rate constant for a second order reaction, A $\rightarrow$ Product is $1 \cdot 62$M^{-1} s^{-1}. What will be the rate of reaction when concentration of reactant is 2×10^{-3}M?

(A) $3 \cdot 24 \times 10^{-3}$Ms^{-1}
(B) $3 \cdot 24 \times 10^{-6}$Ms^{-1}
(C) $6 \cdot 48 \times 10^{-6}$Ms^{-1}
(D) 2×10^{-3}Ms^{-1}

72. In the reaction, $N_2 + 3H_2 \longrightarrow 2NH_3$, the rate of disappearance of H_2 is $0 \cdot 02$M/s. The rate of appearance of NH_3 is

(A) $0 \cdot 0133$M/s
(B) $0 \cdot 023$M/s
(C) $0 \cdot 004$M/s
(D) $0 \cdot 032$M/s

73. Which of the following is a character of catalyst?

(A) It changes the position of equilibrium.
(B) It increases the rates of both forward and Backward reactions equally in reversible reaction.
(C) It affects the energies of reactants and products of the reaction.
(D) It increases the activation energy of reactants.

74. What happens during bessemerization process of extraction of copper from copper pyrites?

(A) Au and Ag metals are deposited as anode mud.
(B) Impurities as As and Sb are removed as volatile oxides.
(C) Cu is obtained by auto reduction of Cu_2O and Cus.
(D) Iron is removed in the form of slag.

75. Which among the following reactions occurs at the zone of slag formation in extraction of iron by blast furnace?

(A) $C + \frac{1}{2}O_2 \longrightarrow CO$

(B) $CaO + SiO_2 \longrightarrow CaSiO_3$

(C) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

(D) $Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$

76. What is the lowest oxidation state possessed by phosphorus in its oxyacids?

(A) $+4$ (B) $+2$

(C) $+5$ (D) $+1$

77. The P-P-P bond angle in white phosphorus is

(A) 90° (B) $109^\circ 28'$

(C) 120° (D) 60°

78. Which of the following oxyacid of sulphur contains S = S linkage?

(A) $H_2S_2O_4$ (B) H_2SO_3

(C) $H_2S_2O_5$ (D) $H_2S_2O_2$

79. Which among the following elements has lowest density and is lightest?

(A) Scandium (B) Cobalt

(C) Copper (D) Iron

80. Which among the following elements is a soft element as compared to others

(A) Co (B) Zn

(C) W (D) Mo

81. What is effective atomic number of Fe in $[Fe(CN)_6]^{4-}$ (At. no. of Fe = 26)

(A) 34 (B) 26

(C) 36 (D) 35

82. Which among the following coordination compounds does not have coordination number equal to number of ligands?

(A) $[Pt(NH_3)_6]^{4+}$ (B) $[Co(en)_3]^{3+}$

(C) $[Cu(NH_3)_4]^{2+}$ (D) $[Co(NH_3)_6]^{3+}$

83. If a mixture of iodomethane and iodoethane is treated with sodium metal in presence of dry ether it forms

(A) propane and ethane (B) ethane and butane

(C) propane and butane (D) ethane, propane and butane

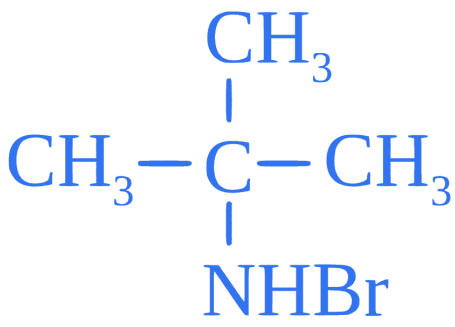
84. Identify 'Z' in the following series of reaction

$$\text{Butan-2-ol} \xrightarrow{PCl_3} X \xrightarrow{\text{alco.KOH}} Y \xrightarrow[\text{ii) H-OH/heat}]{\text{i) } H_2SO_4} Z$$

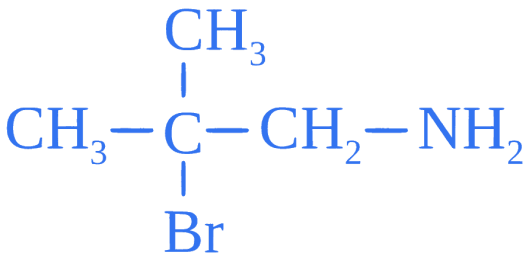
(A) Butan-1-ol (B) 2-chlorobutane

(C) Butan-2-ol (D) But-2-ene

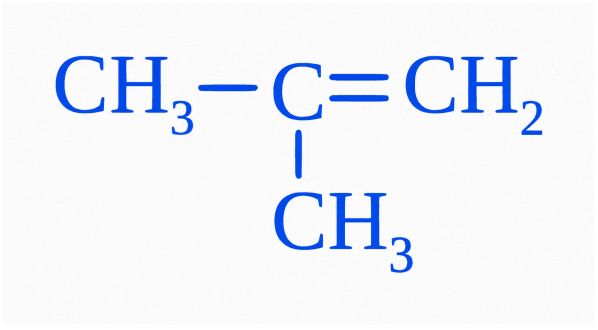
85. Which of the following compounds is obtained when t-butyl bromide is treated with alcoholic ammonia?



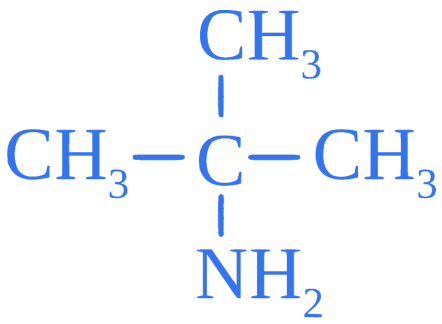
(A)



(B)



(C)



(D)

86. When alkyl halide is boiled with large excess of alcoholic ammonia it forms

(A) primary amine
(B) tertiary amine
(C) secondary amine
(D) quaternary ammonium salt

87. When carbolic acid is heated with concentrated nitric acid in presence of concentrated sulphuric acid it forms

(A) benzoic acid
(B) picric acid
(C) phthalic acid
(D) benzene sulphonic acid

88. Methoxy ethane on reaction with hot concentrated HI gives

(A) iodomethane and ethanol
(B) iodomethane and iodoethane
(C) methanol and ethanol
(D) methanol and iodoethane

89. Which of the following carbonyl compounds does NOT undergo aldol condensation?

(A) Acetone
(B) Benzophenone
(C) Acetaldehyde
(D) Acetophenone

90. Which of the following is Rosenmund reduction?

(A) $R-C\equiv N+2[H]\xrightarrow[\text{dilHCl}]{SnCl_2} R-CH=NH\cdot HCl \xrightarrow{H_3O^+} R-CHO+NH_4Cl$

(B) $R-CHO\xrightarrow[-H_2O]{H_2N-NH_2} R-CH=N-NH_2\xrightarrow[\Delta]{KOH/\text{ethylene glycol}} RCH_3+N_2$

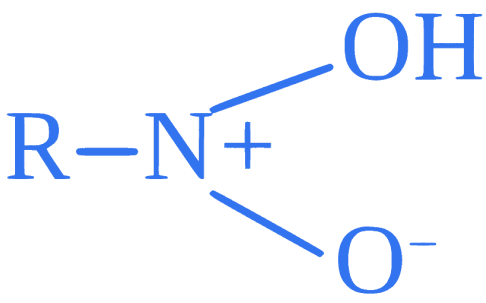
(C) $Ar-CO-Cl\xrightarrow[Pd-BaSO_4]{H_2} Ar-CHO+HCl$

(D) $R-CO-R+4[H]\xrightarrow[\Delta]{Zn-Hg/con.HCl} R-CH_2-R+H_2O$

91. Which of the following reactions does NOT yield an amine

(A) $R-X+NH_{3(alco)}\longrightarrow$
(B) $R-NO_2\xrightarrow{Sn/conc.HCl}$
(C) $R-CH=NOH\xrightarrow[C_2H_5OH]{Na}$
(D) $R-CN+H_2O\xrightarrow{H^+}$

92. Identify 'A' in the following reaction $R-NO_2\xrightarrow[\text{neutral medium}]{Zn/NH_4Cl}A+H_2O$



(A)
(B) $R-NH-OH$
(C) $R-COOH$
(D) $R-NH_2$

93. What is the oxidation number of carbon in glucose?

(A) -6
(B) $+6$
(C) $+3$
(D) Zero

94. Identify the product Y in following reaction $\text{Maltose}\xrightarrow{\text{Hydrolysis}}X\xrightarrow[\text{(excess)}]{\text{dil.}HNO_3}Y$

(A) Gluconic acid
(B) Saccharic acid
(C) n-Hexane
(D) Glucoxime

95. Which of the following monomers is used in manufacture of Neoprene rubber?

(A) 1,3 -Butadien
(B) styrene
(C) 2 -chlorobuta-1,3-diene
(D) Isobutylene

96. Which among the following statements about terpenes is NOT true?

(A) Terpenes occur in essential oils
(B) Terpenes include vitamin A, E and K
(C) Terpenes consist of isoprene units
(D) Terpenes are saturated hydrocarbons

97. Identify the polymer obtained by heating n moles of isobutylene with n moles of isoprene at $100^\circ C$ in presence of anhydrous $AlCl_3$

(A) Butyl rubber
(B) Buna-N
(C) Buna-S
(D) Neoprene rubber

98. What is the percentage of formaldehyde in formalin?

(A) 60%
(B) 40%
(C) 10%
(D) 20%

99. Blurring of vision is a side effect caused by the use of

(A) antibiotics
(B) antacids
(C) tranquilizers
(D) analgesics

100. Which of following antihistamine contain -CN group?

(A) Dimetapp
(B) Cimetidine
(C) Terfenadine
(D) Ranitidine

101. If $|3x-2| \leq \frac{1}{2}$ then $x \in$

(A) $\left[\frac{1}{2}, \frac{5}{6}\right]$ (B) $\left(\frac{1}{2}, \frac{5}{6}\right]$

(C) $\left[\frac{1}{2}, \frac{5}{6}\right)$ (D) $\left(\frac{1}{2}, \frac{5}{6}\right)$

102. $\tan 1^\circ \times \tan 2^\circ \times \tan 3^\circ \times \cdots \cdots \cdots + \cdots \times \tan 89^\circ =$

(A) $\sqrt{3}$ (B) 1

(C) $\sqrt{2}$ (D) 2

103. The maximum value of the function $y = e^{5+\sqrt{3}\sin x + \cos x}$ is

(A) e^7 (B) e^2

(C) e^5 (D) e^8

104. If $\cos 2\theta = \sin \alpha$, then $\theta =$

(A) $2n\pi \pm \left(\frac{\pi}{2} - \alpha\right), n \in z$

(B) $n\pi \pm \left(\frac{\pi}{4} + \frac{\alpha}{2}\right), n \in z$

(C) $\frac{1}{2}[n\pi + (-1)^n \propto], n \in z$

(D) $n\pi \pm \left(\frac{\pi}{4} - \frac{\alpha}{2}\right), n \in z$

105. If $\frac{\sin(A+B)}{\sin(A-B)} = \frac{\cos(C+D)}{\cos(C-D)}$, then $\tan A \cot B =$

(A) $\cot C \cot D$ (B) $-\tan C \tan D$

(C) $\tan C \tan D$ (D) $-\cot C \cot D$

106. If $\sec x + \tan x = 3, x \in \left(0, \frac{\pi}{2}\right)$ then, $\sin x =$

(A) $\frac{3}{5}$ (B) $\frac{4}{5}$

(C) -1 (D) $\frac{1}{5}$

107. With usual notations, in $\triangle ABC$, if $a = 2,\ b = 3,\ c = 5$ and $\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c} = \frac{k+7}{30}$, then $k =$

(A) 6 (B) 16

(C) 17 (D) 12

108. If two angles of $\triangle ABC$ are $\frac{\pi}{4}$ and $\frac{\pi}{3}$, then the ratio of the smallest and greatest side is

(A) $\sqrt{3} : \sqrt{2}$

(B) $(\sqrt{3} - 1) : 1$

(C) $(\sqrt{3} + 1) : (\sqrt{3} - 1)$

(D) $(\sqrt{3} + 1) : 1$

109. If $\frac{2+4+6+8 \text{ upto } n \text{ terms}}{1+3+5+7 \text{ upto } n \text{ terms}} = \frac{37}{36}$, then $n =$

(A) 36 (B) 29

(C) 23 (D) 37

110. The line through the points $(1, 4), (-5, 1)$ intersects the line $4x + 3y - 5 = 0$ in the point

(A) $(-1, -3)$ (B) $\left(\frac{5}{3}, \frac{-5}{3}\right)$

(C) $(-1, 3)$ (D) $(2, 1)$

111. If the equation $x^2 - 3xy + \lambda y^2 + 3x - 5y + 2 = 0$ represents a pair of lines, where λ is real number and θ is angle between them, then value of $\text{cosec}^2\,\theta$ is

(A) 10 (B) 3

(C) 9 (D) $\frac{1}{3}$

112. The auxiliary equation of the lines passing through the origin and having slopes $\sqrt{3}+1$ and $\sqrt{3}-1$ is

(A) $m^2 - 2\sqrt{3}\ m + 2 = 0$

(B) $m^2 - 2\sqrt{3}m - 2 = 0$

(C) $m^2 + 2\sqrt{3}m - 2 = 0$

(D) $m^2 + 2\sqrt{3}m + 2 = 0$

113. The cartesian equation of the curve given by $x = 6\cos\theta, y = 6\sin\theta$ is

(A) $x^2 + y^2 = 36$ (B) $x^2 + y^2 = 5$

(C) $x^2 + y^2 = 25$ (D) $x^2 + y^2 = 6$

114. If θ is a parameter, then the parametric equations of the circle $x^2 + y^2 - 6x + 4y - 3 = 0$ are given by

(A) $x = -3 + 4\sin\theta$ and $y = -2 + 4\cos\theta$

(B) $x = 3 + 4\cos\theta$ and $y = -2 + 4\sin\theta$

(C) $x = 3 + 4\sin\theta$ and $y = 2 + 4\cos\theta$

(D) $x = 3 + 4\cos\theta$ and $y = 2 + 4\sin\theta$

115. Which of the following statement pattern is a tautology? $S_1 \equiv \sim p \to (q \leftrightarrow p)$ $S_2 \equiv \sim pV \sim q$ $S_3 \equiv (p \to q) \wedge (q \to p)$ $S_4 \equiv (q \to p) \vee (\sim p \leftrightarrow q)$

(A) S_2 (B) S_4

(C) S_1 (D) S_3

116. The statement pattern $[(p \vee q) \wedge \sim p] \wedge (\sim q)$ is

(A) a contradiction (B) equivalent to $p \wedge q$

(C) a contingency (D) a tautology

117. A random variable X takes the values $0, 1, 2$. Its mean is $1 \cdot 2$. If $P(X = 0) = 0.3$, then $P(X = 1) =$

(A) 0.1 (B) 0.5

(C) 0.2 (D) 0.4

118. If $A = \{2, 4\}, B = \{3, 4, 5\}$, then $(A \cap B) \times (AUB) =$

(A) $\{(3, 2), (3, 4), (4, 4), (5, 4)\}$

(B) $\{(2, 3), (2, 4), (2, 5)\}$

(C) $\{(4, 2), (4, 3), (4, 4), (4, 5)\}$

(D) $\{(4, 3), (4, 4), (4, 5)\}$

119. If $y = \tan^{-1}(\sec x + \tan x)$, then $\frac{dy}{dx} =$

(A) $\frac{1}{2}$ (B) 1

(C) $\frac{-1}{2}$ (D) -1

120. Which of the following matrix is invertible?

$A_1 = \begin{bmatrix} 4 & 2 \\ 2 & 1 \end{bmatrix}$ $A_2 = \begin{bmatrix} -1 & -2 & 3 \\ 4 & 5 & 7 \\ 2 & 4 & -6 \end{bmatrix}$

$A_3 = \begin{bmatrix} 1 & 0 & 0 \\ 5 & 2 & 1 \\ 7 & 2 & 1 \end{bmatrix}$ $A_4 = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$

(A) A_1 (B) A_3

(C) A_4 (D) A_2

121. If $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$, such that $A^2 - 4A + 3I = 0$, then $A^{-1} =$

(A) $\frac{-1}{3}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$ (B) $\frac{-1}{3}\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$

(C) $\frac{1}{3}\begin{bmatrix} -2 & -1 \\ 1 & -2 \end{bmatrix}$ (D) $\frac{1}{3}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

122. Which of the following functions is not p.d.f. of a continuous random variable X?

F_1 given by

$f(x) = e^{-x}$ if $0 < x < \infty$

$= 0$, otherwise

F_2 given by

$f(x) = \frac{1}{4} \times \frac{1}{\sqrt{x}}$ if $0 < x < 4$

$= 0$, otherwise

F_3 given by

$f(x) = 6x(1 - x)$ if $0 < x < 1$

$= 0$, otherwise

F_4 given by

$f(x) = \frac{x}{2}$ if $-2 < x < 2$

$= 0$, otherwise

(A) F_3 (B) F_4

(C) F_1 (D) F_2

123. If $f(x) = 6\beta - 3 \propto x$, if $-4 \leq x < -2$ $= 4x + 1$, if $-2 \leq x \leq 2$ is continuous on $[-4, 2]$, then $\alpha + \beta =$

(A) $\frac{-7}{6}$ (B) $\frac{4}{7}$

(C) $\frac{-4}{7}$ (D) $\frac{7}{6}$

124. If $y = 3e^{5x} + 5e^{3x}$, then $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} =$

(A) $-10y$ (B) $15y$

(C) $-15y$ (D) $10y$

125. If $x = \log t, y + 1 = \frac{1}{t}$, then $e^{-x}\frac{d^2x}{dy^2} + \frac{dx}{dy} =$

(A) 0 (B) 2

(C) -1 (D) 1

126. The displacement of a particle at the time t is given by $s = \sqrt{1 + t}$, then its acceleration 'a' is proportional to

(A) square of the velocity (B) $\sqrt[3]{S}$

(C) $\sqrt{S}$ (D) cube of the velocity

127. If $f(x) = |x - 2|, x \in [0, 4]$ then the Rolle's theorem cannot be applied to the function because

(A) The function is not differentiable at every point in the $(0, 4)$. (B) $f(4) \neq f(0)$

(C) Function is not well-defined in the domain. (D) The function is not continuous at every point in the $[0, 4]$.

128. $\int \frac{dx}{\cos x\sqrt{\cos 2x}} =$

(A) $\frac{1}{2}\log\left|\tan\left(\frac{\pi}{4}+x\right)\right|+c$

(B) $\frac{1}{2}\log\left|\frac{1-\tan x}{1+\tan x}\right|+c$

(C) $2\log\left|\frac{1+\tan x}{1-\tan x}\right|+c$

(D) $\sin^{-1}(\tan x)+c$

129. $\int e^{\cos^{-1}x}\left[\frac{x-\sqrt{1-x^2}}{\sqrt{1-x^2}}\right]dx =$

(A) $-e^{\sin^{-1}x}+c$ (B) $-xe^{\cos^{-1}x}+c$

(C) $-xe^{\sin^{-1}x}+c$ (D) $-e^{\cos^{-1}x}+c$

130. $\int_0^\infty \frac{dx}{(x^2+4)(x^2+9)} =$

(A) $\frac{\pi}{120}$ (B) $\frac{\pi}{60}$

(C) $\frac{\pi}{80}$ (D) $\frac{-\pi}{60}$

131. $\int \frac{dx}{\sqrt{5+4x-x^2}} =$

(A) $\sin^{-1}\left(\frac{x-2}{3}\right)+c$

(B) $\log|(x-2)+\sqrt{5+4x-x^2}\,|+c$

(C) $\log\left|(x+2)+\sqrt{5+4x-x^2}\right|+c$

(D) $\sin^{-1}\left(\frac{x+2}{3}\right)+c$

132. $\int_{-5}^{5}\left[\frac{e^x+e^{-x}}{e^x-e^{-x}}\right]dx =$

(A) 0 (B) 1

(C) $3e^5$ (D) $2e^5$

133. $\int_0^{\frac{\pi}{2}} \frac{\sin x\cos x}{1+\sin^4 x}dx =$

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{8}$

(C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$

134. If the body cools from 135°C to 80°C at room temperature of 25°C in 60 minutes, then the temperature of body after 2 hours is

(A) (52.5)°C (B) (10.5)°C

(C) (52.75)°C (D) (10.75)°C

135. The area of the region bounded by the parabola $y^2=8x$ and its latus rectum is

(A) $\frac{16}{3}$ sq. units (B) $\frac{8}{3}$ sq. units

(C) $\frac{32}{3}$ sq. units (D) $\frac{4}{3}$ sq. units

136. The rate of growth of bacteria is proportional to number present. If initially there were 1000 bacteria and the number doubles in 1 hour then the number of bacteria after $2\frac{1}{2}$ hours are (Given $\sqrt{2}=1.414$)

(A) 4646 approximately (B) 5056 approximately

(C) 5656 approximately (D) $400\sqrt{2}$ approximately

137. The particular solution of the differential equation $\sin^2 y\frac{dx}{dy}+x=\cot y$ when $x=0$ and $y=\frac{3\pi}{4}$ is

(A) $x=1+\cot y$ (B) $xy=\cot(x+y)$

(C) $xy=\cot(x-y)$ (D) $y=1+\cot x$

138. The solution of differential equation $x^2\frac{dy}{dx}=y^2+xy$ is

(A) $\frac{x}{y}+\log|x|=c$ (B) $\frac{y}{x}+\log|x|=c$

(C) $\frac{x}{y}-\log|x|=c$ (D) $\frac{y}{x}-\log|x|=c$

139. Degree of the differential equation $e^{\frac{dy}{dx}}+\left(\frac{dy}{dx}\right)^3=x$ is

(A) 2 (B) 1

(C) not defined (D) 3

140. The value of m, if the vectors $\hat{i}-\hat{j}-6\hat{k},\hat{i}-3\hat{j}+4\hat{k}$ and $2\hat{i}-5\hat{j}+m\hat{k}$ are coplanar, is

(A) 1 (B) -3

(C) 3 (D) -1

141. If $[\bar{a}\bar{b}\bar{c}]=4$, then volume of parallelopiped with coterminus edges $\bar{a}+2\bar{b},\bar{b}+2\bar{c},\bar{c}+2\bar{a}$ is

(A) 36 units ^{3} (B) 32 units ^{3}

(C) 20 units ^{3} (D) 40 units ^{3}

142. If $\bar{a}=\frac{1}{\sqrt{10}}(3\hat{i}+\hat{k}),\bar{b}=\frac{1}{7}(2\hat{i}+3\hat{j}-6\hat{k})$, then the value of $(2\bar{a}-\bar{b})\cdot[(\bar{a}\times\bar{b})\times(\bar{a}+2\bar{b})]$ is

(A) 7 (B) -5

(C) 5 (D) -7

143. The parametric equations of the line passing through A $(3,4,-7)$, B$(1,-1,6)$ are

(A) $x=3-2\lambda,y=4-5\lambda,z=-7+13\pi$

(B) $x=-2+5\lambda,y=-5+4\lambda,z=13-7\lambda$

(C) $x=1+3\lambda,y=-1+4\lambda,z=6-7\lambda$

(D) $x=3+\lambda,y=-1+4\lambda,z=-7+6\lambda$

144. If cartesian equation of the line is $x-1=2y+3=3-z$, then its vector equation is

(A) $\bar{r}=(\hat{i}-3\hat{j}+3\hat{k})+\lambda(2\hat{i}+\hat{j}-2)$

(B) $\bar{r}=(-\hat{i}-3\hat{j}+3\hat{k})+\lambda\left(\hat{i}+\frac{1}{2}\hat{j}-\hat{k}\right)$

(C) $\bar{r}=\left(-\hat{i}+\frac{3}{2}\hat{j}-3\hat{k}\right)+\lambda(2\hat{i}+\hat{j}-2\hat{k})$

(D) $\bar{r}=\left(\hat{i}-\frac{3}{2}\hat{j}+3\hat{k}\right)+\lambda(2\hat{i}+\hat{j}-2\hat{k})$

145. The angle between the line $\frac{x-1}{2}=\frac{y+3}{1}=\frac{z+7}{2}$ and the plane $\bar{r}\cdot(6\hat{i}-2\hat{j}-3\hat{k})=5$ is

(A) $\sin^{-1}\left(\frac{4}{21}\right)$ (B) $\cos^{-1}\left(\frac{4}{21}\right)$

(C) $\sin^{-1}\left(\frac{5}{7}\right)$ (D) $\cos^{-1}\left(\frac{5}{7}\right)$

146. The equation of a plane containing the point $(1,-1,1)$ and parallel to the plane $2x+3y-4z=17$ is

(A) $\bar{r}.(2\hat{i}+3\hat{j}-4\hat{k})=-5$

(B) $\bar{r}\cdot(2\hat{i}+3\hat{j}-4\hat{k})=-15$

(C) $\bar{r}\cdot(4\hat{i}+3\hat{j}-4\hat{k})=-3$

(D) $\bar{r}\cdot(3\hat{i}+4\hat{j}-2\hat{k})=-3$

147. If $0\equiv(0,0,0)$, $P\equiv(1,\sqrt{2},1)$, then the acute angles made by the line OP with XOY, YOZ, ZOX planes are, respectively

(A) $45^\circ,45^\circ,60^\circ$ (B) $45^\circ,60^\circ,30^\circ$

(C) $60^\circ,45^\circ,60^\circ$ (D) $30^\circ,30^\circ,45^\circ$

148. If $Z=7x+y$ subject to $5x+y\geq 5, x+y\geq 3, x\geq 0, y\geq 0$, then minimum value of Z is

(A) 2 (B) 5

(C) 6 (D) 3

149. The probability that a person wins a prize on a lottery ticket is $\frac{1}{4}$. If he purchases 5 lottery tickets at random, then the probability that he wins at least one prize is

(A) $\frac{121}{1024}$ (B) $\frac{774}{1024}$

(C) $\frac{781}{1024}$ (D) $\frac{223}{1024}$

150. Two cards are drawn from a pack of well shuffled 52 playing cards one by one without replacement. Then the probability that both cards are queens is

(A) $\frac{1}{221}$ (B) $\frac{1}{220}$

(C) $\frac{3}{220}$ (D) $\frac{2}{221}$

- End of Question Paper -