MHT CET 2020 PCM Oct 19 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. The resultant of two vectors $\vec{P}$ and $\vec{Q}$ is $\vec{R}$. When the direction of $\vec{Q}$ is reversed, the resultant is given by $\vec{S}$. Which one of the following is true for vectors $\vec{R}$ and $\vec{S}$?

(A) $R^2 - S^2 = \left(P^2 + Q^2\right)$

(B) $R^2 - S^2 = 2(\vec{P} \cdot \vec{Q})$

(C) $R^2 + S^2 = 4(\vec{P} \cdot \vec{Q})$

(D) $R^2 + S^2 = 2\left(P^2 + Q^2\right)$

2. The percentage errors in measurements of mass and speed of a body are 2% and 3% respectively. What is the percentage error in kinetic energy of the body?

(A) 9%

(B) 5%

(C) 8%

(D) 0%

3. If a unit vector is represented as $\vec{u} = 0 \cdot 4\hat{i} + 0 \cdot 7\hat{j} + c\hat{k}$, then the value of ' c ' is

(A) $\sqrt{0 \cdot 11}$

(B) $\sqrt{0 \cdot 25}$

(C) $\sqrt{0 \cdot 65}$

(D) $\sqrt{0 \cdot 35}$

4. A lift of mass 'm' is ascending with an acceleration 'a' ($a < g$). The tension in the cable of the lift is (g= acceleration due to gravity)

(A) $m(g - a)$

(B) $m(g + a)$

(C) $m(2\ g + a)$

(D) $m(a - g)$

5. A body is revolving with a uniform speed ' v ' in a circle of radius ' r '. The tangential acceleration is:

(A) $\frac{v}{r}$

(B) $\frac{v^2}{r}$

(C) $\frac{v}{r^2}$

(D) zero

6. A motorcyclist rides in a horizontal circle about central vertical axis inside a cylindrical chamber of radius 'r'. If the coefficient of friction between the tyres and the inner surface of chamber is ' μ ', the minimum speed of motorcyclist to prevent him from skidding is ('g' = acceleration due to gravity)

(A) $\sqrt{\frac{\mu g}{r}}$

(B) $\sqrt{\frac{r\mu}{g}}$

(C) $\sqrt{\frac{g}{r\mu}}$

(D) $\sqrt{\frac{rg}{\mu}}$

7. When a mass ' m ' is suspended from a spring of length ' ℓ', the length of the spring becomes ' L' . The mass is pulled down by a distance ' d ' and released. If the equation of motion of the mass is $\frac{d^2x}{dt^2} + P^2x = 0$, then P is equal to (g = acceleration due to gravity)

(A) $\frac{L-\ell}{g}$

(B) $\frac{g}{L-\ell}$

(C) $\sqrt{\frac{g}{L-\ell}}$

(D) $\sqrt{\frac{L-\ell}{g}}$

8. A constant torque of 200 N turns a flywheel, which is at rest, about an axis through its centre and perpendicular to its plane. If its moment of inertia is 50 $kg - m^2$, then in 4 second, what will be change in its angular momentum?

(A) 800 $kg - m^2/s$

(B) 200 $kg - m^2/s$

(C) 40 $kg - m^2/s$

(D) 20 $kg - m^2/s$

9. A particle executes uniform circular motion with angular momentum 'L'. Its rotational kinetic energy becomes half, when the angular frequency is doubled. Its new angular momentum is

(A) 2 L

(B) $\frac{L}{2}$

(C) 4 L

(D) $\frac{L}{4}$

10. A thin metal rod of mass 'M' and length 'L' is cut into 4 equal parts by cutting it perpendicular to its length, If moment of inertia of the rod about an axis passing through its centre and perpendicular to its axis is 'I' then moment of inertia of each part about the similar axis is

(A) $\frac{I}{16}$

(B) $\frac{I}{32}$

(C) $\frac{I}{128}$

(D) $\frac{I}{64}$

11. A satellite of mass 'm' is revolving around the earth of mass 'M' in an orbit of radius 'r' with constant angular velocity ' ω'. The angular momentum of the satellite is (G = gravitational constant)

(A) $m(GMr)$

(B) $m(GMr)^{1/2}$

(C) $(GMmr)^{1/2}$

(D) $\left(\frac{GMr}{m}\right)^2$

12. Two satellites 'A' and 'B' of same mass are revolving round the earth at height '2R' and '3R' respectively above the surface of the earth. The ratio of kinetic energies of A to B will be

(A) 3 : 2

(B) 3 : 4

(C) 2 : 3

(D) 4 : 3

13. A thick brass wire of length ' L ' and density ' ρ ' is suspended from rigid support. Due to its own weight, ' ℓ' ' is the increase in length. Young's modulus ' Y' of brass wire in terms of density is (g = acceleration due to gravity)

(A) $Y = \frac{\rho g L}{4\ell}$ (B) $Y = \frac{\rho g L^2}{4\ell}$

(C) $Y = \frac{\rho g L}{3\ell}$ (D) $Y = \frac{\rho g L^2}{\ell}$

14. A force 'F' of same magnitude is applied tangentially on upper and lower face of a cube, in opposite directions. Side of the cube is 'L'. The upper face of the cube shifts parallel to itself by a distance ' x_1 '. If another cube of same material but side '2L' is subjected to the above condition, then the displacement of the top layer is

(A) $\frac{x_1}{6}$ (B) $\frac{x_1}{2}$

(C) $\frac{x_1}{8}$ (D) $\frac{x_1}{4}$

15. A water film is formed between the two straight parallel wires, each of length 10 cm, kept at a separation of $0 \cdot 5$ cm. Now, the separation between them is increased by 1 mm without breaking the water film. The work done for this is (surface tension of water $= 7 \cdot 2 \times 10^{-2} \mathrm{Nm}^{-1}$)

(A) $7 \cdot 22 \times 10^{-6}$ J (B) $5 \cdot 76 \times 10^{-5}$ J

(C) $1 \cdot 44 \times 10^{-5}$ J (D) $2 \cdot 88 \times 10^{-5}$ J

16. Soap solution is used for cleaning dirty clothes because

(A) surface tension of solution is decreased. (B) viscosity of solution is increased.

(C) temperature of solution is decreased. (D) surface tension of solution in increased.

17. A closed pipe containing liquid showed a pressure ' P_1 ' by guage. When the valve is opened, pressure was reduced to ' P_2 '. The speed of water flowing out of the pipe is [ρ = density of water]

(A) $\left[\frac{2(P_1+P_2)}{\rho}\right]^{1/2}$ (B) $\left[\frac{2(P_1-P_2)}{\rho}\right]^{1/2}$

(C) $\left[\frac{\rho}{2(P_1-P_2)}\right]^{1/2}$ (D) $\left[\frac{\rho}{2(P_1+P_2)}\right]^{1/2}$

18. For athermanous substances, coefficient of transmission is

(A) less than one but greater than zero. (B) zero.

(C) equal to one. (D) greater than one.

19. For a gas $\frac{R}{c_v} = 0 \cdot 67$. This gas is made up of molecules which are

(A) diatomic. (B) polyatomic.

(C) monoatomic. (D) mixture of diatomic and polyatomic.

20. A coin is placed on the horizontal plate. Plate performs S.H.M. vertically with angular frequency ' ω'. The amplitude (A) of oscillations is gradually increased. The coin will lose contact with plate for the first time when amplitude is (g = acceleration due to gravity)

(A) $\frac{g}{\omega^2}$ (B) zero

(C) $\frac{\omega^2}{g}$ (D) $\frac{A}{2}$

21. The equation of simple harmonic wave is given as $y = 5 \sin \frac{\pi}{2}(100t - x)$, where ' x ' and ' y ' are in metre and time in second. The period of the wave is

(A) $0 \cdot 02$ s (B) 5 s

(C) 25 s (D) $0 \cdot 04$ s

22. A body performing simple harmonic motion has potential energy ' P_1' at displacement ' x_1 '. Its potential energy is ' P_2 ' at displacement ' x_2 '. The potential energy 'P' at displacement $(x_1 + x_2)$ is

(A) $P_1 + P_2$ (B) $\sqrt{P_1 P_2}$

(C) $\sqrt{P_1^2 + P_2^2}$ (D) $P_1 + P_2 + 2\sqrt{P_1 P_2}$

23. Two progressive waves are travelling towards each other with velocity 50 m/s and frequency 200 Hz. The distance between two consecutive antinodes is

(A) $0 \cdot 031$ m (B) $0 \cdot 125$ m

(C) $0 \cdot 250$ m (D) $0 \cdot 0625$ m

24. What should be the length of a closed pipe to produce resonance with sound wave of wavelength 62 cm, in fundamental mode? [Neglect end correction]

(A) 31 cm (B) $15 \cdot 5$ cm

(C) $20 \cdot 6$ cm (D) $46 \cdot 5$ cm

25. The fundamental frequency of a sonometer wire is 50 Hz for some length and tension. If the length is increased by 25% by keeping tension same, then frequency change of second harmonic is

(A) decreased by 10% (B) decreased by 20%

(C) decreased by 5% (D) decreased by 15%

26. If the radius of the spherical Gaussian surface is increased then the electric flux due to a pooint charge enclosed by the surface

(A) decreases. (B) remains unchanged.
(C) increases. (D) is zero.

27. The function of a dielectric in a capacitor is

(A) to increase the effective potential on plates. (B) to reduce the effective potential on plates.
(C) to decrease the capacitance. (D) to reduce the plate area of capacitor.

28. In meter-bridge experiment a resistance of 18Ω is connected in left gap and an unknown resistance R is connected in right gap. The null point is obtained at ' ℓ_1° from left end. If unknown resistance is replaced by $\left(\frac{R}{3}\right)\Omega$, the null point is obtained at $1 \cdot 5\ell_1$. The unknown resistance is

(A) 9Ω (B) 36Ω
(C) 18Ω (D) 27Ω

29. A potentiometer wire of length 100 cm and resistance 3Ω is connected in series with resistance of 8Ω and an accumulator of 4 volt whose internal resistance is 1Ω A cell of e.m.f. 'E' is balanced by 50 cm length of the wire. The e.m.f. of the cell is

(A) $1 \cdot 00$ volt. (B) $0 \cdot 75$ volt.
(C) $0 \cdot 50$ volt. (D) $0 \cdot 25$ volt.

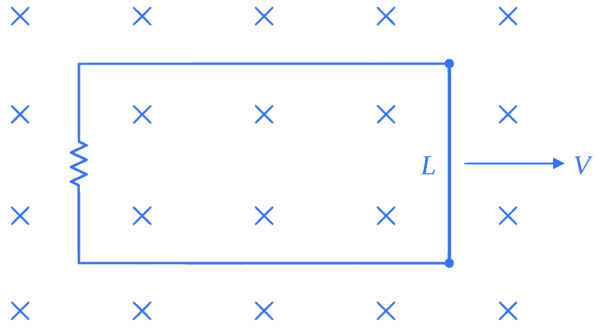
30. Moving coil galvanometers M_1 and M_2 have resistance, number of turns, area of coil and magnetic field as follows.
$R_1 = 10\Omega, R_2 = 14\Omega, N_1 = 30,\ N_2 = 42$

$A_1 = 3 \cdot 6 \times 10^{-3}\ m^2,\ A_2 = 1 \cdot 8 \times 10^{-2}\ m^2,$
$B_1 = 0 \cdot 25\ T,\ B_2 = 0 \cdot 50\ T$

(Spring constants are same for both materials) The ratio of (i) current sensitivity and (ii) voltage sensitivity for galvanometer (M_2 to M_1) is respectively

(A) $1 : 1, 1 \cdot 4 : 1$ (B) $1 : 1 \cdot 4, 1 : 1$
(C) $4 : 1\ 1 : 1$ (D) $1 \cdot 4 : 1\ 1 : 1$

31. A long metal rod of length 'L' completes the circuit as shown. The area of the circuit is perpendicular to magnetic field ' B'. Total resistance of the circuit is ' R '. The force needed to move the rod in the direction as shown with constant speed ' V ' is



(A) $\frac{B^2LV}{R}$ (B) $\frac{BLV}{R}$
(C) $\frac{BLV^2}{R}$ (D) $\frac{B^2L^2V}{R}$

32. The magnetic moment produced in a substance of mass 5 gram is $6 \times 10^{-7} Am^2$. If its density is $5\ g/cm^3$, then intensity of magnetization in $\frac{A}{m}$ will be

(A) 6 (B) 60
(C) $\frac{1}{6}$ (D) $0 \cdot 6$

33. Two concentric circular coils of 'n' turns each are situated in the same plane. Their radii are ' a_1 ' and ' $a_2'(a_2 > a_1)$ and they carry currents 'I $_1$ ' and ' I_2 ' respectively $(I_1 > I_2)$ in opposite direction. The magnetic field at the centre is

(A) $\frac{\mu_0 n}{2}\left[\frac{I_1 a_2 - I_2 a_1}{a_1 a_2}\right]$ (B) $\frac{\mu_0 n}{2a_1 a_2}[I_1 - I_2]$
(C) $\frac{\mu_0 n}{2I_1 I_2}[a_2 - a_1]$ (D) $\frac{\mu_0 n}{2}\left[\frac{I_1 a_1 - I_2 a_2}{a_1 a_2}\right]$

34. A charged particle is always moving parallel to the direction of magnetic field. The magnetic force acting on the particle will be

(A) opposite to its velocity. (B) zero.
(C) perpendicular to its velocity. (D) along its velocity.

35. A sphere of gold when brought towards a powerful magnet experiences

(A) attractive force. (B) repulsive force.
(C) zero force. (D) nuclear force.

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36. A bar magnet is held perpendicular to a uniform magnetic field. The couple acting on the magnet is to be halved by rotating it. Through what angle it should be rotated? $\left[\sin\left(\frac{\pi}{2}\right)=1\right]$

(A) $\sin^{-1}(0\cdot 8660)$ (B) $\sin^{-1}(0\cdot 7071)$

(C) $\sin^{-1}(1)$ (D) $\sin^{-1}(0\cdot 5)$

37. An alternating current of frequency 50 Hz has the peak value as $14\cdot 14$ A. The time taken by the alternating current in reaching from zero to maximum value and r.m.s. value of current will be respectively

(A) 0.025 s, 5 A (B) $0\cdot 005$ s, 5 A

(C) $0\cdot 005$ s, 10 A (D) $0\cdot 025$ s, 10 A

38. A prism having refractive index $\sqrt{2}$ and refracting angle 30° has one of the refracting surfaces silvered. The beam of light incident on the other refracting surface will retrace its path, if angle of incidence is $\left[\sin\frac{\pi}{6}=0\cdot 5\right]$

(A) $\sin^{-1}\left(\frac{3}{4}\right)$ (B) $\sin^{-1}\left(\frac{1}{2}\right)$

(C) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (D) $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

39. The refraction of light ray takes place from air to water, water to glass and again glass to air. The ray emerges parallel to incident ray. The correct relation is $[\mathrm{n_a}, \mathrm{n_w}, \mathrm{n_g}$ represent refractive indices of air, water and glass respectively.

(A) $\mathrm{g}^{\mathrm{n}}_{\mathrm{w}}=\frac{\mathrm{a}^{\mathrm{n}}\mathrm{g}}{\mathrm{a}^{\mathrm{n}}\mathrm{w}}$ (B) $\mathrm{g}^{\mathrm{n}}\mathrm{w}=\mathrm{a}^{\mathrm{n}}\mathrm{g}\times\mathrm{a}^{\mathrm{n}}\mathrm{w}$

(C) $\mathrm{w}^{\mathrm{n}}\mathrm{g}=\frac{\mathrm{a}^{\mathrm{n}}\mathrm{w}}{\mathrm{a}^{\mathrm{n}}\mathrm{g}}$ (D) $\mathrm{w}^{\mathrm{n}}\mathrm{g}=\frac{\mathrm{a}^{\mathrm{n}}\mathrm{g}}{\mathrm{a}^{\mathrm{n}}\mathrm{w}}$

40. A concave mirror of focal length 'f $_1$ ' is placed at a distance 'd' from a convex lens of focal length 'f 2 '. A parallel beam of light coming from infinity parallel to principal axis falls on the convex lens and then after refraction falls on the concave mirror. If it is to retrace the path, the distance 'd' should be

(A) $\mathrm{f}_1+\mathrm{f}_2$ (B) $-\mathrm{f}_1+\mathrm{f}_2$

(C) $2\mathrm{f}_1+\mathrm{f}_2$ (D) $2\mathrm{f}_1-\mathrm{f}_2$

41. In single slit diffraction experiment, when the distance of separation between the slit and screen is doubled, the angular separation between fringes

(A) increases. (B) decreases.

(C) remains same. (D) first increases and then decreases.

42. Young's double slit experiment is performed in water, instead of air, then fringe width

(A) decreases. (B) becomes infinite.

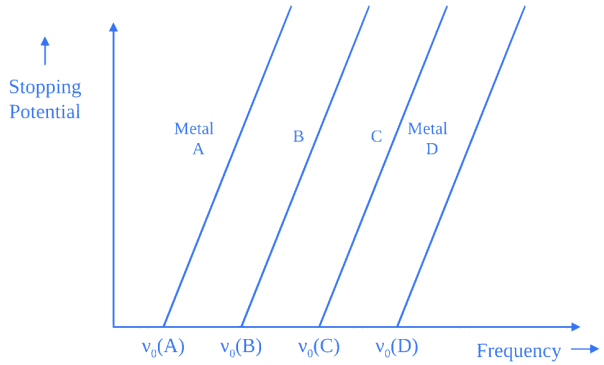
(C) increases. (D) remains same.

43. The threshold wavelengths for photoelectric emission from two metals A and B are 400 nm and 800 nm respectively. The ratio of their work functions, ϕ_A to ϕ ? is

(A) $\frac{1}{2}$ (B) 4

(C) $\frac{1}{4}$ (D) 2

44. The variation of stopping potential for metals A, B, C and D with frequency of incident radiation is as shown in the figure. For which metal, stopping potential is higher for lower values of threshold frequency (v_o) ? [The frequency of incident radiation, ' v' is same.]



(A) C (B) D

(C) A (D) B

45. An electron in the ground state of hydrogen atom is revolving in a circular orbit of radius R. The orbital magnetic moment of the electron is (m = mass of electron, h = Planck's constant, e = electronic charge)

(A) $\frac{-\mathrm{eh}}{\pi\mathrm{m}}$ (B) $\frac{\mathrm{eh}}{2\pi\mathrm{m}}$

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

46. The ground state energy of hydrogen atom is $-13\cdot 6$eV. The kinetic and potential energy of the electron in the second excited state is respectively

(A) $+3\cdot 02\mathrm{eV}, -1\cdot 51\mathrm{eV}$

(B) $1\cdot 51\mathrm{eV}, -3\cdot 02\mathrm{eV}$

(C) $-1\cdot 51\mathrm{eV}, +3\cdot 02\mathrm{eV}$

(D) $+3\cdot 02\mathrm{eV}, +1\cdot 51\mathrm{eV}$

47. A shell of mass 'M' initially at rest suddenly explodes in three fragments. Two of these fragments are of mass 'M /4 ' each, which move with velocities $3\ ms^{-1}$ and $4\ ms^{-1}$ respectively in mutually perpendicular directions. The magnitude of velocity of the third fragment is

(A) $3 \cdot 0\ ms^{-1}$ (B) $2 \cdot 5\ ms^{-1}$

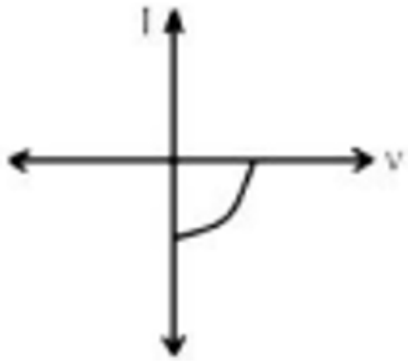
(C) $1 \cdot 5\ ms^{-1}$ (D) $2 \cdot 0\ ms^{-1}$

48. If p – n junction diode is reverse biased then

(A) potential barrier decreases. (B) width of the depletion layer decreases.

(C) electrical conduction is possible. (D) width of the depletion layer increases.

49. I-V characteristics for a junction diode is shown. The device is



(A) LED. (B) solar cell.

(C) photo cell. (D) zener diode.

50. In the process of space communication, use of modem is necessary. In which one of the following modes modem acts as a modulator and a demodulator respectively?

(A) Transmitting and receiving. (B) Both receiving.

(C) Both transmitting. (D) Receiving and transmitting.

51. Find the empirical formula of organic compound if it contains $18.6\%C, 1 \cdot 55\%H, 55 \cdot 04\%$ chlorine ? (atomic mass $C = 12$, $H = 1$, $Cl = 35 \cdot 5$, $O = 16$)

(A) $C_2H_2Cl_2O_2$ (B) CH_2ClO
(C) $CHClO$ (D) $CHClO_2$

52. A sample of calcium carbonate has the following percentage composition. $Ca = 40\%$, $C = 12\%$ and $0 = 48\%$ According to law of definite proportion the weight of calcium in 4 g of a sample of calcium carbonate from another source will be (at. no. $Ca = 40$, $C = 40$, $C = 12, 0 = 16$)

(A) 1.6×10^{-2} g (B) 1.6 g
(C) 0.1 g (D) 0.2 g

53. Which among the following elements has lowest value of electronegativity?

(A) Bi (B) As
(C) Sb (D) N

54. What is the bond order in N_2 Molecule?

(A) 2 (B) zero
(C) 1 (D) 3

55. Which of the following is an ionic compound?

(A) SO_2 (B) ICl
(C) $CHCl_3$ (D) KI

56. The number of σ bonds in carbolic acid are

(A) 13 (B) 8
(C) 12 (D) 6

57. At what temperature the volume of a gas becomes absolutely zero?

(A) $273 \cdot 15^{\circ}C$ (B) $-273 \cdot 15$ K
(C) $273 \cdot 15$ K (D) $-273 \cdot 15^{\circ}C$

58. Standard enthalpy of formation of water is -286 kJ mol^{-1}. When 1800mg of water is formed from its constituent elements in their standard states the amount of energy liberated is

(A) $2 \cdot 86$ kJ (B) $5 \cdot 72$ kJ
(C) $57 \cdot 2$ kJ (D) $28 \cdot 6$ kJ

59. From the given reaction, $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)} \Delta H = -92 \cdot 6$ kJ, the enthalpy of formation of NH_3 is

(A) $-92 \cdot 6$ kJ (B) $-138 \cdot 9$kJ
(C) $-185 \cdot 2$ kJ (D) $-46 \cdot 3$ kJ

60. If 2 kJ of heat is released from system and 6 kJ of work is done on the system, what is enthalpy change of system?

(A) $+8$k (B) $+6$kJ
(C) -8k] (D) -2kJ

61. Identify the reducing agent in following reaction. $CH_{4(g)} + O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}$

(A) $CO_{2(g)}$ (B) $H_2O_{(l)}$
(C) $O_{2(g)}$ (D) $CH_{4(g)}$

62. What is the oxidation state of sulphur in oil of vitriol?

(A) $+2$ (B) $+6$
(C) -3 (D) $+3$

63. Which is an example of molecular hydride?

(A) KH (B) NaH
(C) HF (D) LiH

64. Which among the following alkali metal elements is used as coolant in fast breeder nuclear reactors.

(A) Sodium (B) Potassium
(C) Caesium (D) Lithium

65. Which of the following is a tricarboxylic acid?

(A) Valeric acid (B) Oxalic acid
(C) Caproic acid (D) Citric acid

66. How many primary amines are possible for the formula C_4H_{11} N ?

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

67. What is the difference in molar mass of any two neighbouring alkanes?

(A) 12 g mol^{-1} (B) 10 g mol^{-1}
(C) 15 g mol^{-1} (D) 14 g mol^{-1}

68. IUPAC name of isobutyl chloride is

(A) 2-chloropropane
(B) 2-chlorobutane
(C) 2-chloro-2-methylpropane
(D) 1-chloro-2-methylpropane

69. How much part of an atom occupies each corner of bcc unit cell?

(A) $1/4$
(B) $1/8$
(C) $1/2$
(D) $1/6$

70. Which among the following is an example of amorphous solid?

(A) Camphor
(B) Magnesium
(C) Diamond
(D) Glass

71. What is the coordination number of cation in ionic compound if the type of hole occupied by cation is octahedral?

(A) 8
(B) 6
(C) 4
(D) 3

72. Henry's law is a relation between

(A) pressure and solubility
(B) temperature and pressure
(C) volume and solubility
(D) pressure and volume

73. Relative lowering in vapour pressure of a solution containing non volatile solute is the ratio of

(A) Number of moles of solute to number of moles of solvent.
(B) Number of moles of solvent to total number of moles of solution.
(C) Number of moles of solvent to number of moles of solute.
(D) Number of moles of solute to total number of moles of solution.

74. Which among the following is an example of metal-sparingly soluble salt electrode?

(A) OH^- (aq.) $|O_{2(g)}$, Pt
(B) Cl^- (aq.) $|AgCl_{(s)}|Ag_{(s)}$
(C) Zn^{2+} (aq.) $|Zn(s)$
(D) Cu^+ (aq.), Cu^{2+} (aq.) Pt

75. The distance between electrodes of a conductivity cell is 0.98 cm and area of cross section is 1.96 cm^2. What is the cell constant?

(A) 1 cm^{-1}
(B) 1.5 cm^{-1}
(C) 2 cm^{-1}
(D) 0.5 cm^{-1}

76. Half-life of first order reaction $X \longrightarrow Y + Z$ is 3 minutes. What is the time required to reduce the concentration of 'X' by 90% of it's initial concentration?

(A) $4 \cdot 12$ minutes
(B) 9.969 minutes
(C) $9 \cdot 105$ minutes
(D) $12 \cdot 05$ minutes

77. In the reaction $2\,N_2O_{5(g)} \longrightarrow 4NO_{2(g)} + O_{2(g)}$ the rate of formation of $NO_{2(g)}$ and $O_{2(g)}$ are in the ratio of

(A) 1 : 4
(B) 1 : 1
(C) 6 : 1
(D) 4 : 1

78. If a dilute solution of $AgNO_3$ is added to dilute solution of excess Nal, then the species adsorbed on AgI colloidal particles is

(A) NO_3^-
(B) Na^+
(C) I^-
(D) Ag^+

79. Which of the following alloy contain Al, Cu, Mg and Mn?

(A) Babbitt metal
(B) Stainless steel
(C) Spiegeleisen
(D) Duralumin

80. Which among the following elements is obtained in pure form by liquation process of refining?

(A) Copper
(B) Tin
(C) Gallium
(D) Silicon

81. Which among the following is a mineral of magnesium?

(A) Limonite
(B) Cryolite
(C) Magnesite
(D) Magnetite

82. What is the oxidation state of chlorine atom in hypochlorous acid?

(A) $+2$
(B) $+3$
(C) -1
(D) $+1$

83. What is the highest oxidation state exhibited by any transition element among all ?

(A) $+7$
(B) $+5$
(C) $+8$
(D) $+6$

84. What is the highest oxidation state exhibited by actinoids?

(A) $+7$
(B) $+3$
(C) $+6$
(D) $+4$

85. Which coordinate compound from following has a net negative charge on complex ion?

(A) Tris(ethylene diammine) cobalt(III) chloride
(B) Potassium trioxalato aluminate(III)
(C) Tetracarbonyl Nickel(0)
(D) Diammine silver(I)chloride

86. What is the oxidation state and coordination number of platinum respectively in $[Pt(NH_3)_6]^{4+}$?

(A) +6 and 4
(B) +4 and 4
(C) +6 and 6
(D) +4 and 6

87. Which among the following is NOT obtained when bromobenzene treated with bromoethane and sodium in presence of dry ether?

(A) n-butane
(B) Diphenyl
(C) Toluene
(D) Ethylbenzene

88. Which of the following alcohols is least soluble in water?

(A) Pentan-1-ol
(B) 2 -methyl butan-2-ol
(C) Pentan-2-ol
(D) 2,2-Dimethyl propan-1-ol

89. Which of the following is reacted with benzaldehyde to obtain l-phenylethanol?

(A) C_6H_5MgBr
(B) $C_6H_5CH_2MgBr$
(C) CH_3MgBr
(D) CH_3CH_2MgBr

90. Which catalyst is used in conversion of chlorobenzene to phenol by Rasching process?

(A) Calcium phosphate
(B) Calcium carbonate
(C) Calcium sulphate
(D) Calcium chloride

91. Identify 'A' in the following reaction. $A + SOCl_2 \xrightarrow[\text{reflux}]{\text{pyridine}} B \xrightarrow[\triangle]{KCN(\text{ alco })}$ propane nitrile

(A) Ethanol
(B) Propane
(C) 1-Chloropropane
(D) Propan-1-ol

92. Which of the following reactions involves α - halogenation of carboxylic acid?

(A) Gattermann reaction
(B) Riemer - Tiemann reaction
(C) Sandmeyer reaction
(D) Hell-Vohlard-Zelinsky reaction

93. Which of the following groups increases the basic strength of substituted aniline?

(A) $-SO_3$
(B) $-OCH_3$
(C) $-NO_2$
(D) $-CN$

94. Benzene diazonium chloride on reaction with ethanol forms

(A) aniline
(B) benzene
(C) nitrobenzene
(D) phenol

95. Which among the following amino acids has a lowest molecular mass?

(A) Proline
(B) Aspartic acid
(C) Serine
(D) Glycine

96. Which among the following polymers belongs to class thermoplastic polymers?

(A) Bakelite
(B) Polythene
(C) Terylene
(D) Neoprene

97. Which class of terpenes includes β - carotene?

(A) Tetraterpenes
(B) Triterpenes
(C) Monoterpenes
(D) Sesquiterpenes

98. Identify the monomers used in preparation of Novolac.

(A) Phenol and Ethanol
(B) Urea and Phenol
(C) Phenol and Methanal
(D) Urea and Methanal

99. Which of the following is the formula of BHA?

(A) $C_{15}H_{24}O$
(B) $C_7H_5SNO_3$
(C) $C_{11}H_{16}O_2$
(D) $C_{14}H_{18}\ N_2O_5$

100. Which of the following is used as disinfectant as well as antiseptic?

(A) Veronal
(B) Seldane
(C) Prontocil
(D) Phenol

101. If $f : R \to R$ is given by $f(x) = 7x + 8$ and $f^{-1}(12) = \frac{k}{7}$, then the value of k is

(A) 7 (B) 1

(C) 4 (D) 8

102. If a function $f : R \to R$ is defined by $f(x) = \frac{4x}{5} + 3$, then $f^{-1}(x) =$

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

(C) $\frac{4(x+3)}{5}$ (D) $\frac{4(x-3)}{5}$

103. If A and B are two angles such that A, B, $\in (0, \pi)$ and they are not supplementary angles such that $\sin A - \sin B = 0$, then

(A) $A - B = \frac{\pi}{3}$ (B) $A - B = \frac{\pi}{2}$

(C) $A = B$ (D) $A \neq B$

104. $\operatorname{cosec} 2\theta - \cot 2\theta =$

(A) $\tan\theta$ (B) $\sin 2\theta$

(C) $\cos\theta$ (D) $\tan 2\theta$

105. The general solutions of $\sin^2 x \cdot \sec x = \tan x - \sin x + 1$ is

(A) $x = n\pi + (-1)^n \frac{\pi}{4}$ or $x = m\pi + \frac{3\pi}{4}; m, n \in z$

(B) $x = n\pi + (-1)^n \frac{\pi}{2}$ or $x = m\pi + \frac{3\pi}{4}; m, n \in z$

(C) $x = n\pi + (-1)^n \frac{\pi}{2}$ or $x = m\pi + \frac{5\pi}{4}; m, n \in z$

(D) $x = n\pi + (-1)^n \frac{\pi}{4}$ or $x = m\pi + \frac{5\pi}{4}; m, n \in z$

106. If $3\sin^2 x - 8\sin x + 4 = 0, x \in \left(\frac{\pi}{2}, \pi\right)$, then $\tan x =$

(A) $-\frac{\sqrt{5}}{2}$ (B) $\frac{2}{\sqrt{5}}$

(C) $-\frac{2}{\sqrt{5}}$ (D) $\frac{\sqrt{5}}{2}$

107. The principal solutions of $\cos 2x = \frac{-1}{2}$ are

(A) $x = \frac{-2\pi}{3}, x = \frac{4\pi}{3}$ (B) $x = \frac{\pi}{3}, x = \frac{2\pi}{3}$

(C) $x = \frac{-\pi}{3}, x = \frac{5\pi}{6}$ (D) $x = \frac{\pi}{3}, x = \frac{7\pi}{6}$

108. The sum of first four terms of a G.P. is 160 and the common ratio is 3 , then the 4^{th} term is

(A) 118 (B) 100

(C) 108 (D) 102

109. If the length of perpendicular drawn from the point $(4, 1)$ on the line $3x - 4y + k = 0$ is 2 units, then the values of k are

(A) $2, -18$ (B) $-2, -18$

(C) $-2, 1$ (D) $-2, 18$

110. The joint equation of bisectors of the angle between the lines represented by $3x^2 + 2xy - y^2 = 0$ is

(A) $x^2 - 4xy - y^2 = 0$ (B) $x^2 + 4xy - y^2 = 0$

(C) $x^2 - 4xy + y^2 = 0$ (D) $x^2 + 4xy + y^2 = 0$

111. The separate equations of the lines represented by $4x^2 - y^2 + 2x + y = 0$ are

(A) $2x - 2y + 1 = 0, x + 2y = 0$

(B) $2x - y + 1 = 0, 2x + y = 0$

(C) $2x - y + 1 = 0, 2x - y = 0$

(D) $2x - y = 0, 2x + y + 1 = 0$

112. If B is end point of minor axis of the ellipse $b^2x^2 + a^2y^2 = a^2b^2(a > b)$ and S and S' are foci of ellipse such that $\Delta SBS'$ is an equilateral triangle, then eccentricity e =

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$

(C) $\frac{3}{5}$ (D) $\frac{4}{5}$

113. The eccentricity of a rectangular hyperbola is

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

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

114. The negation of the statement "If $5 < 7$ and $7 > 2$, then $5 > 2$" is

(A) $5 < 7$ and $7 > 2$ and $5 \leq 2$ (B) $5 < 7$ and $7 > 2$ or $5 < 2$

(C) $5 < 7$ and $7 > 2$ and $5 > 2$ (D) $5 < 7$ and $7 > 2$ or $5 \leq 2$

115. The dual of a statement 'Mangoes are delicious but expensive' is

(A) Mangoes are delicious or Mangoes are not expensive.
(B) Mangoes are not delicious and Mangoes are not expensive.
(C) Mangoes are delicious or Mangoes are expensive.
(D) Mangoes are delicious and Mangoes are expensive.

116. The value of $\cos^{-1}\left(\cos\left(\frac{7\pi}{6}\right)\right)$ is

(A) $\frac{5\pi}{6}$
(B) $\frac{\pi}{3}$
(C) $\frac{7\pi}{6}$
(D) $\frac{\pi}{6}$

117. If ω is a complex cube root of unity and $A = \begin{bmatrix} \omega & 0 \\ 0 & \omega \end{bmatrix}$, then $A^{-1} =$

(A) A^2
(B) 2 A
(C) $-A$
(D) A

118. If $AX = B$, where $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 4 \\ 1 & 3 & 4 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and $B = \begin{bmatrix} 12 \\ 15 \\ 13 \end{bmatrix}$, then $x^2 + y^2 + z^2 =$

(A) 14
(B) 19
(C) 21
(D) 6

119. If $f(x) = \frac{4\sin\pi x}{5x}$ for $x \neq 0$ $= 2k$ for $x = 0$ is continuous at $x = 0$, then the value of k is

(A) $\frac{2\pi}{5}$
(B) $\frac{\pi}{5}$
(C) $\frac{\pi}{10}$
(D) $\frac{4\pi}{5}$

120. If $x^2 + y^2 = t + \frac{1}{t}, x^4 + y^4 = t^2 + \frac{1}{t^2}$ then $\frac{dy}{dx} =$

(A) $-\frac{y}{x}$
(B) $\frac{y}{x}$
(C) $\frac{x}{2y}$
(D) $-\frac{x}{2y}$

121. The derivative of $\sin^{-1}\left(\frac{\sqrt{1+x}+\sqrt{1-x}}{2}\right)$ w.r.t. $\cos^{-1}x$ is

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

122. The derivative of $\cot^{-1}x$ w.r.t $\log\left(1+x^2\right)$ is

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

123. If L.M.V.T. is applicable for the function $f(x) = x + \frac{1}{x}, x \in [1, 3]$, then $c =$

(A) $-\sqrt{3}$
(B) $\sqrt{3}$
(C) 2
(D) $\sqrt{2}$

124. The function $f(x) = (x+2)e^{-x}$ is

(A) decreasing in $(-\infty, -1)$ and increasing in $(-1, \infty)$
(B) decreasing for all x
(C) increasing in $(-\infty, -1)$ and decreasing in $(-1, \infty)$
(D) increasing for all x

125. If $f'(x) = k(\cos x - \sin x), f'(0) = 3, f\left(\frac{\pi}{2}\right) = 15$, then $f(x) =$

(A) $3(\sin x + \cos x) + 12$
(B) $3(\sin x + \cos x) - 12$
(C) $-3(\sin x + \cos x) - 12$
(D) $12(\sin x + \cos x) + 3$

126.

$\int \frac{x^2+1}{(x-3)(x-2)}dx = Px + Q\log|x-3| + R\log|x-2| + c$

, where c is constant of integration, then the values of P, Q, R are, respectively

(A) $0, 10, 5$
(B) $0, 10, -5$
(C) $1, 10, 5$
(D) $1, 10, -5$

127. $\int \frac{dx}{1+\sqrt{x}} =$

(A) $2\sqrt{x} - 2\log|1+\sqrt{x}| + c$
(B) $\sqrt{x} + \log|1+\sqrt{x}| + c$
(C) $2\sqrt{x} + \log|1+\sqrt{x}| + c$
(D) $\sqrt{x} - \log|1+\sqrt{x}| + c$

128. $\int_{-2}^{2.24}[x]dx =$ where $[x]$ is the greatest integer function

(A) 2
(B) 4
(C) -2
(D) 0

129. If $\int_1^k \left(3x^2 + 2x + 1\right)dx = 11$, then k =

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

130. $\int_0^1 x(1-x)^5 dx =$

(A) $\frac{1}{7}$ (B) $-\frac{1}{42}$

(C) $\frac{1}{42}$ (D) $\frac{1}{6}$

131. The area of the region bounded by the parabola $x^2 = 16y, y = 1, y = 4$ and the Y-axis lying in the first quartrant is

(A) $\frac{55}{3}$ sq. units (B) $\frac{56}{3}$ sq. units

(C) $\frac{52}{3}$ sq. units (D) $\frac{53}{3}$ sq. units

132. The order and degree of the differential equation $\sqrt{1+\frac{1}{\left(\frac{dy}{dx}\right)^2}} = \left(\frac{d^2y}{dx^2}\right)^{\frac{3}{2}}$ are respectively

(A) 3,2 (B) 2,3

(C) 2,2 (D) 3,3

133. A body is heated to 110°C and placed in air at 10°C. After 1 hour its temperature is 60°C. The additional time required for it to cool to 30°C is

(A) $\left(\frac{\log 2}{\log 5}+1\right)$ hours (B) $\left(\frac{\log 5}{\log 2}\right)$ hours

(C) $\left(\frac{\log 5}{\log 2}-1\right)$ hours (D) $\left(\frac{\log 2}{\log 5}\right)$ hours

134. If the radius of a circular blot of oil is increasing at the rate of 2 cm/ min, then the rate of change of its area when its radius is 3cms is

(A) $10\pi \text{cm}^2/\text{min}$ (B) $12\pi \text{cm}^2/\text{min}$

(C) $14\pi \text{cm}^2/\text{min}$ (D) $16\pi \text{cm}^2/\text{min}$

135. The bacteria increases at the rate proportional to the number of bacteria present. If the original number ' N′ doubles in 4 hours then the number of bacteria in 12 hours will be

(A) 3 N (B) 4 N

(C) 6 N (D) 8 N

136. The integrating factor of differential equation $\left(1+y+x^2y\right)dx + \left(x+x^3\right)dy = 0$ is

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

(C) $\log x$ (D) e^x

137. The differential equation of the circles having their centres on the line y = 8 and touching the X -axis is

(A) $(y-8)^2\left[1-\left(\frac{dy}{dx}\right)^2\right] = 64$

(B) $(y-8)^2\left[1+\left(\frac{dy}{dx}\right)^2\right] = 64$

(C) $(y-8)\left[1+\left(\frac{dy}{dx}\right)^2\right] = 64$

(D) $y^2\left(1+\frac{dy}{dx}\right) = 64$

138. If the points A(2, 1, −1), B(0, −1, 0), C(4, 0, 4) and D(2, 0, x) are coplanar, then $x =$

(A) 2 (B) 1

(C) 4 (D) 3

139. If $\bar{a}, \bar{b}, \bar{c}$ are nonzero vectors along the coterminus edges of a parallelopiped with volume 7 cubic units, then the volume of a parallelopiped with $\bar{a}+\bar{b}, \bar{b}+\bar{c}, \bar{c}+\bar{a}$ as the coterminus edges is

(A) 49 cubic units (B) 2 cubic units

(C) 14 cubic units (D) 7 cubic units

140. The direction ratios of the line perpendicular to the lines having direction ratios 2, 3, 1 and 1, 2, 1 are

(A) −2, 1, 1 (B) 1, 1, 1

(C) 1, −1, 1 (D) 2, 2, −2

141. If a, b, c are distinct positive numbers and vectors $a\hat{i}+a\hat{j}+c\hat{k}, \hat{i}+\hat{k}$ and $c\hat{i}+c\hat{j}+b\hat{k}$ lie in a plane, then

(A) c is A.M. of a and b (B) $c^2 = 0$

(C) c is H.M. of a and b (D) c is G.M. of a and b

142. The co-ordinates of the point where the line $\frac{x-1}{2} = \frac{y-2}{-3} = \frac{z+3}{4}$ meet the plane $2x+4y-z=1$ are

(A) (3, −1, −1) (B) (3, −1, 1)

(C) (3, 1, −1) (D) (−2, 1, −1)

143. The distance of a point (1, 2, −1) from the plane $x-2y+4z+10=0$ is

(A) $\frac{3}{\sqrt{7}}$ units (B) $\frac{\sqrt{3}}{7}$ units

(C) $\sqrt{\frac{7}{3}}$ units (D) $\sqrt{\frac{3}{7}}$ units

144. The equation of the line passing through the point $(1, 2, 3)$ and perpendicular to the lines $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$ and $\bar{r} = \lambda(-3\hat{i} + 2\hat{j} + 5\hat{k})$ is

(A) $\bar{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + 7\hat{j} - 4\hat{k})$

(B) $\bar{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + 7\hat{j} + 4\hat{k})$

(C) $\bar{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} - 7\hat{j} - 4\hat{k})$

(D) $\bar{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} - 7\hat{j} + 4\hat{k})$

145. The angle between the lines $\bar{r} = (2\hat{i} + \hat{j} - 3\hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $\frac{x-1}{1} = \frac{y+2}{3} = \frac{z-3}{2}$ is

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$

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

146. If $Z = 10x + 25y$ subject to $0 \le x \le 3, 0 \le y \le 3, x + y \le 5, x \ge 0$, $y \ge 0$ then z is maximum at the point

(A) $(2, 4)$ (B) $(1, 6)$

(C) $(2, 3)$ (D) $(4, 3)$

147. Given $X \sim B(n, p)$, If $E(X) = 4$ and $\text{Var}(X) = 2 \cdot 4$, then n =

(A) 20 (B) 15

(C) 5 (D) 10

148. If the p.m.f. of a r.v. X is

x	0	1	2
P(X = x)	q^2	$2pq$	p^2

then, the standard deviation of X is (given $p + q = 1$)

(A) $2\sqrt{q}$ (B) $\sqrt{2pq}$

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

149. The c.d.f. F(x) of discrete r.v. X is given by

X	-3	-1	0	1	3	5	7	9
F(X)	$0 \cdot 1$	$0 \cdot 3$	$0 \cdot 5$	$0 \cdot 65$	$0 \cdot 75$	$0 \cdot 85$	$0 \cdot 90$	1

then $P[X = 3] =$

(A) $0 \cdot 85$ (B) $0 \cdot 10$

(C) $0 \cdot 75$ (D) $0 \cdot 65$

150. A problem in statistics is given to three students P, Q and R. Their chances of solving the problem are $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ respectively. If all of them try independently, then the probability that the problem is solved, is

(A) $\frac{2}{3}$ (B) $\frac{1}{2}$

(C) $\frac{3}{4}$ (D) $\frac{1}{4}$

- End of Question Paper -