MHT CET 2026 PCM May 15 Shift 2 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 2026**, 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 angle made by a vector $\vec{B} = 3\hat{i} + 2\hat{j} + 4\hat{k}$ with Y axis is

(A) $\cos^{-1}\left(\frac{4}{\sqrt{11}}\right)$ (B) $\cos^{-1}\left(\frac{3}{\sqrt{17}}\right)$

(C) $\cos^{-1}\left(\frac{2}{\sqrt{29}}\right)$ (D) $\cos^{-1}\left(\frac{5}{\sqrt{23}}\right)$

2. A physical quantity C is related to four other quantities P, Q, R and S as $C = \frac{PQ^2}{R^3\sqrt{S}}$. The percentage error in the measurement of P, Q, R and S are 1%, 2%, 3% and 2% respectively. The percentage error in the measurement of C will be

(A) 18% (B) 6%

(C) 9% (D) 15%

3. A person travelling in a straight line moves with uniform velocity V_1 for a distance x and with a uniform velocity V_2 for the next $\frac{3x}{2}$ distance. The average velocity in this motion is $\frac{50}{7}$ m/s. If V_1 is 5 m/s then V_2 (in m/s) is

(A) 5 (B) 15

(C) 10 (D) 8

4. A student runs along a circular track of diameter 80 m. The distance travelled and the magnitude of displacement of the student when he covers $\left(\frac{3}{4}\right)^{th}$ of the circle is (in m)

(A) $60\pi, 40\sqrt{2}$ (B) $40\pi, 60\sqrt{2}$

(C) $120\pi, 80\sqrt{2}$ (D) $80\pi, 120\sqrt{2}$

5. If the force acting on a body is inversely proportional to its speed, the kinetic energy of the body is

(A) constant (B) directly proportional to time

(C) inversely proportional to time (D) directly proportional to square of time

6. A sphere of mass 50 gram is placed on a vertical spring. It is compressed by 0.4 m using a force 10 N. When the spring is released the sphere will reach to a height of ($g = 10m/s^2$)

(A) $8m$ (B) $4m$

(C) $2m$ (D) $16m$

7. A circular ring and a solid sphere having same radius roll down on an inclined plane from rest without slipping. The ratio of their velocities when reached at the bottom of the plane $\sqrt{\frac{x}{5}}$ where the value of x is

(A) 3 (B) 3.5

(C) 4 (D) 2.5

8. Moment of inertia of a disc of mass m and radius R about the centre of mass and perpendicular to plane is I_1 and moment of inertia of disc at a distance $\frac{2R}{3}$ from centre and perpendicular to plane is I_2 then I_1/I_2 is

(A) $\frac{6}{17}$ (B) $\frac{9}{17}$

(C) $\frac{8}{9}$ (D) $\frac{5}{7}$

9. A particle of mass m is projected with a velocity $v = KV_e$ ($K < 1$) from the surface of the earth. The maximum height above the surface reached by the particle is (V_e = escape velocity, R is radius of earth)

(A) $R\left(\frac{K}{1+K}\right)^2$ (B) $\frac{R^2K}{1+K}$

(C) $\frac{RK^2}{1-K^2}$ (D) $R\left(\frac{K}{1-K}\right)^2$

10. A capillary tube is taken from the earth to the surface of the moon. The rise of the liquid column on the moon (acceleration due to gravity on earth is 6 times that of the moon) is

(A) 6 times that of earth's surface (B) $\frac{1}{6}$ that on the earth's surface

(C) equal to that on the earth's surface (D) zero

11. The velocity of a small ball of mass M and density d when dropped in a container filled with glycerine becomes constant after some time. If density of glycerine is $\frac{d}{2}$ then the viscous force acting on the ball will be (g=acceleration due to gravity)

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

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

12. Two water drops each of radius r coalesce to form a big drop. If T is the surface tension, the surface energy released in this process is $4\pi r^2 Tx$. The value of x is

(A) $\left(2-2^{2/3}\right)$ (B) $\left(2-2^{1/3}\right)$

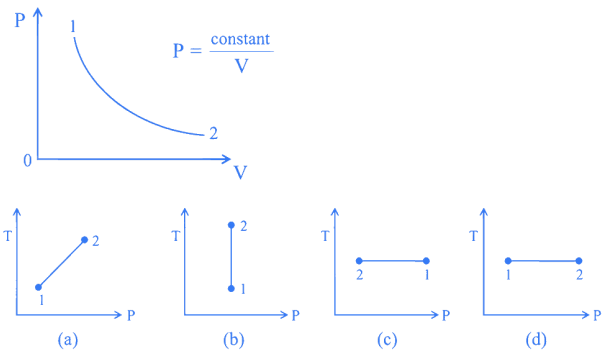
(C) $\left(1+\sqrt{2}\right)$ (D) $\left(\sqrt{2}-1\right)$

13. A sheet of solid material having area A and coefficient of linear expansion α. The mass of sheet is m and specific heat capacity is s. If dQ is the amount of heat given to the sheet then change in its area is

(A) $\frac{A(2\alpha)ms}{\Delta Q}$ (B) $\frac{A(2\alpha)\Delta Q}{ms}$

(C) $\frac{A\alpha\Delta Q}{ms}$ (D) $\frac{A\alpha ms}{\Delta Q}$

14. Consider p-V diagram for an ideal gas as shown. Out of the following diagrams which represents the T-p diagram?



(A) d (B) c

(C) b (D) a

15. Two moles of a rigid diatomic gas does a work $\frac{Q}{4}$ when the amount of heat supplied is Q. In this process the total heat capacity of the gas is (R = gas constant)

(A) $\frac{12R}{5}$ (B) $\frac{10R}{7}$

(C) $\frac{15R}{4}$ (D) $\frac{20R}{3}$

16. In an adiabatic process, which one of the following statement is true ?

(A) The molar heat capacity is infinite

(B) Work done by the gas equals the increase in internal energy

(C) The molar heat capacity is zero

(D) The internal energy of the gas decreases as the temperature increases

17. For a gas, if the ratio of specific heats at constant pressure and volume is γ then the value of degree of freedom is

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

(C) $\frac{9(\gamma-1)}{2}$ (D) $\frac{25(\gamma-1)}{2}$

18. The internal energy of a diatomic molecule (air) in $4m \times 4m \times 3m$ sized room at 10^5 N/m^2 atmospheric pressure will be $x \times 10^6$ J. The value of x is

(A) 6 (B) 12

(C) 4 (D) 16

19. A horizontal spring executes S.H.M. with amplitude A_1 when mass m is attached to it. When it passes through mean position another mass m is placed on it. Both masses move together with amplitude A_2. The ratio $\frac{A_1}{A_2}$ is

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

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

20. Two simple pendulums having lengths ℓ_1 and ℓ_2 with negligible string mass undergo angular displacement θ_1 and θ_2 from their mean positions respectively. If the angular acceleration of both pendulums are same, then which equation is correct ?

(A) $\theta_1\ell_2^2 = \theta_2\ell_1^2$ (B) $\theta_1\ell_1 = \theta_2\ell_2$

(C) $\theta_1\ell_1^2 = \theta_2\ell_2^2$ (D) $\theta_1\ell_2 = \theta_2\ell_1$

21. In a sine wave, minimum distance between 2 particles always having same speed is

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

(C) $\frac{\lambda}{3}$ (D) λ

22. An organ pipe P_1 closed at one end and vibrating in its first overtone and other pipe P_2 open at both ends vibrating in its third overtone are in resonance with a given tuning fork. The ratio of length of P_1 and P_2 will be

(A) 3 : 8 (B) 3 : 4

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

23. In an experiment with a closed organ pipe, it is filled with water by $\left(\frac{1}{5}\right)^{th}$ of its volume. The frequency of the fundamental note will change by

(A) 25% (B) 20%

(C) -20% (D) -25%

24. Two points separated by 6 cm on a string has phase difference of 60°. If frequency of oscillation is 500 Hz, the velocity of the wave in $\frac{m}{s}$ is

(A) 200 (B) 180

(C) 100 (D) 80

25. Two concentric spheres kept in air have radii R and r. They have similar charge and equal surface charge density σ. The electric potential at their common centre is (ϵ_0 = permittivity of free space)

(A) $\frac{\sigma(R+r)}{\epsilon_0}$ (B) $\frac{\sigma(R-r)}{\epsilon_0}$

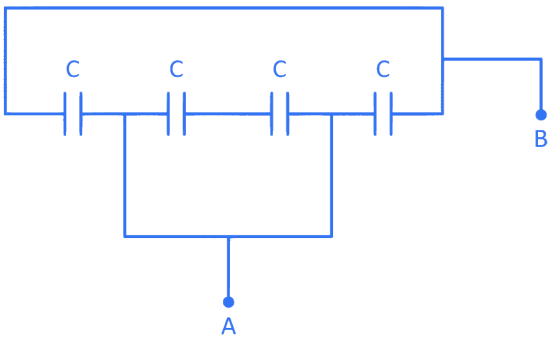
(C) $\frac{\sigma(R+r)}{2\epsilon_0}$ (D) $\frac{\sigma(R+r)}{4\epsilon_0}$

26. Two point charges placed at a certain distance r in air exert force F on each other. Then the distance r_1 at which these charges will exert the same force in a medium of dielectric constant K is

(A) r (B) $\frac{r}{K}$

(C) $\frac{r}{\sqrt{K}}$ (D) $r\sqrt{K}$

27. Four capacitors each of 16 μF are connected as shown. The capacitance between points A and B is (in μF)



(A) 4 (B) 16

(C) 32 (D) 64

28. A parallel plate capacitor of plate separation 2 mm and plate area 40 cm^2 is filled with dielectric whose area is same as plates of capacitor. Thickness is 1 mm and dielectric constant is 5. New capacitance is (ϵ_0 = permittivity of free space)

(A) $\frac{3\epsilon_0}{10}F$ (B) $\frac{10\epsilon_0}{3}F$

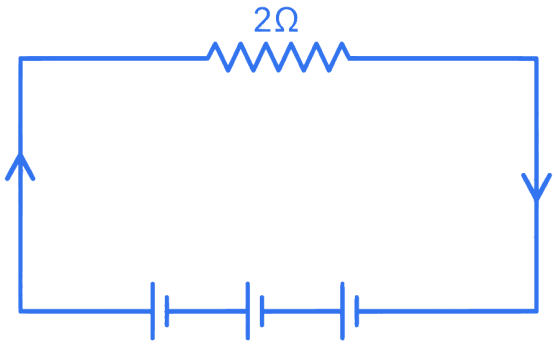
(C) $\frac{20\epsilon_0}{3}F$ (D) $\frac{3\epsilon_0}{20}F$

29. Two wires A and B of equal lengths are connected in left and right gap of a metre bridge, 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) 4 : 1 (B) 3 : 1

(C) 6 : 1 (D) 8 : 1

30. In an electric circuit shown, each cell has e.m.f. $2V$ and internal resistance 1Ω. The external resistance is 2Ω. The value of current (in A) is



(A) 2 (B) 1.25

(C) 0.4 (D) 1.2

31. The magnitude of the magnetic field inside a long solenoid is increased by

(A) decreasing its radius (B) decreasing the current through it

(C) increasing the area of cross-section (D) introducing a medium of higher permeability

32. A uniform conducting wire of length $'12a'$ and resistance R is wound up as a current carrying coil in the shape of an equilateral triangle of side $'a'$ and then a square of side $'a'$. The ratio of magnetic dipole moments of triangular to square coil is

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

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

33. The relationship between the magnetic susceptibility (χ) and magnetic permeability (μ) of a material is (μ_0 and μ_r is the permeability of free space and relative permeability respectively)

(A) $\chi = \frac{\mu}{\mu_0} - 1$ (B) $\chi = \frac{\mu_r}{\mu_0} + 1$

(C) $\chi = \mu_r + 1$ (D) $\chi = 1 - \frac{\mu}{\mu_0}$

34. Two coils P and Q are separated by some distance. When a current of $3A$ flows through coil P, a magnetic flux of 10^{-3} Wb passes through Q. No current is passed through Q. When no current passes through P and a current of $2A$ passes through Q, the flux through P is $x \times 10^{-3}$ Wb. The value of x is

(A) 6.67 (B) 0.667

(C) 3.67 (D) 0.367

35. A rectangular wire loop of resistance 1.5Ω placed in a region of uniform magnetic field of magnitude 0.3 T directed normal to the loop. If the area of the loop decreases at a rate of 0.05 m^2/s in this magnetic field, the heat produced in it is $x \times 10^{-6}$ W. The value of x is

(A) 1.5 (B) 15

(C) 2 (D) 150

36. The inductance of a coil is proportional to

(A) its length (B) the number of turns

(C) the resistance of coil (D) the square of the number of turns

37. An AC source is 120 V - 60 Hz. The value of voltage after $\frac{1}{720}$ s from start will be $\left(\sin 30^\circ = \frac{1}{2}\right)$

(A) $20.2V$ (B) $42.4V$

(C) $84.8V$ (D) $106.9V$

38. Same current is flowing in two AC circuits. First contains only inductance and second contains only capacitance. If frequency of AC is increased for both, the current will

(A) increase in first circuit and decrease in second (B) increase in both circuits

(C) decrease in both circuits (D) decrease in first circuit and increase in second

39. An alternating voltage $V = 200\sqrt{2}\sin(100t)$ volt is connected to $1\mu F$ capacitor through ammeter (AC). The reading of ammeter is (in mA)

(A) 5 (B) 10

(C) 15 (D) 20

40. For the same angle of incidence, the angles of refraction in media A, B, C and D are 50°, 40°, 30° and 20° respectively. The speed of light is minimum in medium

(A) A (B) B

(C) C (D) D

41. A biconvex lens has radius of curvature of both the surfaces same as $\frac{1}{6}$ cm. If this lens is replaced by another convex lens having different radii of curvature on both sides without change in lens power then possible combination of R_1 and R_2 is ($R_1 \neq R_2$)

(A) 1/3 cm and 1/5 cm (B) 1/5 cm and 1/7 cm

(C) 1/3 cm and 1/7 cm (D) 1/6 cm and 1/9 cm

42. At two points P and Q on the screen in Young's double slit experiment, waves from slits S_1 and S_2 have a path difference of zero and $\frac{\lambda}{4}$ respectively. The ratio of intensities at P and Q will be $\left(\cos 0^\circ = 1, \cos 45^\circ = \frac{1}{\sqrt{2}}\right)$

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

(C) $\sqrt{2}$: 1 (D) 4 : 1

43. Three polaroid sheets are co-axially placed such that pass axis of polaroids 2 and 3 make 30° and 90° with pass axis of sheet. If I_0 is the intensity of unpolarised light entering first sheet, the intensity of the emergent light through 3^{rd} sheet is

(A) zero (B) $\frac{3I_0}{32}$

(C) $\frac{3I_0}{8}$ (D) $\frac{3I_0}{16}$

44. When a certain metal surface is illuminated with a light of wavelength λ, the stopping potential is V. When the same surface is illuminated by light of wavelength 2λ, the stopping potential is $\left(\frac{V}{3}\right)$. The threshold wavelength for the surface is

(A) $\frac{8\lambda}{3}$ (B) $\frac{4\lambda}{3}$

(C) 4λ (D) 6λ

45. The number of photons per second emitted by the source of monochromatic light of wavelength 600 nm, when it delivers the power of 3.3×10^{-3} W will be
(Planck's constant $= 6.6 \times 10^{-34}$ Js, $c = 3 \times 10^{8}$ m/s)

(A) 10^{17} (B) 10^{16}

(C) 10^{15} (D) 10^{18}

46. In hydrogen like spectrum if wavelength of transition from 3^{rd} to 2^{nd} orbit is λ_1 then wavelength of transition from 4^{th} to 3^{rd} orbit (Bohr's) is λ_2. If $\lambda_2/\lambda_1 = 20/x$ then value of x is

(A) 5 (B) 6

(C) 7 (D) 8

47. A radioactive nucleus ${}^{A}_{Z}X$ undergoes spontaneous decay in the sequence ${}^{A}_{Z}X \rightarrow {}^{\square}_{Z-1}B \rightarrow {}^{\square}_{Z-3}C \rightarrow {}^{\square}_{Z-2}D$ where Z is the atomic number of element. The possible decay particles in the sequence are

(A) α, β^{+}, β (B) β^{+}, α, β

(C) β, α, β^{+} (D) α, β, β^{+}

48. An AND gate is followed by a NOT gate in series. With two input A and B, the Boolean expression for the output Y will be

(A) $\overline{A+B}$ (B) $\overline{A \cdot B}$

(C) $A \cdot B$ (D) $A + B$

49. At room temperature, a p-type semiconductor has

(A) large number of holes and few electrons (B) large number of free electrons and few holes

(C) equal number of free electrons and holes (D) no electrons or holes

50. The Zener diode has reverse breakdown voltage V_Z. The current through the load resistance R_L is I_L. The current through Zener diode is
(V_0 = Input voltage , R_S = Series resistance)

(A) $\frac{(V_0 - V_Z)}{R_S}$ (B) $\frac{(V_0 - V_Z)}{R_L}$

(C) $\frac{V_Z}{R_L}$ (D) $\left(\frac{V_0 - V_Z}{R_S}\right) - I_L$

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51. A man purchased 171 kg of cane sugar for Rs. 6840. Calculate the cost of cane sugar per mole.

(A) Rs. 12.56 (B) Rs. 13.68
(C) Rs. 14.28 (D) Rs. 15.42

52. What is a correct set of four quantum number values for an electron present in $3p$ orbital?

(A) $3, 2, 1, +1/2$ (B) $3, 2, 0, +1/2$
(C) $3, 1, 0, +1/2$ (D) $3, 0, 1, +1/2$

53. Which is the incorrect statement among the following?

(A) The oxide that forms acid when combined with water, is acidic oxide.
(B) The oxides showing acidic as well as basic characteristics are amphoteric oxides.
(C) The acidic character of oxides increases, whereas basic character decreases in a period from left to right in the periodic table.
(D) NO, N_2O and CO are amphoteric oxides.

54. Which of the following terms is used for presence of H bonding in a molecule itself?

(A) London dispersion forces.
(B) Ion -dipole interactions
(C) intramolecular H bonding
(D) intermolecular H bonding

55. What is bond order in N_2 molecule?

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

56. Calculate the standard enthalpy of combustion of $C_2H_2(g)$,
$C_2H_2(g) + 5/2O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$
$[\Delta_f H^0(CO_2) = -390 \text{ kJ mol}^{-1}$, $\Delta_f H^0(H_2O) = -285 \text{ kJ mol}^{-1}$ and $\Delta_f H^0(C_2H_2) = 225 \text{ kJ mol}^{-1}]$

(A) $\Delta_c H^0(C_2H_2) = -1290 \text{ kJ mol}^{-1}$
(B) $\Delta_c H^0(C_2H_2) = -645 \text{ kJ mol}^{-1}$
(C) $\Delta_c H^0(C_2H_2) = -1935 \text{ kJ mol}^{-1}$
(D) $\Delta_c H^0(C_2H_2) = -2580 \text{ kJ mol}^{-1}$

57. Calculate the work done when 2 moles of an ideal gas expand isothermaly and reversibly from 10 dm^3 to 20 dm^3 at 300 K
$(R = 8.314 JK^{-1}mol^{-1})$

(A) $-3458J$ (B) $-1729J$
(C) $-864.5J$ (D) $-2593J$

58. In a process, $\Delta U = 0$ and $q \neq 0$. Then the process must involve

(A) No work is done during the process.
(B) Heat is transferred, but no mechanical work occurs.
(C) Work done by or on a system exactly equal in magnitude and opposite in sign to a heat transfer.
(D) There is a change in internal energy of the system throughout the process.

59. The K_{SP} of $Mg(OH)_2$ is 1.2×10^{-11}. Then what will be the highest pH of the 0.1 M Mg^{2+} ions from which $Mg(OH)_2$ is not precipitated?

(A) 4.96 (B) 6.96
(C) 7.54 (D) 9.04

60. Calculate the solubility in g/L of sparingly soluble salt BA if solubility product is 5.2×10^{-13} (molar mass $BA = 188$ g/mol).

(A) $2.68 \times 10^{-4} g/L$ (B) $2.15 \times 10^{-4} g/L$
(C) $1.355 \times 10^{-4} g/L$ (D) $4.845 \times 10^{-4} g/L$

61. Identify the conjugate base of NH_3 from following.

(A) NH_4^+ (B) NH_4OH
(C) NH_2OH (D) NH_2^-

62. Assign the oxidation number of N in the following species respectively.
(i) NH_4^+ (ii) NO_2

(A) $+3, -3$ (B) $-3, +4$
(C) $-4, +3$ (D) $+5, +3$

63. Which one of the following nitrates will decompose to give NO_2 on heating ?

(A) $NaNO_3$ (B) KNO_3
(C) $RbNO_3$ (D) $LiNO_3$

64. What type of information is collected using FTIR spectroscopy ?

(A) Preliminary confirmation of formation of nanoparticles.
(B) Crystal structure.
(C) Structure of surface material.
(D) Absorption by functional groups, Binding nature.

65. What is IUPAC name of allylbromide ?

(A) 1-Bromopropene
(B) 2-Bromopropene
(C) 3-Bromopropene
(D) 1-Bromoprop-2-ene

66. Bottom ash of thermal power stations can be used as raw material for cement and brick industry. This example illustrates which of the following principle of green chemistry?

(A) Atom economy
(B) Designing safer chemicals
(C) Design for energy efficiency
(D) Prevention of waste or by products

67. Calculate the void volume of a unit cell of polonium metal if the radius of polonium is 190 pm.

(A) $1.756 \times 10^{-23} \text{cm}^3$
(B) $1.427 \times 10^{-23} \text{cm}^3$
(C) $2.613 \times 10^{-23} \text{cm}^3$
(D) $5.487 \times 10^{-23} \text{cm}^3$

68. Calculate the molar mass of a metal having density 10 g cm^{-3} and fcc structure with edge length 400 pm.

(A) 104.5g mol^{-1}
(B) 96.35g mol^{-1}
(C) 146.0g mol^{-1}
(D) 79.4g mol^{-1}

69. What is the total number of atoms present per fcc unit cell on all its faces only ?

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

70. The solubility of N_2 gas in water at $25^\circ C$ and 1 bar is 6.85×10^{-4} mol L^{-1}. Calculate the molarity of N_2 gas dissolved in water under atmospheric conditions when the partial pressure of N_2 in atmosphere is 0.50 bar.

(A) $12.425 \times 10^{-4} \text{mol L}^{-1}$
(B) $3.425 \times 10^{-4} \text{mol L}^{-1}$
(C) $5.251 \times 10^{-4} \text{mol L}^{-1}$
(D) $3.425 \times 10^{-2} \text{mol L}^{-1}$

71. Calculate the boiling point elevation of an aqueous solution containing 0.5 g glucose in 20 g water if K_b for water is 0.52 K kg mol^{-1}. [Molar mass of glucose = 180 g mol^{-1}]

(A) $0.072K$
(B) $0.054K$
(C) $0.091K$
(D) $1.08K$

72. Calculate van't Hoff factor for $CaCl_2$, if osmotic pressure of $CaCl_2$ and urea solutions of same concentrations at same temperature are 0.65 and 0.27 atm respectively.

(A) 1.95
(B) 2.1
(C) 2.9
(D) 2.41

73. The main function of a salt bridge in an electrochemical cell is to:

(A) Increase cell potential
(B) Decreases the reaction rate
(C) Maintain electrical neutrality in half-cells
(D) Increase the reaction rate

74. A conductivity cell containing 0.01 M KCl produces resistance 600 ohms at $25^\circ C$. Find the cell constant if conductivity of 0.01 M KCl at the same temperature is 0.0014 $\text{ohm}^{-1}\text{cm}^{-1}$.

(A) 0.8cm^{-1}
(B) 0.84cm^{-1}
(C) 0.88cm^{-1}
(D) 0.76cm^{-1}

75. If a galvanized iron sheet is scratched and the iron surface is exposed to the atmosphere, the iron does not undergo corrosion. This is because:

(A) Zinc forms a protective oxide layer that covers the scratch.
(B) Iron has a higher reduction potential than zinc, making iron the cathode.
(C) Zinc has a lower oxidation potential than iron, acting as a sacrificial anode.
(D) Electrons flow from the iron to the zinc to prevent oxidation.

76. How is the rate of second order reaction affected when the concentration of the reactant is increased by 2 times its initial value ?

(A) Remains the same.
(B) It quadruples
(C) It triples
(D) It doubles

77. Determine the rate law for a reaction, $2NO + Br_2 \rightarrow 2NOBr$ that occurs in following two steps.
i) $NO + Br_2 \rightarrow NOBr_2$ (fast)
ii) $NOBr_2 + NO \rightarrow 2NOBr$ (slow)

(A) $r = k[NOBr_2][NO]$ (B) $r = k'[NO]^2[Br_2]$
(C) $r = k'[NO][Br_2]$ (D) $r = k[NO][Br_2]^2$

78. For the reaction $A(g) + B(g) \rightarrow 2AB(g)$ rate law is rate $= k[A][B]^{1/2}$. Identify TRUE statements about the reaction from following.

(A) The reaction is bimolecular and its order is two.
(B) The reaction is unimolecular and its order is one.
(C) The reaction is bimolecular and it is first order.
(D) The reaction is bimolecular and its order is $3/2$.

79. Which of the following cations has maximum coagulating power to cause precipitation of negatively charged arsenious sulfide ?

(A) Na^+ (B) Zn^{++}
(C) Ca^{++} (D) Al^{+++}

80. Which of the following catalysts is used in the manufacture of ammonia by Haber's process?

(A) Fe-Cr (B) Mo/Fe
(C) MnO_2 (D) Pt

81. Which of the following halogens is never the central atom in interhalogen compounds?

(A) F (B) Cl
(C) Br (D) I

82. Which of the following is responsible for forming Interstitial compounds?

(A) Metallic bonding (B) Hydrogen bonding
(C) Covalent bonding (D) Defect in the crystal lattice of transition metals

83. Identify the solvate isomer pair from the following:

(A) $[Co(NH_3)_5(NO_2)]^{2\oplus}$ and $[Co(NH_3)_5(ONO)]^{2\oplus}$
(B) $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$
(C) $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$
(D) $[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

84. What type of hybridization is present in $[CoF_6]^{3-}$?

(A) d^2sp^3 (B) sp^3d^2
(C) dsp^2 (D) sp^3

85. Which of the following alkyl halides undergo nucleophilic substitution either by SN^2 or SN^1 mechanism?

(A) CH_3Br (B) $(CH_3)_3C$-Br
(C) $(CH_3)_2CH$-Br (D) CH_3CH_2Br

86. Which of the following compounds when comes in contact with the eyes, damages the cornea?

(A) Chloromethane (B) Dichloromethane
(C) Trichloromethane (D) Tetrachloromethane

87. Which of the following is gaseous ether?

(A) Ethyl methyl ether
(B) Anisole
(C) 4-Methoxyacetophenone
(D) p-Bromo anisole

88. Identify the temperature required for preparation of ethoxyethane from ethanol in the presence of H_2SO_4.

(A) $113K$ (B) $443K$
(C) $413K$ (D) $213K$

89. An organic compound gives hydrogen on reaction with sodium metal and it also forms an aldehyde having molecular formula C_2H_4O on oxidation with pyridinium chlorochromate, identify the organic compound from following ?

(A) Acetone (B) Ethyl alcohol
(C) Dimethyl ether (D) Acetic acid

90. Which of the following functional groups is functional isomer of Ethers?

(A) Aldehydes (B) Carboxylic acids
(C) Alcohols (D) Ketones

91. Which of the following most readily gives 2-Methylbut-2-ene on heating with concentrated sulphuric acid ?

(A) 2-Bromo-2-methylbutane (B) 2-Bromo-3-methylbutane
(C) 2-Methylbutan-1-ol (D) 2-Methylbutan-2-ol

92. Which of the following compounds forms 4-Methylpent-3-en-2-one by aldol condensation on further dehydration.

(A) Two molecules of acetone
(B) Two molecules of acetaldehyde
(C) Acetaldehyde and formaldehyde
(D) Acetaldehyde and acetone

93. Which of the following compounds develops a pink color with Schiff's reagent?

(A) Acetaldehyde
(B) Acetone
(C) Acetic acid
(D) Methyl acetate

94. Which of the following reagents tests the presence of $-COOH$ in carboxylic acids?

(A) Tollen's reagent
(B) $NaHCO_3$
(C) Fehling's solution
(D) $NaHSO_3$

95. Which of the following has highest pK_b value ?

(A) $CCl_3 - CH_2 - NH_2$
(B) $CCl_3 - CH_2 - CH_2 - NH_2$
(C) $CF_3 - CH_2 - NH_2$
(D) $CF_3 - CH_2 - CH_2 - NH_2$

96. Sucrose on hydrolysis gives

(A) two glucose units
(B) one glucose unit and one fructose unit
(C) one glucose unit and two fructose units
(D) one unit each of glucose, fructose and sucrose

97. Which of the following is constituents of ribonucleoside ?

(A) D-ribose + cytosine
(B) D-ribose + cytosine + phosphate
(C) D-2- deoxyribose + cytosine + phosphate
(D) D-ribose + cysteine

98. Which of the following forms of proteins is used for transport of cholesterol in our body?

(A) Glycoprotein
(B) Lipoprotein
(C) Chromoprotein
(D) Enzymes

99. The correct reactant pair for the formation of PHBV polymer is-

(A) 3-hydroxybutanoicacid and 3-hydroxypentanoicacid
(B) 2-ethyl-3-hydroxybutanoicacid and 3-hydroxybutanoicacid
(C) 3-hydroxybutanoicacid and 4-hydroxy-2-methylpentanoicacid
(D) 3-hydroxy-2-methylbutanoicacid and 4-hydroxy-3-methylpentanoicacid.

100. Quaternary ammonium salts are used in ___

(A) Anionic detergents.
(B) Cationic detergents.
(C) Nonionic detergents.
(D) Soaps.

101. If $f(x)+2f(1-x)=x^2+5$ for all real x, then $f(x)$ is equal to...

(A) $\frac{(x-2)^2+3}{3}$ (B) $\frac{(x-2)^2-3}{3}$

(C) $\frac{(x-3)^2-2}{2}$ (D) $\frac{(x-3)^2+2}{2}$

102. If α and β are the solutions of $2\cos\theta=1$ in the interval $[0,2\pi)$, then the solutions of $2\cos\theta+\cos(\alpha+\beta)=0$ in the interval $[0,2\pi)$ are...

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

(C) $0,\pi$ (D) $\frac{\pi}{2},\frac{3\pi}{2}$

103. If $x\in(0,2\pi)$ satisfies the equation $\cos x+\sin x=\frac{1}{2}$, then the sum of all distinct values of $\tan x$ is...

(A) $-\frac{8}{3}$ (B) 0

(C) $\frac{2\sqrt{7}}{3}$ (D) $\frac{8}{3}$

104. In a triangular plot ABC, the side lengths are $BC=7m$, $CA=8m$, and $AB=9m$. A vertical lamp post is located at the midpoint E of side AC. If the angle of elevation of the top of the lamp post from point B is $\tan^{-1}(4)$, then the height of the lamp post is...

(A) 22 (B) 24

(C) 26 (D) 28

105. In a triangle, the lengths of the two largest sides are 10 cm. and 9 cm. If the angles of the triangle are in arithmatic progression (A. P.), then the length of the third side (in cm.) is...

(A) $3\pm\sqrt{6}$ (B) $4\pm\sqrt{6}$

(C) $5\pm\sqrt{6}$ (D) $6\pm\sqrt{6}$

106. If ω is a complex cube root of unity, then the value of the expression $(1-\omega+\omega^2)^7+(1+\omega-\omega^2)^7$ is equal to...

(A) 128 (B) -128

(C) 128ω (D) 0

107. If all permutations of the letters of the word THREE are arranged as in dictionary, then 47^{th} word is...

(A) $RTEHE$ (B) $RTHEE$

(C) $TEEHR$ (D) $TEERH$

108. If θ_1 and θ_2 are the acute angles between the lines $3x^2-7xy+4y^2=0$ and $6x^2-5xy+y^2=0$ respectively, then ...

(A) $\theta_1=\theta_2$ (B) $\theta_1=2\theta_2$

(C) $2\theta_1=\theta_2$ (D) $\theta_1+\theta_2=\frac{\pi}{2}$

109. The coordinates of the point on the curve $x^2+y^2=8$ which are nearest to the point $(2,0)$ are:

(A) $(2,2)$ (B) $(\sqrt{2},\sqrt{6})$

(C) $(2\sqrt{2},0)$ (D) $(\sqrt{6},\sqrt{2})$

110. The angle between the tangents drawn from the point $(1,1)$ to the circle $2x^2+2y^2-8x+4y+5=0$ is .....

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

(C) $\frac{\pi}{4}$ (D) $\frac{\pi}{6}$

111. The equations of the lines passing through the center of circle $x^2+y^2-4x-10y-7=0$ and intersecting the line $3x-y-1=0$ at an angle $\frac{\pi}{4}$ is...

(A) $2y=x+8$ or $y=9-2x$ (B) $x+2y=8$ or $2x-y=9$

(C) $x+2y+8=0$ or $y-2x=9$ (D) $2y-x+8=0$ or $2x-y=9$

112. The equation of the directrix of the parabola $x^2-4x-5y-1=0$ is...

(A) $4x+9=0$ (B) $4y+9=0$

(C) $4y-9=0$ (D) $4x-9=0$

113. If $\lim_{x\to0}\left(\frac{f(x)}{x^2}\right)$ exists finitely and $\lim_{x\to0}\left(1+x+\frac{f(x)}{x}\right)^{1/x}=e^3$, then $\int f(x)\cdot\log x\,dx$ is equal to:

(A) $\frac{2}{9}x^3(3\log x-1)+c$

(B) $\frac{1}{9}x^3(3\log x-1)+c$

(C) $\frac{2}{9}x^3(3\log x+1)+c$

(D) $\frac{2}{9}x^3(3\log x-1/3)+c$

114. Let $f(x)$ be a function continuous at $x = 0$, defined for $x \neq 0$ as $f(x) = \frac{1-\cos(1-\cos(6x))}{x^2 \sin^2(3x)}$. Then the value of $f(0)$ is...

(A) 9 (B) 18

(C) 36 (D) 162

115. If $k > 5$ and $\lim_{x\to 0} \frac{k^{2x}+25^x-2\cdot(5k)^x}{\tan 3x \cdot \ln(1+3x)} = \lim_{n\to\infty} \frac{(n+1)!+n!}{(n+1)!-n!}$, then value of k is...

(A) e^{15} (B) $5e$

(C) $3e^{9/2}$ (D) $5e^3$

116. The statement $(p \wedge (\sim q)) \vee ((\sim p) \wedge q) \vee ((\sim p) \wedge (\sim q))$ is equivalent to :

(A) $(p \vee q)$ (B) $p \vee (\sim q)$

(C) $\sim p \vee q$ (D) $\sim p \vee \sim q$

117. Let $A = \{1, 2, 3, \ldots, 10\}$. Consider the following statements:
$p : \forall x \in A, x^2 - x > 0$
$q : \exists x \in A$, such that $x + 10 = 20$
Then the truth values of p and q are respectively ____

(A) T, T (B) T, F

(C) F, T (D) F, F

118. If the compound statement $(p \wedge \sim q) \to (q \vee \sim r)$ is false then which of the following statements is a true ?

(A) $(p \wedge r) \to q$ (B) $(\sim p \vee q) \to r$

(C) $(p \to q) \wedge r$ (D) $p \to (q \wedge r)$

119. If $y = \tan^{-1}\left(\frac{2x^{5/2}}{1-x^5}\right)$, then $\frac{dy}{dx}$ is equal to ....

(A) $\frac{5x^{3/2}}{1-x^5}$ (B) $\frac{2x^{3/2}}{1+x^5}$

(C) $\frac{5x^{3/2}}{1+x^5}$ (D) $\frac{5x^{2/3}}{1+x^5}$

120. If $x \in [0, 1)$ then the value of $\tan\left\{\frac{1}{2}\sin^{-1}\left(\frac{2x}{1+x^2}\right) + \frac{1}{2}\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right\}$ is:

(A) ∞ (B) 1

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

121. If $A^{-1} = \begin{bmatrix} 1 & 0 & -4 \\ 0 & -1 & 2 \\ -1 & 2 & 1 \end{bmatrix} = \frac{\text{adj}(A)}{k}$, then k is a root of the equation...

(A) $x^2 + 1 = 0$ (B) $x^2 - 1 = 0$

(C) $x^2 - 2 = 0$ (D) $x^2 - x + 1 = 0$

122. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & a & 1 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} \\ -4 & 3 & c \\ \frac{5}{2} & -\frac{3}{2} & \frac{1}{2} \end{bmatrix}$, then ...

(A) $a = 1, c = 1$ (B) $a = 1, c = -1$

(C) $a = 1, c = 2$ (D) $a = -1, c = 2$

123. If the planes $ax = y + z$, $by = z + x$, $cz = x + y$ pass through a common line, then the value of $(a + b + c - abc) = \cdots$

(A) -2 (B) -1

(C) 1 (D) 2

124. If $f'\left(\frac{1}{2}\right) = \sqrt{3}$ and $g'\left(\frac{\sqrt{3}}{2}\right) = -2$, then the derivative of $f(\sin x)$ with respect to $g(\cos x)$ at $x = \frac{\pi}{6}$ is:

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

(C) $\frac{1}{2}$ (D) $\frac{3}{2}$

125. If the derivative of $\tan^{-1}(a + bx)$ at $x = 0$ is 1, then $1 - b^3 + a^6$ is:

(A) $3b^2a$ (B) $-6a^2b$

(C) $-3b^2a$ (D) $-3a^2b$

126. If $f(x) = \frac{x-1}{4} + \frac{(x-1)^3}{12} + \frac{(x-1)^5}{20} + \frac{(x-1)^7}{28} + \ldots$ where $0 < x < 2$, then $f'(x) =$

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

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

127. The coordinates of the point on the curve $y = \sin\left(\frac{\pi x}{2}\right)$ at which the normal is parallel to the Y- axis are:

(A) $(1, 0)$ (B) $(1, 2)$

(C) $(1, 1)$ (D) $(2, 0)$

128. A right circular cone is melting such that its volume is decreasing at the rate of 12π cm^3/sec. The radius of the base is always equal to half of its height. Then the rate of change of the radius when the radius is 2 cm is:

(A) radius is increasing at the rate of 1 cm/sec (B) radius is decreasing at the rate of 1 cm/sec

(C) radius is increasing at the rate of 1.5 cm/sec (D) radius is decreasing at the rate of 1.5 cm/sec

129. If $\int(\sqrt{\tan x}+\sqrt{\cot x})dx = a\tan^{-1}\left(\frac{\tan x-1}{\sqrt{b\tan x}}\right)+c$, for $x\in\left(0,\frac{\pi}{2}\right)$, then $a^{10}+b^5=\cdots$

(A) 16 (B) 64

(C) 36 (D) 100

130. The value of $\int\tan^{-1}\left(\frac{6x}{1-9x^2}\right)dx$, where $|x|<\frac{1}{3}$ is:

(A) $2x\tan^{-1}3x+\frac{1}{3}\log(1+9x^2)+c$

(B) $2x\tan^{-1}3x-\log(1+9x^2)+c$

(C) $2x\tan^{-1}3x-\frac{1}{3}\log(1+9x^2)+c$

(D) $x\tan^{-1}3x+\frac{1}{3}\log(1+9x^2)+c$

131. If $\int x(a-x)^9dx=\frac{[f(x)]^{11}}{11}-a\frac{[f(x)]^{10}}{10}+c$, where c is a constant of integration, then $f'(x)=\cdots$

(A) a (B) -1

(C) $-a$ (D) 1

132. $\int_{\pi/5}^{3\pi/10}\frac{1}{1+\sqrt{\tan x}}dx=\cdots$

(A) $\frac{\pi}{10}$ (B) $\frac{\pi}{15}$

(C) $\frac{\pi}{20}$ (D) $\frac{\pi}{25}$

133. The value of the integral $\int_{1/2}^{2}\frac{1}{x}\sin^{101}\left(x-\frac{1}{x}\right)dx$ is equal to:

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

(C) 0 (D) $\frac{101}{2}$

134. The value of $I=\int_1^3 e^x\frac{(x+2)^2}{(x+4)^2}dx$ is:

(A) $e\left(\frac{3e^2}{7}+\frac{1}{5}\right)$ (B) $e\left(\frac{3e^2}{7}-\frac{1}{5}\right)$

(C) $e^2\left(\frac{3e}{7}-\frac{1}{5}\right)$ (D) $e\left(\frac{3e^2}{7}-\frac{e}{5}\right)$

135. The area bounded by the parabola $y=4x-x^2$ and the x-axis (in sq. units) is:

(A) $\frac{32}{3}$ (B) 8

(C) 12 (D) $\frac{16}{3}$

136. If the general solution of the differential equation $y\sec^2\left(\frac{x}{y}\right)dx-\left(x\sec^2\left(\frac{x}{y}\right)-y\right)dy=0$ is $\tan\left(\frac{x}{y}\right)+g(y)=c$, then $g(y)=\ldots$

(A) $\log|y|$ (B) $\tan\sqrt{y}$

(C) $\cos 2y$ (D) $3y^2+1$

137. The general solution of the differential equation $(x+1)\frac{dy}{dx}-y=e^x(x+1)^2$ is given by:

(A) $y=(x+1)(e^x+c)$

(B) $y=(x+1)(e^{-x}+c)$

(C) $y=\frac{e^x+c}{x+1}$

(D) $y=e^x+c(x+1)$

138. For a certain substance, the rate of change of vapor pressure P with respect to temperature T is directly proportional to the vapor pressure P, and inversely proportional to the square of the temperature T. The representation of this statement in the form of a differential equation is: (where k is a constant of proportionality)

(A) $\frac{dP}{dT}=\frac{kP}{T^2}$ (B) $\frac{dP}{dT}=\frac{P}{T^2}$

(C) $\frac{dP}{dT}=\frac{kT}{P^2}$ (D) $\frac{dP}{dT}=\frac{T^2}{P}$

139. If $\bar{a}=2\hat{i}-\hat{j}+\hat{k}$, $\bar{b}=\hat{i}+3\hat{j}-\hat{k}$, $\bar{c}=-2\hat{i}+\hat{j}-3\hat{k}$ and $\bar{d}=3\hat{i}+2\hat{j}+5\hat{k}$, then the value of x^2+z^2-y is $\cdots$, where $\bar{d}=x\bar{a}+y\bar{b}+z\bar{c}$

(A) $\frac{35}{4}$ (B) $\frac{17}{2}$

(C) $\frac{33}{4}$ (D) $\frac{15}{2}$

140. Let $\bar{a}=2\hat{i}-\hat{j}+\hat{k}$ and $\bar{b}=\hat{i}+2\hat{j}-2\hat{k}$. If a third vector $\bar{c}=x\hat{i}+y\hat{j}+z\hat{k}$ is coplanar with $\bar{a}$ and $\bar{b}$, is perpendicular to $\bar{a}$, and satisfies $|\bar{c}|=\sqrt{45}$, then the sum of all possible values of y is:

(A) 0 (B) 2

(C) 5 (D) -5

141. A unit vector $\bar{u}$ makes an angle of 45° with the X- axis. If $\bar{u}+\hat{j}+\hat{k}$ is also a unit vector, then the sum of the projections of $\bar{u}$ on the coordinate axes is:

(A) $\sqrt{2}-1$ (B) $\sqrt{2}+1$

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

142. The position vectors of vertices A, B and C of triangle ABC are $\hat{i}-\hat{j}-3\hat{k}$, $2\hat{i}+\hat{j}-2\hat{k}$, and $-5\hat{i}+2\hat{j}-6\hat{k}$ respectively. The length of the bisector AD of angle BAC, where D is on the line segment BC, is

(A) 15/2 (B) 11/2

(C) 1/4 (D) $\frac{3}{4}\sqrt{10}$

143. The equation of the plane containing the line $\bar{r} = (2\hat{i} - \hat{k}) + \lambda(\hat{i} + \hat{j} + 2\hat{k})$ and perpendicular to the plane $\bar{r} \cdot (3\hat{i} - \hat{j} + \hat{k}) = 20$ is.....

(A) $\bar{r} \cdot (3\hat{i} + 5\hat{j} - 4\hat{k}) = 10$

(B) $\bar{r} \cdot (3\hat{i} + 5\hat{j} - 4\hat{k}) = 6$

(C) $\bar{r} \cdot (3\hat{i} - 5\hat{j} - 4\hat{k}) = 6$

(D) $\bar{r} \cdot (3\hat{i} - 5\hat{j} - 4\hat{k}) = 10$

144. If the direction cosines of the line $\frac{2x+5}{3} = \frac{2-3z}{-1}; 3y = -2$ are $\frac{9}{\sqrt{85}}, m, \frac{2}{\sqrt{85}}$ then the value of m is:

(A) $\frac{9}{\sqrt{85}}$ (B) 0

(C) $\frac{-2}{\sqrt{85}}$ (D) 1

145. If the line $\frac{x+4}{a} = \frac{y-2}{b} = \frac{z+1}{c}$ passes through the point $(-3, 1, -2)$ and its direction is chosen such that it makes an acute angle γ with the positive direction of Z- axis, then value of $\cos\gamma$ is:

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

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

146. If l, m, n are direction cosines of a vector $\bar{r}$ such that $l + m + n = 1$ and $l^2 + m^2 + n^2 = 1$, then:
(where $l, m, n \geq 0$)

(A) the vector lies along one of the coordinate axes.

(B) the vector $\bar{r}$ is equally inclined to the three coordinate axes.

(C) The vector $\bar{r}$ is perpendicular to the vector $\hat{i} + \hat{j} + \hat{k}$

(D) The vector $\bar{r}$ makes an angle of $\frac{\pi}{3}$ with each of the coordinate axes.

147. The linear programming problem:
Maximize : $Z = x + y$
Subject to :
$x + 2y \leq 200, x + y \leq 150, 0 \leq y \leq 60, x \geq 0$ has:

(A) a finite number of optimal solutions

(B) a unique optimal solution

(C) infinite number of optimal solutions

(D) no feasible solution

148. It is known that 10% of certain articles manufactured are defective. What is the probability that in a random sample of 12 such articles, 9 are defective?

(A) $22\left(\frac{9^3}{10^{12}}\right)$ (B) $22\left(\frac{9^{12}}{10^{12}}\right)$

(C) $22\left(\frac{9^3}{10^9}\right)$ (D) $22\left(\frac{9^3}{10^{11}}\right)$

149. The probability distribution of a discrete random variable (r.v.) X is given below:

$X = x$	0	1	2	3	4
$P(X = x)$	k	$2k$	$4k$	$2k$	k

Then the value of $P[X \leq E(X)]$ is:

(A) $\frac{7}{10}$ (B) $\frac{1}{10}$

(C) $\frac{3}{10}$ (D) $\frac{9}{10}$

150. A husband and wife appeared for an interview for two vacancies in an office. The probability of the husband's selection is $\frac{1}{5}$ and that of the wife's selection is $\frac{1}{7}$, then the probability that exactly one of them is selected is...

(A) $\frac{1}{35}$ (B) $\frac{11}{35}$

(C) $\frac{2}{7}$ (D) $\frac{1}{7}$

- End of Question Paper -