

WBC

Solved Paper 2013

JEE Main

Joint Entrance Examination

Time : 3 hrs

MM : 360

Instructions

1. This test consists of 90 questions.
2. There are three parts in the question paper A, B, C consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage. Each question is allotted 4 marks for correct response.
3. Candidates will be awarded marks as stated above for correct response of each question. 1/4 mark will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted according as per instructions.

Physics

1. A uniform cylinder of length L and mass M having cross-sectional area A is suspended, with its length vertical from a fixed point by a massless spring such that it is half submerged in a liquid of density σ at equilibrium position. The extension x_0 of the spring when it is in equilibrium is

- (a) $\frac{Mg}{k}$
- (b) $\frac{Mg}{k} \left(1 - \frac{LA\sigma}{M}\right)$
- (c) $\frac{Mg}{k} \left(1 - \frac{LA\sigma}{2M}\right)$
- (d) $\frac{Mg}{k} \left(1 + \frac{LA\sigma}{M}\right)$

2. A metallic rod of length l is tied to a string of length $2l$ and made to rotate with angular speed ω on a horizontal

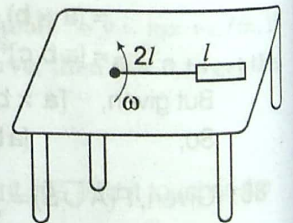


table with one end of the string fixed. If there is a vertical magnetic field B in the region, the emf induced across the ends of the rod is

- (a) $\frac{2B\omega l^3}{2}$
- (b) $\frac{3B\omega l^3}{2}$
- (c) $\frac{4B\omega l^2}{2}$
- (d) $\frac{5B\omega l^2}{2}$

3. This question has Statement I and Statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement I A point particle of mass m moving with speed v collides with stationary point particle of mass M . If the maximum energy loss possible is given as $f \left(\frac{1}{2} mv^2 \right)$, then $f = \left(\frac{m}{M+m} \right)$.

Statement II Maximum energy loss occurs when the particles get stuck together as a result of the collision.

- (a) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I
 (b) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I
 (c) Statement I is true, Statement II is false
 (d) Statement I is false, Statement II is true

4. Let $[\epsilon_0]$ denotes the dimensional formula of the permittivity of vacuum. If $M =$ mass, $L =$ length, $T =$ time and $A =$ electric current, then

- (a) $[\epsilon_0] = [M^{-1}L^{-3}T^2A]$
 (b) $[\epsilon_0] = [M^{-1}L^{-3}T^4A^2]$
 (c) $[\epsilon_0] = [M^{-2}L^2T^{-1}A^{-2}]$
 (d) $[\epsilon_0] = [M^{-1}L^2T^{-1}A^2]$

5. A projectile is given an initial velocity of $(\hat{i} + 2\hat{j})$ m/s, where \hat{i} is along the ground and \hat{j} is along the vertical. If $g = 10$ m/s², the equation of its trajectory is

- (a) $y = x - 5x^2$
 (b) $y = 2x - 5x^2$
 (c) $4y = 2x - 5x^2$
 (d) $4y = 2x - 25x^2$

6. The amplitude of a damped oscillator decreases to 0.9 times its original magnitude is 5 s. In another 10 s, it will decrease to α times its original magnitude, where α equals

- (a) 0.7 (b) 0.81 (c) 0.729 (d) 0.6

7. Two capacitors C_1 and C_2 are charged to 120 V and 200 V respectively. It is found that by connecting them together the potential on each one can be made zero. Then,

- (a) $5C_1 = 3C_2$ (b) $3C_1 = 5C_2$
 (c) $3C_1 + 5C_2 = 0$ (d) $9C_1 = 4C_2$

8. A sonometer wire of length 1.5 m is made of steel. The tension in it produces an elastic strain of 1%. What is the fundamental frequency of steel, if density and elasticity of steel are 7.7×10^3 kg/m³ and 2.2×10^{11} N/m² respectively?

- (a) 188.5 Hz (b) 178.2 Hz
 (c) 200.5 Hz (d) 770 Hz

9. A circular loop of radius 0.3 cm lies parallel to a much bigger circular loop of radius 20 cm. The centre of the smaller loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with bigger loop is

- (a) 9.1×10^{-11} Wb (b) 6×10^{-11} Wb
 (c) 3.3×10^{-11} Wb (d) 6.6×10^{-9} Wb

10. Diameter of a plano-convex lens is 6 cm and thickness at the centre is 3 mm. If speed of light in material of lens is 2×10^8 m/s, the focal length of the lens is

- (a) 15 cm (b) 20 cm (c) 30 cm (d) 10 cm

11. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of $2R$?

- (a) $\frac{5GmM}{6R}$ (b) $\frac{2GmM}{3R}$
 (c) $\frac{GmM}{2R}$ (d) $\frac{GmM}{3R}$

12. A diode detector is used to detect an amplitude modulated wave of 60% modulation by using a condenser of capacity 250 pico farad in parallel with a load resistance 100 k Ω . Find the maximum modulated frequency which could be detected by it.

- (a) 10.62 MHz (b) 10.62 kHz
 (c) 5.31 MHz (d) 5.31 kHz

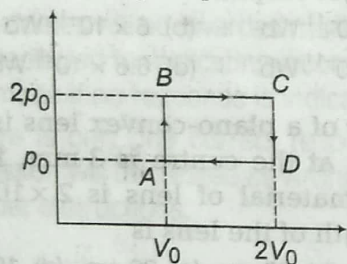
13. A beam of unpolarised light of intensity I_0 is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of 45° relative to that of A. The intensity of the emergent light is

- (a) I_0 (b) $I_0/2$
(c) $I_0/4$ (d) $I_0/8$

14. The supply voltage to room is 120 V. The resistance of the lead wires is 6Ω . A 60 W bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 W heater is switched on in parallel to the bulb?

- (a) Zero (b) 2.9 V
(c) 13.3 V (d) 10.04 V

15. The shown p - V diagram represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. The amount of heat, extracted from the source in a single cycle is



- (a) $p_0 V_0$ (b) $\left(\frac{13}{2}\right) p_0 V_0$
(c) $\left(\frac{11}{2}\right) p_0 V_0$ (d) $4 p_0 V_0$

16. A hoop of radius r and mass m rotating with an angular velocity ω_0 is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases to slip?

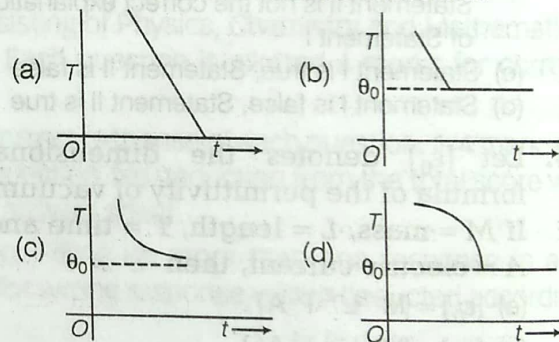
- (a) $\frac{r\omega_0}{4}$ (b) $\frac{r\omega_0}{3}$
(c) $\frac{r\omega_0}{2}$ (d) $r\omega_0$

17. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M . The piston and

the cylinder have equal cross-sectional area A . When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is p_0 . The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency

- (a) $\frac{1}{2\pi} \frac{A\gamma p_0}{V_0 M}$ (b) $\frac{1}{2\pi} \frac{V_0 M p_0}{A^2 \gamma}$
(c) $\frac{1}{2\pi} \sqrt{\frac{A^2 \gamma p_0}{M V_0}}$ (d) $\frac{1}{2\pi} \sqrt{\frac{M V_0}{A \gamma p_0}}$

18. If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0 . The graph between the temperature T of the metal and time t will be closed to



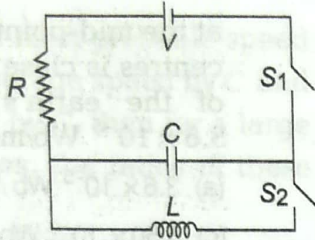
19. This question has Statement I and Statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement I Higher the range, greater is the resistance of ammeter.

Statement II To increase the range of ammeter, additional shunt needs to be used across it.

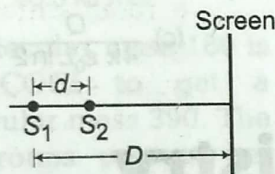
- (a) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I
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20. In an L-C-R circuit as shown, both switches are open initially. Now, switch S_1 and S_2 , kept open. (q is charge on the capacitor and $\tau = RC$ is capacitance time constant). Which of the following statement is correct?



- (a) Work done by the battery is half of the energy dissipated in the resistor
- (b) $Att = \tau, q = CV/2$
- (c) $Att = 2\tau, q = CV(1 - e^{-2})$
- (d) $Att = \frac{\tau}{2}, q = CV(1 - e^{-1})$

21. Two coherent point sources S_1 and S_2 are separated by a small distance d as shown. The fringes obtained on the screen will be

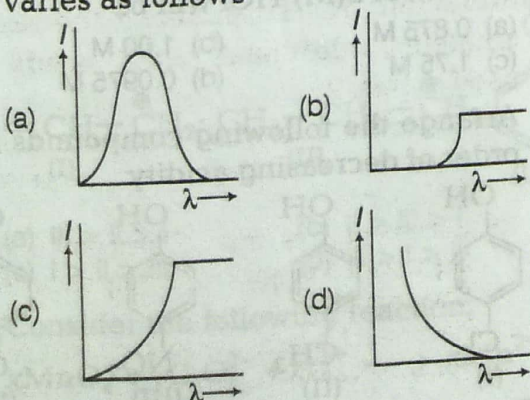


- (a) points
- (b) straight lines
- (c) semi-circle
- (d) concentric circles

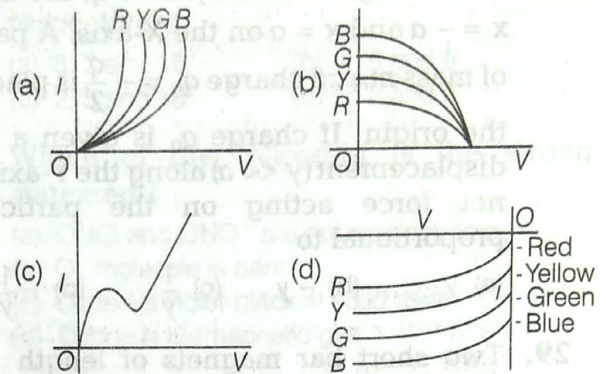
22. The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is

- (a) 3 V/m
- (b) 6 V/m
- (c) 9 V/m
- (d) 12 V/m

23. The anode voltage of a photocells kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of photocell varies as follows



24. The I-V characteristic of an LED is



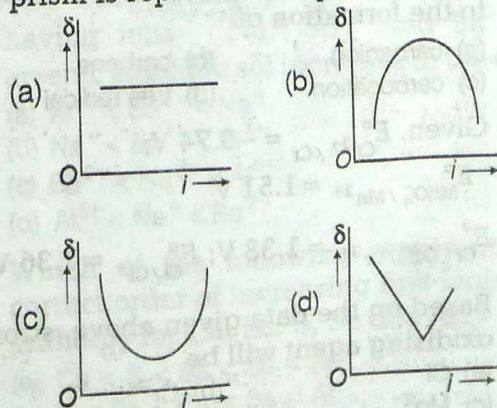
25. Assume that a drop of liquid evaporates by decrease in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible? The surface tension is T , density of liquid is ρ and L is its latent heat of vapourisation

- (a) $\rho L/T$
- (b) $\sqrt{T/\rho L}$
- (c) $T/\rho L$
- (d) $2T/\rho L$

26. In a hydrogen like atom, electron makes transition from an energy level with quantum number n to another with quantum number $(n - 1)$. If $n \gg 1$, the frequency of radiation emitted is proportional to

- (a) $\frac{1}{n}$
- (b) $\frac{1}{n^2}$
- (c) $\frac{1}{n^{3/2}}$
- (d) $\frac{1}{n^3}$

27. The graph between angle of deviation (δ) and angle of incidence (i) for a triangular prism is represented by



28. Two charges, each equal to q , are kept at $x = -a$ and $x = a$ on the X-axis. A particle of mass m and charge $q_0 = -\frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement ($y \ll a$) along the Y-axis, the net force acting on the particle is proportional to

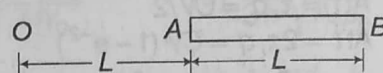
- (a) y (b) $-y$ (c) $\frac{1}{y}$ (d) $-\frac{1}{y}$

29. Two short bar magnets of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the south. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction

at the mid-point O of the line joining their centres is close to (horizontal component of the earth's magnetic induction is $3.6 \times 10^{-5} \text{ Wb/m}^2$)

- (a) $3.6 \times 10^{-5} \text{ Wb/m}^2$ (b) $2.56 \times 10^{-4} \text{ Wb/m}^2$
(c) $3.50 \times 10^{-4} \text{ Wb/m}^2$ (d) $5.80 \times 10^{-4} \text{ Wb/m}^2$

30. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at distance L from the end A is



- (a) $\frac{Q}{8\pi\epsilon_0 L}$ (b) $\frac{3Q}{4\pi\epsilon_0 L}$
(c) $\frac{Q}{4\pi\epsilon_0 L \ln 2}$ (d) $\frac{Q \ln 2}{4\pi\epsilon_0 L}$

Chemistry

31. Which of the following complex species is not expected to exhibit optical isomerism?

- (a) $[\text{Co}(\text{en})_3]^{3+}$ (b) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
(c) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (d) $[\text{Co}(\text{en})(\text{NH}_3)_2\text{Cl}_2]^+$

32. Which one of the following molecules is expected to exhibit diamagnetic behaviour?

- (a) C_2 (b) N_2
(c) O_2 (d) S_2

33. A solution of (-)-1-chloro-1-phenylethane in toluene racemises slowly in the presence of a small amount of SbCl_5 , due to the formation of

- (a) carbanion (b) carbene
(c) carbocation (d) free radical

34. Given, $E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$;

$$E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V}$$

$$E^\circ_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}} = 1.33 \text{ V}; E^\circ_{\text{Cl}/\text{Cl}^-} = 1.36 \text{ V}$$

Based on the data given above, strongest oxidising agent will be

- (a) Cl (b) Cr^{3+}
(c) Mn^{2+} (d) MnO_4^-

35. A piston filled with 0.04 mole of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C . As it does so, it absorbs 208 J of heat. The values of q and W for the process will be

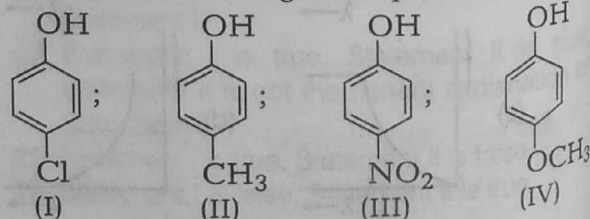
$$(R = 8.314 \text{ J/mol K}, \ln 7.5 = 2.01)$$

- (a) $q = +208 \text{ J}, W = -208 \text{ J}$
(b) $q = -208 \text{ J}, W = -208 \text{ J}$
(c) $q = -208 \text{ J}, W = +208 \text{ J}$
(d) $q = +208 \text{ J}, W = +208 \text{ J}$

36. The molarity of a solution obtained by mixing 750 mL of 0.5 (M) HCl with 250 mL of 2(M) HCl will be

- (a) 0.875 M (b) 1.00 M
(c) 1.75 M (d) 0.0975 M

37. Arrange the following compounds in the order of decreasing acidity



- (a) $\text{II} > \text{IV} > \text{I} > \text{III}$ (b) $\text{I} > \text{II} > \text{III} > \text{IV}$
(c) $\text{III} > \text{I} > \text{II} > \text{IV}$ (d) $\text{IV} > \text{III} > \text{I} > \text{II}$

38. For gaseous state, if most probable speed is denoted by C^* , average speed by \bar{C} and mean square speed by C , then for a large number of molecules, the ratios of these speeds are

- (a) $C^* : \bar{C} : C = 1.225 : 1.128 : 1$
 (b) $C^* : \bar{C} : C = 1.128 : 1.225 : 1$
 (c) $C^* : \bar{C} : C = 1 : 1.128 : 1.225$
 (d) $C^* : \bar{C} : C = 1 : 1.225 : 1.128$

39. The rate of a reaction double when its temperature changes from 300 K to 310 K. Activation energy of such a reaction will be ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ and $\log 2 = 0.301$)

- (a) 53.6 kJ mol^{-1} (b) 48.6 kJ mol^{-1}
 (c) 58.5 kJ mol^{-1} (d) 60.5 kJ mol^{-1}

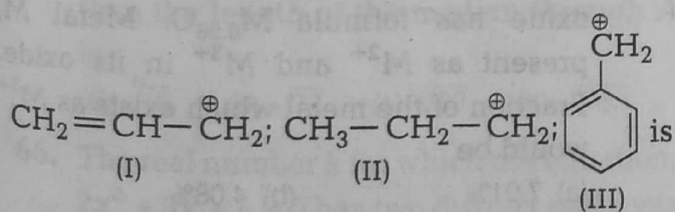
40. A compound with molecular mass 180 is acylated with CH_3COCl to get a compound with molecular mass 390. The number of amino groups present per molecule of the former compound is

- (a) 2 (b) 5 (c) 4 (d) 6

41. Which of the following arrangements does not represent the correct order of the property stated against it?

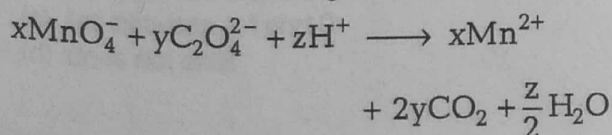
- (a) $\text{V}^{2+} < \text{Cr}^{2+} < \text{Mn}^{2+} < \text{Fe}^{2+}$: paramagnetic behaviour
 (b) $\text{Ni}^{2+} < \text{Co}^{2+} < \text{Fe}^{2+} < \text{Mn}^{2+}$: ionic size
 (c) $\text{Co}^{3+} < \text{Fe}^{3+} < \text{Cr}^{3+} < \text{Sc}^{3+}$: stability in aqueous solution
 (d) $\text{Sc} < \text{Ti} < \text{Cr} < \text{Mn}$: number of oxidation states

42. The order of stability of the following carbocations



- (a) $\text{III} > \text{II} > \text{I}$ (b) $\text{II} > \text{III} > \text{I}$
 (c) $\text{I} > \text{II} > \text{III}$ (d) $\text{III} > \text{I} > \text{II}$

43. Consider the following reaction,



The values of x , y and z in the reaction are respectively

- (a) 5, 2 and 16 (b) 2, 5 and 8
 (c) 2, 5 and 16 (d) 5, 2 and 8

44. Which of the following is the wrong statement?

- (a) ONCl and ONO^- are not isoelectronic
 (b) O_3 molecule is bent
 (c) Ozone is violet-black in solid state
 (d) Ozone is diamagnetic gas

45. A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO_2 . The empirical formula of the hydrocarbon is

- (a) C_2H_4 (b) C_3H_4
 (c) C_6H_5 (d) C_7H_8

46. In which of the following pairs of molecules/ions, both the species are not likely to exist?

- (a) H_2^+ , He_2^{2-} (b) H_2^- , He_2^{2-}
 (c) H_2^{2+} , He_2 (d) H_2^- , He_2^{2+}

47. Which of the following exists as covalent crystals in the solid state?

- (a) Iodine (b) Silicon
 (c) Sulphur (d) Phosphorus

48. Synthesis of each molecule of glucose in photosynthesis involves

- (a) 18 molecules of ATP
 (b) 10 molecules of ATP
 (c) 8 molecules of ATP
 (d) 6 molecules of ATP

49. The coagulating power of electrolytes having ions Na^+ , Al^{3+} and Ba^{2+} for arsenic sulphide sol increases in the order

- (a) $\text{Al}^{3+} < \text{Ba}^{2+} < \text{Na}^+$
 (b) $\text{Na}^+ < \text{Ba}^{2+} < \text{Al}^{3+}$
 (c) $\text{Ba}^{2+} < \text{Na}^{2+} < \text{Al}^{3+}$
 (d) $\text{Al}^{3+} < \text{Na}^+ < \text{Ba}^{2+}$

50. Which of the following represents the correct order of increasing first ionisation enthalpy for Ca, Ba, S, Se and Ar?

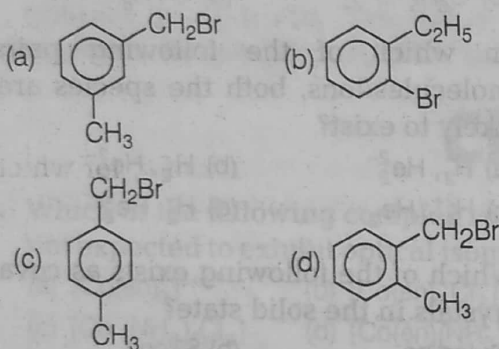
- (a) $\text{Ca} < \text{S} < \text{Ba} < \text{Se} < \text{Ar}$
 (b) $\text{S} < \text{Se} < \text{Ca} < \text{Ba} < \text{Ar}$
 (c) $\text{Ba} < \text{Ca} < \text{Se} < \text{S} < \text{Ar}$
 (d) $\text{Ca} < \text{Ba} < \text{S} < \text{Se} < \text{Ar}$

51. Energy of an electron is given by

$$E = -2.178 \times 10^{-18} \text{ J} \left(\frac{Z^2}{n^2} \right)$$

Wavelength of light required to excite an electron in an hydrogen atom from level $n = 1$ to $n = 2$ will be ($h = 6.62 \times 10^{-34}$ Js and $c = 3.0 \times 10^8 \text{ ms}^{-1}$)

- (a) $1.214 \times 10^{-7} \text{ m}$ (b) $2.816 \times 10^{-7} \text{ m}$
 (c) $6.500 \times 10^{-7} \text{ m}$ (d) $8.500 \times 10^{-7} \text{ m}$
52. Compound (A), $\text{C}_8\text{H}_9\text{Br}$ gives a white precipitate when warmed with alcoholic AgNO_3 . Oxidation of (A) gives an acid (B), $\text{C}_8\text{H}_6\text{O}_4$. (B) easily forms anhydride on heating. Identify the compound (A).



53. Four successive members of the first row transition elements listed below with atomic numbers. Which one of them is expected to have the highest $E_{M^{3+}/M^{2+}}^\circ$ value?

- (a) Cr ($Z = 24$) (b) Mn ($Z = 25$)
 (c) Fe ($Z = 26$) (d) Co ($Z = 27$)

54. How many litres of water must be added to 1 L of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2?

- (a) 0.1 L (b) 0.9 L (c) 2.0 L (d) 9.0 L

55. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be

- (a) -2.55 eV (b) -5.1 eV
 (c) -10.2 eV (d) +2.55 eV

56. An organic compound A upon reacting with NH_3 gives B. On heating, B gives C. C in the presence of KOH reacts with Br_2 to give $\text{CH}_3\text{CH}_2\text{NH}_2$. A is

- (a) CH_3COOH (b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
 (c) $\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{COOH}$ (d) $\text{CH}_3\text{CH}_2\text{COOH}$

57. Stability of the species Li_2 , Li_2^- and Li_2^+ increases in the order of

- (a) $\text{Li}_2 < \text{Li}_2^+ < \text{Li}_2^-$ (b) $\text{Li}_2^- < \text{Li}_2^+ < \text{Li}_2$
 (c) $\text{Li}_2 < \text{Li}_2^- < \text{Li}_2^+$ (d) $\text{Li}_2^- < \text{Li}_2 < \text{Li}_2^+$

58. An unknown alcohol is treated with the "Lucas reagent" to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism?

- (a) Secondary alcohol by $\text{S}_{\text{N}}1$
 (b) Tertiary alcohol by $\text{S}_{\text{N}}1$
 (c) Secondary alcohol by $\text{S}_{\text{N}}2$
 (d) Tertiary alcohol by $\text{S}_{\text{N}}2$

59. The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was

- (a) Methylisocyanate (b) Methylamine
 (c) Ammonia (d) Phosgene

60. Experimentally it was found that a metal oxide has formula $\text{M}_{0.98}\text{O}$. Metal M present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be

- (a) 7.01% (b) 4.08%
 (c) 6.05% (d) 5.08%

Mathematics

61. Distance between two parallel planes $2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is
 (a) $\frac{3}{2}$ (b) $\frac{5}{2}$ (c) $\frac{7}{2}$ (d) $\frac{9}{2}$
62. At present, a firm is manufacturing 2000 items. It is estimated that the rate of change of production P with respect to additional number of workers x is given by $\frac{dP}{dx} = 100 - 12\sqrt{x}$. If the firm employees 25 more workers, then the new level of production of items is
 (a) 2500 (b) 3000
 (c) 3500 (d) 4500
63. Let A and B be two sets containing 2 elements and 4 elements respectively. The number of subsets of $A \times B$ having 3 or more elements is
 (a) 256 (b) 220 (c) 219 (d) 211
64. If the lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar, then k can have
 (a) any value
 (b) exactly one value
 (c) exactly two values
 (d) exactly three values
65. If the vectors $\mathbf{AB} = 3\hat{i} + 4\hat{k}$ and $\mathbf{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a $\triangle ABC$, then the length of the median through A is
 (a) $\sqrt{18}$ (b) $\sqrt{72}$ (c) $\sqrt{33}$ (d) $\sqrt{45}$
66. The real number k for which the equation, $2x^3 + 3x + k = 0$ has two distinct real roots in $[0, 1]$
 (a) lies between 1 and 2
 (b) lies between 2 and 3
 (c) lies between -1 and 0
 (d) does not exist
67. The sum of first 20 terms of the sequence $0.7, 0.77, 0.777, \dots$, is
 (a) $\frac{7}{81}(179 - 10^{-20})$
 (b) $\frac{7}{9}(99 - 10^{-20})$
 (c) $\frac{7}{81}(179 + 10^{-20})$
 (d) $\frac{7}{9}(99 + 10^{-20})$
68. A ray of light along $x + \sqrt{3}y = \sqrt{3}$ gets reflected upon reaching X -axis, the equation of the reflected ray is
 (a) $y = x + \sqrt{3}$
 (b) $\sqrt{3}y = x - \sqrt{3}$
 (c) $y = \sqrt{3}x - \sqrt{3}$
 (d) $\sqrt{3}y = x - 1$
69. The number of values of k , for which the system of equations
 $(k+1)x + 8y = 4k$
 $kx + (k+3)y = 3k-1$
 has no solution, is
 (a) infinite (b) 1
 (c) 2 (d) 3
70. If the equations $x^2 + 2x + 3 = 0$ and $ax^2 + bx + c = 0$, $a, b, c \in R$, have a common root, then $a : b : c$ is
 (a) 1 : 2 : 3 (b) 3 : 2 : 1
 (c) 1 : 3 : 2 (d) 3 : 1 : 2
71. The circle passing through $(1, -2)$ and touching the axis of x at $(3, 0)$ also passes through the point
 (a) $(-5, 2)$ (b) $(2, -5)$
 (c) $(5, -2)$ (d) $(-2, 5)$
72. If x, y and z are in AP and $\tan^{-1} x, \tan^{-1} y$ and $\tan^{-1} z$ are also in AP, then
 (a) $x = y = z$
 (b) $2x = 3y = 6z$
 (c) $6x = 3y = 2z$
 (d) $6x = 4y = 3z$

73. **Statement I** $(p \wedge \sim q) \wedge (\sim p \wedge q)$ is a fallacy.

Statement II $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$ is a tautology.

- (a) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I
- (b) Statement I is true, Statement II is true; Statement II is not a correct explanation for Statement I
- (c) Statement I is true, Statement II is false
- (d) Statement I is false, Statement II is true

74. If $\int f(x) dx = \psi(x)$, then $\int x^5 f(x^3) dx$ is equal to

- (a) $\frac{1}{3} [x^3 \psi(x^3) - \int x^2 \psi(x^3) dx] + C$
- (b) $\frac{1}{3} x^3 \psi(x^3) - 3 \int x^3 \psi(x^3) dx + C$
- (c) $\frac{1}{3} x^3 \psi(x^3) - \int x^2 \psi(x^3) dx + C$
- (d) $\frac{1}{3} [x^3 \psi(x^3) - \int x^3 \psi(x^3) dx] + C$

75. $\lim_{x \rightarrow 0} \frac{(1 - \cos 2x)(3 + \cos x)}{x \tan 4x}$ is equal to

- (a) $-\frac{1}{4}$
- (b) $\frac{1}{2}$
- (c) 1
- (d) 2

76. **Statement I** The value of the integral

$$\int_{\pi/6}^{\pi/3} \frac{dx}{1 + \sqrt{\tan x}}$$

is equal to $\pi/6$.

Statement II $\int_a^b f(x) dx = \int_a^b f(a + b - x) dx$

- (a) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I
- (b) Statement I is true, Statement II is true; Statement II is not a correct explanation for Statement I
- (c) Statement I is true, Statement II is false
- (d) Statement I is false, Statement II is true

77. The equation of the circle passing through the foci of the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ and having centre at $(0, 3)$ is

- (a) $x^2 + y^2 - 6y - 7 = 0$
- (b) $x^2 + y^2 - 6y + 7 = 0$
- (c) $x^2 + y^2 - 6y - 5 = 0$
- (d) $x^2 + y^2 - 6y + 5 = 0$

78. A multiple choice examination has 5 questions. Each question has three alternative answers of which exactly one is correct. The probability that a student will get 4 or more correct answers just by guessing is

- (a) $\frac{17}{3^5}$
- (b) $\frac{13}{3^5}$
- (c) $\frac{11}{3^5}$
- (d) $\frac{10}{3^5}$

79. The x-coordinate of the incentre of the triangle that has the coordinates of mid-points of its sides as $(0, 1)$, $(1, 1)$ and $(1, 0)$ is

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

80. The term independent of x in expansion

$$\left(\frac{x+1}{x^{2/3} - x^{1/3} + 1} - \frac{x-1}{x - x^{1/2}} \right)^{10}$$

is

- (a) 4
- (b) 120
- (c) 210
- (d) 310

81. The area (in square units) bounded by the curves $y = \sqrt{x}$, $2y - x + 3 = 0$, X-axis and lying in the first quadrant is

- (a) 9
- (b) 36
- (c) 18
- (d) $\frac{27}{4}$

82. Let T_n be the number of all possible triangles formed by joining vertices of an n -sided regular polygon. If $T_{n+1} - T_n = 10$, then the value of n is

- (a) 7
- (b) 5
- (c) 10
- (d) 8

83. If z is a complex number of unit modulus and argument θ , then \arg

$$\left(\frac{1+z}{1+\bar{z}} \right)$$

is equal to

- (a) $-\theta$
- (b) $\frac{\pi}{2} - \theta$
- (c) θ
- (d) $\pi - \theta$

84. ABCD is a trapezium such that AB and CD are parallel and $BC \perp CD$. If $\angle ADB = \theta$, $BC = p$ and $CD = q$, then AB is equal to

- (a) $\frac{(p^2 + q^2) \sin \theta}{p \cos \theta + q \sin \theta}$
- (b) $\frac{p^2 + q^2 \cos \theta}{p \cos \theta + q \sin \theta}$
- (c) $\frac{p^2 + q^2}{p^2 \cos \theta + q^2 \sin \theta}$
- (d) $\frac{(p^2 + q^2) \sin \theta}{(p \cos \theta + q \sin \theta)^2}$

85. If $P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$ is the adjoint of a 3×3 matrix A and $|A| = 4$, then α is equal to

- (a) 4
- (b) 11
- (c) 5
- (d) 0

86. The intercepts on X-axis made by tangents to the curve, $y = \int_0^x |t| dt$, $x \in R$, which are parallel to the line $y = 2x$, are equal to

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

87. Given A circle, $2x^2 + 2y^2 = 5$ and a parabola, $y^2 = 4\sqrt{5}x$.

Statement I An equation of a common tangent to these curves is $y = x + \sqrt{5}$.

Statement II If the line,

$y = mx + \frac{\sqrt{5}}{m}$ ($m \neq 0$) is the common tangent, then m satisfies $m^4 - 3m^2 + 2 = 0$.

- (a) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I
- (b) Statement I is true, Statement II is true; Statement II is not a correct explanation for Statement I
- (c) Statement I is true, Statement II is false
- (d) Statement I is false, Statement II is true

88. If $y = \sec(\tan^{-1} x)$, then $\frac{dy}{dx}$ at $x = 1$ is equal to

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

89. The expression $\frac{\tan A}{1 - \cot A} + \frac{\cot A}{1 - \tan A}$ can be written as

- (a) $\sin A \cos A + 1$
- (b) $\sec A \operatorname{cosec} A + 1$
- (c) $\tan A + \cot A$
- (d) $\sec A + \operatorname{cosec} A$

90. All the students of a class performed poorly in Mathematics. The teacher decided to give grace marks of 10 to each of the students. Which of the following statistical measures will not change even after the grace marks were given?

- (a) Mean
- (b) Median
- (c) Mode
- (d) Variance

Answers

- | | | | | | | | | | |
|---------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 2. (d) | 3. (d) | 4. (b) | 5. (b) | 6. (c) | 7. (b) | 8. (b) | 9. (a) | 10. (c) |
| 11. (a) | 12. (b) | 13. (c) | 14. (d) | 15. (b) | 16. (c) | 17. (c) | 18. (c) | 19. (d) | 20. (c) |
| 21. (d) | 22. (b) | 23. (d) | 24. (a) | 25. (d) | 26. (d) | 27. (c) | 28. (a) | 29. (b) | 30. (d) |
| 31. (c) | 32. (a,b) | 33. (c) | 34. (d) | 35. (a) | 36. (a) | 37. (c) | 38. (c) | 39. (a) | 40. (b) |
| 41. (a) | 42. (d) | 43. (c) | 44. (*) | 45. (d) | 46. (c) | 47. (b) | 48. (a) | 49. (b) | 50. (c) |
| 51. (a) | 52. (d) | 53. (d) | 54. (d) | 55. (b) | 56. (d) | 57. (b) | 58. (b) | 59. (a) | 60. (b) |
| 61. (c) | 62. (c) | 63. (c) | 64. (c) | 65. (c) | 66. (d) | 67. (c) | 68. (b) | 69. (b) | 70. (a) |
| 71. (c) | 72. (a) | 73. (b) | 74. (c) | 75. (d) | 76. (d) | 77. (a) | 78. (c) | 79. (b) | 80. (c) |
| 81. (a) | 82. (b) | 83. (c) | 84. (a) | 85. (b) | 86. (a) | 87. (b) | 88. (a) | 89. (b) | 90. (d) |