EAMCET
ENGINEERING
SOLVED PAPER 2006

Physics

1. If C, R, L and I denote capacity, resistance, inductance and electric current respectively, the quantities having the same dimensions of time are :

(1) CR (2) $\frac{L}{R}$

(3) $\sqrt{LC}$ (4) LI^2

(a) (1) and (2) only
(b) (1) and (3) only
(c) (1) and (4) only
(d) (1), (2) and (3) only

2. A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/h. He finds that raindrops are hitting his head vertically. The actual speed of raindrops is :

(a) 20 km/h (b) $10\sqrt{3}$ km/h
(c) $20\sqrt{3}$ km/h (d) 10 km/h

3. A body is projected from the earth at angle 30° with the horizontal with some initial velocity. If its range is 20 m, the maximum height reached by it is : (in metres)

(a) $5\sqrt{3}$ (b) $\frac{5}{\sqrt{3}}$

(c) $\frac{10}{\sqrt{3}}$ (d) $10\sqrt{3}$

4. A motor is used to deliver water at a certain rate through a given horizontal pipe. To deliver n-times the water through the same pipe in the same time the power of the motor must be increased as follows :

(a) n-times (b) n^2-times
(c) n^3-times (d) n^4-times

5. A bullet of mass 10 g is fired horizontally with a velocity 1000 ms^{-1} from a rifle situated at a height 50 m above the ground. If the bullet reaches the ground with a velocity 500 ms^{-1}, the work done against air resistance in the trajectory of the bullet is : ($g = 10\ ms^{-2}$)

(a) 5005 J (b) 3755 J
(c) 3750 J (d) 17.5 J

6. A man of 50 kg is standing at one end on a boat of length 25 m and mass 200 kg. If he starts running and when he reaches the other end, he has a velocity 2 ms^{-1} with respect to the boat. The final velocity of the boat is : (in ms^{-1})

(a) $\frac{2}{5}$ (b) $\frac{2}{3}$

(c) $\frac{8}{5}$ (d) $\frac{8}{3}$

7. For a system to follow the law of conservation of linear momentum during a collision, the condition is :

(1) total external force acting on the system is zero.
(2) total external force acting on the system is finite and time of collision is negligible.
(3) total internal force acting on the system is zero.

(a) (1) only (b) (2) only
(c) (3) only (d) (1) or (2)

8. When the angle of inclination of an inclined plane is 0, an object slides down with uniform velocity. If the same object is pushed up with a initial velocity u on the same inclined plane; it goes up the plane and stops at a certain distance on the plane. Thereafter the body :

(a) slides down the inclined plane and reaches the ground with velocity u.
(b) slides down the inclined plane and reaches the ground with velocity less than u.
(c) slides down the inclined pane and reaches the ground with velocity greater than u.
(d) stays at rest on the inclined plane and will not slide down.

9. A uniform rod of length $8a$ and mass $6m$ lies on a smooth horizontal surface. Two point masses m and $2m$ moving in the same plane with speed $2v$ and v respectively strike the rod perpendicularly at distances a and $2a$ from the mid point of the rod in the opposite directions and stick to the rod. The angular velocity of the system immediately after the collision is :

(a) $\frac{6v}{32a}$ (b) $\frac{6v}{33a}$

(c) $\frac{6v}{40a}$ (d) $\frac{6v}{41a}$

10. Assume the earth's orbit around the sun as circular and the distance between their centres as D. Mass of the earth is M and its radius is R. If earth has an angular velocity ω_0 with respect to its centre and ω with respect to the centre of the sun, the total kinetic energy of earth is :

(a) $\frac{MR^2\omega_0^2}{5}\left[1+\left(\frac{\omega}{\omega_0}\right)^2+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

(b) $\frac{MR^2\omega_0^2}{5}\left[1+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

(c) $\frac{2}{5}MR^2\omega_0^2\left[1+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

(d) $\frac{2}{5}MR^2\omega_0^2\left[1+\left(\frac{\omega}{\omega_0}\right)^2+\frac{5}{2}\left(\frac{D\omega}{R\omega_0}\right)^2\right]$

11. **Assertion (a)** : A particle of mass m dropped into a hole made along the diameter of the earth from one end to the other and possess simple harmonic motion.

Reason (R) : Gravitational force between any two particles is inversely proportional to the square of the distance between them.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

12. To the free end of spring hanging from a rigid support, a block of mass m is hung and slowly allowed to come to its equilibrium position. Then stretching in the spring is d. If the same block is attached to the same spring and allowed to fall suddenly, the amount of stretching is : (force constant, k)

(a) $\frac{mg}{k}$ (b) $2d$

(c) $\frac{mg}{3k}$ (d) $4d$

13. **Assertion (a)** : Ductile metals are used to prepare thin wires.

Reason (R) : In the stress-strain curve of ductile metals, the length between the points representing elastic limit and breaking point is very small.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

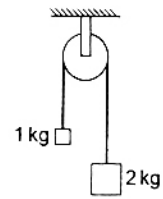
14. Two soap bubbles combine to form a single bubble. In this process, the change in volume and surface area are respectively V and A. If P is the atmospheric pressure, and T is the surface tension of the soap solution, the following relation is true .

(a) $4PV + 3TA = 0$ (b) $3PV - 4TA = 0$
(c) $4PV - 3TA = 0$ (d) $3PV + 4TA = 0$

15. An air bubble of radius 1 cm rises from the bottom portion through a liquid of density 1.5 g/cc at a constant speed of 0.25 cm s^{-1}. If the density of air is neglected, the coefficient of viscosity of the liquid is approximately, (In Pas) :

(a) 13000 (b) 1300
(c) 130 (d) 13

16. Two blocks of masses 1 kg and 2 kg are connected by a metal wire going over a smooth pulley as shown in figure. The breaking stress of the metal is 2×10^9 N/m^2. What should be the minimum radius of the wire used if it is not to break ? Take $g = 10$ m/s^2



(a) 4.6×10^{-5} m (b) 4.6×10^{-6} m
(c) 2.5×10^{-6} m (d) 2.5×10^{-5} m

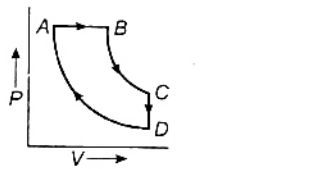
17. The temperature of a thin uniform circular disc, of one metre diameter is increased by 10°C. The percentage increase in moment of inertia of the disc about an axis passing through its centre and perpendicular to the circular face : (linear coefficient of expansion $= 11\times10^{-6}$/°C)

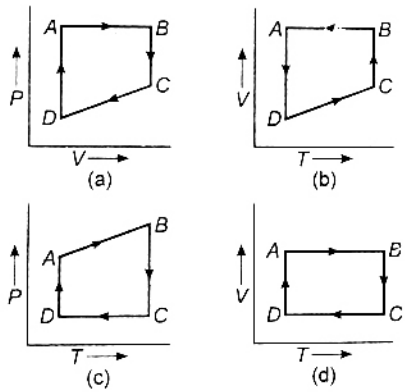
(a) 0.0055 (b) 0.011
(c) 0.022 (d) 0.044

18. A given mass of a gas is compressed isothermally until its pressure is doubled. It is then allowed to expand adiabatically until its original volume is restored and its pressure is then found to be 0.75 of its initial pressure. The ratio of the specific heats of the gas is approximately :

(a) 1.20 (b) 1.41
(c) 1.67 (d) 1.83

19. A cyclic process *ABCD* is shown below in the given *P-V* diagram. In the following answers the one that represents the same process as in *P-V* diagram :





20. Two solid spheres *A* and *B* made of the same material have radii r_A and r_B respectively. Both the spheres are cooled from the same temperature under the conditions valid for Newton's law of cooling. The ratio of the rate of change of temperature of *A* and *B* is :

(a) $\frac{r_A}{r_B}$ (b) $\frac{r_B}{r_A}$
(c) $\frac{r_A^2}{r_B^2}$ (d) $\frac{r_B^2}{r_A^2}$

21. Two strings *A* and *B* of lengths, $L_A = 80$ cm and $L_B = x$ cm respectively are used separately in a sonometer. The ratio of their densities (d_A / d_B) is 0.81. The diameter of *B* is one-half that of *A*. If the strings have the same tension and fundamental frequency the value of *x* is :

(a) 33 (b) 102
(c) 144 (d) 130

22. An observer is standing 500 m away from a vertical hill. Starting between the observer and the hill, a police van sounding a siren of frequency 1000 Hz moves towards the hill with a uniform speed. If the frequency of the sound heard directly from the siren is 970 Hz, the frequency of the sound heard after reflection from the hill (in Hz) is about, (velocity of sound $= 330\ ms^{-1}$) :

(a) 1042 (b) 1032
(c) 1022 (d) 1012

23. The two surfaces of a biconvex lens has same radii of curvatures. This lens is made of glass of refractive index 1.5 and has a focal length 10 cm in air. The lens is cut into two equal halves along a plane perpendicular to its principal axis to yield two plano-convex lenses. The two pieces are glued such that the convex surfaces touch each other. If this combination lens is immersed in water (refractive index = 4/3), its focal length (in cm) is :

(a) 5 (b) 10
(c) 20 (d) 40

24. Dispersive power depends on the following :

(a) material of the prism
(b) shape of the prism
(c) size of the prism
(d) size, shape and material of the prism

25. Match the appropriate pairs from Lists I and II :

	List-I		List-II
1.	Nitrogen molecules	(A)	Continuous spectrum
2.	Incandescent solids	(B)	Absorption spectrum
3.	Fraunhoffer lines	(C)	Band spectrum
4.	Electric arc between iron rods	(D)	Emission spectrum

(a) 1– C, 2–A, 3–B, 4 –D
(b) 1–B, 2–A, 3–D, 4 –C
(c) 1–D, 2–A, 3–B, 4 –C
(d) 1–A, 2–C, 3–D, 4 –B

26. In Young's double slit experiment,first slit has width four times the width of the second slit. the ratio of the maximum intensity to the minimum intensity in the interference fringe system is :

(a) 2 : 1 (b) 4 : 1
(c) 9 : 1 (d) 8 : 1

27. The effect due to uniform magnetic field on a freely suspended magnetic needle is as follows :

(a) both torque and net force are present
(b) torque is present but no net force
(c) both torque and net force are absent
(d) net force is present but not torque

28. Two short magnets AB and CD are in the X-Y plane and are parallel to X-axis and co-ordinates of their centres respectively are (0, 2) and (2, 0). Line joining the north-south poles of CD is opposite to that of AB and lies along the positive X-axis. The resultant field induction due to AB and CD at a point P (2, 2) is 100×10^{-7} T. When the poles of the magnet CD are reversed, the resultant field induction is 50×10^{-7} T. The value of magnetic moments of AB and CD (in Am^2) are :

(a) 300; 200 (b) 600; 400
(c) 200; 100 (d) 300; 150

29. The bob of simple pendulum is hanging vertically down from a fixed identical bob by means of a sting of length l. If both bobs are charged with a charge q each, time period of the pendulum is : (ignore the radii of the bobs)

(a) $2\pi\sqrt{\dfrac{l}{g+\left(\dfrac{q^2}{l^2m}\right)}}$ (b) $2\pi\sqrt{\dfrac{l}{g-\left(\dfrac{q^2}{l^2m}\right)}}$

(c) $2\pi\sqrt{\dfrac{l}{g}}$ (d) $2\pi\sqrt{\dfrac{l}{g-\left(\dfrac{q^2}{l}\right)}}$

30. Along the X-axis, three charges $\frac{q}{2}$, $-q$ and $\frac{q}{2}$ are placed at $x = 0$, $x = a$ and $x = 2a$ respectively. The resultant electric potential at $x = a + r$ (if $a \ll r$) is : (ε_0 is the permittivity of free space)

(a) $\dfrac{qa}{4\pi\varepsilon_0 r^2}$ (b) $\dfrac{qa^2}{4\pi\varepsilon_0 r^3}$

(c) $\dfrac{q\left(\dfrac{a^2}{4}\right)}{4\pi\varepsilon_0 r^3}$ (d) $\dfrac{q}{4\pi\varepsilon_0 r}$

31. One end each of a resistance r capacitor C and resistance $2r$ are connected together. The other ends are respectively connected to the positive terminals of batteries, P, Q, R having respectively emf's E, E and $2E$. The negative terminals of the batteries are then connected together. In this circuit, with steady current the potential drop across the capacitor is :

(a) $\dfrac{E}{3}$ (b) $\dfrac{E}{2}$

(c) $\dfrac{2E}{3}$ (d) E

32. Twelve cells, each having emf E volts are connected in series and are kept in a closed box. Some of these cells are wrongly connected with positive and negative terminals reversed. This 12 cell battery is connected in series with an ammeter, an external resistance R ohms and a two-cell battery (two cells of the same type used earlier, connected perfectly in series). The current in the circuit when the 12-cell battery and 2-cell battery aid each other is 3A and is 2A when they oppose each other. Then, the number of cells in 12-cell battery that are connected wrongly is :

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

33. If the cold junction is held at 0°C, the same thermo emf V of a thermocouple varies as $V = 10 \times 10^{-6} t - \dfrac{1}{40} \times 10^{-6} t^2$, where t is the temperature of the hot junction in °C. The neutral temperature and the maximum value of thermo emf are respectively :

(a) 200°C; 2 mV (b) 400°C; 2 mV
(c) 100°C; 1 mV (d) 200°C; 1 mV

34. When a positively charged particle enters a uniform magnetic field with uniform velocity, its trajectory can be :

(1) a straight line (2) a circle
(3) a helix
(a) (1) only
(b) (1) or (2)
(c) (1) or (3)
(d) any one of (1), (2) and (3)

35. A rectangular loop of length l and breadth b is placed at distance of x from infinitely long wire carrying current i such that the direction of current is parallel to breadth. If the loop moves away from the current wire in a direction perpendicular to it with a velocity v, the magnitude of the emf in the loop is : (μ_0 = permeability of free space)

(a) $\frac{\mu_0 iv}{2\pi x}\left(\frac{l+b}{b}\right)$ (b) $\frac{\mu_0 i^2 v}{4\pi^2 x}\log\left(\frac{b}{l}\right)$

(c) $\frac{\mu_0 ilbv}{2\pi x(l+x)}$ (d) $\frac{\mu_0 ilbv}{2\pi}\log\left(\frac{x+l}{x}\right)$

36. A small square loop of wire of side l is placed inside a large square loop of side $L(L>>l)$. If the loops are coplanar and their centres coincide, the mutual induction of the system is directly proportional to :

(a) $\frac{L}{l}$ (b) $\frac{l}{L}$

(c) $\frac{L^2}{l}$ (d) $\frac{l^2}{L}$

37. A oil drop having a mass 4.8×10^{-10} g and charge 2.4×10^{-18} C stands still between two charged horizontal plates separated by a distance of 1 cm. If now the polarity of the plates is changed, instantaneous acceleration of the drop is : ($g = 10\ ms^{-2}$)

(a) $5\ ms^{-2}$ (b) $10\ ms^{-2}$

(c) $15\ ms^{-2}$ (d) $20\ ms^{-2}$

38. A proton, a deuteron (nucleus of $_1H^2$) and an α-particle with same kinetic energy enter a region of uniform magnetic field moving at right angles to the field. The ratio of the radii of their circular paths is :

(a) 1 : 2 : 4 (b) $1:\sqrt{2}:1$

(c) $2:\sqrt{2}:1$ (d) 1 : 1 : 2

39. A free neutron decays spontaneously into :

(a) a proton, an electron and anti-neutrino

(b) a proton, an electron and a-neutrino

(c) a proton and electron

(d) a proton, and electron, a neutrino and an anti-neutrino.

40. Consider a *p-n* junction as a capacitor, formed with *p* and *n*-materials acting as thin metal electrodes and depletion layer width acting as separation between them. Basing on this, assume that a *n-p-n* transistor is working as an amplifier in CE configuration. If C_1 and C_2 are the base-emitter and collector-emitter junction capacitances, then :

(a) $C_1 > C_2$ (b) $C_1 < C_2$

(c) $C_1 = C_2$ (d) $C_1 = C_2 = 0$

Chemistry

1. The standard reduction potentials of $Zn^{2+}|Zn$, $Cu^{2+}|Cu$ and $Ag^{+}|Cu$ and $Ag^{+}|Ag$ are respectively –0.76, 0.34 and 0.8 V. The following cells were constructed :

(1) $Zn \mid Zn^{2+} \| Cu^{2+} \mid Cu$

(2) $Zn \mid Zn^{2+} \| Ag^{+} \mid Ag$

(3) $Cu \mid Cu^{2+} \| Ag^{+} \mid Ag$

What is the correct order of E°_{cell} of these cells ?

(a) 2 > 3 > 1 (b) 2 > 1 > 3

(c) 1 > 2 > 3 (d) 3 > 1 > 2

2. What is the correct order of spin only magnetic moment (in BM) of Mn^{2+}, Cr^{2+} and V^{2+} ?

(a) $Mn^{2+} > V^{2+} > Cr^{2+}$

(b) $V^{2+} > Cr^{2+} > Mn^{2+}$

(c) $Mn^{2+} > Cr^{2+} > V^{2+}$

(d) $Cr^{2+} > V^{2+} > Mn^{2+}$

3. A molecule (X) has (i) four sigma bonds formed by the overlap of sp^2 and s orbitals (ii) one sigma bond formed by sp^2 and sp^2 orbitals and (iii) one π bond formed by p_x and p_z orbitals. Which of the following is X ?

(a) C_2H_6 (b) C_2H_3Cl

(c) $C_2H_2Cl_2$ (d) C_2H_4

4. Which of the following is used for making optical instruments ?

(a) SiO_2 (b) Si

(c) SiH_4 (d) SiC

5. Which of the following is not correct ?

(a) $3O_2 \underset{\text{discharge}}{\overset{\text{silent electric}}{\rightleftharpoons}} 2O_3$; $\Delta H = -284.5$ kJ

(b) Ozone undergoes addition reaction with unsaturated carbon compounds

(c) Sodium thiosulphate reacts with I_2 to form sodium tetrathionate and sodium iodide.

(d) Ozone oxidises lead sulphide to lead sulphate.

6. Which of the following reactions can produce aniline as main product ?

(a) $C_6H_5NO_2 + Zn / KOH$

(b) $C_6H_5NO_2 + Zn / NH_4Cl$

(c) $C_6H_5NO_2 + LiAlH_4$

(d) $C_6H_5NO_2 + Zn / HCl$

7. Observe the following statements :
   I. The physical and chemical properties of elements are periodic functions of their electronic configuration.
   II. Electronegativity of fluorine is less than the electronegativity of chlorine.
   III. Electropositive nature decreases from top to bottom in a group.
   The correct answer is :
   (a) I, II and III are correct
   (b) only I is correct
   (c) only I and II is correct
   (d) only II and III are correct

8. Which of the following reagents when heated with ethyl chloride, forms ethylene ?
   (a) Aqueous KOH (b) Zn/HCl
   (c) Alcoholic KOH (d) HI

9. Which of the following statements is not correct ?
   (a) In oxyhaemoglobin Fe^{2+} is paramagnetic
   (b) During respiration the size of Fe^{2+} increases when it changes from diamagnetic to paramagnetic state.
   (c) Four heme groups are present in haemoglobin
   (d) Heme is the prosthetic group and it is non-protein part.

10. The uncertainties in the velocities of two particles A and B are 0.05 and 0.02 m/s^{-1} respectively. The mass of B is five times to that of mass A. What is the ratio of uncertainties $\left(\frac{\Delta x_A}{\Delta x_B}\right)$ in their positions ?
   (a) 2 (b) 0.25
   (c) 4 (d) 1

11. The energy of a photon is 3×10^{-12} ergs. What is its wavelength in nm ?
   ($h = 6.62 \times 10^{-27}$ ergs-s; $c = 3 \times 10^{10}$ cm/s)
   (a) 662 (b) 1324
   (c) 66.2 (d) 6.62

12. What is the time (in sec) required for depositing all the silver present in 125mL of 1 M $AgNO_3$ solution by passing a current of 241.25 A ? (1F = 96500 coulombs)
   (a) 10 (b) 50
   (c) 1000 (d) 100

13. $CFCl_3$ is responsible for the decomposition of ozone to oxygen. Which of the following reacts with ozone to form oxygen ?
   (a) Cl_2 (b) Cl^-
   (c) F^- (d) Cl^*

14. The disperse phase, dispersion medium and nature of colloidal solution (lyophilic or lyophobic) of 'gold sol' respectively are :
   (a) solid, solid, lyophobic
   (b) liquid, liquid, lyophobic
   (c) solid, liquid, lyophobic
   (d) solid, liquid, lyophilic

15. Electrolysis of X gives Y at anode. Vacuum distillation of Y gives H_2O_2. The number of peroxy (O–O) bonds present in X and Y respectively are :
   (a) 1, 1 (b) 1, 2
   (c) zero, 1 (d) zero, zero

16. AB is an ionic solid. The ionic radii of A^+ and B^- are respectively r_c and r_a. Lattice energy of AB is proportional to :
   (a) $\frac{r_c}{r_a}$ (b) $(r_c + r_a)$
   (c) $\frac{r_a}{r_c}$ (d) $\frac{1}{(r_c + r_a)}$

17. Which of the following set of variables give a straight line with a negative slope when plotted ?
   (P = vapour pressure. T = Temperature in K)

	***y*-axis**	***x*-axis**		***y*-axis**	***x*-axis**
(a)	P	T	(b)	$\log_{10} P$	T
(c)	$\log_{10} P$	$\frac{1}{T}$	(d)	$\log_{10} P$	$\log_{10} \frac{1}{T}$

18. Which of the following is not a characteristic property of chemical equilibrium ?
   (a) Rate of forward reaction is equal to rate of backward reaction at equilibrium.
   (b) After reaching the chemical equilibrium, the concentrations of reactants and products remain unchanged with time.
   (c) For $A(g) \rightleftharpoons B(g)$, K_c is 10^{-2}. If this reaction is carried out in the presence of catalyst, the value of K_c decreases
   (d) After reaching the equilibrium, both forward and backward reactions continue to take place

19. The rate constant of a first order reaction at 27°C is $10^{-3} min^{-1}$. The temperature coefficient of this reaction is 2. What is the rate constant (in min^{-1}) at 17°C for this reaction ?
   (a) 10^{-3} (b) 5×10^{-4}
   (c) 2×10^{-3} (d) 10^{-2}

20. The concentration of oxalic acid is 'x' mol L^{-1}. 40 mL of this solution reacts with 16 mL of 0.05 M acidified $KMnO_4$. What is the pH of 'x' M oxalic acid solution ? (Assume that oxalic acid dissociates completely)

(a) 1.3 (b) 1.699
(c) 1 (d) 2

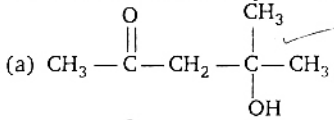
21. Which of the following is added to chloroform to slow down its aerial oxidation in presence of light ?

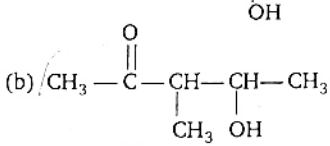
(a) Carbonyl chloride
(b) Ethyl alcohol
(c) Sodium hydroxide
(d) Nitric acid

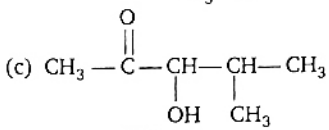
22. At T (K), 100 L of dry oxygen is present in a sealed container. It is subjected to silent electric discharge, till the volumes of oxygen and ozone become equal. What is the volume (in litres) of ozone formed at T (K)?

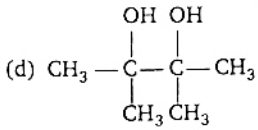
(a) 50 (b) 60
(c) 30 (d) 40

23. Which of the products is formed when acetone is reacted with barium hydroxide solution ?

(a) 

(b) 

(c) 

(d) 

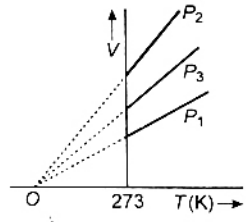
24. Which of the following is not correct ?

(a) Nuclei of atoms participate in nuclear reactions
(b) $_{20}Ca^{40}$ and $_{18}Ar^{40}$ are isotones
(c) 1 amu of mass defect is approximately equal to 931.5 MeV
(d) Uranium (U^{238}) series is known as $(4n + 2)$ series

25. When acetaldehyde is heated with Fehling solution, a red precipitate is formed. Which of the following is that ?

(a) Cu_2O (b) Cu
(c) CuO (d) $CuSO_4$

26. The volume-temperature graphs of a given mass of an ideal gas at constant pressures are shown below. What is the correct order of pressures ?



(a) $P_1 > P_3 > P_2$ (b) $P_1 > P_2 > P_3$
(c) $P_2 > P_3 > P_1$ (d) $P_2 > P_1 > P_3$

27. Match the following lists :

	List-I		List-II
A.	Grignard reagent	**1.**	H_2 / Pd - $BaSO_4$
B.	Clemmensen reduction	**2.**	N_2H_4 | KOH | CH_2—OH, CH_2—OH
C.	Rosenumund reduction	**3.**	CH_3MgX
D.	Wolff-Kishner reduction	**4.**	Zn-Hg |conc. HCl
		5.	H_2 | Ni

	A	B	C	D
(a)	3	4	2	1
(b)	3	4	1	2
(c)	2	1	4	5
(d)	5	3	2	1

28. What is the correct order of occurrence (% by weight) in air of Ne, Ar and Kr ?

(a) Ne > Ar > Kr (b) Ar > Ne > Kr
(c) Ar > Kr > Ne (d) Ne > Kr > Ar

29. Observe the following statements :

I. Bleaching powder is used in the preparation of chloroform.
II. Bleaching powder decomposes in the presence of $CoCl_2$ to liberate O_2.
III. Aqueous KHF_2 is used in the preparation of fluorine.

The correct combination is :

(a) I, II and III are correct
(b) Only II is correct
(c) Only I and III are correct
(d) Only I and II are correct

30. Which of the following compounds when heated with CO at 150°C and 500 atm pressure in presence of BF_3 forms ethyl propionate ?
(a) C_2H_5OH (b) CH_3OCH_3
(c) $C_2H_5OC_2H_5$ (d) $CH_3OC_2H_5$

31. Identify the reaction for which $\Delta H \neq \Delta E$:
(a) S (rhombic) + $O_2(g) \longrightarrow SO_2(g)$
(b) $N_2(g) + O_2(g) \longrightarrow 2NO(g)$
(c) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$
(d) $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$

32. Which of the following reacts with benzene in presence of anhydrous aluminum chloride and forms acetophenone ?
(a) CH_3Cl (b) CH_3COOH
(c) CH_3CHO (d) CH_3COCl

33. **Assertion (A)** : A current of 96.5 A is passed into aqueous $AgNO_3$ solution for 100 s. The weight of silver deposited is 10.8 g (At. wt. of Ag = 108)
Reason (R) : The mass of a substance deposited during the electrolysis of an electrolyte is inversely proportional to the quantity of electricity passing through the electrolyte.
The correct answer is :
(a) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
(b) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**
(c) **(A)** is true but **(R)** is false
(d) **(A)** is false but **(R)** is true

34. When compound *X* is oxidised by acidified potassium dichromate, compound *Y* is formed. Compound *Y* on reduction with $LiAlH_4$ gives *X*. *X* and *Y* respectively are :
(a) C_2H_5OH, CH_3COOH
(b) CH_3COCH_3, CH_3COOH
(c) C_2H_5OH, CH_3COCH_3
(d) CH_3CHO, CH_3COCH_3

35. Hydrolysis of NCl_3 gives NH_3 and *X*. Which of the following is *X* ?
(a) $HClO_4$ (b) $HClO_3$
(c) HOCl (d) $HClO_2$

36. What are the metal ions present in carnallite ?
(a) Mg, K (b) Al, Na
(c) Na, Mg (d) Zn, Mg

37. Ethyl chloride reacts with sodium ethoxide to form a compound *A*. Which of the following reactions also yields *A* ?
(a) C_2H_5Cl, KOH (alc.), Δ
(b) $2C_2H_5OH$, conc. H_2SO_4, 140°C
(c) C_2H_5Cl, Mg (dry ether)
(d) C_2H_2 dil H_2SO_4, $HgSO_4$

38. Which of the following reactions does not liberate gaseous product ?
(a) $AlCl_3 + NaOH \longrightarrow$
(b) $NaOH + P\text{ (white)} + H_2O \longrightarrow$
(c) $Al + NaOH \xrightarrow{\Delta}$
(d) $Zn + NaOH \xrightarrow{\Delta}$

39. $CH_3CH_2OH \xrightarrow[\text{step-1}]{Cl_2} CH_3CHO \xrightarrow[\text{step-2}]{3Cl_2} Cl_3CCHO$
In above reactions the role of Cl_2 in step-1 and step-2 respectively is :
(a) oxidation, chlorination
(b) reduction, chlorination
(c) oxidation, addition
(d) reduction, substitution

40. The number of sigma and pi (π) bonds present in benzene respectively are :
(a) 12, 6 (b) 6, 6
(c) 6, 12 (d) 12, 3

Mathematics

1. If $f : R \to R$ is defined by $f(x) = x - [x] - \frac{1}{2}$ for $x \in R$, where $[x]$ is the greatest integer not exceeding x, then $\left\{x \in R : f(x) = \frac{1}{2}\right\}$ is equal to :
(a) *Z*, the set of all integers
(b) *N*, the set of all natural numbers
(c) ϕ, the empty set
(d) *R*

2. If $f : R \to R$ is defined by $f(x) = [2x] - 2[x]$ for $x \in R$, where $[x]$ is the greatest integer not exceeding x, then the range of f is :

(a) $\{x \in R : 0 \le x \le 1\}$

(b) $\{0, 1\}$

(c) $\{x \in R : x > 0\}$

(d) $\{x \in R : x \le 0\}$

3. If $f : R \to R$ is defined by

$$f(x) = \begin{cases} x + 4 & \text{for} \quad x < -4 \\ 3x + 2 & \text{for} \quad -4 \le x < 4 \\ x - 4 & \text{for} \quad x \ge 4 \end{cases}$$

then the correct matching of List I from List II is :

	List-I		**List-II**
(A)	$f(-5) + f(-4)$	(i)	14
(B)	$f(\lvert f(-8) \rvert)$	(ii)	4
(C)	$f(f(-7) + f(3))$	(iii)	-11
(D)	$f(f(f(f(0)))) + 1$	(iv)	-1
		(v)	1
		(vi)	0

	(A)	(B)	(C)	(D)
(a)	(iii)	(vi)	(ii)	(v)
(b)	(iii)	(iv)	(ii)	(v)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(iii)	(vi)	(v)	(ii)

4. If $x = \sqrt{\dfrac{2+\sqrt{3}}{2-\sqrt{3}}}$, then $x^2(x-4)^2$ is equal to :

(a) 7 (b) 4

(c) 2 (d) 1

5. $\sqrt{12 - \sqrt{68 + 48\sqrt{2}}}$ is equal to :

(a) $\sqrt{2} - 3$ (b) $2 + \sqrt{2}$

(c) $2 - \sqrt{2}$ (d) $6 - 2\sqrt{8}$

6. For all integers $n \ge 1$, which of the following is divisible by 9 ?

(a) $8^n + 1$ (b) $4^n - 3n - 1$

(c) $3^{2n} + 3n + 1$ (d) $10^n + 1$

7. Eight different letters of an alphabet are given. Words of four letters from these are formed. The number of such words with at least one letter repeated is :

(a) $\binom{8}{4} - {}^8P_4$ (b) $8^4 + \binom{8}{4}$

(c) $8^4 - {}^8P_4$ (d) $8^4 - \binom{8}{4}$

8. The number of natural numbers less than 1000, in which no two digits are repeated, is :

(a) 738 (b) 792

(c) 837 (d) 720

9. $1 + \dfrac{2}{4} + \dfrac{2\cdot5}{4\cdot8} + \dfrac{2\cdot5\cdot8}{4\cdot8\cdot12} + \dfrac{2\cdot5\cdot8\cdot11}{4\cdot8\cdot12\cdot16} + \ldots\ldots$ is equal to :

(a) $4^{-2/3}$ (b) $\sqrt[3]{16}$

(c) $\sqrt[3]{4}$ (d) $4^{3/2}$

10. The correct matching of List I from List II is :

	List-I		**List-II**
(A)	$(1-x)^{-n}$	(i)	$\dfrac{x}{x+1}$
(B)	$(1+x)^{-n}$	(ii)	$1 - nx + \dfrac{n(n+1)}{2!}x^2 - \ldots$ if $\lvert x \rvert < 1$
(C)	If $x > 1$, then $1 + \dfrac{1}{x} + \dfrac{1}{x^2} + \ldots$ is	(iii)	$1 + nx + \dfrac{n(n+1)}{2!}x^2 + \ldots$ if $\lvert x \rvert < 1$
(D)	If $\lvert x \rvert > 1$, then $1 - \dfrac{2}{x^2} + \dfrac{3}{x^4} - \dfrac{4}{x^6} + \ldots$ is	(iv)	$\dfrac{x}{x-1}$
		(v)	$\dfrac{x^4}{(x^2+1)^2}$
		(vi)	$\dfrac{x^4}{(x^2-1)^2}$

	(A)	(B)	(C)	(D)
(a)	(i)	(iii)	(iv)	(v)
(b)	(ii)	(iii)	(iv)	(v)
(c)	(iii)	(ii)	(iv)	(v)
(d)	(ii)	(iii)	(i)	(v)

11. If $\dfrac{3x+2}{(x+1)(2x^2+3)} = \dfrac{A}{x+1} + \dfrac{Bx+C}{2x^2+3}$, then $A + C - B$ is equal to :

(a) 0 (b) 2

(c) 3 (d) 5

12. The coefficient of x^n in $\dfrac{1-2x}{e^x}$ is :

(a) $\dfrac{(1+2n)}{n!}$ (b) $(-1)^n \cdot \dfrac{(1+2n)}{n!}$

(c) $(-1)^n \cdot \dfrac{(1-2n)}{n!}$ (d) $(-1)^n \cdot \dfrac{(1+4n)}{n!}$

13. If $\lvert x \rvert < 1$ and $y = x - \dfrac{x^2}{2} + \dfrac{x^3}{3} - \dfrac{x^4}{4} + \ldots$, then x is equal to :

(a) $y + \dfrac{y^2}{2} + \dfrac{y^3}{3} + \ldots$

(b) $y - \dfrac{y^2}{2} + \dfrac{y^3}{3} - \dfrac{y^4}{4} + \ldots$

(c) $y + \frac{y^2}{2!} + \frac{y^3}{3!} + \cdots$

(d) $y - \frac{y^2}{2!} + \frac{y^3}{3!} - \frac{y^4}{4!} + \cdots$

14. If $\sqrt{9x^2 + 6x + 1} < (2 - x)$, then :

(a) $x \in \left(-\frac{3}{2}, \frac{1}{4}\right)$ (b) $x \in \left(-\frac{3}{2}, \frac{1}{4}\right]$

(c) $x \in \left[-\frac{3}{2}, \frac{1}{4}\right)$ (d) $x < \frac{1}{4}$

15. The difference between two roots of the equation $x^3 - 13x^2 + 15x + 189 = 0$ is 2. Then the roots of the equation are :

(a) –3, 5, 7 (b) – 3, –7, – 9

(c) 3, – 5, 7 (d) – 3, – 7, 9

16. If α, β, γ are the roots of the equation $x^3 - 6x^2 + 11x + 6 = 0$, then $\Sigma \alpha^2\beta + \Sigma \alpha\beta^2$ is equal to :

(a) 80 (b) 84

(c) 90 (d) – 84

17. $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ then $A^3 - 4A^2 - 6A$ is equal to :

(a) 0 (b) A

(c) $-A$ (d) I

18. If A is an invertible matrix of order n, then the determinant of adj A is equal to :

(a) $|A|^n$ (b) $|A|^{n+1}$

(c) $|A|^{n-1}$ (d) $|A|^{n+2}$

19. $\begin{vmatrix} \log e & \log e^2 & \log e^3 \\ \log e^2 & \log e^3 & \log e^4 \\ \log e^3 & \log e^4 & \log e^5 \end{vmatrix}$ is equal to :

(a) 0 (b) 1

(c) 4 log e (d) 5 log e

20. The locus of the point $z = x + iy$ satisfying the equation $\left|\frac{z-1}{z+1}\right| = 1$ is given by :

(a) $x = 0$ (b) $y = 0$

(c) $x = y$ (d) $x + y = 0$

21. The equation of the locus of z such that $\left|\frac{z-i}{z+i}\right| = 2$, where $z = x + iy$ is a complex number, is

(a) $3x^2 + 3y^2 + 10y - 3 = 0$

(b) $3x^2 + 3y^2 + 10y + 3 = 0$

(c) $3x^2 + 3y^2 - 10y - 3 = 0$

(d) $x^2 + y^2 - 5y + 3 = 0$

22. The product of the distinct $(2n)$th roots of $1 + i\sqrt{3}$ is equal to :

(a) 0 (b) $-1 - i\sqrt{3}$

(c) $1 + i\sqrt{3}$ (d) $-1 + i\sqrt{3}$

23. sin 120° cos 150° – cos 240° sin 330° is equal to :

(a) 1 (b) – 1

(c) $\frac{2}{3}$ (d) $-\left(\frac{\sqrt{3}+1}{4}\right)$

24. cosec 15° + sec 15° is equal to :

(a) $2\sqrt{2}$ (b) $\sqrt{6}$

(c) $2\sqrt{6}$ (d) $\sqrt{6} + \sqrt{2}$

25. If $5 \cos x + 12 \cos y = 13$, then the maximum value of $5 \sin x + 12 \sin y$ is :

(a) 12 (b) $\sqrt{120}$

(c) $\sqrt{20}$ (d) 13

26. The quadratic equation whose roots are $\sin^2 18°$ and $\cos^2 36°$ is :

(a) $16x^2 - 12x + 1 = 0$

(b) $16x^2 + 12x + 1 = 0$

(c) $16x^2 - 12x - 1 = 0$

(d) $16x^2 + 10x + 1 = 0$

27. For all values of θ, the values of $3 - \cos\theta + \cos\left(\theta + \frac{\pi}{3}\right)$ lie in the interval :

(a) [– 2, 3] (b) [– 2, 1]

(c) [2, 4] (d) [1, 5]

28. If $x = \tan 15°$, $y = \text{cosec}\, 75°$ and $z = 4 \sin 18°$, then :

(a) $x < y < z$ (b) $y < z < x$

(c) $z < x < y$ (d) $x < z < y$

29. $e^{\log(\cosh^{-1} 2)}$ is equal to :

(a) $\log(2 - \sqrt{3})$ (b) $\log(\sqrt{3} - 2)$

(c) $\log(2 + \sqrt{3})$ (d) $\log(2 + \sqrt{5})$

30. If, in a ΔABC, $\tan\frac{A}{2} = \frac{5}{6}$ and $\tan\frac{C}{2} = \frac{2}{5}$, then a, b, c are such that :

(a) $b^2 = ac$ (b) $2b = a + c$

(c) $2ac = b(a + c)$ (d) $a + b = c$

31. The angles of a triangle are in the ratio 3 : 5 : 10. Then the ratio of the smallest side to the greatest side is :

(a) 1 : sin 10° (b) 1 : 2 sin 10°

(c) 1 : cos 10° (d) 1 : 2 cos 10°

32. If $b + c = 3a$, then $\cot\frac{B}{2}\cot\frac{C}{2}$ is equal to :

(a) 3 (b) 1

(c) 4 (d) 2

33. The elevation of an object on a hill is observed from a certain point in the horizontal plane through its base, to be 30°. After walking 120 metres towards it on level ground the elevation is found to be 60°. Then the height of the object (in metres) is :

(a) 120 (b) $60\sqrt{3}$

(c) $120\sqrt{3}$ (d) 60

34. If $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ and $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{c}| = \sqrt{37}$, then the angle between $\vec{a}$ and $\vec{b}$ is :

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$

(c) $\frac{\pi}{6}$ (d) $\frac{\pi}{3}$

35. The position vector of a point lying on the line joining the points whose positions vectors are $\hat{i} + \hat{j} - \hat{k}$ and $\hat{i} - \hat{j} + \hat{k}$ is :

(a) $\hat{j}$ (b) $\hat{i}$

(c) $\hat{k}$ (d) $\vec{0}$

36. If $\hat{i} - 3\hat{j} + \hat{k}$ and $\lambda\hat{i} + 3\hat{j}$ are coplanar, then λ is equal to :

(a) -1 (b) 1/2

(c) $-3/2$ (d) 2

37. If the volume of parallelopiped with conterminus edges $4\hat{i} + 5\hat{j} + \hat{k}$, $-\hat{j} + \hat{k}$ and $3\hat{i} + 9\hat{j} + p\hat{k}$ is 34 cubic units, then p is equal to :

(a) 4 (b) -13

(c) 13 (d) 6

38. $\vec{a} \cdot \hat{i} = \vec{a} \cdot (2\hat{i} + \hat{j}) = \vec{a}\,(\hat{i} + \hat{j} + 3\hat{k}) = 1$, then $\vec{a}$ is equal to :

(a) $\hat{i} - \hat{k}$ (b) $1/3\,(3\hat{i} + 3\hat{j} + \hat{k})$

(c) $1/3\,(\hat{i} + \hat{j} + \hat{k})$ (d) $1/3\,(3\hat{i} - 3\hat{j} + \hat{k})$

39. If A and B are two independent events such that $P(B) = \frac{2}{7}$, $P(A \cup B^c) = 0.8$, then $P(A)$ is equal to :

(a) 0.1 (b) 0.2

(c) 0.3 (d) 0.4

40. A number n is chosen at random from $\{1, 2, 3, 4, \ldots, 1000\}$. The probability that n is a number that leaves remainder 1 when divided by 7, is :

(a) $\frac{71}{500}$ (b) $\frac{143}{1000}$

(c) $\frac{72}{500}$ (d) $\frac{71}{1000}$

41. In the random experiment of tossing two unbiased dice let E be the event of getting the sum 8 and F be the event of getting even numbers on both the dice. Then :

I. $P(E) = \frac{7}{36}$ II. $P(F) = \frac{1}{3}$

Which of the following is a correct statement ?

(a) Both I and II are true

(b) Neither I nor II is true

(c) I is true, II is false

(d) I is false, II is true

42. Seven balls are drawn simultaneously from a bag containing 5 white and 6 green balls. The probability of drawing 3 white and 4 green balls is :

(a) $\frac{7}{{}^{11}C_7}$ (b) $\frac{{}^5C_3 + {}^6C_4}{{}^{11}C_7}$

(c) $\frac{{}^5C_2\,{}^6C_2}{{}^{11}C_7}$ (d) $\frac{{}^6C_3\,{}^5C_4}{{}^{11}C_7}$

43. In a book of 500 pages, it is found that there are 250 typing errors. Assume that Poisson law holds for the number of errors per page. Then, the probability that a random sample of 2 pages will contain no error, is :

(a) $e^{-0.3}$ (b) $e^{-0.5}$

(c) e^{-1} (d) e^{-2}

44. The transformed equation of $x^2 + 6xy + 8y^2 = 10$ when the axes are rotated through an angle $\frac{\pi}{4}$ is :

(a) $15x^2 - 14xy + 3y^2 = 20$

(b) $15x^2 + 14xy - 3y^2 = 20$

(c) $15x^2 + 14xy + 3y^2 = 20$

(d) $15x^2 - 14xy - 3y^2 = 20$

45. The lines $x - y - 2 = 0$, $x + y - 4 = 0$ and $x + 3y = 6$ meet in the common point :

(a) (1, 2) (b) (2, 2)

(c) (3, 1) (d) (1, 1)

46. The equation of the line passing through the point of intersection of the lines $x - 3y + 2 = 0$ and $2x + 5y - 7 = 0$ and perpendicular to the line $3x + 2y + 5 = 0$ is :

(a) $2x - 3y + 1 = 0$ (b) $6x - 9y + 11 = 0$

(c) $2x - 3y + 5 = 0$ (d) $3x - 2y + 1 = 0$

47. Let O be the origin and A be a point on the curve $y^2 = 4x$. Then the locus of the mid point of OA is :

(a) $x^2 = 4y$ (b) $x^2 = 2y$
(c) $y^2 = 16x$ (d) $y^2 = 2x$

48. The lines represented by the equation $x^2 - y^2 - x + 3y - 2 = 0$ are :
(a) $x + y - 1 = 0,\ x - y + 2 = 0$
(b) $x - y - 2 = 0,\ x + y + 1 = 0$
(c) $x + y + 2 = 0,\ x - y - 1 = 0$
(d) $x - y + 1 = 0,\ x + y - 2 = 0$

49. The centroid of the triangle formed by the pair of straight lines $12x^2 - 20xy + 7y^2 = 0$ and the line $2x - 3y + 4 = 0$ is :
(a) $\left(-\frac{7}{3}, \frac{7}{3}\right)$ (b) $\left(-\frac{8}{3}, \frac{8}{3}\right)$
(c) $\left(\frac{8}{3}, \frac{8}{3}\right)$ (d) $\left(\frac{4}{3}, \frac{4}{3}\right)$

50. If OA is equally inclined to OX, OY and OZ and if A is $\sqrt{3}$ units from the origin, then A is :
(a) (3, 3, 3) (b) (− 1, 1, − 1)
(c) (- 1, 1, 1) (d) (1, 1, 1)

51. If the direction cosines of two lines are such that $l + m + n = 0,\ l^2 + m^2 - n^2 = 0$, then the angle between them is :
(a) π (b) $\pi/3$
(c) $\pi/4$ (d) $\pi/6$

52. The number of common tangents to the two circles $x^2 + y^2 - 8x + 2y = 0$ and $x^2 + y^2 - 2x - 16y + 25 = 0$ is :
(a) 1 (b) 2
(c) 3 (d) 4

53. Observe the following statements :
I. The circle $x^2 + y^2 - 6x - 4y - 7 = 0$ touches y-axis.
II. The circle $x^2 + y^2 + 6x + 4y - 7 = 0$ touches x-axis.
Which of the following is a correct statement ?
(a) Both I and II are true
(b) Neither I nor II is true
(c) I is true, II is false
(d) I is false, II is true

54. The length of the tangent drawn to the circle $x^2 + y^2 - 2x + 4y - 11 = 0$ from the point (1, 3) is :
(a) 1 (b) 2
(c) 3 (d) 4

55. If b and c are the lengths of the segments of any focal chord of a parabola $y^2 = 4ax$, then the length of the semi-latus rectum is :
(a) $\frac{bc}{b+c}$ (b) $\sqrt{bc}$
(c) $\frac{b+c}{2}$ (d) $\frac{2bc}{b+c}$

56. Equations of the latus rectum of the ellipse $9x^2 + 4y^2 - 18x - 8y - 23 = 0$ are :
(a) $y = \pm\sqrt{5}$ (b) $x = \pm\sqrt{5}$
(c) $y = 1 \pm \sqrt{5}$ (d) $x = -1 \pm \sqrt{5}$

57. The sides of the rectangle of greatest area that can be inscribed in the ellipse $x^2 + 4y^2 = 64$ are :
(a) $(6\sqrt{2}, 4\sqrt{2})$ (b) $(8\sqrt{2}, 4\sqrt{2})$
(c) $(8\sqrt{2}, 8\sqrt{2})$ (d) $(16\sqrt{2}, 4\sqrt{2})$

58. If the eccentricity of a hyperbola is $\sqrt{3}$; then the eccentricity of its conjugate hyperbola is :
(a) $\sqrt{2}$ (b) $\sqrt{3}$
(c) $\sqrt{\frac{3}{2}}$ (d) $2\sqrt{3}$

59. The polar equation of the circle with centre $\left(2, \frac{\pi}{2}\right)$ and radius 3 units is :
(a) $r^2 + 4r\cos\theta = 5$ (b) $r^2 + 4r\sin\theta = 5$
(c) $r^2 - 4r\sin\theta = 5$ (d) $r^2 - 4r\cos\theta = 5$

60. If $x^y = y^x$, then $x(x - y\log x)\frac{dy}{dx}$ is equal to :
(a) $y(y - x\log y)$ (b) $y(y + x\log y)$
(c) $x(x + y\log x)$ (d) $x(y - x\log y)$

61. $f(x) = e^x \sin x$, then $f^{(6)}(x)$ is equal to :
(a) $e^{6x}\sin 6x$ (b) $-8e^x\cos x$
(c) $8e^x\sin x$ (d) $8e^x\cos x$

62. If $0 < p < q$, then $\lim_{n\to\infty}(q^n + p^n)^{1/n}$ is equal to :
(a) e (b) p
(c) q (d) 0

63. $\lim_{x\to\infty}[\sqrt{x^2 + 2x - 1} - x]$ is equal to :
(a) ∞ (b) $\frac{1}{2}$
(c) 4 (d) 1

64. If $\lim_{x\to 0}\left(\frac{\cos 4x + a\cos 2x + b}{x^4}\right)$ is finite, then the values of a, b are respectively :
(a) 5, − 4 (b) − 5, − 4
(c) − 4, 3 (d) 4, 5

65. If $l_1 = \lim_{x\to 2^+}(x + [x])$, $l_2 \lim_{x\to 2^-}(2x - [x])$ and $l_3 = \lim_{x\to\pi/2}\frac{\cos x}{(x - \pi/2)}$, then :

(a) $l_1 < l_2 < l_3$ (b) $l_2 < l_3 < l_1$
(c) $l_3 < l_2 < l_1$ (d) $l_1 < l_3 < l_2$

66. If $f(x) = \begin{cases} \frac{1-\sqrt{2}\sin x}{\pi - 4x} & \text{if } x \neq \frac{\pi}{4} \\ a & \text{if } x = \frac{\pi}{4} \end{cases}$

is continuous at $\frac{\pi}{4}$, then a is equal to :

(a) 4 (b) 2
(c) 1 (d) 1/4

67. If θ is the angle between the curves $xy = 2$ and $x^2 + 4y = 0$ and $x^2 + 4y = 0$, then $\tan\theta$ is equal to :

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

68. In the interval $(-3, 3)$ the function $f(x) = \frac{x}{3} + \frac{3}{x}$, $x \neq 0$ is :

(a) increasing
(b) decreasing
(c) neither increasing nor decreasing
(d) partly increasing and partly decreasing

69. The perimeter of a sector is a constant. If its area is to be maximum, the sectorial angle is :

(a) $\frac{\pi^c}{6}$ (b) $\frac{\pi^c}{4}$
(c) 4^c (d) 2^c

70. If $u = \sin^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(a) $\sin u$ (b) $\tan u$
(c) $\cos u$ (d) $\cot u$

71. If $f(x, y) = \frac{\cos(x - 4y)}{\cos(x + 4y)}$, then $\left.\frac{\partial f}{\partial x}\right|_{y = \frac{x}{2}}$ is equal to :

(a) -1 (b) 0
(c) 1 (d) 2

72. If $\int \sqrt{\frac{x}{a^3 - x^3}}\, dx = g(x) + c$, then $g(x)$ is equal to :

(a) $\frac{2}{3}\cos^{-1} x$ (b) $\frac{2}{3}\sin^{-1}\left(\frac{x^3}{a^3}\right)$

(c) $\frac{2}{3}\sin^{-1}\left(\sqrt{\frac{x^3}{a^3}}\right)$ (d) $\frac{2}{3}\cos^{-1}\left(\frac{x}{a}\right)$

73. If $\int \frac{dx}{x^2 + 2x + 2} = f(x) + c$, then $f(x)$ is equal

(a) $\tan^{-1}(x + 1)$ (b) $2\tan^{-1}(x + 1)$
(c) $-\tan^{-1}(x + 1)$ (d) $3\tan^{-1}(x + 1)$

74. Observe the following statements :

A : $\int\left(\frac{x^2 - 1}{x^2}\right)e^{\frac{x^2+1}{x}}\, dx = e^{\frac{x^2+1}{x}} + c$.

R : $\int f'(x)e^{f(x)}dx = f(x) + c$.

Then which of the following is true ?

(a) Both A and R are true and R is not the correct reason for A
(b) Both A and R are true and R is the correct reason for A
(c) A is true, R is false
(d) A is false, R is true

75. Dividing the interval [0, 6] into 6 equal parts and by using trapezoidal rule the value of $\int_0^6 x^3\, dx$ is approximately :

(a) 330 (b) 331
(c) 332 (d) 333

76. $\int_0^{\pi/2} \frac{dx}{1 + \tan^3 x}$ is equal to :

(a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{4}$ (d) $\frac{3\pi}{2}$

77. $\int_{-1}^{1} \frac{\cosh x}{1 + e^{2x}}\, dx$ is equal to :

(a) 0 (b) 1
(c) $\frac{e^2 - 1}{2e}$ (d) $\frac{e^2 + 2}{2e}$

78. The solution of $(x^2 + y^2)dx = 2xy\, dy$ is :

(a) $c(x^2 - y^2) = x$ (b) $c(x^2 + y^2) = x$
(c) $c(x^2 - y^2) = y$ (d) $c(x^2 + y^2) = y$

79. The solution of $(1 + x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$ is :

(a) $3x(1 + y^2) = 4y^3 + c$
(b) $3y(1 + x^2) = 4x^3 + c$
(c) $3x(1 - y^2) = 4y^3 + c$
(d) $3y(1 + y^2) = 4x^3 + c$

80. The solution of $\frac{dx}{dy} + \frac{x}{y} = x^2$ is :

(a) $\frac{1}{y} = cx - x\log x$ (b) $\frac{1}{x} = cy - y\log y$

(c) $\frac{1}{x} = cx + x\log y$ (d) $\frac{1}{y} = cx - y\log x$

ANSWERS

PHYSICS

1.	(d)	2.	(a)	3.	(b)	4.	(c)	5.	(c)	6.	(a)	7.	(a)	8.	(d)
9.	(d)	10.	(b)	11.	(a)	12.	(b)	13.	(c)	14.	(d)	15.	(c)	16.	(a)
17.	(c)	18.	(b)	19.	(a)	20.	(b)	21.	(c)	22.	(b)	23.	(d)	24.	(a)
25.	(a)	26.	(c)	27.	(b)	28.	(a)	29.	(c)	30.	(b)	31.	(a)	32.	(d)
33.	(d)	34.	(d)	35.	(c)	36.	(d)	37.	(b)	38.	(b)	39.	(a)	40.	(a)

CHEMISTRY

1.	(b)	2.	(c)	3.	(d)	4.	(a)	5.	(a)	6.	(d)	7.	(b)	8.	(c)
9.	(a)	10.	(a)	11.	(a)	12.	(b)	13.	(d)	14.	(c)	15.	(c)	16.	(d)
17.	(c)	18.	(c)	19.	(b)	20.	(a)	21.	(b)	22.	(d)	23.	(a)	24.	(a)
25.	(a)	26.	(a)	27.	(b)	28.	(b)	29.	(d)	30.	(c)	31.	(d)	32.	(d)
33.	(c)	34.	(a)	35.	(c)	36.	(a)	37.	(b)	38.	(a)	39.	(a)	40.	(d)

MATHEMATICS

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

HINTS & SOLUTIONS

Physics

1. $[C] = [M^{-1}L^{-2}T^4A^2]$, $[R] = [M\,L^2\,T^{-3}A^{-2}]$
$[L] = [ML^2T^{-2}A^{-2}]$ and $[I] = [M^0L^0T^0A]$

(1) $[CR] = [M^{-1}L^{-2}T^4A^2]\,[ML^2T^{-3}A^{-2}]$
$= [M^0L^0TA^0]$

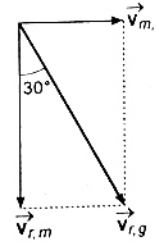
(2) $\left[\frac{L}{R}\right] = \frac{[ML^2T^{-2}A^{-2}]}{[ML^2T^{-3}A^{-2}]} = [M^0L^0TA^0]$

(3) $[\sqrt{LC}] = ([ML^2T^{-2}A^{-2}] \times [M^{-1}L^{-2}T^4A^2])^{1/2}$
$= [M^0L^0TA^0]$

(4) $[LI^2] = [ML^2T^{-2}A^{-2}]\,[M^0L^0T^0A^0]^2$
$= [ML^2T^{-2}A^0]$

Hence, option (d) is correct.

2. When the man is at rest with respect to the ground, the rain comes to him at an angle 30° with the vertical. This is the direction of the velocity of raindrops with respect to the ground.



Here, $\vec{v}_{r,g}$ = velocity of the rain with respect to the ground