EAMCET

ENGINEERING ENTRANCE EXAM

SOLVED PAPER–2003

PHYSICS

1. 'A horizontal uniform glass tube of 100 cm, length sealed at both ends contains 10 cm mercury column in the middle. The temperature and pressure of air on either side of mercury column are respectively 31°C and 76 cm of mercury. If the air column at one end is kept at 0°C and the other end at 273°C, the pressure of air which is at 0°C is : (in cm of Hg)
(a) 76 (b) 88.2 (c) 102.4 (d) 122

2. The temperature of 5 moles of a gas at constant volume is changed from 100°C to 120°C. The change in internal energy is 80 J. The total heat capacity of the gas at constant volume will be in J/K is :
(a) 8 (b) 4 (c) 0.8 (d) 0.4

3. The radiation emitted by a star A is 10,000 times that of the sun. If the surface temperatures of the sun and the star A are 6000 K and 2000 K respectively, the ratio of the radii of the star A and the sun is :
(a) 300 : 1 (b) 600 : 1
(c) 900 : 1 (d) 1200 : 1

4. Two uniform strings A and B made of steel are made to vibrate under the same tension. If the first overtone of A is equal to the second overtone of B and if the radius of A is twice that of B, the ratio of the lengths of the strings is :
(a) 1 : 2 (b) 1 : 3 (c) 1 : 4 (d) 1 : 5

5. If the length of a stretched string is shortened by 40% and the tension is increased by 44%, then the ratio of the final and initial fundamental frequencies is :
(a) 2 : 1 (b) 3 : 2 (c) 3 : 4 (d) 1 : 3

6. A ray of light is incident on the hypotenuse of a right-angled prism after travelling parallel to the base inside the prism. If μ is the refractive index of the material of the prism, the maximum value of the base angle for which light is totally reflected from the hypotenuse is :
(a) $\sin^{-1}\left(\frac{1}{\mu}\right)$ (b) $\tan^{-1}\left(\frac{1}{\mu}\right)$
(c) $\sin^{-1}\left(\frac{\mu-1}{\mu}\right)$ (d) $\cos^{-1}\left(\frac{1}{\mu}\right)$

7. A prism of refractive index μ and angle A is placed in the minimum deviation position. If the angle of minimum deviation is A, then the value of A in terms of μ is :
(a) $\sin - 1\left(\frac{\mu}{2}\right)$ (b) $\sin - 1\sqrt{\frac{\mu-1}{2}}$
(c) $2\cos^{-1}\left(\frac{\mu}{2}\right)$ (d) $\cos^{-1}\left(\frac{\mu}{2}\right)$

8. When a body of mass 1.0 kg is suspended from a certain light spring hanging vertically, its length increases by 5 cm. By suspending 2.0 kg block to the spring and if the block is pulled through 10 cm and released, the maximum velocity in it in m/s is : (Acceleration due to gravity = 10 m/s^2)
(a) 0.5 (b) 1 (c) 2 (d) 4

9. An object is attached to the bottom of a light vertical spring and set vibrating. The maximum speed of the object is 15 cm/s and the period is 628 milli-seconds. The amplitude of the motion in cm is :
(a) 3.0 (b) 2.0 (c) 1.5 (d) 1.0

10. Bulk modulus of water is 2×10^9 N/m^2. The pressure required to increase the volume of water by 0.1% in N/m^2 is :
(a) 2×10^9 (b) 2×10^0
(c) 2×10^6 (d) 2×10^4

11. Two spherical soap bubbles of radii r_1 and r_2 in vacuum combine under isothermal conditions. The resulting bubble has a radius equal to :

(a) $\frac{r_1 + r_2}{2}$ (b) $\frac{r_1 r_2}{r_1 + r_2}$

(c) $\sqrt{r_1 r_2}$ (d) $\sqrt{r_1^2 + r_2^2}$

12. The rate of steady volume flow of water through a capillary tube of length l and radius r, under a pressure difference of P is V. This tube is connected with another tube of the same length but half the radius, in series. Then the rate of steady volume flow through them is :
(The pressure difference across the combination is P.)

(a) $\frac{V}{16}$ (b) $\frac{V}{17}$ (c) $\frac{16V}{17}$ (d) $\frac{17V}{16}$

13. A large tank filled with water to a height h is to be emptied through a small hole at the bottom. The ratio of times taken for the level of water to fall from h to $h/2$ and $h/2$ to zero is :

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

14. The densities of a liquid at 0°C and 100°C are respectively 1.0127 and 1. A specific gravity bottle is filled with 300 g of the liquid at 0°C upto the brim and it is heated to 100°C. Then the mass of the liquid expelled in grams is :
(Coefficient of linear expansion of glass $= 9 \times 10^{-6}/°C$)

(a) $\frac{3}{10.1}$ (b) $\frac{3}{1.01}$ (c) $\frac{3.81}{1.0127}$ (d) $\frac{3.81}{0.0127}$

15. In Young's double slit experiment, an interference pattern is obtained on a screen by a light of wavelength 6000 Å coming from the coherent sources S_1 and S_2. At certain point P on the screen third dark fringe is formed. Then the path difference $S_1P - S_2P$ in microns is :

(a) 0.75 (b) 1.5 (c) 3.0 (d) 4.5

16. A vibration magnetometer consists of two identical bar magnets placed one over the other such that they are perpendicular and bisect each other. The time period of oscillation in a horizontal magnetic field $2^{5/4}$ seconds. One of the magnets is removed and if the other magnet oscillates in the same field, then the time period in seconds is :

(a) $2^{1/4}$ (b) $2^{1/2}$ (c) 2 (d) $2^{5/4}$

17. The magnetic susceptibility of the material of a rod is 499. Permeability of vaccum is $4\pi \times 10^{-7}$ H/m. Absolute permeability of the material of the rod in H/m is :

(a) $\pi \times 10^{-4}$ (b) $2\pi \times 10^{-4}$

(c) $3\pi \times 10^{-4}$ (d) $4\pi 10^{-4}$

18. A parallel plate capacitor of capacity C_0 is charged to a potential V_0. (i) The energy stored in the capacitor when the battery is disconnected and the plate separation is doubled is E_1. (ii) The energy stored in the capacitor when the charging battery is kept connected and the separation between the capacitior plates is doubled is E_2. Then E_1/E_2 value is :

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

19. An inifinite number of electric charges each equal to 5 nano-coulomb (magnitude) are placed along x-axis at $x = 1$ cm, $x = 2$ cm, $x = 4$ cm, $x = 8$ cm..... and so on. In this set up if the consecutive charges have opposite sign, then the electric field in newton/coulomb at $x = 0$ is :
$\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ N - m}^2/\text{C}^2\right)$

(a) 12×10^4 (b) 24×10^4

(c) 36×10^4 (d) 48×10^4

20. Two resistances of 400 Ω and 800 Ω are connected in series with 6 volt battery of negligible internal resistance. A voltmeter of resistance 10,000 Ω is used to measure the potential difference across 400 Ω. The error in the measurement of potential difference in volts approximately is :

(a) 0.01 (b) 0.02 (c) 0.03 (d) 0.05

21. Three unequal resistors in parallel are equivalent to a resistance 1 ohm. If two of them are in the ratio 1 : 2 and if no resistance value is fractional, the largest of the three resistances in ohms is :

(a) 4 (b) 6 (c) 8 (d) 12

22. Consider the two following statements *A* and *B*, and identify the correct choice given in the answers : (*A*) Duddell's thermo galvanometer is suitable to measure direct current only. (*B*) Thermopile can measure temperature differences of the order of 10^{-3} °C.
(a) Both *A* and *B* are true
(b) Both *A* and *B* are false
(c) *A* is true but *B* is false
(d) *A* is false but *B* is true

23. A galvanometer, having a resistance of 50 Ω, gives a full scale deflection for a current of 0.05 A. The length in meter of a resistance wire of area of cross-section 2.97×10^{-2} cm^2 that can be used to convert the galvanometer into an ammeter which can read a maximum of 5 A current is : (Specific resistance of the wire $= 5 \times 10^{-7}$ Ω-m)
(a) 9 (b) 6 (c) 3 (d) 1.5

24. A coil has 1,000 turns and 500 cm^2 as its area. The plane of the coil is placed at right angles to a magnetic induction field of 2×10^{-5} Wb/m^2. The coil is rotated through 180° in 0.2 seconds. The average emf induced in the coil, in mV, is :
(a) 5 (b) 10 (c) 15 (d) 20

25. A long straight wire carrying a current of 30 A is placed in an external uniform magnetic field of induction 4×10^{-4} T. The magnetic field is acting parallel to the direction of current. The magnitude of the resultant magnetic induction in tesla at a point 2.0 cm away from the wire is : ($\mu_0 = 4\pi \times 10^{-7}$ H/m)
(a) 10^{-4} (b) 3×10^{-4}
(c) 5×10^{-4} (d) 6×10^{-4}

26. Two ions having masses in the ratio 1 : 1 and charges 1 : 2 are projected into uniform magnetic field perpendicular to the field with speeds in the ratio 2 : 3 . The ratio of the radii of circular paths along which the two particles move is :
(a) 4 : 3 (b) 2 : 3 (c) 3 : 1 (d) 1 : 4

27. Consider the two following statements *A* and *B*, and identify the correct choice given in the answers :
(*A*) In photovoltaic cells the photoelectric current produced is not proportional to the intensity of incident light.
(*B*) In gas filled photoemissive cells, the velocity of photoelectrons depends on the wavelength of the incident radiation.
(a) both *A* and *B* are true
(b) both *A* and *B* are false
(c) *A* is true but *B* is false
(d) *A* is false but *B* is true

28. When radiation of the wavelength λ is incident on a metallic surface, the stopping potential is 4.8 volts. If the same surface is illuminated with radiation of double the wavelength, then the stopping potential becomes 1.6 volts. Then the threshold wavelength for the surface is :
(a) 2 λ (b) 4 λ (c) 6 λ (d) 8 λ

29. The mass defect in a particular nuclear reaction is 0.3 g. The amount of energy liberated in kilowatt hour is : (Velocity of light $= 3 \times 10^8$ m/s)
(a) 1.5×10^6 (b) 2.5×10^6
(c) 3×10^6 (d) 7.5×10^6

30. When *n-p-n* transistor is used as an amplifier :
(a) electrons move from base to collector
(b) holes move from emitter to base
(c) holes move from collector to base
(d) holes move from base to emitter

31. In planetary motion the areal velocity of position vector of a planet depends on angular velocity ω and the distance of the planet from sun *r*. If so the correct relation for areal velocity is :
(a) $\frac{dA}{dt} \propto \omega r$ (b) $\frac{dA}{dt} \propto \omega^2 r$
(c) $\frac{dA}{dt} \propto \omega r^2$ (d) $\frac{dA}{dt} \propto \sqrt{\omega r}$

32. Two particles having position vectors $\vec{r_1} = (3\hat{i} + 5\hat{j})$ metres and $\vec{r_2} = (-5\hat{i} - 3\hat{j})$ metres are moving with velocities $\vec{V_1} = (4\hat{i} + 3\hat{j})$ m/s and $\vec{V_2} = (a\hat{i} + 7\hat{j})$ m/s. If they collide after 2 seconds, the value of *a* is :
(a) 2 (b) 4 (c) 6 (d) 8

33. Two identical blocks A and B, each of mass m resting on smooth floor, are connected by a light spring of natural length L and the spring constant k, with the spring at its natural length. A third identical block C (mass m) moving with a speed (v) along the line joining A and B collides with A. The maximum compression in the spring is proportional to :

(a) $v\sqrt{\frac{m}{2k}}$ (b) $m\sqrt{\frac{v}{2k}}$

(c) $\sqrt{\frac{mv}{k}}$ (d) $\frac{mv}{2k}$

34. The equations of motion of a projectile are given by $x = 36\,t$ metre and $2y = 96t - 9.8t^2$ metre. The angle of projection is :

(a) $\sin^{-1}\left(\frac{4}{5}\right)$ (b) $\sin^{-1}\left(\frac{3}{5}\right)$

(c) $\sin^{-1}\left(\frac{4}{3}\right)$ (d) $\sin^{-1}\left(\frac{3}{4}\right)$

35. Consider the following statements A and b and identify the correct answer given below :

(A) A body initially at rest is acted upon by a constant force. The rate of change of its kinetic energy varies linearly with time.

(B) When a body is at rest, it must be in equilibrium.

(a) A and B are correct
(b) A and B are wrong
(c) A is correct and B is wrong
(d) A is wrong and B is correct

36. Two objects of masses 200 g and 500 g possess velocities $10\hat{i}$ m/s and $3\hat{i} + 5\hat{j}$ m/s respectively. The velocity of their centre of mass in m/s is :

(a) $5\hat{i} - 25\hat{j}$ (b) $\frac{5}{7}\hat{j} - 25\hat{j}$

(c) $5\hat{i} + \frac{25}{7}\hat{j}$ (d) $25\hat{j} - \frac{5}{7}\hat{j}$

37. The horizontal acceleration that should be given to a smooth inclined plane of anlge $\sin^{-1}\left(\frac{1}{l}\right)$ to keep an object stationary on the plane, relative to the inclined plane is :

(a) $\frac{g}{\sqrt{l^2-1}}$ (b) $g\sqrt{l^2-1}$

(c) $\frac{\sqrt{l^2-1}}{g}$ (d) $-\frac{g}{\sqrt{l^2+1}}$

38. The moment of inertia of a meter scale of mass 0.6 kg about an axis perpendicular to the scale and located at the 20 cm position on the scale in kg-m^2 is :
(Breadth of the scale is negligible)
(a) 0.078 (b) 0.104 (c) 0.148 (d) 0.208

39. A circular disc of radius R and thickness $\frac{R}{6}$ has moment of inertia I about an axis passing through its centre and perpendicular to its plane. It is melted and recasted into a solid sphere. The moment of inertia of the sphere about its diameter as axis of rotation is :

(a) I (b) $\frac{2I}{3}$ (c) $\frac{I}{5}$ (d) $\frac{I}{10}$

40. A satellite is launched into a circular orbit of radius R around earth while a second satellite is launched into a orbit of radius $1.02\,R$. The percentage difference in the time periods of the two satellites is :
(a) 0.7 (b) 1.0
(c) 1.5 (d) 3

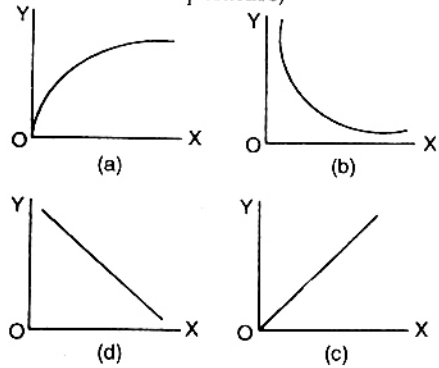
CHEMISTRY

1. Which one of the following is a correct set ?
(a) H_2O, sp^3, angular
(b) H_2O, sp^2, linear
(c) NH_4^+, dsp^2, square planar
(d) CH_4, dsp^2, tetrahedral

2. Which one of the following reactions occur at the anode, in the Castner process of extracting sodium metal ?

(a) $H_2 \longrightarrow 2H^+ + 2e^-$
(b) $2Cl^- \longrightarrow Cl_2 + 2e^-$
(c) $4OH^- \longrightarrow 2H_2O + O_2 + 4e^-$
(d) $Na^+ + e^- \longrightarrow Na$

3. Which one of the following represents the graph between $\log p$ (on Y-axis) and $\frac{1}{T}$ (on X-axis) ?
(p = vapour pressure of a liquid, T = absolute temperature)



4. An organic compound X gives a red precipitate on heating with Fehling's solution . Which one, of the following reactions yields X as a major product ?

(a) $HCHO \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgI}$

(b) $C_2H_5Br + AgOH \xrightarrow{\Delta}$

(c) $2C_2H_5Br + Ag_2O \xrightarrow{\Delta}$

(d) $C_2H_2 + H_2O \xrightarrow[60\ °C]{40\%\ H_2SO_4,\ 1\%\ HgSO_4}$

5. What is the volume (in litres) of oxygen required at STP to completely convert 1.5 mol of sulphur into sulphur dioxide ?
(a) 11.2 (b) 22.4 (c) 33.6 (d) 44.8

6. In the reaction,

$$C_2H_5OC_2H_5 + CO \xrightarrow[150°C,\ 500\ atm\ pressure]{BF_3} X$$

What is X ?
(a) Diethyl carbonate (b) Ethyl carbonate
(c) Diethyl peroxide (d) Ethyl propionate

7. If a gas contains only three molecules that move with velocities of 100, 200, 500 ms^{-1}. What is the rms velocity of that gas in ms^{-1} ?
(a) $100\frac{\sqrt{8}}{3}$ (b) $100\sqrt{30}$ (c) $100\sqrt{10}$ (d) $\frac{800}{3}$

8. Which one of the following gases is liberated when ethyl alcohol is heated with methyl magnesium iodide ?
(a) Methane (b) Ethane
(c) Carbon dioxide (d) Propane

9. Which one of the following electrolytes is used in Down's process of extracting sodium metal ?
(a) NaCl + KCl + KF (b) NaCl
(c) NaOH + KCl + KF (d) NaCl + NaOH

10. Consider the following reactions :

$$X + HCl \xrightarrow[(addition)]{\text{anhydrous } AlCl_3} C_2H_5Cl$$

$$C_2H_5Cl \xrightarrow[(substitution)]{\text{ahydrous } ZnCl_2/HCl} Y.$$

Y can be conserted to X on heating with ..... at ..... temperature :
(a) Al_2O_3, 350°C
(b) Cu, 300°C
(c) $Ca(OH)_2 + CaOCl_2$, 60°C
(d) $NaOH/I_2$, 60°C

11. When 10 g of methane is completely burnt in oxygen, the heat evolved is 560 kJ. What is the heat of combustion (in kJ mol^{-1}) of methane ?
(a) –1120 (b) –968 (c) –896 (d) –560

12. In the reaction sequence,

$$C_2H_5Cl + KCN \xrightarrow{C_2H_5OH} X \xrightarrow[\Delta]{H_3O^{\oplus}} Y$$

What is the molecular formula of Y ?
(a) $C_3H_6O_2$ (b) C_3H_5N
(c) $C_2H_4O_2$ (d) C_2H_6O

13. When acetylene is passed through red hot iron tube, compound X is formed. Which one of the following reactions will yield X as the major product ?

(a) $C_6H_5OH + Zn \xrightarrow{\text{distillation}}$

(b) $C_6H_5SO_3H + NaHCO_3 \longrightarrow$

(c) $C_6H_{12} + 3H_2 \xrightarrow{Ni}$

(d) $C_6H_5Cl + H_2O \xrightarrow{\Delta}$

14. Consider the following reaction equilibrium :
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
Initially, 1 mole of N_2 and 3 moles of H_2 are taken in a 2 L flask. At equilibrium state if, the number of moles of N_2 is 0.6, what is the total number of moles of all gases present in the flask ?
(a) 0.8 (b) 1.6 (c) 3.2 (d) 6.4

15. If the ionic product of water (K_w) is 1.96×10^{-14} at 35°C, what is its value at 10°C ?
(a) 1.96×10^{-14} (b) 3.92×10^{-14}
(c) 2.95×10^{-15} (d) 1.96×10^{-13}

16. 2, 3-dimethyl hexane contains ..... tertiary ..... secondary and ..... primary carbon atoms, respectively :
(a) 2, 2, 4 (b) 2, 4, 3
(c) 4, 3, 2 (d) 3, 2, 4

17. Which of the following reactions proceeds *via* a secondary free radical ?

(a) $CH_3—CH=CH_2 \xrightarrow{HBr} CH_3—\underset{\displaystyle Br}{\underset{|}{CH}}—CH_3$

(b) $CH_3—CH=CH_2 \xrightarrow[UV\ light]{HBr} CH_3—CH_2—CH_2Br$

(c) $C_6H_6 \xrightarrow{Br_2/FeBr_3} C_6H_5Br$

(d) $C_6H_6 \xrightarrow[UV\ light]{Br_2} CH_3—CH_2Br$

18. Compound X is anhydride of sulphuric acid. The number of σ-bonds and the number of π-bonds present in X are, respectively :
(a) 3, 3 (b) 4, 2 (c) 2, 4 (d) 4, 3

19. During the electrolysis of cryolite, aluminium and fluorine are formed in ..... molar ratio :
(a) 1 : 2 (b) 2 : 3 (c) 1 : 1 (d) 1 : 3

20. Water is considered to be polluted if the dissolved oxygen D.O. content is less than ..... ppm :
(a) 5 (b) 10 (c) 15 (d) 100

21. A mixture of sodium oxide and calcium oxide are dissolved in water, and saturated with excess carbon dioxide gas. The resulting solution is .... It contains..... :
(a) basic; NaOH and $Ca(OH)_2$
(b) neutral; Na_2CO_3 and $CaCO_3$
(c) basic; Na_2CO_3 and $CaCO_3$
(d) acidic; NaOH and $CaCO_3$

22. Ferrous ion charges to X ion, on reacting with acidified hydrogen peroxide.
The number of *d*-electrons present in X and its magnetic moment (in BM) are, respectively :
(a) 6 and 6.93 (b) 5 and 5.92
(c) 5 and 4.9 (d) 4 and 5.92

23. The oxidation state of Xe in XeO_3 and the bond angle in it respectively are :
(a) + 6, 109° (b) + 8, 103°
(c) + 6, 103° (d) + 8, 120°

24. Which one of the following is correct about stability of the given ions ?
(a) $Pb^{2+} > Pb^{4+}$ (b) $Pb^{4+} > Pb^{2+}$
(c) $Si^{2+} > Si^{4+}$ (d) $Sn^{4+} > Sn^{2+}$

25. The product obtained at anode when 50% H_2SO_4 aqueous solution is electrolysed using platinum electrodes is :
(a) H_2SO_3 (b) $H_2S_2O_8$ (c) O_2 (d) H_2

26. If the electron of a hydrogen atom is present in the first orbit, the total energy of the electron is :
(a) $\frac{-e^2}{r}$ (b) $\frac{-e^2}{r^2}$ (c) $\frac{-e^2}{2r}$ (d) $\frac{-e^2}{2r^2}$

27. If the wavelength of an electromagnetic radiation is 2000 Å, what is its energy in ergs ?
(a) 9.94×10^{-12} (b) 9.94×10^{-19}
(c) 4.97×10^{-12} (d) 4.97×10^{-19}

28. Which one of the following equations represents Freundlich adsorption isotherm ?
(a) $\frac{x}{m} = KP$ (b) $\frac{x}{m} = KP^n$
(c) $\log \frac{x}{m} = KP^n$ (d) $\log \frac{x}{m} = Kn \log P$

29. Sulphur trioxide is dissolved in heavy water to form a compound X. The hybridisation state of sulphur in X is :
(a) sp^2 (b) sp^3 (c) sp (d) dsp^2

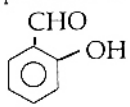
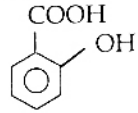
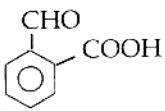
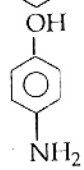
30. What are the products formed when an aqueous solution of magnesium bicarbonate is boiled ?
(a) MgO, H_2O, CO_2
(b) $Mg(HCO_3)_2, H_2O$
(c) $Mg(OH)_2, H_2O$
(d) Mg, CO_2, H_2O

31. Two oxides of nitrogen, NO and NO_2 react together at 253°K and form a compound of nitrogen X. X reacts with water to yield another compound of nitrogen Y. The shape of the anion of Y molecule is ..... :
(a) tetrahedral (b) triangular planar
(c) square planar (d) pyramidal

32. Chlorine atom, in its third excited state, reacts with fluorine to form a compound X. The formula and shape of X are :
(a) ClF_5, pentagonal
(b) ClF_4, tetrahedral
(c) ClF_4, pentagonal bipyramidal
(d) ClF_7, pentagonal bipyramidal

33. If the mass defect of a nuclide is 3.32×10^{-26} g, its binding energy is ..... MeV :
(a) 9.31 (b) 18.62 (c) 27.93 (d) 37.24

34. Which one of the following compounds give aspirin on reacting with acetic anhydride in the presence of conc. H_2SO_4 ?

(a) 
(b) 
(c) 
(d) 

35. When X amperes of current is passed through molten $AlCl_3$ for 96.5 second, 0.09 g of aluminium is deposited. What is the value of X ?
(a) 10 ampere
(b) 20 ampere
(c) 30 ampere
(d) 40 ampere

36. Aniline is not the major product in one of the following reactions. Identify that reaction :

(a) $C_6H_5OH + NH_3 \xrightarrow[300°C]{ZnCl_2}$

(b) $C_6H_5NO_2 + Zn$ powder $\xrightarrow{\text{alcoholic KOH}}$

(c) $C_6H_5Cl + NH_3 \xrightarrow[Cu_2O]{200°C}$ high pressure

(d) $C_6H_5NO_2 + 6(H) + \xrightarrow[HCl]{Fe + H_2O}$

37. Which one of the following equation is correct for the reaction

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$?

(a) $3\frac{d[NH_3]}{dt} = 2\frac{d[H_2]}{dt}$

(b) $2\frac{d[NH_3]}{dt} = 3\frac{d[H_2]}{dt}$

(c) $2\frac{d[NH_3]}{dt} = -3\frac{d[H_2]}{dt}$

(d) $3\frac{d[NH_3]}{dt} = -2\frac{d[H_2]}{dt}$

38. Acid hydrolysis of X yields two different organic compounds. Which one of the following is X ?
(a) CH_3COOH
(b) CH_3CONH_2
(c) $CH_3COOC_2H_5$
(d) $(CH_3CO)_2O$

39. If the bond length and dipole moment of a diatomic molecule are 1.25 A and 1.0 D respectively, what is the per cent ionic character of the bond ?
(a) 10.66 (b) 12.33
(c) 16.66 (d) 19.33

40. Acetaldehyde forms a white crystalline precipitate on mixing with a ..... solution of ..... :
(a) acidic, Zn—Hg
(b) alcoholic, Na_2SO_3
(c) saturated aqueous, $NaHSO_3$
(d) aqueous, NaCl

1. $\sinh^{-1}(2^{3/2})$ is equal to :
(a) $\log(3+\sqrt{8})$ (b) $\log(3-\sqrt{8})$
(c) $\log(2+\sqrt{18})$ (d) $\log(\sqrt{8}+\sqrt{27})$

2. If in a triangle ABC, $r_1 < r_2 < r_3$, then :
(a) $a < b < c$ (b) $a > b > c$
(c) $b < a < c$ (d) $a < c < b$

3. In a ΔABC, if $3a = b + c$, then $\cot\frac{B}{2}\cot\frac{C}{2}$ is equal to :
(a) 1 (b) 2 (c) 3 (d) 4

4. In a triangle, if $b = 20$, $c = 21$ and $\sin A = \frac{3}{5}$, then a is equal to :
(a) 12 (b) 13 (c) 14 (d) 15

5. A tower subtends angles $\alpha, 2\alpha$ and 3α respectively at points A, B and C, all lying on a horizontal line through the foot of the tower, then $\frac{AB}{BC}$ is equal to :
(a) $\frac{\sin 3\alpha}{\sin 2\alpha}$ (b) $1 + 2\cos 2\alpha$
(c) $2\cos 2\alpha$ (d) $\frac{\sin 2\alpha}{\sin\alpha}$

6. If D, E and F are respectively the mid points of AB, AC and BC in ΔABC, then $\vec{BE} + \vec{AF}$ is equal to :
(a) $\vec{DC}$ (b) $\frac{1}{2}\vec{BF}$ (c) $2\vec{BF}$ (d) $\frac{3}{2}\vec{BF}$

7. If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar vectors, then the vector equation $\vec{r} = (1-p-q)\vec{a} + p\vec{b} + q\vec{c}$ represents a :
(a) straight line
(b) plane
(c) plane passing through the origin
(d) sphere

8. If $\vec{a}, \vec{b}, \vec{c}$ are three vectors such that $\vec{a} = \vec{b} + \vec{c}$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{2}$, then :
(a) $a^2 = b^2 + c^2$ (b) $b^2 = c^2 + a^2$
(c) $c^2 = a^2 + b^2$ (d) $2a^2 - b^2 = c^2$

9. Let $\vec{a}, \vec{b}, \vec{c}$ be the position vectors of the vertices A, B, C respectively of ΔABC. The vector area of ΔABC is :
(a) $\frac{1}{2}\{\vec{a}\times(\vec{b}\times\vec{c}) + \vec{b}\times(\vec{c}\times\vec{a}) + \vec{c}\times(\vec{a}\times\vec{b})\}$
(b) $\frac{1}{2}\{\vec{a}\times\vec{b} + \vec{b}\times\vec{c} + \vec{c}\times\vec{a}\}$
(c) $\frac{1}{2}\{\vec{a} + \vec{b} + \vec{c}\}$
(d) $\frac{1}{2}\{(\vec{b}\cdot\vec{c})\vec{a} + (\vec{c}\cdot\vec{a})\vec{b} + (\vec{a}\cdot\vec{b})\vec{c}\}$

10. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + \hat{j}$, $\vec{c} = \hat{i}$ and $(\vec{a}\times\vec{b})\times\vec{c} = \lambda\vec{a} + \mu\vec{b}$, then $\lambda + \mu$ is equal to :
(a) 0 (b) 1 (c) 2 (d) 3

11. If $P(A \cup B) = 0.8$ and $P(A \cap B) = 0.3$, then $P(\bar{A}) + P(\bar{B})$ is equal to :
(a) 0.3 (b) 0.5 (c) 0.8 (d) 0.9

12. A coin is tossed n times the probability of getting head at least once is greater than 0.8. Then the least value of such n is :
(a) 2 (b) 3 (c) 4 (d) 5

13. A bag X contains 2 white and 3 black balls and another bag Y contains 4 white and 2 black balls. One bag is selected at random and a ball is drawn from it. Then the probability for the ball chosen be white, is :
(a) $\frac{2}{15}$ (b) $\frac{7}{15}$ (c) $\frac{8}{15}$ (d) $\frac{14}{15}$

14. For a poisson variate X, if $P(X = 2) = 3P(X = 3)$, then the mean of X is :
(a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) $\frac{1}{4}$

15. A random variate X takes the values 0, 1, 2, 3 and its mean is 1.3. If $P(X = 3) = 2P(X = 1)$ and $P(X = 2) = 0.3$, then $P(X = 0)$ is equal to :
(a) 0.1 (b) 0.2
(c) 0.3 (d) 0.4

16. The co-ordinate axes are rotated through an angle 135°. If the co-ordinates of a point P in the new system are known to be $(4, -3)$, then the co-ordinates of P in the original system are :
(a) $\left(\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$ (b) $\left(\frac{1}{\sqrt{2}}, -\frac{7}{\sqrt{2}}\right)$
(c) $\left(-\frac{1}{\sqrt{2}}, -\frac{7}{\sqrt{2}}\right)$ (d) $\left(-\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$

17. The point P is equidistant from $A(1, 3)$, $B(-3, 5)$ and $C(5, -1)$, then PA is equal to :
(a) 5 (b) $5\sqrt{5}$ (c) 25 (d) $5\sqrt{10}$

18. If the lines $4x + 3y - 1 = 0$, $x - y + 5 = 0$ and $kx + 5y - 3 = 0$ are concurrent, then k is equal to :
(a) 4 (b) 5 (c) 6 (d) 7

19. If the pair of straight lines given by $Ax^2 + 2Hxy + By^2 = 0$ $(H^2 > AB)$ forms an equilateral triangle with line $ax + by + c = 0$, then $(A + 3B)(3A + B)$ is equal to :
(a) H^2 (b) $-H^2$
(c) $2H^2$ (d) $4H^2$

20. The area (in square units) of the quadrilateral formed by two pairs of lines $\lambda^2x^2 - m^2y^2 - n(\lambda x + my) = 0$ and $\lambda^2x^2 - m^2y^2 + n(\lambda x + my) = 0$, is :
(a) $\frac{n^2}{2|\lambda m|}$ (b) $\frac{n^2}{|\lambda m|}$
(c) $\frac{n}{2|\lambda m|}$ (d) $\frac{n^2}{4|\lambda m|}$

21. XOZ plane divides the join of (2, 3, 1) and (6, 7, 1) in the ratio :
(a) 3 : 7 (b) 2 : 7
(c) $-3 : 7$ (d) $-2 : 7$

22. If the direction ratio of two lines are given by $3lm - 4ln + mn = 0$ and $l + 2m + 3n = 0$, then the angle between the lines, is :
(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

23. A plane π makes intercepts 3 and 4 respectively on z-axis and x-axis. If π is parallel to y-axis, then its equation is :
(a) $3x + 4z = 12$ (b) $3z + 4x = 12$
(c) $3y + 4z = 12$ (d) $3z + 4y = 12$

24. The equation of the plane passing through (1, 1, 1) and (1, −1, −1) and perpendicular to $2x - y + z + 5 = 0$, is :
(a) $2x + 5y + z - 8 = 0$
(b) $x + y - z - 1 = 0$
(c) $2x + 5y + z + 4 = 0$
(d) $x - y + z - 1 = 0$

25. If the circle $x^2 + y^2 + 6x - 2y + k = 0$ bisects the circumference of the circle $x^2 + y^2 + 2x - 6y - 15 = 0$, then k is equal to :
(a) 21 (b) −21 (c) 23 (d) −23

26. If P is a point such that the ratio of the square of the lengths of the tangents from P to the circles $x^2 + y^2 + 2x - 4y - 20 = 0$ and $x^2 + y^2 - 4x + 2y - 44 = 0$ is 2 : 3, then the locus of P is a circle with centre :
(a) (7, −8) (b) (−7, 8)
(c) (7, 8) (d) (−7, −8)

27. If $5x - 12y + 10 = 0$ and $12y - 5x + 16 = 0$ are two tangents to a circle, then the radius of the circle is :
(a) 1 (b) 2 (c) 4 (d) 6

28. The eccentricity of the ellipse $9x^2 + 5y^2 - 18x - 20y - 16 = 0$, is :
(a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{3}{2}$ (d) 2

29. The product of the lengths of perpendiculars drawn from any point on the hyperbola $x^2 - 2y^2 - 2 = 0$ to its asymptotes is :
(a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{3}{2}$ (d) 2

30. The equation of the parabola with focus (0, 0) and directrix $x + y = 4$ is :
(a) $x^2 + y^2 - 2xy + 8x + 8y - 16 = 0$
(b) $x^2 + y^2 - 2xy + 8x + 8y = 0$
(c) $x^2 + y^2 + 8x + 8y - 16 = 0$
(d) $x^2 - y^2 + 8x + 8y - 16 = 0$

31. The line passing through $\left(-1, \frac{\pi}{2}\right)$ and perpendicular to $\sqrt{3}\sin\theta + 2\cos\theta = \frac{4}{r}$, is :
(a) $2 = \sqrt{3}r\cos\theta - 2r\sin\theta$
(b) $5 = -2\sqrt{3}r\sin\theta + 4r\cos\theta$
(c) $2 = \sqrt{3}r\cos\theta + 2r\sin\theta$
(d) $5 = 2\sqrt{3}r\sin\theta + 4r\cos\theta$

32. $\lim\limits_{x \to \frac{\pi}{6}} \left[\frac{3\sin x - \sqrt{3}\cos x}{6x - \pi}\right]$:
(a) $\sqrt{3}$ (b) $\frac{1}{\sqrt{3}}$ (c) $-\frac{1}{\sqrt{3}}$ (d) $-\frac{1}{3}$

33. If $a > 0$, $\lim\limits_{x \to a} \frac{a^x - x^a}{x^x - a^a} = -1$, then a is equal to :
(a) 0 (b) 1
(c) e (d) $2e$

34. If

$$f(x)=\begin{cases}\dfrac{\sqrt{1+kx}-\sqrt{1-kx}}{x}, & \text{for } -1\le x<0\\ 2x^2+3x-2, & \text{for } 0\le x\le 1\end{cases}$$

is continuous at $x=0$, then k is equal to :

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

35. If

$$f(x)=\begin{cases}\dfrac{x-1}{2x^2-7x+5}, & \text{for } x\neq 1\\ -\dfrac{1}{3}, & \text{for } x=1\end{cases}$$

then $f'(1)$ is equal to :

(a) $-\frac{1}{9}$ (b) $-\frac{2}{9}$ (c) $-\frac{1}{3}$ (d) $\frac{1}{3}$

36. If $f(x)=\dfrac{x}{1+|x|}$, for $x\in R$, then $f'(0)$ is equal to :

(a) 0 (b) 1 (c) 2 (d) 3

37. The sum of two numbers is 20. If the product of the square of one number and cube of the other is maximum, then the numbers are :

(a) 12, 8 (b) 3, 4 (c) 9, 12 (d) 15, 18

38. A minimum value of $\int_0^x te^{t^2}\,dt$ is :

(a) 0 (b) 1 (c) 2 (d) 3

39. Gas is being pumed into a spherical balloon at the rate of 30 ft^3/min. The rate at which the radius increase when it reaches the value 15 ft, is :

(a) $\frac{1}{30\pi}$ ft/min (b) $\frac{1}{15\pi}$ ft/min

(c) $\frac{1}{20}$ ft/min (d) $\frac{1}{25}$ ft/min

40. The angle between the curves $y=\sin x$ and $y=\cos x$ is :

(a) $\tan^{-1}(2\sqrt{2})$ (b) $\tan^{-1}(3\sqrt{2})$

(c) $\tan^{-1}(3\sqrt{3})$ (d) $\tan^{-1}(5\sqrt{2})$

41. If $u(x,y)=y\log x+x\log y$, then $u_x u_y-u_x\log x-u_y\log y+\log x\log y$ is equal to :

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

42. $\int\dfrac{1+x+\sqrt{x+x^2}}{\sqrt{x}+\sqrt{1+x}}\,dx$ is equal to :

(a) $\frac{1}{2}\sqrt{1+x}+c$ (b) $\frac{2}{3}(1+x)^{3/2}+c$

(c) $\sqrt{1+x}+c$ (d) $2(1+x)^{3/2}+c$

43. $\int(1+x-x^{-1})\,e^{x+x^{-1}}\,dx$:

(a) $(1+x)\,e^{x+x^{-1}}+c$ (b) $(x-1)\,e^{x+x^{-1}}+c$

(c) $-x\,e^{x+x^{-1}}+c$ (d) $x\,e^{x+x^{-1}}+c$

44. $\int_{-2}^{2}|[x]|\,dx$ is equal to :

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

45. $\int_0^1\sin\left(2\tan^{-1}\sqrt{\dfrac{1+x}{1-x}}\right)dx$ is equal to :

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

46. $\int_0^3\dfrac{3x+1}{x^2+9}\,dx$ is equal to :

(a) $\log(2\sqrt{2})+\frac{\pi}{12}$ (b) $\log(2\sqrt{2})+\frac{\pi}{2}$

(c) $\log(2\sqrt{2})+\frac{\pi}{6}$ (d) $\log(2\sqrt{2})+\frac{\pi}{3}$

47. If [2, 6] is divided into four intervals of equal length, then the approximate value of $\int_2^6\dfrac{1}{x^2-x}\,dx$ using Simpson's rule, is :

(a) 0.3222 (b) 0.2333 (c) 0.5222 (d) 0.2555

48. The differential equation of the family of parabola with focus as the origin and the axis as x-axis, is :

(a) $y\left(\dfrac{dy}{dx}\right)^2+4x\dfrac{dy}{dx}=4y$

(b) $-y\left(\dfrac{dy}{dx}\right)^2=2x\dfrac{dy}{dx}-y$

(c) $y\left(\dfrac{dy}{dx}\right)^2+y=2xy\dfrac{dy}{dx}$

(d) $y\left(\dfrac{dy}{dx}\right)^2+2xy\dfrac{dy}{dx}+y=0$

49. Solution of $\dfrac{dy}{dx}=\dfrac{x\log x^2+x}{\sin y+y\cos y}$ is :

(a) $y\sin y=x^2\log x+c$

(b) $y\sin y=x^2+c$

(c) $y\sin y=x^2+\log x$

(d) $y\sin y=x\log x+c$

50. The general solution of $y^2\,dx + (x^2 - xy + y^2)\,dy = 0$ is :

(a) $\tan^{-1}\left(\frac{y}{x}\right) = \log y + c$

(b) $2\tan^{-1}\left(\frac{x}{y}\right) + \log x + c = 0$

(c) $\log\left(y + \sqrt{x^2 + y^2}\right) + \log y + c = 0$

(d) $\sinh^{-1}\left(\frac{x}{y}\right) + \log y + c = 0$

51. If $f : R \to R$ and $g : R \to R$ are defined by $f(x) = 2x + 3$ and $g(x) = x^2 + 7$, then the values of x such that $g(fx)) = 8$ are :

(a) 1, 2 (b) $-1, 2$ (c) $-1, -2$ (d) $1, -2$

52. Suppose $f : [-2, 2] \to R$ is defined by

$$f(x) = \begin{cases} -1, & \text{for } -2 \le x \le 0 \\ x - 1, & \text{for } 0 \le x \le 2 \end{cases}$$

then $\{x \in [-2, 2] : x \le 0 \text{ and } f(|x|) = x\}$ is equal to :

(a) $\{-1\}$ (b) $\{0\}$ (c) $\left\{-\frac{1}{2}\right\}$ (d) ϕ

53. If $f : R \to R$ and $g : R \to R$ are given by $f(x) = |x|$ and $g(x) = [x]$ for each $x \in R$, then $\{x \in R : g(f(x)) \le f(g(x))\}$ is equal to :

(a) $Z \cup (-\infty, 0)$ (b) $(-\infty, 0)$

(c) Z (d) R

54. If $t_n = \frac{1}{4}(n + 2)(n + 3)$ for $n = 1, 2, 3 \ldots$, then $\frac{1}{t_1} + \frac{1}{t_2} + \ldots + \frac{1}{t_{2003}}$ is equal to :

(a) $\frac{4006}{3006}$ (b) $\frac{4003}{3007}$

(c) $\frac{4006}{3008}$ (d) $\frac{4006}{3009}$

55. If $f(x) = \frac{1}{\sqrt{x + 2\sqrt{2x - 4}}} + \frac{1}{\sqrt{x - 2\sqrt{2x - 4}}}$, for $x > 2$, then $f(11)$ is equal to :

(a) $\frac{7}{6}$ (b) $\frac{5}{6}$ (c) $\frac{6}{7}$ (d) $\frac{5}{7}$

56. If $e^{f(x)} = \frac{10 + x}{10 - x}$, $x \in (-10, 10)$ and $f(x) = kf\left(\frac{200x}{100 + x^2}\right)$, then k is equal to :

(a) 0.5 (b) 0.6 (c) 0.7 (d) 0.8

57. Let l_1 and l_2 be two lines intersecting at P. If A_1, B_1, C_1 are points on l_1, and A_2, B_2, C_2, D_2, E_2 are points on l_2 and if none of these coincides with P, then the number of triangles formed by these eight points, is :

(a) 56 (b) 55

(c) 46 (d) 45

58. Consider the fourteen lines in the plane given by $y = x + r$, $y = -x + r$, where $r \in \{0, 1, 2, 3, 4, 5, 6\}$. The number of squares formed by these lines, whose sides are of length $\sqrt{2}$, is :

(a) 9 (b) 16 (c) 25 (d) 36

59. If the coefficient of $(2r + 1)$th term and $(r + 2)$th term in the expansion of $(1 + x)^{43}$ are equal, then r is equal to :

(a) 12 (b) 14 (c) 16 (d) 18

60. The coefficient of x^5 in the expansion of $(1 + x^2)^5 (1 + x)^4$, is :

(a) 60 (b) 50 (c) 40 (d) 56

61. Let a, b and c be such that

$$\frac{1}{(1 - x)(1 - 2x)(1 - 3x)} = \frac{a}{1 - x} + \frac{b}{1 - 2x} + \frac{c}{1 - 3x},$$

then $\frac{a}{1} + \frac{b}{3} + \frac{c}{5}$ is equal to :

(a) $\frac{1}{15}$ (b) $\frac{1}{6}$ (c) $\frac{1}{5}$ (d) $\frac{1}{3}$

62. If $0 < y < 2^{1/3}$ and $x(y^3 - 1) = 1$, then $\frac{2}{x} + \frac{2}{3x^3} + \frac{2}{5x^5} + \ldots$ is equal to :

(a) $\log\left(\frac{y^3}{2 - y^3}\right)$ (b) $\log\left(\frac{y^3}{1 - y^3}\right)$

(c) $\log\left(\frac{2y^3}{1 - y^3}\right)$ (d) $\log\left(\frac{y^3}{1 - 2y^3}\right)$

63. $\frac{1}{2!} + \frac{1 + 2}{3!} + \frac{1 + 2 + 3}{4!} + \ldots$ is equal to :

(a) $\frac{e}{2}$ (b) $\frac{e}{3}$ (c) $\frac{e}{4}$ (d) $\frac{e}{5}$

64. The solution set contained in R of the inequation $3^x + 3^{1-x} - 4 < 0$, is :

(a) (1, 3) (b) (0, 1)

(c) (1, 2) (d) (0, 2)

65. The minimum value of $2x^2 + x - 1$ is :

(a) $-\frac{1}{4}$ (b) $\frac{3}{2}$ (c) $-\frac{9}{8}$ (d) $\frac{9}{8}$

66. If α, β, γ are the roots of the equation $x^3 + 4x + 1 = 0$, then
$(\alpha+\beta)^{-1} + (\beta+\gamma)^{-1} + (\gamma+\alpha)^{-1}$ is equal to :
(a) 2 (b) 3 (c) 4 (d) 5

67. Let $a \neq 0$ and $p(x)$ be a polynomial of degree greater than 2. If $p(x)$ leaves remainders a and $-a$ when divided respectively by $x+a$ and $x-a$, then the remainder when $p(x)$ is divided by $x^2 - a^2$ is :
(a) x (b) $-x$ (c) $-2x$ (d) $2x$

68. If the sum of two of the roots of $x^3 + px^2 - qx + r = 0$ is zero, then pq is equal to :
(a) $-r$ (b) r (c) $2r$ (d) $-2r$

69. If $a \neq p$, $b \neq q$, $c \neq r$ and
$$\begin{vmatrix} p & b & c \\ p+a & q+b & 2c \\ a & b & r \end{vmatrix} = 0,$$ then
$$\frac{p}{p-a} + \frac{q}{q-b} + \frac{r}{r-c}$$ is equal to :
(a) 0 (b) 1 (c) 2 (d) 3

70. The number of solutions of the system of equations $2x + y - z = 7$, $x - 3y + 2z = 1$, $x + 4y - 3z = 5$ is :
(a) 0 (b) 1 (c) 2 (d) 3

71. If
$$\begin{vmatrix} \cos(A+B) & -\sin(A+B) & \cos 2B \\ \sin A & \cos A & \sin B \\ -\cos A & \sin A & \cos B \end{vmatrix} = 0,$$
then B is equal to :
(a) $(2n+1)\frac{\pi}{2}$ (b) $(2n+1)\pi$
(c) $n\pi$ (d) $2n\pi$

72. If the amplitude of $z - 2 - 3i$ is $\frac{\pi}{4}$, then the locus of $z = x + iy$, is :
(a) $x + y - 1 = 0$ (b) $x - y - 1 = 0$
(c) $x + y + 1 = 0$ (d) $x - y + 1 = 0$

73. If ω is a complex cube root of unity , then $225 + (3\omega + 8\omega^2)^2 + (3\omega^2 + 8\omega)^2$ is equal to :
(a) 72 (b) 192 (c) 200 (d) 248

74. If $\sin 6\theta = 32\cos^5\theta \sin\theta - 32\cos^3\theta \sin\theta + 3x$, then x is equal to :
(a) $\cos\theta$ (b) $\cos 2\theta$ (c) $\sin\theta$ (d) $\sin 2\theta$

75. The period of the function $f(\theta) = \sin\frac{\theta}{3} + \cos\frac{\theta}{2}$ is :
(a) 3π (b) 6π (c) 9π (d) 12π

76. $\cos\alpha \sin(\beta-\gamma) + \cos\beta \sin(\gamma-\alpha) + \cos\gamma \sin(\alpha-\beta)$ is equal to :
(a) 0 (b) $\frac{1}{2}$
(c) 1 (d) $4\cos\alpha\cos\beta\cos\gamma$

77. The value of
$$\cos\frac{2\pi}{15}\cos\frac{4\pi}{15}\cos\frac{8\pi}{15}\cos\frac{14\pi}{15}$$ is :
(a) $\frac{1}{16}$ (b) $\frac{1}{8}$ (c) $\frac{1}{12}$ (d) $\frac{1}{4}$

78. If $A + B + C = 270°$, then
$\cos 2A + \cos 2B + \cos 2C$ is equal to :
(a) $4\sin A \sin B \sin C$
(b) $4\cos A \cos B \cos C$
(c) $1 - 4\sin A \sin B \sin C$
(d) $1 - 4\cos A \cos B \cos C$

79. The solution set of $(5 + 4\cos\theta)(2\cos\theta + 1) = 0$ in the interval $[0, 2\pi]$, is :
(a) $\left\{\frac{\pi}{3}, \frac{2\pi}{3}\right\}$ (b) $\left\{\frac{\pi}{3}, \pi\right\}$
(c) $\left\{\frac{2\pi}{3}, \frac{4\pi}{3}\right\}$ (d) $\left\{\frac{2\pi}{3}, \frac{5\pi}{3}\right\}$

80. $\cos\left[\cos^{-1}\left(-\frac{1}{7}\right) + \sin^{-1}\left(-\frac{1}{7}\right)\right]$ is equal to :
(a) $-\frac{1}{3}$ (b) 0 (c) $\frac{1}{3}$ (d) $\frac{4}{9}$

Answers

Physics

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

Chemistry

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

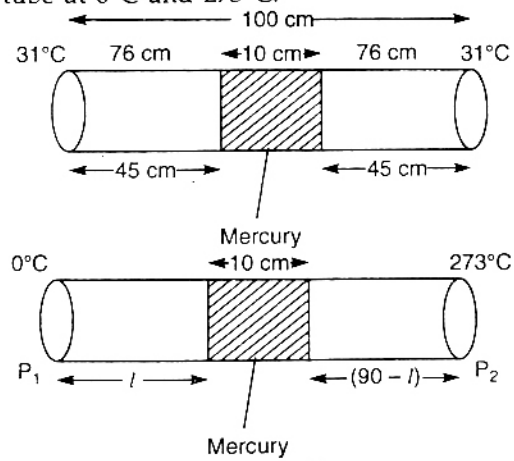
Mathematics

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

Hints & Solutions

PHYSICS

1. On keeping the temperature of the ends of tube at 0°C and 273°C.



Applying ideal gas equation

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} = \frac{P_3 V_3}{T_3}$$

$$\frac{76 \times 45}{(273+31)} = \frac{P_2 \times l}{(273+0)} = \frac{P_3 (90-l)}{273+273}$$

$$\frac{76 \times 45}{304} = \frac{P_2 \times l}{273} = \frac{P_3 (90-l)}{546}$$

I II III

From II and III

$$\frac{P_2 \times l}{273} = \frac{P_3 (90-l)}{546}$$

(Mercury column is at rest, so pressu difference $P_2 - P_3 = 0 \Rightarrow P_2 = P_3$)

$$\therefore \quad \frac{P_2 \times l}{273} = \frac{P_2 (90-l)}{546}$$

$$2l = 90 - l \Rightarrow l = 30 \text{ cm}$$

From I and II

$$\frac{76 \times 45}{304} = \frac{P_2 \times 30}{273}$$

$$\Rightarrow \quad P_2 = \frac{76 \times 45 \times 273}{30 \times 304}$$

$$P_2 = 102.4$$

2. $n = 5$ moles, $T_1 = 100°C$

$T_2 = 120°C$, $\Delta U = 80$ J

Rise in temperature $\Delta t = 120 - 100$ 20°C

$$\Delta U = m\, s\, \Delta t$$

$$\frac{80}{5} = 1 \times s \times 20$$

$$s = 0.8 \text{ J}$$

$\therefore$ For 5 moles, $s = 0.8 \times 5$ J/K

$= 4$ J/K