# EAMCET

## ENGINEERING ENTRANCE EXAM

## SOLVED PAPER–2004

### *PHYSICS*

1. The position of a particle at time $t$ is given by the equation $x(t) = \frac{v_0}{A}(1 - e^{At})$

$v_0$ = constant and $A > 0$

Dimensions of $v_0$ and $A$ respectively are :

(a) $[M^0LT^0]$ and $[M^0L^0T^{-1}]$

(b) $[M^0LT^{-1}]$ and $[M^0LT^{-2}]$

(c) $[M^0LT^{-1}]$ and $[M^0L^0T]$

(d) $[M^0LT^{-1}]$ and $[M^0L^0T^{-1}]$

2. At a given instant of time two particles are having the position vectors $4\hat{i} + 4\hat{j} + 57\hat{k}$ metres and $2\hat{i} + 2\hat{j} + 5\hat{k}$ respectively. If the velocity of the first particle be $0.4\,\hat{i}\ ms^{-1}$, the velocity of second particle in metre per second if they collide after 10 sec is :

(a) $6\left(\hat{i} - \hat{j} + \frac{1}{3}\hat{k}\right)$

(b) $0.6\left(\hat{i} - \hat{j} + \frac{1}{3}\hat{k}\right)$

(c) $6\left(\hat{i} + \hat{j} + \frac{1}{3}\hat{k}\right)$

(d) $0.6\left(\hat{i} + \hat{j} - \frac{1}{3}\hat{k}\right)$

3. The horizontal and vertical displacements $x$ and $y$ of a projectile at a given time $t$ are given by $x = 6t$ metre and $y = 8t - 5t^2$ metre. The range of the projectile in metre is :

(a) 9.6 (b) 10.6

(c) 19.2 (d) 38.4

4. A 2 kg ball moving at 24 $ms^{-1}$ undergoes inelastic head-on collision with a 4 kg ball moving in the opposite direction at 48 $ms^{-1}$. If the coefficient of restitution is 2/3, their velocities in $ms^{-1}$ after impact are :

(a) $-56, -8$ (b) $-28, -4$

(c) $-14, -2$ (d) $-7, -1$

5. A block of mass 2 kg is initially at rest on a horizontal frictionless surface. A horizontal force $\vec{F} = (9 - x^2)\,\hat{i}$ newtons acts on it, when the block is at $x = 0$. The maximum kinetic energy of the block between $x = 0$ and $x = 3$m in joule is :

(a) 24 (b) 20

(c) 18 (d) 15

6. Two particles of equal mass have velocities $\vec{v_1} = 4\,\hat{i}$ and $\vec{v_2} = 4\,\hat{j}\ ms^{-1}$. First particle has an acceleration $\vec{a_1} = (5\hat{i} + 5\hat{j})\ ms^{-2}$ while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of :

(a) straight line

(b) parabola

(c) circle

(d) ellipse

7. Consider the following statements $A$ and $B$ and identify the correct answer :

A : When a person walks on a rough surface the direction of frictional force exerted by the surface on the person is opposite to the direction of his motion.

B : When a cycle is in motion, the force of friction exerted by the ground on the front wheel is in the backward direction :

(a) A and B are correct

(b) A is correct, B is wrong

(c) A and B are wrong

(d) A is wrong, B is correct

8. A thin uniform square lamina of side $a$ is placed in the $xy$-plane with its sides parallel to $x$ and $y$-axes and with its centre coinciding with origin. Its moment of inertia about an axis passing through a point on the $y$-axis at a distance $y = 2a$ and parallel to $x$-axis is equal to its moment of inertia about an axis passing through a point on the $x$-axis at a distance $x = d$ and perpendicular to $xy$-plane. Then value of $d$ is :

(a) $\frac{7}{3}a$ (b) $\sqrt{\frac{47}{12}}a$ (c) $\frac{9}{5}a$ (d) $\sqrt{\frac{51}{12}}a$

9. A particle of mass 1 kg is projected with an initial velocity 10 $ms^{-1}$ at an angle of projection 45° with the horizontal. The average torque acting on the projectile, between the time at which it is projected and the time at which it strikes the ground, about the point of projection in newton-metre is :

(a) 25 (b) 50 (c) 75 (d) 100

10. The escape velocity of a body on the earth's surface is $v_e$. A body is thrown up with a speed $\sqrt{5}\,v_e$. Assuming that the sun and planets do not influence the motion of the body, velocity of the body at infinite distance, is :

(a) 0 (b) $v_e$ (c) $\sqrt{2}\,v_e$ (d) $2\,v_e$

11. The time period of a simple pendulum is $T$. When the length is increased by 10 cm, its period is $T_1$. When the length is decreased by 10 cm, its period is $T_2$. Then, relation between $T$, $T_1$ and $T_2$ is :

(a) $\frac{2}{T^2} = \frac{1}{T_1^2} + \frac{1}{T_2^2}$ (b) $\frac{2}{T^2} = \frac{1}{T_1^2} - \frac{1}{T_2^2}$

(c) $2T^2 = T_1^2 + T_2^2$ (d) $2T^2 = T_1^2 - T_2^2$

12. A metallic ring of radius $r$ and cross sectional area $A$ is fitted into a wooden circular disc of radius $R$ ($R > r$). If the Young's modulus of the material of the ring is $Y$, the force with which the metal ring expands is :

(a) $\frac{AYR}{r}$ (b) $\frac{AY(R-r)}{r}$

(c) $\frac{Y(R-r)}{Ar}$ (d) $\frac{YR}{AR}$

13. One end of a uniform glass capillary tube of radius $r = 0.025$ cm is immersed vertically in water to a depth $h = 1$ cm. The excess pressure in $N/m^2$ required to blow an air bubble out of the tube :

(Surface tension of water $= 7 \times 10^{-2}$ N/m
Density of water $= 10^3$ $kg/m^3$
Acceleration due to gravity = 10 $m/s^2$)

(a) $0.0048 \times 10^5$ (b) $0.0066 \times 10^5$

(c) $1.0048 \times 10^5$ (d) $1.0066 \times 10^5$

14. Water in a river 20 m deep is flowing at a speed of 10 $ms^{-1}$. The shearing stress between the horizontal layers of water in the river in $Nm^{-2}$ is : (Coefficient of viscosity of water $= 10^{-3}$ SI units)

(a) $1 \times 10^{-2}$ (b) $0.5 \times 10^{-2}$

(c) $1 \times 10^{-3}$ (d) $0.5 \times 10^{-3}$

15. There are two holes one each along the opposite sides of a wide rectangular tank. The cross-section of each hole is $0.01m^2$ and the vertical distance between the holes is one metre. The tank is filled with water. The net force on the tank in newton when the water flows out of the holes is :

(Density of water $= 1000$ $kg/m^3$)

(a) 100 (b) 200 (c) 300 (d) 400

16. A metallic solid sphere is rotating about its diameter as axis of rotation. If the temperature is increased by 200°C, the percentage increase in its moment of inertia is : (Coefficient of linear expansion of the metal $= 10^{-5/°C}$)

(a) 0.1% (b) 0.2% (c) 0.3% (d) 0.4%

17. Two identical vessels $A$ and $B$ with frictionless pistons contain the same ideal gas at the same temperature and the same volume $V$. The masses of gas in $A$ and $B$ and $m_A$ and $m_B$ respectively. The gases are allowed to expand isothermally to the same final volume $2V$. The change in pressures of the gas in $A$ and $B$ are found to be $\Delta P$ and $1.5\,\Delta P$ respectively. Then :

(a) $9m_A = 4m_B$ (b) $3m_A = 2m_B$

(c) $2m_A = 3m_B$ (d) $4m_A = 9m_B$

18. The pressure and density of a given mass of a diatomic gas $\left(\gamma=\frac{7}{5}\right)$ change adiabatically from $(P, d)$ to $(P', d')$. If $\frac{d'}{d}=32$, then $\frac{P'}{P}$ is : ( $\gamma=$ ratio of specific heats)
(a) 1/128 (b) 1/64
(c) 64 (d) 128

19. If 4 moles of an ideal monoatomic gas at temperature 400 K is mixed with 2 moles of another ideal monoatomic gas at temperature 700 K, the temperature of the mixture is :
(a) 550°C (b) 500°C
(c) 550 K (d) 500 K

20. A black body of mass 34.38 g and surface area 19.2 $cm^2$ is at an initial temperature of 400 K. It is allowed to cool inside an evacuated enclosure kept at constant temperature 300 K. The rate of cooling is 0.04°C per second. The specific heat of the body in $J\,kg^{-1}K^{-1}$ is :
(Stefan's constant $\sigma=5.73\times10^{-8}\,Wm^{-2}K^{-4}$)
(a) 2800 (b) 2100
(c) 1400 (d) 1200

21. The wavelengths of two notes in air are $\frac{36}{195}$ m and $\frac{36}{193}$ m. Each note produces 10 beats per second separately with a third note of fixed frequency. The velocity of sound in air in m/s is :
(a) 330 (b) 340
(c) 350 (d) 360

22. An iron load of 2 kg is suspended in air from the free end of a sonometer wire of length 1 m. A tuning fork of frequency 256 Hz, is in resonance with $\frac{1}{\sqrt{7}}$ times the length of the sonometer wire. If the load is immensed in water, the length of the wire in metre that will be in resonance with the same tuning fork is : (Specific gravity of iron = 8)
(a) $\sqrt{8}$ (b) $\sqrt{6}$ (c) $\frac{1}{\sqrt{6}}$ (d) $\frac{1}{\sqrt{8}}$

23. **Assertion (A)** : Optical fibres are widely used in communication network.
**Reason (R)** : Optical fibres are small in size, light weight, flexible and there is no scope for interference in 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

24. The refracting angle of a prism is $A$ and the refractive index of the material of the prism is cot $(A/2)$. The angle of minimum deviation of the prism is :
(a) $\pi+2A$ (b) $\pi-2A$
(c) $\frac{\pi}{2}+A$ (d) $\frac{\pi}{2}-A$

25. The principal section of a glass prism is an isosceles triangle $ABC$ with $AB=AC$. The face $AC$ is silvered. A ray of light is incident normally on the face $AB$ and after two reflections, it emerges from the base $BC$ perpendicular to the base. Angle $BAC$ of the prism is :
(a) 30° (b) 36° (c) 60° (d) 72°

26. Consider the following statements $A$ and $B$ and identify the correct answer :
A : Fresnel's diffraction pattern occurs when the source of light or the screen on which the diffraction pattern is seen or when both are at finite distance from the aperture.
B : Diffracted light can be used to estimate the helical structure of nucleic acids.
(a) A and B are true
(b) A and B are false
(c) A is true but B is false
(d) A is false but B is true

27. The magnetic induction and the intensity of magnetic field inside an iron core of an electromagnet are 1 Wb $m^{-2}$ and 150 $Am^{-1}$ respectively. The relative permeability of iron is :
( $\mu_0=4\pi\times10^{-7}$ henry/m)
(a) $\frac{10^6}{4\pi}$ (b) $\frac{10^6}{6\pi}$ (c) $\frac{10^5}{4\pi}$ (d) $\frac{10^3}{6\pi}$

28. The magnetic needle of a vibration magnetometer makes 12 oscillations per minute in the horizontal component of earth's magnetic field. When an external short bar magnet is placed at some distance along the axis of the needle in the same line, it makes 15 oscillations per minute. If the poles of the bar magnet are interchanged, the number of oscillations it makes per minute is :
(a) $\sqrt{61}$ (b) $\sqrt{63}$
(c) $\sqrt{65}$ (d) $\sqrt{67}$

29. The plates of a parallel plate capacitor are charged upto 200 volts. A dielectirc slab of thickness 4 mm is inserted between its plates. Then, to maintain the same potential difference between the plates of the capacitor, the distance between the plates is increased by 3.2 mm. The dielectric constant of the dielectric slab is :
(a) 1 (b) 4
(c) 5 (d) 6

30. Three point charges 1C, – 2C and – 2C are placed at the vertices of an equilateral triangle of side 1 metre. The work done by an external force to increase the separation of the charges to 2 metre in joule is :
( $\varepsilon_0$ = permittivity of air)
(a) $\frac{1}{4\pi\varepsilon_0}$ (b) $\frac{1}{8\pi\varepsilon_0}$ (c) $\frac{1}{16\pi\varepsilon_0}$ (d) zero

31. $n$ conducting wires of same dimensions but having resistivities 1, 2, 3, ... $n$ are connected in series. The equivalent resistivity of the combination is :
(a) $1\frac{n(n+1)}{2}$ (b) $\frac{n+1}{2}$
(c) $\frac{n+2}{2n}$ (d) $\frac{2n}{n+1}$

32. **Assertion (A)** : Rapidly changing temperatures can be measured by thermocouples.
**Reason (R)** : The thermal capacity of the junction of a thermocouple is very small.
(a) Both (A) and (R) are true and (R) is not 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

33. Magnetic induction at the centre of a circular loop of area $\pi\,m^2$ is 0.1 tesla. The magnetic moment of the loop is :
( $\mu_0$ = permeability of air)
(a) $\frac{0.1\,\pi}{\mu_0}$ (b) $\frac{0.2\,\pi}{\mu_0}$
(c) $\frac{0.3\,\pi}{\mu_0}$ (d) $\frac{0.4\,\pi}{\mu_0}$

34. A wire of length $l$ is bent into a circular coil of one turn of radius $R_1$. Another wire of the same material and same area of cross-section and same lengths is bent into a circular coil of two turns of radius $R_2$. When the same current flows, through the two coils, the ratio of magnetic induction at the centres of the two coils is :
(a) 1 : 2 (b) 1 : 1 (c) 1 : 4 (d) 3 : 1

35. $\Delta\lambda$ is the difference between the wavelength of $k_\alpha$ line and the minimum wavelength of the continuous X-ray spectrum when the X-ray tube is operated at a voltage $V$. If the operating voltage is changed to $V/3$, then the above difference is $\Delta\lambda'$. Then :
(a) $\Delta\lambda' = 5\Delta\lambda$ (b) $\Delta\lambda' = 4\Delta\lambda$
(c) $\Delta\lambda' = 3\Delta\lambda$ (d) $\Delta\lambda' < 3\Delta\lambda$

36. Electrons ejected from the surface of a metal, when light of certain frequency is incident on it, are stopped fully by a retarding potential of 3 volts. Photoelectric effect in this metallic surface begins at a frequency $6 \times 10^{14}\ s^{-1}$. The frequency of the incident light in $s^{-1}$ is : [Planck's constant $= 6.4 \times 10^{-34}$ Js, charge on the electron $= 1.6 \times 10^{-19}$ C]
(a) $7.5 \times 10^{13}$ (b) $13.5 \times 10^{13}$
(c) $13.5 \times 10^{14}$ (d) $7.5 \times 10^{15}$

37. Consider the following two statements $A$ and $B$ and identify the correct answer given below :
A : Nuclear density is same for all nuclei
B : Radius of the nucleus R and its mass number A are related as $\sqrt{A} \propto R^{1/6}$.
(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

38. In *n-p-n* transistor, in *CE* configuration :
(1) The emitter is heavily doped than the collector.
(2) Emitter and collector can be interchanged.
(3) The base region is very thin but is heavily doped.
(4) The conventional current flows from base to emitter.
(a) (1) and (2) are correct
(b) (1) and (3) are correct
(c) (1) and (4) are correct
(d) (2) and (3) are correct

39. Two cells *A* and *B* are connected in the secondary circuit of a potentiometer one at a time and the balancing length are respectively 400 cm and 440 cm. The emf of the cell *A* is 1.08 volt. The emf of the second cell *B* in volts is :
(a) 1.08 (b) 1.188 (c) 11.88 (d) 12.8

40. Match the pairs in two lists given below :

| List-I | List-II |
|---|---|
| (1) Spectra produced by light from incandescent solid | (d) Photon (e) Continuous spectra |
| (2) Elementary particles with zero mass and with a spin of unity | (f) Photo emissive cell |
| (3) Photocell in which current changes with change in intensity of light after time gap. | (g) Photoconducing cell (h) Neutrino (i) Band spectra |

(a) a-e, b-h, c-g
(b) a-i, b-h, c-f
(c) a-e, b-h, c-f
(d) a-i, b-d, c-g

## *CHEMISTRY*

1. $_6C^{12}$ and $_1T^3$ are formed in nature due to the nuclear reaction of neutron with :
(a) $_7N^{14}$ (b) $_6C^{13}$ (c) $_2He^4$ (d) $_3Li^6$

2. Exhausted permutit does not contain ..... ion :
(a) $Na^+$ (b) $Mg^{2+}$ (c) $Al^{3+}$ (d) $Si^{4+}$

3. Which one of the following is a secondary alcohol ?
(a) 2-methyl-1- propanol
(b) 2-methyl-2-propanol
(c) 2-butanol
(d) 1-butanol

4. In which of the following reactions, the concentration of product is higher than the concentration of reactant at equilibrium ? ($K$ = equilibrium constant)
(a) $A \rightleftharpoons B$; $K = 0.001$
(b) $M \rightleftharpoons N$; $K = 10$
(c) $X \rightleftharpoons Y$; $K = 0.005$
(d) $R \rightleftharpoons P$; $K = 0.01$

5. The electrochemical equivalent of a metal is '$x$' g. coulomb$^{-1}$. The equivalent weight of metal is :
(a) $x$ (b) $x \times 96500$
(c) $\frac{x}{96500}$ (d) $1.6 \times 10^{-19} \times x$

6. The correct structure of 4-bromo-3-methyl-but-1- ene :
(a) $Br—CH = C(CH_3)_2$
(b) $CH_2 = CH - CH(CH_3) - CH_2Br$
(c) $CH_2 = C(CH_3)CH_2CH_2Br$
(d) $CH_3 - C(CH_3) = CHCH_2 - Br$

7. In the hardening stage of plaster of paris, the compound formed is :
(a) $CaSO_4$
(b) orthorhombic $CaSO_4 . 2H_2O$
(c) $CaSO_4 . H_2O$
(d) monoclinic $CaSO_4 . 2H_2O$

8. The IUPAC name of an unsymmetrical ether with the molecular formula $C_4H_{10}O$ :
(a) ethoxy propane
(b) methoxy ethane
(c) ethoxy ethane
(d) methoxy propane

9. Which of the following pairs of ions are colourless ?
(a) $Ti^{3+}$, $Cu^{2+}$
(b) $Sc^{3+}$, $Zn^{2+}$
(c) $Co^{2+}$, $Fe^{3+}$
(d) $Ni^{2+}$, $V^{3+}$

10. Which of the following is a lyophobic colloidal solution ?
(a) Aqueous starch solution
(b) Aqueous protein solution
(c) Gold sol
(d) Polymer solutions in some organic solvents

11. The following reactions is an example of ..... reaction.

$$C_2H_4Br_2 \xrightarrow{\text{alc. KOH}} C_2H_2$$

(a) addition (b) dehydrobromination
(c) substitution (d) debromination

12. The molecular formula of potash alum is :
(a) $KAl_2S_4H_{48}O_{40}$ (b) $K_2Al_2S_4H_{48}O_{39}$
(c) $K_2Al_2S_4H_{48}O_{40}$
(d) $KAl_2S_4H_{48}O_{40}$

13. Which of the following is not correct regarding the properties of ionic compounds ?
(a) Ionic compounds have high melting and boiling points
(b) Their reaction velocity in aqueous medium is very high
(c) Ionic compounds in their molten and aqueous solutions do not conduct electricity
(d) They are highly soluble in polar solvents

14. $x$ grams of water is mixed in 69 g of ethanol. Mole fraction of ethanol in the resultant solution is 0.6. What is the value of $x$ in grams ?
(a) 54 (b) 36 (c) 180 (d) 18

15. Match the following lists

| List-I | List-II |
|---|---|
| A. Ethane | 1. 2 $sp$ carbons |
| B. Ethylene | 2. 6 $sp^2$ carbons |
| C. Acetylene | 3. 2 $sp^3$ carbons |
| D. Benzene | 4. 2 $sp^2$ carbons |
| | 5. 1 $sp$ and 1 $sp^2$ carbons |

The correct answer is

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 3 | 4 | 1 | 2 |
| (c) | 3 | 1 | 2 | 5 |

| | A | B | C | D |
|---|---|---|---|---|
| (b) | 4 | 5 | 3 | 2 |
| (d) | 2 | 3 | 4 | 5 |

16. The number of oxygen atoms bonded to one phosphorus atom in $P_4O_6$ is :
(a) 4 (b) 3 (c) 6 (d) 5

17. Which of the following has S—S bond ?
(a) $H_2S_2O_6$ (b) $H_2S_2O_7$
(c) $H_2S_2O_8$ (d) Mustard gas

18. In the Dewar's method of separation of noble gases, the mixture of noble gases is kept in contact with coconut charcoal at 173K. Which one of the following gaseous mixtures is not adsorbed on to the charcoal ?
(a) Ar, Kr (b) Xe, Ar
(c) He, Ne (d) Xe, Kr

19. Identify 'acetaldoxime'
(a) $CH_3CH{=}N{-}NH_2$
(b) $CH_3CH{=}N{-}OH$
(c) $(CH_3)_2C{=}N{-}OH$
(d) $CH_2{=}N{-}OH$

20. An organic compound containing C and H has 92.3% of carbon, Its empirical formula is :
(a) CH (b) $CH_3$ (c) $CH_2$ (d) $CH_4$

21. Identify $A$ and $B$ in the following reaction

$$C_2H_5Cl \xrightarrow{A} C_2H_5OH \xleftarrow{B} C_2H_5Cl$$

(a) $A$ = aqueous KOH; $B$ = AgOH
(b) $A$ = alcoholic KOH/$\Delta$; $B$ = aqueous NaOH
(c) $A$ = aqueous NaOH; $B = AgNO_2$
(d) $A = AgNO_2$; $B = KNO_2$

22. ..... of a reaction cannot be determined experimentally :
(a) order (b) rate
(c) rate constant (d) molecularity

23. In the extraction of sodium by Down's process, cathode and anode are respectively :
(a) copper and nickel
(b) copper and chromium
(c) nickel and chromium
(d) iron and graphite

24. Which one of the following functional groups undergoes hydrolysis with alkali to yield an acid group ?
(a) —CN (b) —CHO
(c) $-COCH_3$ (d) —Br

25. Which one of the following is used as an acid flux in metallurgy ?
(a) CaO (b) $SiO_2$ (c) $Na_2CO_3$ (d) $SO_2$

26. Which of the following pair of ions have same paramagnetic moment ?
(a) $Cu^{2+}$, $Ti^{3+}$ (b) $Mn^{2+}$, $Cu^{2+}$
(c) $Ti^{4+}$, $Cu^{2+}$ (d) $Ti^{3+}$, $Ni^{2+}$

27. Which of the following elements has least number of electrons in its M shell ?
(a) K (b) Mn (c) Ni (d) Sc

28. Which one of the following compounds forms a quaternary salt on reacting with excess methyl iodide ?
(a) $C_2H_5OCH_3$ (b) $(CH_3)_2CHOC_2H_5$
(c) $C_6H_5NH_2$ (d) $C_6H_5NO_2$

29. The chemical formula of 'tear gas is :
(a) $COCl_2$ (b) $CO_2$
(c) $Cl_2$ (d) $CCl_3NO_2$

30. Which of the following is a favourable factor for cation formation ?
(a) High electronegativity
(b) High electron affinity
(c) Low ionisation potential
(d) Smaller atomic size

31. Which of the following reagents can form a hydrazone with alkanone ?
(a) $NH_3OHCl$
(b) $PhNHNH_2$
(c) $NH_2NHCONH_2$
(d) HCN

32. Average C—H bond energy is 416 kJ. $mol^{-1}$. Which of the following is correct ?
(a) $CH_4(g) + 416kJ \rightarrow C(g) + 4H(g)$
(b) $CH_4(g) \rightarrow C(g) + 4H(g) + 416kJ$
(c) $CH_4(g) + 1664\ kJ \rightarrow C(g) + 4H(g)$
(d) $CH_4(g) \rightarrow C(g) + 4H(g) + 1664\ kJ$

33. What is the molecular formula of the product formed when benzene is reacted with ethyl chloride in presence of anhydrous aluminium chloride ?
(a) $C_8H_{10}$ (b) $C_6H_6$
(c) $C_8H_8$ (d) $C_6H_5Cl$

34. At 27°C, 500 mL of helium diffuses in 30 minutes. What is the time (in hours) taken for 1000 mL of $SO_2$ to diffuse under same experimental conditions ?
(a) 240 (b) 3 (c) 2 (d) 4

35. The metal used for the de-bromination reaction of 1, 2-dibromoethane :
(a) Na (b) Zn (c) Mg (d) Li

36. **Assertion (A) :** At 300 K, kinetic energy of 16 g of methane is equal to the kinetic energy of 32 g of oxygen.
**Reason (R) :** At constant temperature, kinetic energy of one mole of all gases is equal.
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 not true
(d) (A) is not true but (R) is true

37. Identify the correct decreasing order of the following with respect to altitude from atmosphere :
I. Troposphere II. Mesosphere
III. Thermosphere
(a) II, III, I (b) III, II, I
(c) I, II, III (d) I, III, II

38. Study the following table :

| Buffer Solution | Volume (in mL) of 0.M Weak acid | Volume (in mL) of 0.1 M sodium salt of weak acid |
|---|---|---|
| I | 4.0 | 4.0 |
| II | 4.0 | 40.0 |
| III | 40.0 | 4.0 |
| IV | 0.1 | 10.0 |

Which of the two sets of buffer solutions have least pH ?
(a) I and II (b) I and III
(c) II and III (d) II and IV

39. Which of the following is an endothermic reaction ?
(a) $N_2(g) + 3H_2(g) - 92kJ \rightarrow 2NH_3(g)$
(b) $N_2(g) + O_2(g) + 180.8\ kJ \rightarrow 2NO(g)$
(c) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g) + 184.6\ kJ$
(d) C (graphite) $+ 2H_2(g) \rightarrow CH_2(g) + 74.8\ kJ$

40. Which of the following is correct ?
(a) $_1H^1$ and $_2He^3$ are isotopes
(b) $_6C^{14}$ and $_7N^{14}$ are isotopes
(c) $_{19}K^{39}$ and $_{20}Ca^{40}$ are isotones
(d) $_9F^{19}$ and $_{11}Na^{24}$ are isodiaphers

## MATHEMATICS

1. For any integer $n \geq 1$, the number of positive divisors of $n$ is denoted by $d(n)$. Then for a prime $P$, $d(d(d(P^7))) =$
(a) 1 (b) 2 (c) 3 (d) $P$

2. If $f: N \to Z$ is defined by
$$f(n) = \begin{cases} 2 & \text{if } n = 3k, k \in Z \\ 10 & \text{if } n = 3k+1, k \in Z \\ 0 & \text{if } n = 3k+2, k \in Z \end{cases}$$
then $\{n \in N : f(n) > 2\} =$
(a) {3, 6, 4} (b) {1, 4, 7}
(c) {4, 7} (d) {7}

3. The function $f: R \to R$ is defined by $f(x) = 3^{-x}$. Observe the following statements of it :
I. $f$ is one-one II. $f$ is onto
III. $f$ is a decreasing function
Out of these, true statement are :
(a) only I, II (b) only II, III
(c) only I, III (d) I, II, III

4. $\sum_{k=1}^{5} \frac{1^3 + 2^3 + \ldots + k^3}{1 + 3 + 5 + \ldots + (2k-1)} =$
(a) 22.5 (b) 24.5 (c) 28.5 (d) 32.5

5. The value of $\sqrt{42 + \sqrt{42 + \sqrt{42 + \ldots}}}$ is equal to :
(a) 7 (b) $-6$ (c) 5 (d) 4

6. If $\log_{27}(\log_3 x) = \frac{1}{3}$, then the value of $x$ is :
(a) 3 (b) 6 (c) 9 (d) 27

7. $S_1, S_2, \ldots\ldots, S_{10}$ are the speakers in a conference. If $S_1$ addresses only after $S_2$, then the number of ways the speakers address is :
(a) 10! (b) 9! (c) $10 \times 8!$ (d) $\frac{(10!)}{2}$

8. The number of positive odd divisors of 216 is :
(a) 4 (b) 6 (c) 8 (d) 12

9. The binomial coefficients which are in decreasing order are :
(a) ${}^{15}C_5, {}^{15}C_6, {}^{15}C_7$
(b) ${}^{15}C_{10}, {}^{15}C_9, {}^{15}C_8$
(c) ${}^{15}C_6, {}^{15}C_7, {}^{15}C_8$
(d) ${}^{15}C_7, {}^{15}C_6, {}^{15}C_5$

10. If $\frac{x-4}{x^2-5x+6}$ can be expanded in the ascending powers of $x$, then the coefficient of $x^3$ is :
(a) $\frac{-73}{648}$ (b) $\frac{73}{648}$
(c) $\frac{71}{648}$ (d) $\frac{-71}{648}$

11. If $\frac{(x+1)}{(2x-1)(3x+1)} = \frac{A}{(2x-1)} + \frac{B}{(3x+1)}$, then $16A + 9B$ is equal to :
(a) 4 (b) 5
(c) 6 (d) 8

12. The value of the series $x \log_e a + \frac{x^3}{3!}(\log_e a)^3 + \frac{x^5}{5!}(\log_e a)^5 + \ldots$ is :
(a) $\cosh(x \log_e a)$
(b) $\coth(x \log_e a)$
(c) $\sinh(x \log_e a)$
(d) $\tanh(x \log_e a)$

13. Coefficient of $x^{10}$ in the expansion of $(2+3x)e^{-x}$ is :
(a) $\frac{-26}{(10)!}$ (b) $\frac{-28}{(10)!}$
(c) $\frac{-30}{(10)!}$ (d) $\frac{-32}{(10)!}$

14. The set of all solutions of the inequation $x^2 - 2x + 5 \leq 0$ in $R$ is :
(a) $R - (-\infty, -5)$
(b) $R - (5, \infty)$
(c) $\phi$
(d) $R - (-\infty, -4)$

15. If $(x-2)$ is a common factor of the expressions $x^2 + ax + b$ and $x^2 + cx + d$, then $\frac{b-d}{c-a}$ is equal to :
(a) $-2$ (b) $-1$
(c) 1 (d) 2

16. If the roots of the equation $4x^3 - 12x^2 + 11x + k = 0$ are in arithmetic progression, then $k$ is equal to :
(a) $-3$ (b) 1
(c) 2 (d) 3

17. $\alpha, \beta, \gamma$ are the roots of the equation $x^3 - 10x^2 + 7x + 8 = 0$. Match the following and choose the correct answer.

A. $\alpha + \beta + \gamma$ (1) $-\frac{43}{4}$

B. $\alpha^2 + \beta^2 + \gamma^2$ (2) $-\frac{7}{8}$

C. $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$ (3) 86

D. $\frac{\alpha}{\beta\gamma} + \frac{\beta}{\gamma\alpha} + \frac{\gamma}{\alpha\beta}$ (4) 0

(5) 10

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

18. If $f(x)$ is a polynomial of degree $n$ with rational coefficients and $1 + 2i$, $2 - \sqrt{3}$ and 5 are three roots of $f(x) = 0$, then the least value of $n$ is :

(a) 5 (b) 4 (c) 3 (d) 6

19. Match the following elements of $\begin{bmatrix} 1 & -1 & 0 \\ 0 & 4 & 2 \\ 3 & -4 & 6 \end{bmatrix}$ with their cofactors and choose the correct answer.

| Element | Cofactor |
|---|---|
| A. – 1 | (1) – 2 |
| B. 1 | (2) 32 |
| C. 3 | (3) 4 |
| D. 6 | (4) 6 |
| | (5) – 6 |

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

20. The value of $\begin{vmatrix} 1990 & 1991 & 1992 \\ 1991 & 1992 & 1993 \\ 1992 & 1993 & 1994 \end{vmatrix}$ is :

(a) 1992 (b) 1993 (c) 1994 (d) 0

21. The rank of $\begin{bmatrix} 1 & -1 & 1 \\ 1 & 1 & -1 \\ -1 & 1 & 1 \end{bmatrix}$ is :

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

22. If $z_1, z_2$ are two complex numbers satisfying $\left|\frac{z_1 - 3z_2}{3 - z_1\bar{z}_2}\right| = 1$, $|z_1| \neq 3$, then $|z_2|$ is equal to :

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

23. The value of $\sum_{n=0}^{\infty} \left(\frac{2i}{3}\right)^n$ is :

(a) $\frac{9 + 6i}{13}$ (b) $\frac{9 - 6i}{13}$

(c) $9 + 6i$ (d) $9 - 6i$

24. If $x_n = \cos\frac{\pi}{2^n} + i\sin\frac{\pi}{2^n}$, then $\prod_{n=1}^{\infty} x_n$ is equal to :

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

25. If $n \in N$, and the period of $\frac{\cos nx}{\sin\left(\frac{x}{n}\right)}$ is $4\pi$, then $n$ is equal to :

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

26. The expression $\tan 9° - \tan 27° - \tan 63° + \tan 81°$ is equal to :

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

27. In a $\Delta ABC$, $\cos\left(\frac{B + 2C + 3A}{2}\right) + \cos\left(\frac{A - B}{2}\right)$ is equal to :

(a) – 1 (b) 0 (c) 1 (d) 2

28. The value of the series $\cos 12° + \cos 84° + \cos 132° + \cos 156°$ is :

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

29. For $x \in IR$, $3\cos(4x - 5) + 4$ lies in the interval :

(a) [1, 7] (b) [4, 7] (c) [0, 7] (d) [2, 7]

30. If $\sin^{-1}x + \sin^{-1}(1 - x) = \cos^{-1}x$, then $x \in$ to :

(a) {1. 0} (b) {– 1, 1} (c) $\left\{0, \frac{1}{2}\right\}$ (d) {2, 0}

31. If $x = \log\left[\cot\left(\frac{\pi}{4} + \theta\right)\right]$, then the value of $\sin hx$ is :

(a) $\tan 2\theta$ (b) $-\tan 2\theta$

(c) $\cot 2\theta$ (d) $-\cot 2\theta$

32. If, in a $\Delta ABC$, $r_3 = r_1 + r_2 + r$, then $\angle A + \angle B$ is equal to :

(a) 120° (b) 100° (c) 90° (d) 80°

33. In a $\Delta ABC$, $(a - b)^2\cos^2\frac{C}{2} + (a + b)^2\sin^2\frac{C}{2}$ is equal to :

(a) $a^2$ (b) $c^2$ (c) $b^2$ (d) $a^2 + b^2$

34. In a $\Delta ABC$, the correct formulae among the following are :

I. $r = 4R \sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$

II. $r_1 = (s-a)\tan\frac{A}{2}$

III. $r_3 = \frac{\Delta}{s-c}$

(a) only I, II (b) only II, III
(c) only I, III (d) I, II, III

35. An aeroplane flying with uniform speed horizontally one kilometer above the ground is observed at an elevation of 60°. After 10 seconds if the elevation is observed to be 30°, then the speed of the plane (in km/hr) is :

(a) $\frac{240}{\sqrt{3}}$ (b) $200\sqrt{3}$ (c) $240\sqrt{3}$ (d) $\frac{120}{\sqrt{3}}$

36. If $\hat{i}+2\hat{j}+3\hat{k}, 3\hat{i}+2\hat{j}+\hat{k}$ are sides of a parallelogram, then a unit vector is parallel to one of the diagonals of the parallelogram is :

(a) $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$ (b) $\frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$
(c) $\frac{\hat{i}+\hat{j}-\hat{k}}{\sqrt{3}}$ (d) $\frac{-\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$

37. If $G$ is the centroid of the $\Delta ABC$, then $\vec{GA}+\vec{BG}+\vec{GC}$ is equal to :

(a) $2\vec{GB}$ (b) $2\vec{GA}$ (c) $\vec{0}$ (d) $2\vec{BG}$

38. If the vectors $\hat{i}+3\hat{j}+4\hat{k}, \lambda\hat{i}-4\hat{j}+\hat{k}$ are orthogonal to each other, then $\lambda$ is equal to :

(a) 5 (b) $-5$ (c) 8 (d) $-8$

39. The vector $\vec{c}.(\vec{b}+\vec{c})\times(\vec{a}+\vec{b}+\vec{c})$ is equal to :

(a) $\vec{c}.\vec{b}\times\vec{a}$ (b) $\vec{0}$
(c) $\vec{c}.\vec{a}\times\vec{b}$ (d) $\vec{a}.\vec{c}\times\vec{b}$

40. If $3\hat{i}+3\hat{j}+\sqrt{3}\hat{k}, \hat{i}+\hat{k}, \sqrt{3}\hat{i}+\sqrt{3}\hat{j}+\lambda\hat{k}$ are coplanar, then $\lambda$ is equal to :

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

41. An unbiased coin is tossed to get 2 points for turning up a head and one point for the tail. If three unbiased coins are tossed simultaneously, then the probability of getting a total of odd number of points is :

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

42. Suppose $E$ and $F$ are two events of a random experiment. If the probability of occurrence of $E$ is 1/5 and the probability of occurrence of $F$ given $E$ is 1/10, then the probability of non-occurrence of at least one of the events $E$ and $F$ is :

(a) $\frac{1}{18}$ (b) $\frac{1}{2}$ (c) $\frac{49}{50}$ (d) $\frac{1}{50}$

43. Six faces of an unbiased die are numbered with 2, 3, 5, 7, 11 and 13. If two such dice are thrown, then the probability that the sum on the uppermost faces of the dice is an odd number is :

(a) $\frac{5}{18}$ (b) $\frac{5}{36}$ (c) $\frac{13}{18}$ (d) $\frac{25}{36}$

44. A person who tosses an unbiased coin gains two points for turning up a head and loses one point for a tail. If three coins are tossed and the total score $X$ is observed, then the range of $x$ is :

(a) {0, 3, 6} (b) {−3, 0, 3}
(c) {−3, 0, 3, 6} (d) {−3, 3, 6}

45. If $X$ is a poisson variate with $P(X=0)=0.8$, then the variance of $X$ is :

(a) $\log_e 20$ (b) $\log_{10} 20$
(c) $\log_e 5/4$ (d) 0

46. If the distance between the points $(a\cos\theta, a\sin\theta)$ and $(a\cos\phi, a\sin\phi)$ is $2a$ then $\theta$ is equal to :

(a) $2n\pi \pm \pi + \phi, n \in Z$

(b) $n\pi + \frac{\pi}{2} + \phi, n \in Z$

(c) $n\pi - \phi, n \in Z$

(d) $2n\pi + \phi, n \in Z$

47. The number of circles that touch all the three lines $x+y-1=0$, $x-y-1=0$ and $y+1=0$ is :

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

48. Suppose $A, B$ are two points on $2x-y+3=0$ and $P(1,2)$ is such that $PA=PB$. Then the mid-point of $AB$ is :

(a) $\left(\frac{-1}{5}, \frac{13}{5}\right)$ (b) $\left(\frac{-7}{5}, \frac{9}{5}\right)$
(c) $\left(\frac{7}{5}, \frac{-9}{5}\right)$ (d) $\left(\frac{-7}{5}, \frac{-9}{5}\right)$

49. The angle between the lines represented by $y^2\sin^2\theta - xy\sin^2\theta + x^2(\cos^2\theta - 1) = 0$ is :

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{2}$

50. Area of the triangle formed by the lines $3x^2 - 4xy + y^2 = 0, 2x - y = 6$ is :
(a) 16 sq. units (b) 25 sq. units
(c) 36 sq. units (d) 49 sq. units

51. If $P_1, P_2, P_3$ are the perimeters of the three circles $x^2 + y^2 + 8x - 6y = 0$, $4x^2 + 4y^2 - 4x - 12y - 186 = 0$ and $x^2 + y^2 - 6x + 6y - 9 = 0$ respectively, then :
(a) $P_1 < P_2 < P_3$ (b) $P_1 < P_3 < P_2$
(c) $P_3 < P_2 < P_1$ (d) $P_2 < P_3 < P_1$

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

53. If $(2, -1, 3)$ is the foot of the perpendicular drawn from the origin to the plane, then the equation of the plane is :
(a) $2x + y - 3z + 6 = 0$
(b) $2x - y + 3z - 14 = 0$
(c) $2x - y + 3z - 13 = 0$
(d) $2x + y + 3z - 10 = 0$

54. If the plane $3x - 2y - z - 18 = 0$ meets the coordinate axes in $A, B, C$ then the centroid of $\Delta ABC$ is :
(a) $(2, 3, -6)$ (b) $(2, -3, 6)$
(c) $(-2, -3, 6)$ (d) $(2, -3, -6)$

55. If the line $3x - 2y + 6 = 0$ meets $X$-axis and $Y$-axis respectively at $A$ and $B$, then the equation of the circle with radius $AB$ and centre at $A$ is :
(a) $x^2 + y^2 + 4x + 9 = 0$
(b) $x^2 + y^2 + 4x - 9 = 0$
(c) $x^2 + y^2 + 4x + 4 = 0$
(d) $x^2 + y^2 + 4x - 4 = 0$

56. A line $l$ meets the circle $x^2 + y^2 = 61$ in $A, B$ and $P(-5, 6)$ is such that $PA = PB = 10$. Then the equation of $l$ is :
(a) $5x + 6y + 11 = 0$
(b) $5x - 6y - 11 = 0$
(c) $5x - 6y + 11 = 0$
(d) $5x - 6y + 12 = 0$

57. If $(1, a), (b, 2)$ are conjugate points with respect to the circle $x^2 + y^2 = 25$, then $4a + 2b$ is equal to :
(a) 25 (b) 50 (c) 100 (d) 150

58. The eccentricity of the conic $36x^2 + 144y^2 - 36x - 96y - 119 = 0$ is :
(a) $\frac{\sqrt{3}}{2}$ (b) $\frac{1}{2}$
(c) $\frac{\sqrt{3}}{4}$ (d) $\frac{1}{\sqrt{3}}$

59. The polar equation $\cos\theta + 7\sin\theta = \frac{1}{r}$ represents a :
(a) circle (b) parabola
(c) straight line (d) hyperbola

60. The centre of the circle $r^2 - 4r(\cos\theta + \sin\theta) - 4 = 0$ in cartesian coordinates is :
(a) $(1, 1)$ (b) $(-1, -1)$
(c) $(2, 2)$ (d) $(-2, -2)$

61. The radius of the circle $r = \sqrt{3}\sin\theta + \cos\theta$ is :
(a) 1 (b) 2 (c) 3 (d) 4

62. The value of $\lim_{n \to \infty} \frac{1}{n^3} \sum_{k=1}^{n} (k^2 x)$ is :
(a) $x$ (b) $\frac{x}{2}$ (c) $\frac{x}{3}$ (d) $\frac{x}{4}$

63. If $f(x) = \begin{cases} [x] & \text{if } -3 < x \le -1 \\ |x| & \text{if } -1 < x < 1 \\ |[x]| & \text{if } 1 \le x < 3 \end{cases}$ then the set $(x : f(x) \ge 0)$ is equal to :
(a) $(-1, 3)$ (b) $[-1, 3)$
(c) $(-1, 3]$ (d) $[-1, 3]$

64. If $f : R \to R$ is an even function having derivatives of all orders, then an odd function among the following is :
(a) $f''$ (b) $f''''$
(c) $f' + f''$ (d) $f'' + f''''$

65. If $x > 0$, $x^y = e^{x-y}$, then $\frac{dy}{dx}$ is equal to :
(a) $\frac{1}{(1 + \log x)^2}$ (b) $\frac{\log x}{(1 + \log x)^2}$
(c) $\left(\frac{\log x}{1 + \log x}\right)^2$ (d) $\frac{(\log x)^2}{1 + \log x}$

66. If $f(x) = \frac{1}{x^2} \int_3^x (2t - 3f'(t))\, dt$, then $f'(3)$ is equal to :
(a) $\frac{-1}{2}$ (b) $\frac{-1}{3}$
(c) $\frac{1}{2}$ (d) $\frac{1}{3}$

67. If the function $y = \sin^{-1} x$, then $(1 - x^2)\frac{d^2y}{dx^2}$ is equal to :

(a) $-x\frac{dy}{dx}$ (b) 0

(c) $x\frac{dy}{dx}$ (d) $x\left(\frac{dy}{dx}\right)^2$

68. A particle moves along the curve $y = x^2 + 2x$. Then the point on the curve such that $x$ and $y$ co-ordinates of the particle change with the same rate is :

(a) (1, 3) (b) $\left(\frac{1}{2}, \frac{5}{2}\right)$

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

69. A point is moving on $y = 4 - 2x^2$. The $x$-co-ordinate of the point is decreasing at the rate of 5 units per second. Then the rate at which $y$ co-ordinate of the point is changing when the point is at (1, 2) is :

(a) 5 unit/s (b) 10 unit/s

(c) 15 unit/s (d) 20 unit/s

70. Match the points on the curve $2y^2 = x + 1$ with the slopes of normals at those points and choose the correct answer.

| Point | | Slope of the normal |
|---|---|---|
| A. (7,2) | (1) | $-4\sqrt{2}$ |
| B. $\left(0, \frac{1}{\sqrt{2}}\right)$ | (2) | −8 |
| C. (1, −1) | (3) | 4 |
| D. $(3, \sqrt{2})$ | (4) | 0 |
| | (5) | $-2\sqrt{2}$ |

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

71. $f(x, y) = 2(x - y)^2 - x^4 - y^4$

$\left|(f_{xx}f_{yy} - f_{xy}^2)\right|_{(0,0)}$ :

(a) 32 (b) 16 (c) 0 (d) −1

72. $\int \frac{dx}{(x + 100)\sqrt{x + 99}} = f(x) + c \Rightarrow f(x)$ :

(a) $2(x + 100)^{1/2}$

(b) $3(x + 100)^{1/2}$

(c) $2\tan^{-1}(\sqrt{x + 99})$

(d) $2\tan^{-1}(\sqrt{x + 100})$

73. $\int \frac{3 - x^2}{1 - 2x + x^2} e^x \, dx = e^x f(x) + c \Rightarrow f(x)$ :

(a) $\frac{1 + x}{1 - x}$ (b) $\frac{1 - x}{1 + x}$

(c) $\frac{1 + x}{x - 1}$ (d) $\frac{x - 1}{1 + x}$

74. $\int \frac{\sqrt{\cot x}}{\sin x \cos x} dx = -f(x) + c \Rightarrow f(x)$ :

(a) $2\sqrt{\tan x}$ (b) $-2\sqrt{\tan x}$

(c) $-2\sqrt{\cot x}$ (d) $2\sqrt{\cot x}$

75. $\int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} \log\left(\frac{2 - \sin\theta}{2 + \sin\theta}\right) d\theta =$

(a) 0 (b) 1 (c) 2 (d) −1

76. The area bounded by $y = x^2 + 2$, $x$-axis, $x = 1$ and $x = 2$ is :

(a) $\frac{16}{3}$ sq unit (b) $\frac{17}{3}$ sq unit

(c) $\frac{13}{3}$ sq unit (d) $\frac{20}{3}$ sq unit

77. $\int_0^2 \frac{2x - 2}{2x - x^2} dx =$

(a) 0 (b) 2 (c) 3 (d) 4

78. Integrating factor of $(x + 2y^3)\frac{dy}{dx} = y^2$ is :

(a) $e^{\left(\frac{1}{y}\right)}$ (b) $e^{-\left(\frac{1}{y}\right)}$

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

79. $y = Ae^x + Be^{2x} + Ce^{3x}$ satisfies the differential equation :

(a) $y''' - 6y'' + 11y' - 6y = 0$

(b) $y''' + 6y'' + 11y' + 6y = 0$

(c) $y''' + 6y'' - 11y' + 6y = 0$

(d) $y''' - 6y'' - 11y' + 6y = 0$

80. Observe the following statements :

A : Integrating factor of $\frac{dy}{dx} + y = x^2$ is $e^x$

R : Integrating factor of $\frac{dy}{dx} + P(x)\,y = Q(x)$ is $e^{\int P(x)\,dx}$

Then the true statement among the following is :

(a) A is true, R is false

(b) A is false, R is true

(c) A is true, R is true, R ⇒ A

(d) A is false, R is false

# Answers

## *Physics*

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

## *Chemistry*

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

## *Mathematics*

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

# Hints & Solutions

## *PHYSICS*

1. The dimensions of $x$ = dimensions of $\frac{v_0}{A}$

Therefore, out of the given options
$v_0$ has dimensions equal to $[M^0LT^{-1}]$
and $A$ has dimensions equal to $[M^0L^0T^{-1}]$

So, that $\frac{[v_0]}{[A]} = \frac{[M^0LT^{-1}]}{[M^0L^0T^{-1}]} = [L]$

= dimension of $x$

2. $s_1 + (u_1)\,t = s_2 + (u_2)\,t$

$$(4\,\hat{i} - 4\,\hat{j} + 7\,\hat{k}) + (0.4\,\hat{i})\,10 = (2\,\hat{i} + 2\,\hat{j} + 5\,\hat{k}) + (u_2)\,10$$

$$\Rightarrow \quad u_2 = \frac{(6\,\hat{i} - 6\,\hat{j} + 2\,\hat{k})}{10}$$

$$= 0.6\left[\hat{i} - \hat{j} + \frac{1}{3}\,\hat{k}\right]$$

3. $x = (u\cos\theta)\,t = 6\,t$

$y = (u\sin\theta)\,t - \frac{1}{2}gt^2 = 8t - 5t^2$

Therefore, $u\sin\theta = 8$

$u\cos\theta = 6$

Range $R = \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \times 2\sin\theta\cos\theta}{g}$