PHYSICS

1. In two system of unit relations among velocity acceleration and force are respectively $v_2 = \frac{\alpha^2}{\beta} v_1$, $a_2 = \alpha\beta a$, and $F_2 = \frac{F}{\alpha\beta}$. If α and β are constant then relations among mass, length and time in two system are -

(A) $M_2 = \frac{\alpha}{\beta} M_1$, $L_2 = \frac{\alpha^2}{\beta^2} L_1$, $T_2 = \frac{\alpha^3 T_1}{\beta}$

(B) $M_2 = \frac{1}{\alpha^2\beta^2} M_1$, $L_2 = \frac{\alpha^3}{\beta^3} L_1$, $T_2 = T_1 \frac{a}{\beta^2}$

(C) $M_2 = \frac{\alpha^3}{\beta^3} M_1$, $L_2 = \frac{\alpha^2}{\beta^2} L_1$, $T_2 = \frac{\alpha}{\beta} T_1$

(D) $M_2 = \frac{1}{\alpha^2\beta^2} M_1$, $\frac{\alpha}{\beta^2} L_1$, $T_2 = \frac{\alpha^3}{\beta^3} T_1$

2. A driver driving a truck at a constant speed of 20 ms^{-1} suddenly saw a parked car ahead of him by 95m. He could apply the brake after some time to produce retardation of 2.58 ms^{-2}. An accident was just avoided, his reaction time is -

(A) 0.5 s (B) 0.75 s
(C) 0.8 s (D) 1 s

3. What is the maximum range that a ball thrown with a speed of 40 ms^{-1} can cover without hitting the 25 m high ceiling of a long hall ?

(A) 150.5 m (B) 100.25 m
(C) 110.3 m (D) 200.5 m

4. If $\vec{P} + \vec{Q} + \vec{R} = 0$ and out of these, two vectors are equal in magnitude and the third vector has magnitude $\sqrt{2}$ times that of any of these two vectors, then angles among the three vectors are -

(A) 45°, 75°, 75° (B) 45°, 90°, 135°
(C) 90°, 135°, 180° (D) 90°, 135°, 135°

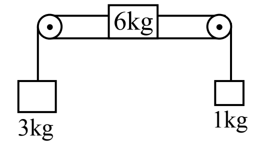
5. A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time the stone is at its lowest position and speed u. The magnitude of change in its velocity as its reaches a position, where the string is horizontal is -

(A) $\sqrt{u^2 - 2g\ell}$ (B) $\sqrt{2g\ell}$
(C) $\sqrt{u^2 - g\ell}$ (D) $\sqrt{2(u^2 - g\ell)}$

6. A body takes n times, the time to slide down a rough inclined plane as it takes to slide down the same inclined plane when it is perfectly frictionless. The coefficient of kinetic friction between body and the plane for an angle of inclination of 45° is given by μ -

(A) $1 - \frac{1}{n}$ (B) $\frac{1}{n}$
(C) $\left(1 - \frac{1}{n^2}\right)$ (D) $\left(\frac{1}{n^2 - 1}\right)$

7. Three blocks of masses 3 kg, 6 kg and 1 kg are connected by a string passing over two smooth pulleys attached at the two ends of a frictionless horizontal surface. The acceleration of 3 kg mass is -

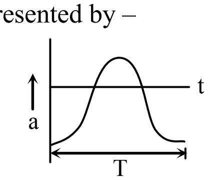


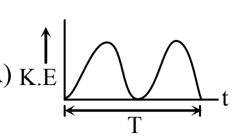
(A) 1 ms^{-2} (B) 2 ms^{-2}
(C) 3 ms^{-2} (D) 4 ms^{-2}

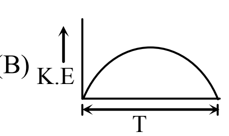
8. A particle of mass 4 m which is at rest explodes into three fragments. Two of the fragments each of mass m are found to move with a speed v each mutually perpendicular directions. The energy released in the process of explosion is –

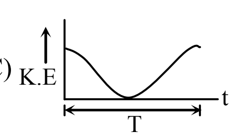
(A) $\frac{3}{2}mv^2$ (B) $3 mv^2$
(C) $2mv^2$ (D) $\frac{1}{2}mv^2$

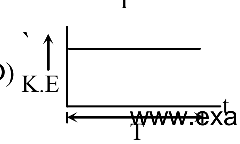
9. Acceleration a and time period T of a body is SHM is given by a curve shown below. Then corresponding graph between kinetic energy K.E. and time t is correctly represented by –



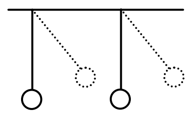
(A) 

(B) 

(C) 

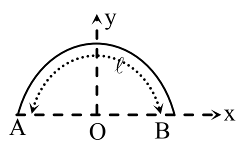
(D) 

10. Two pendulums start swinging together. Their lengths are respectively 1.44 m and 1 m. They will again start swinging together after –



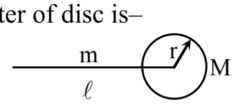
(A) 1 vibration (B) 3 vibrations
(C) 4 vibrations (D) 5 vibrations

11. Gravitational field at the centre of a semicircle formed by a thin wire AB of mass m and length ℓ is –



(A) $\frac{Gm}{\ell}$ along x-axis (B) $\frac{Gm}{\pi\ell}$ along y-axis
(C) $\frac{2\pi Gm}{\ell^2}$ along x-axis (D) $\frac{2\pi GM}{\ell^2}$ along y-axis

12. A thin rod of length ℓ and mass m has a disc with attached to one of its ends such that rod and disc are coplanar. Mass of the disc is M and radius is r, CM from the center of disc is–

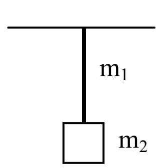


(A) $\frac{\ell M}{2(m+M)}$ (B) $\frac{\ell mM}{2(M+m)}$
(C) $\frac{\ell m}{M+m}$ (D) $\frac{\ell m}{2(M+m)}$

13. A rod is non uniform having mass per unit length as μ which varies linearly with distance x as per relation $\mu = ax$ (a is a constant). If its total mass is M and length ℓ, the centre of mass is given by –

(A) $\frac{3}{4}\ell$ (B) $\frac{2}{3}\ell$ (C) $\frac{2}{5}\ell$ (D) $\frac{\ell}{3}$

14. One end of a uniform rod of mass m_1 and cross sectional area A is hung from a ceiling. The other end of the bar is supporting mass m_2. The stress at the midpoint is -

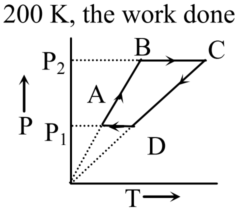


(A) $\frac{g(m_2+2m_1)}{2A}$ (B) $\frac{g(m_2+m_1)}{2A}$
(C) $\frac{g(2m_2+m_1)}{2A}$ (D) $\frac{g(m_2+m_1)}{A}$

15. A wave is represented by a equation $y = 0.5 \sin \frac{2\pi}{\lambda}(10t + x)$ metre. It is stated that it is a travelling wave propagating along + x direction with velocity 10 ms^{-1} then it is determined that –
(A) The statement is correct
(B) The statement is false
(C) The statement may be false or correct
(D) Nothing can be said because data is incomplete

16. A column of air at 51°C and a tuning fork produce 4 beats per second when sounded together. When temperature is 10°C the two produce only 1 beat per second. The frequency of tuning fork is –
(A) 50 (B) 40 (C) 60 (D) 55

17. Six moles an ideal gas performs a cycle show. If the temperatures are T_A = 600K, T_B = 800K, T_C = 2200 K and T_D = 1200 K, the work done per cycle is -



(A) 20000 J (B) 10000 J
(C) 30000 J (D) 40000 J

18. A gas mixture consists of 2 moles of oxygen and 4 moles of organ at temperature T. Neglecting all vibrational modes, the total internal energy of the system is-
(A) 4RT (B) 15 RT (C) 9RT (D) 11 RT

19. Starting with the same initial conditions if an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by gas is W_1, if the process is purely isothermal, W_2 if purely isobaric and W_3 if purely adiabatic, then -
(A) $W_2 > W_1 > W_3$ (B) $W_2 > W_3 > W_1$
(C) $W_1 > W_2 > W_3$ (D) $W_1 > W_3 > W_2$

20. Two capillaries of same length and radii in the ratio 1 : 2 are connected in series. A liquid flows through them in streamlined condition. If the pressure across the two extreme ends of the combination is 1 m of water, the pressure difference across first capillary is–
(A) 9.4 m (B) 4.9 m (C) 0.49 m (D) 0.94 m

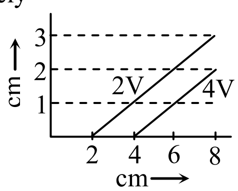
21. If the distance between the earth and the sun were half the present value then the number of days in a year could have been –
(A) 64.5 (B) 129
(C) 182.5 (D) 730

22. Potential difference between shell of an electrostatic generator and spray point is MV. If the transfer of charge to the shell is at the rate of Q unit per second, considering electrical forces only, the power provided to drive the belt is –

(A) $\frac{VQ}{t} \times 10^6$ (B) $VQ \times 10^6$

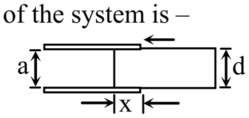
(C) $\frac{VQ}{10^6}$ (D) $\frac{VQ}{t}$

23. Figure shows two equipotential lines in x, y plane for an electric field. Then x component [E_x] and y component (E_y) of field in space between these lines are respectively –



(A) – 100 Vm^{-1}, 200 Vm^{-1}
(B) – 100 Vm^{-1}, – 200 Vm^{-1}
(C) 200 Vm^{-1}, 100 Vm^{-1}
(D) 100 Vm^{-1}, 100 Vm^{-1}

24. A dielectric slab is partially introduced between two square plates of area A of a parallel plats capacitor as shown. Dielectric constant of slab is ε_r. Total capacitance of the system is –



(A) $\frac{\varepsilon_0\sqrt{Ax}}{d}$

(B) $\frac{\varepsilon_0}{d}(A - \sqrt{A}x + \varepsilon_r\sqrt{A}x)$

(C) $\frac{\varepsilon_0}{d}(\varepsilon_r\sqrt{A}x - A - \sqrt{A}x)$

(D) $\frac{\varepsilon_0\varepsilon_{rl}}{d}(-\sqrt{A}x + A + \varepsilon_r\sqrt{A}x)$

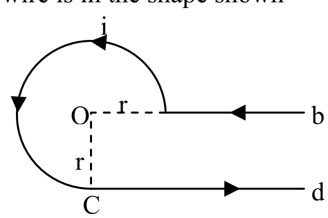
25. A piece of copper and another of germanium are cooled from room temperature to 80 K. The resistance of -
(A) Each of them increases
(B) Each of them decreases
(C) Cooper increases and germanium decreases
(D) Copper decreases and germanium increases

26. Two resistances 300 Ω and 400 Ω are connected in series with a battery of emf 60 V and negligible internal resistance. An ideal voltmeter reads 30 V when connected across 400Ω resistor. The reading of same voltmeter across 300 Ω resistor is –
(A) 19 V (B) 20 V (C) 22 V (D) 21 V

27. A potentiometer wire of length 100 cm has a resistance of 10Ω. It is connected with a resistance in series and an accumulator of emf 2V and of negligible internal resistance. A source of emf 10 mV is balanced against a length of 40 cm of potentiometer wire. The value of external resistance is -
(A) 790 Ω (B) 970 Ω
(C) 97 Ω (D) 709 Ω

28. A parallel combination of 0.1 MΩ resistor and a 10 μF capacitor is connected across a 1.5 V source of negligible resistance. The time (in seconds) required for the capacitor to get charged upto 0.75 V is approximately –
(A) ∞ (B) $\log_e 2$
(C) $\log_{10} 2$ (D) Zero

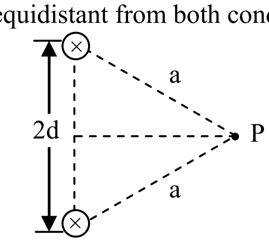
29. The magnetic induction at point O. If the current carrying wire is in the shape shown –



(A) $\frac{\mu_0 i}{4\pi r}\left[\frac{3}{2}\pi + 1\right]$ (B) $\frac{\mu_0 i}{2\pi r}\left[\frac{3}{2}\pi + 1\right]$

(C) $\frac{\mu_0 i}{\pi r}\left[\frac{3}{2}\right]$ (D) $\frac{\mu_0 i}{2\pi r}\left[1 - \frac{3}{2}\pi\right]$

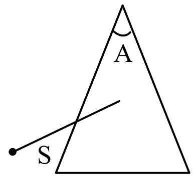
30. Some current I flows in two parallel conductors distant 2d as shown. The strength of magnetic field at a point P equidistant from both conductors is –



(A) $\frac{\mu_0 Id}{4\pi a}$ (B) $\frac{\mu_0 Id}{2\pi a}$ (C) $\frac{\mu_0 Id}{4\pi a^2}$ (D) $\frac{\mu_0 Id}{\pi a^2}$

31. A coil in the shape of an equilateral triangle of side 0.02 m is suspended from a vertex such that it is hanging in a vertical plane between the pole pieces of a permanent magnet producing a horizontal magnetic field of 5×10^{-2} T. The couple acting on coil when a current of 0.1 A is passed through it and the magnetic field is parallel to its plane –
(A) 6.86×10^{-7} Nm (B) 8.66×10^{-7} Nm
(C) 8.7×10^{-9} Nm (D) 8×10^{-8} Nm

32. A Thin prism of angle A and refractive index μ for sodium light is placed at a distance S from a slit illuminated by sodium light. Distance between slit and image formed by prism is –



(A) As $(1 - \mu)$ (B) As $(1 + \mu)$

(C) As $(\mu - 1)$ (D) $\frac{A}{S}(1 - \mu)$

33. The resolution limit of eye is 60s. A distance of x km from the eye two persons stand with lateral separation of 3m. For the two persons to be just resolved by eye. X should be –

(A) 10 km (B) 15 km

(C) 20 cm (D) 30 km

34. In a compound microscope, the intermediate image is–

(A) Virtual, erect and magnified

(B) real, erect and magnified

(C) real, inverted and magnified

(D) virtual, erect and reduced

35. Yellow light is used in a single slit diffraction experiment with slit width of a 0.6 mm. If yellow light is replaced by x-rays then the observed pattern will reveal –

(A) That the central maximum is narrower

(B) more number of fringes

(C) less number of fringes

(D) no diffraction patterns

36. Two beams of light having intensities I and 4I interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\frac{\pi}{2}$ at point A and π at point B. Then the difference between the resultant intensities at A and B is-

(A) 2 I (B) 4 I

(C) 5 I (D) 7 I

37. In the ideal double slit experiment, when a glass plate (refractive index 1.5) of thickness t is introduced in the path of one of the interfering beams (wavelength) the intensity at the position where the central maximum occurs previously remains unchanged. The minimum thickness of glass plate is-

(A) 2λ (B) $\frac{2\lambda}{3}$ (C) $\frac{\lambda}{3}$ (D) λ

38. A proton and an α particle have KE in the ratio of 16 : 1. The ratio of de-Broglie waves associated with them is –

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

39. Light of wavelength 5000 Å falls on a sensitive surface. If the surface has received 10^{-7} J of energy then number of photons just falling on the surface are–

(A) 2.5×10^{6} (B) 2.5×10^{11}

(C) 2.5×10^{3} (D) 5000

40. The wavelength of K_α line produced by an x-ray tube of material is 0.76Å. The atomic number of material of anode tube is –

(A) 41 (B) 14 (C) 51 (D) 15

CHEMISTRY

1. According to Bohr's theory, angular momentum of an electron in fourth orbit is -

(A) $\frac{h}{2\pi}$ (B) $\frac{h}{4\pi}$ (C) $\frac{2h}{\pi}$ (D) $\frac{4h}{\pi}$

2. 1.25g of a solid dibasic acid is completely neutralized by 25 ml. of 0.25 molar $Ba(OH)_2$ solution. Molecular mass of the acid is -

(A) 100 (B) 150 (C) 120 (D) 200

3. Rates of effusion of hydrogen and deuterium under similar conditions are in the ratio -

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

4. For equilibrium $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$ $K_C = 1.8 \times 10^{-4}$ at 298 K. The value of K_p at 298 K is-

(A) 0.108 (B) 4.4×10^{-3}

(C) 1.8×10^{-4} (D) 4.4×10^{-4}

5. Given that $H_2O(\ell) \rightarrow H_2O(g)$; $\Delta H = +43.7$ kJ

$H_2O(s) \rightarrow H_2O(\ell)$; $\Delta H = +6.05$ kJ

$\Delta H_{sublimation}$ of ice is -

(A) 49.75 kJ mol^{-1} (B) 37.65 kJ mol^{-1}

(C) 43.7 kJ mol^{-1} (D) – 43.67 kJ mol^{-1}

6. Which of the following is a Lewis base ?

(A) CO_2 (B) BF_3 (C) Al^{3+} (D) CH_3NH_2

7. The solubility product K_{sp} of sparingly soluble salt Ag_2CrO_4 is 4×10^{-12}. The solubility of the salt is -

(A) 1×10^{-12} M (B) 2×10^{-6} M

(C) 1×10^{-6} M (D) 1×10^{-4} M

8. Which of the following chemical reactions depicts the oxidising behaviour of H_2SO_4 ?

(A) $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$
(B) $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$
(C) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$
(D) $2PCl_5 + H_2SO_4 \rightarrow 2POCl_3 + 2HCl + SO_2Cl_2$

9. Potassium has a bcc structure with nearest neighbour distance of 4.52 Å. If atomic mass of potassium is 3a, its density is -

(A) 454 kg m^{-3} (B) 804 kg m^{-3}
(C) 852 kg m^{-3} (D) 900 kg m^{-3}

10. If $E^0_{Zn^{2+}/Zn} = -0.763$ V and $E^0_{Cd^{2+}/Cd} = -0.403$ V, the emf of the cell

$Zn \mid Zn^{2+} \| Cd^{2+} | Cd$ (a = 0.004), (a = 0.2) will be given by -

(A) $E = -0.36 + \frac{0.059}{2} \log \frac{0.004}{2}$
(B) $E = +0.36 + \frac{0.059}{2} \log \frac{0.04}{2}$
(C) $E = -0.36 + \frac{0.059}{2} \log \frac{0.2}{0.004}$
(D) $E = +0.36 + \frac{0.059}{2} \log \frac{0.2}{0.004}$

11. The value of P° for benzene of certain temperature is 640 mm of Hg. The vapour pressure of solution containing 2.5 g of a certain substance 'A' in 39.0 g of benzene is 600 mm of Hg. The molecular mass of A is -

(A) 65.25 (B) 130 (C) 40 (D) 80

12. For adsorption, ΔH is -

(A) + ve (B) – ve
(C) zero (D) may + ve or –ve

13. A reaction which is of first order w r.t. reactant A, has a rate constant 6 min^{-1}. If we start with [A] = 0.5 mol L^{-1}, when would [A] reach the value of 0.05 mol L^{-1} ?

(A) 0.384 min (B) 0.15 min
(C) 3 min (D) 3.84 min

14. The number of molecules present in 1 cm^3 of water is (density of H_2O = 1 g cm^{-3})

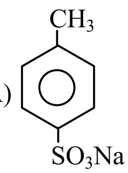
(A) 2.7×10^{18} (B) 3.3×10^{22}
(C) 6.02×10^{20} (D) 1000

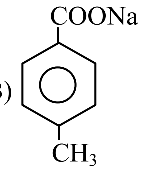
15. $CH_3NH_2 + CHCl_3 + KOH \rightarrow$ Nitrogen containing compound + KCl + H_2O

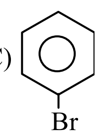
Nitrogen containing compound is –

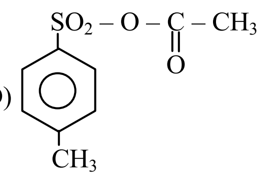
(A) $CH_3 - C \equiv N$ (B) $CH_3 - NH - CH_3$
(C) $CH_3 - N \equiv C^+$ (D) $CH_3 - N^+ \equiv C^-$

16. 4-methyl benzene sulphonic acid react with sodium acetate to give –

(A)  ; CH_3COOH

(B)  ; SO_3

(C)  ; SO_3

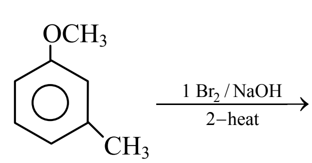
(D)  ; NaOH

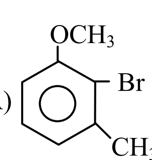
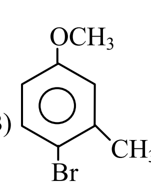
17. The product(s) obtained via oxymercuration ($HgSO_4 + H_2SO_4$) of 1-butyne would be –

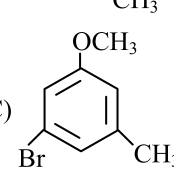
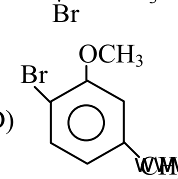
(A) $CH_3CH_2COCH_3$
(B) $CH_3CH_2CH_2CHO$
(C) $CH_3CH_2CHO + HCHO$
(D) $CH_3CH_2COOH + HCOOH$

18. Acetophenone is prepared by the reaction of which of the following in the presence of $AlCl_3$ catalyst –

(A) Phenol and acetic acid
(B) Benzene and acetone
(C) Benzene and acetyl chloride
(D) Phenol and acetone

19. 

(A)  (B) 

(C)  (D) 

20. Phenol $\xrightarrow{NaNO_2/H_2SO_4}$ B $\xrightarrow{H_2O}$ C $\xrightarrow{NaOH}$ D

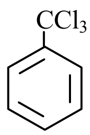
Name of the above reaction is –

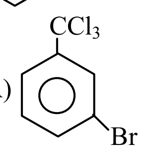
(A) Libermann's reaction

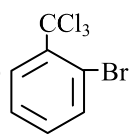
(B) Phthalein fusion test

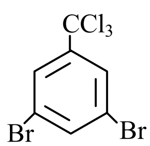
(C) Reimer-Tiemann reaction

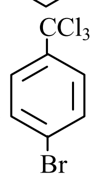
(D) Schotten-Baumann reaction

21.  $\xrightarrow{1eqv\ of\ Br_2/Fe}$ A. Compound A is -

(A) 

(B) 

(C) 

(D) 

22. In a reaction

$$CH_2=CH_2 \xrightarrow[\text{acid}]{\text{Hypochlorous}} M \xrightarrow{R} \begin{array}{l} CH_2-OH \\ | \\ CH_2-OH \end{array}$$

where M = molecule

R = Reagent

M and R are

(A) CH_3CH_2Cl and NaOH

(B) $CH_2Cl - CH_2OH$ and aq. $NaHCO_3$

(C) CH_3CH_2OH and HCl

(D) $CH_2 = CH_2$ and heat

23. Which of the following will have least hindered rotation about carbon-carbon bond –

(A) Ethane

(B) Ethylene

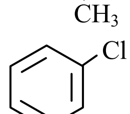
(C) Acetylene

(D) Hexachloroethane

24. Which is least reactive towards nucleophilic substitution (SN2)

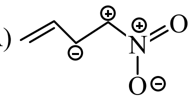
(A) $CH_2 = CH_2 - CH_2 - Cl$

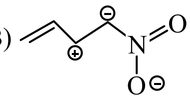
(B) $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Cl$

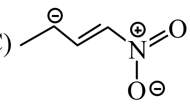
(C) 

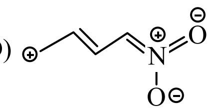
(D) $CH_3-\underset{Cl}{CH}-CH_3$

25. Among the following the least stable reasonance structure is –

(A) 

(B) 

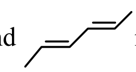
(C) 

(D) 

26. Homolytic fission of C–C bond in ethane gives an intermediate in which carbon is -

(A) sp^3 hybridised (B) sp^2 hybridised

(C) sp hybridised (D) sp^2d hybridised

27. The IUPAC name of the compound  is –

(A) (2E, 4E)-2, 4-hexadiene

(B) (2Z, 4Z)-2, 4-hexadiene

(C) (2Z, 4E)-2, 4-hexadiene

(D) (2E, 4Z)-4, 2-hexadiene

28. The brown ring test for NO_2^- and NO_3^- is due to the formation of complex ion with the formula –

(A) $[Fe(H_2O)_6]^{2+}$ (B) $[Fe(NO)(CN)_5]^{2+}$

(C) $[Fe(H_2O)_5NO]^{2+}$ (D) $[Fe(H_2O)(NO)_5]^{2+}$

29. The correct order for the wavelength of absorption in the visible region is –

(A) $[Ni(NO_2)_6]^{4-} < [Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+}$

(B) $[Ni(NO_2)_6]^{4-} < [Ni(H_2O)_6]^{2+} < [Ni(NH_3)_6]^{2+}$

(C) $[Ni(H_2O)_6]^{2+} < [Ni(NH_3)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

(D) $[Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

30. In nitroprusside ion,, the iron and NO exists as Fe (II) and NO^+ rather than Fe(III) and NO these forms can be differentiated by –

(A) Estimating the concentration of iron

(B) Measuring the concentration of CN^-

(C) Measuring the solid state magnetic moment

(D) Thermally decomposing the compound

31. Four reactions are given below

I $2Li + 2H_2O \rightarrow 2LiOH + H_2$

II $2Na + 2H_2O \rightarrow 2NaOH + H_2$

III $2LiNO_3 \xrightarrow{heat} 2LiNO_2 + O_2$

IV $2NaNO_3 \xrightarrow{heat} 2NaNO_2 + O_2$

Which of the above if any is wrong

(A) IV (B) III

(C) I (D) None of these

32. Name of the structure of silicates in which three oxygen atoms of $[SiO_4]^{4-}$ are shared is –
(A) Pyrosilicate
(B) Sheet silicate
(C) Linear chain silicate
(D) Three dimensional silicate

33. The metallic lusture exhibited by sodium is explained by –
(A) Diffusion of sodium ions
(B) Oscillation of loose electron
(C) Excitation of free protons
(D) Existence of body centred cubic lattice

34. Hydrogen is evolved by the action of cold dil. HNO_3 on –
(A) Fe (B) Mn (C) Cu (D) Al

35. 'Lapis-Lazuli' is a blue coloured precious stone. It is mineral of the class –
(A) Sodium alumino silicate
(B) Zinc-cobaltate
(C) Basic copper carbonate
(D) Prussian blue

36. In which of the following arrangements the order is not according to the property indicating against it –
(A) $Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$ (increasing ionic size)
(B) B < C < N < O (increasing first I.E.)
(C) I < Br < F < Cl
(increasing electron gain enthalpy (–ve))
(D) Li < Na < K < Rb (increasing metallic radius)

37. Which set of hybridisation is correct for the following compound
NO_2, SF_4, PF_6^-
(A) sp, sp^2, sp^3 (B) sp, sp^3d, sp^3d^2
(C) sp^2, sp^3, d^2sp^3 (D) sp^3, sp^3d^2, sp^3d^2

38. The increasing order of atomic radius for the elements Na, Rb, K and Mg is –
(A) Mg < Na < K < Rb (B) K < Na < Mg < Rb
(C) Na < Mg < K < Rb (D) Rb < K < Mg < Na

39. Which of the following ion forms a hydroxide highly soluble in water –
(A) Ni^{2+} (B) K^{+} (C) Zn^{2+} (D) Al^{3+}

40. When CO_2 is bubbled into an aqueous solution of Na_2CO_3 the following is formed –
(A) NaOH (B) $NaHCO_3$
(C) H_2O (D) OH^-

MATHEMATICS

1. $y = 2x^2 - \log|x|$ passes -
(A) two minima & one maxima
(B) Two maxima and one minima
(C) Only two minima
(D) Only two maxima

2. The function $f(x) = 1 + x \sin x [\cos x]$,
$0 < x \le \frac{\pi}{2}$ [.] = G.I.F.
(A) is continuous on $(0, \pi/2)$
(B) is strictly decreasing in $(0, \pi/2)$
(C) is strictly increasing in $(0, \pi/2)$
(D) has global maximum value 2

3. If the radius of a spherical balloon is measured with in 1 % the error (in percent) in the volume is –
(A) $4\pi r^2$ % (B) 3 % (C) $\left(\frac{88}{7}\right)$% (D) None

4. The relation R defined on the set A = {1, 2, 3} is given by R = {(1, 1) (2, 2)} then number of correct choices from the following is -
(i) reflexive (ii) symmetric
(iii) Transitive (iv) anti symmetric
(A) 1 (B) 2 (C) 3 (D) 4

5. Let U be the universal set and $A \cup B \cup C = U$ then $\{(A - B) \cup (B - C) \cup (C - A)\}^c =$
(A) $A \cap (B \cap C)$ (B) $A \cap (B \cup C)$
(C) $(A \cap B \cap C)$ (D) None of these

6. If A and B are square matrices of same size and $|B| \ne 0$ then $(B^{-1}AB)^4 =$
(A) $(B^4)^{-1}AB^4$ (B) BA^4B^{-1}
(C) $B^{-1}A^4B$ (D) None of these

7. Let $g(x) = \begin{vmatrix} f(x+\alpha) & f(x+2\alpha) & f(x+3\alpha) \\ f(\alpha) & f(2\alpha) & f(3\alpha) \\ f'(\alpha) & f'(2\alpha) & f'(3\alpha) \end{vmatrix}$
where α is a constant then $\lim_{x\to 0} \frac{g(x)}{x} =$
(A) 0 (B) 1 (C) –1 (D) None

8. If $\Delta_1 = \begin{vmatrix} f & 2d & e \\ 2z & 4x & 2y \\ e & 2a & b \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} 2a & b & e \\ 2d & e & f \\ 4x & 2y & 2z \end{vmatrix}$ then
$\Delta_1/\Delta_2 =$
(A) 1 (B) 2 (C) $\frac{1}{2}$ (D) None

9. The number of ways in which 20 one rupee coin can be distributed among 5 people such that each person gets at least 3 rupee is –

(A) 26 (B) 63 (C) 125 (D) None

10. The total number of six digit number $x_1 x_2 x_3 x_4 x_5 x_6$ have the property that

$x_1 < x_2 \le x_3 < x_4 < x_5 \le x_6$ is equal to –

(A) ${}^{10}C_6$ (B) ${}^{12}C_6$

(C) ${}^{11}C_6$ (D) None

11. $2\left\{1+\frac{a^2}{\lfloor 2}+\frac{a^4}{\lfloor 4}+....\right\}$; $a = \log_e n$ is equal to –

(A) $\frac{(n-1)}{n}$ (B) $\frac{n^2-1}{n}$ (C) $\frac{n+1}{n}$ (D) $\frac{n^2+1}{n}$

12. The term independent of x in $\left(\sqrt{x}-\frac{2}{x}\right)^{18}$ is –

(A) ${}^{18}C_6 2^6$ (B) ${}^{18}C_{12} 2^{12}$

(C) ${}^{18}C_8 2^8$ (D) None of these

13. $1 + \frac{2}{3} \cdot \frac{1}{2} + \frac{2.5}{3.5}\left(\frac{1}{2}\right)^2 + \frac{2.5.8}{3.6.9}\left(\frac{1}{2}\right)^3 + \ldots =$

(A) $2^{1/3}$ (B) $3^{1/4}$ (C) $4^{1/3}$ (D) $3^{1/3}$

14. If ω is imaginary cube root of unity then $\arg(i\omega) + \arg(i\omega^2)$

(A) 0 (B) π/2 (C) π (D) None

15. $\sum_{r=1}^{n} \frac{1}{\log_{2^r} 4}$ is equal to –

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

(C) n(n + 1) (D) None of these

16. If $a_1, a_2, \ldots a_{15}$ are in A.P. and $a_1 + a_8 + a_{15} = 15$ then $a_2 + a_3 + a_8 + a_{13} + a_{14} =$

(A) 15 (B) 10 (C) 25 (D) None

17. Let a, b, c be positive real numbers, such that

$bx^2 + \sqrt{(a+c)^2+4b^2}\, x + (a + c) \ge 0 \ \forall\, x \in R$ then a, b, c are in –

(A) G.P. (B) A.P. (C) H.P. (D) None

18. If $a_1 < a_2 < a_3 < a_4 < a_5 < a_6$ then the equation $(x - a_1)(x - a_3)(x - a_5) + 2(x - a_2)(x - a_4)(x - a_6) = 0$ has –

(A) Four real roots (B) One real root

(C) One real root in each interval (a_1, a_2), (a_3, a_4) and (a_5, a_6)

(D) None of these

19. Solution of the differential equation $xdx + zdy + (y + 2z)dz = 0$ is –

(A) $x^2 + 2yz + 2z^2 = c$ (B) $x^2 + yz + z^2 = c$

(c) $x^2 + 2yz + z^2 = c$ (D) None of these

20. The slope of the tangent to the curve y = f(x) at (x, f(x)) is (2x + 1). If the curve passes through the point (1, 2), then the area bounded by the curve, x-axis and the lines x = 1, x = 0 is –

(A) 5/6 (B) 6/5 (C) 6 (D) 1

21. The maximum area of a rectangle whose two consecutive vertices lie on the x-axis and another two lie on the curve

$y = e^{-|x|}$ is equal to –

(A) 2e (B) 2/e (C) e (D) 1/e

22. $\int \sqrt{\sin^2 x}\, dx =$

(A) – cos x + C (B) cos x + C

(C) – cos x sgn sin x + C (D) None of these

23. $\int \frac{f(x)\phi'(x) - f'(x)\phi(x)}{f(x)\phi(x)} \log \frac{\phi(x)}{f(x)} dx =$

(A) $\log \frac{\phi(x)}{f(x)} + C$ (B) $\frac{1}{2}\left\{\log\left(\frac{\phi(x)}{f(x)}\right)\right\}^2 + C$

(C) $\frac{\phi(x)}{f(x)} \log \frac{\phi(x)}{f(x)} + C$ (D) None of these

24. Segment of the tangent to the curve $xy = c^2$ at the point (x′, y′) which is contained between the co-ordinate axes is bisected at the point –

(A) (–x′, y′) (B) (y′, x′)

(C) $\left(\frac{x'}{2}, \frac{y'}{2}\right)$ (D) None of these

25. There is a point P(a, a, a) on the line passing through the origin and equally inclined with axes the equation of the plane perpendicular to OP and passing through P cuts the intercepts on axes the sum of whose reciprocals is –

(A) a (B) 3/2a (C) 3a/2 (D) 1/a

26. If $\vec{a} = p\hat{i} + 5\hat{j} + 17\hat{k}$ and $\vec{b} = 2\sqrt{q}\,\hat{i} + 13\hat{j} + \hat{k}$ have equal magnitude and p, q are positive integer ∈ [1, 1000] then the total number of ordered pair (p, q) is –

(A) 33 (B) 32 (C) 31 (D) None

27. If $\vec{a}$, $\vec{b}$, $\vec{c}$ be such that $|\vec{a}+\vec{b}+\vec{c}| = 1$, $\vec{c} = \lambda \vec{a} \times \vec{b}$ and $|\vec{a}| = \frac{1}{\sqrt{2}}$, $|\vec{b}| = \frac{1}{\sqrt{3}}$, $|\vec{c}| = \frac{1}{\sqrt{6}}$ then the angle between $\vec{a}$ and $\vec{b}$ is-

(A) π/6 (B) π/4 (C) π/3 (D) π/2

28. The equation $\frac{x^2}{8-a} + \frac{y^2}{a-2} = 1$ will represent an ellipse if –
(A) $a \in (1, 4)$ (B) $a \in (-\infty, 2) \cup (8, \infty)$
(C) $a \in (2, 8)$ (D) None of these

29. Angle between the tangent drawn to $y^2 = 4x$ at the point where it is intersected by line $y = x - 1$ is –
(A) $\pi/6$ (B) $\pi/3$ (C) $\pi/4$ (D) $\pi/2$

30. Consider four circles $(x \pm 1)^2 + (y \pm 1)^2 = 1$ equation of smaller circle touching these four circles is –
(A) $x^2 + y^2 = 3 - \sqrt{2}$ (B) $x^2 + y^2 = 6 - 3\sqrt{2}$
(C) $x^2 + y^2 = 5 - 2\sqrt{2}$ (D) $x^2 + y^2 = 3 - 2\sqrt{2}$

31. If the point $P(a, a^2)$ lies completely inside the triangle formed by the lines $x = 0$, $y = 0$ and $x + y = 2$ then exhaustive range of 'a' is –
(A) $a \in (0, 1)$
(B) $a \in (1, \sqrt{2})$
(C) $a \in (\sqrt{2} - 1, \sqrt{2})$
(D) $a \in (\sqrt{2} - 1, 1)$

32. The distance between the orthocentre and the circumcentre of the triangle with vertices (0, 0) (0, a) and (b, 0) is –
(A) $\sqrt{\frac{1}{2}(a^2 + b^2)}$ (B) $a + b$
(C) $a - b$ (D) $\frac{\sqrt{a^2 + b^2}}{2}$

33. If the sides of a Δ are 3 : 7 : 8 then R : r is equal to –
(A) 2 : 7 (B) 7 : 2 (C) 3 : 7 (D) None

34. The equation $\sin x (\sin x + \cos x) = K$ has real solution then K belongs to –
(A) $\left(0, \frac{1+\sqrt{2}}{2}\right)$ (B) $(2 - \sqrt{3}, 2 + \sqrt{3})$
(C) $(0, 2\sqrt{3})$ (D) $\left(\frac{1-\sqrt{2}}{2}, \frac{1+\sqrt{2}}{2}\right)$

35. The function $f(x) = \frac{x}{1 + x \tan x}$, $(0, \frac{\pi}{2})$ has –
(A) One point of minimum
(B) One point of maximum
(C) No extreme point
(D) Two point of maximum

36. If solution of the equation
$3\cos^2\theta - 2\sqrt{3} \sin\theta \cos\theta - 3 \sin^2\theta = 0$ are $n\pi + \frac{\pi}{r}$ and $n\pi + \frac{\pi}{s}$ then $| r - s | =$
(A) 3 (B) 9 (C) 7 (D) 1

37. If $\cot^{-1} \frac{n}{\pi} > \frac{\pi}{6}$, $n \in N$ then maximum value of n =
(A) 6 (B) 5 (C) 4 (D) 3

38. Period of the function $f(x) = \sin 3\pi\{x\} + \tan \pi [x]$ where [.] and {.} denote the integral part and fractional part respectively, is given by –
(A) 1 (B) 2 (C) 3 (D) π

39. The domain and range of $f(x) = \cos^{-1}\sqrt{\log_{[x]}\left(\frac{|x|}{x}\right)}$.
Where [.] denotes the greatest integer function respectively –
(A) $[1, \infty), [0, \frac{\pi}{2}]$ (B) $[2, \infty), [0, \frac{\pi}{2}]$
(C) $[2, \infty), \{\frac{\pi}{2}\}$ (D) $[1, \infty), \{0\}$

40. The graph of the function $y = f(x)$ has a unique tangent not parallel to x-axis at the point (a, 0) through which the graph passes, then $\lim_{x \to a} \frac{\log_e\{1 + 6f(x)\}}{3f(x)}$ is –
(A) 1 (B) 0 (C) 2 (D) None

41. If $P = \lim_{x \to 5^+} \frac{x^2 - 9x + 20}{x - [x]} - \lim_{x \to 4^-} \frac{x^2 - 9x + 20}{x - [x]}$ and
$Q = \lim_{x \to 4^+} \frac{x^2 - 9x + 20}{x - [x]} - \lim_{x \to 5^-} \frac{x^2 - 9x + 20}{x - [x]}$
[.] = G.I.F. then $\frac{P}{Q} =$
(A) 1 (B) 2 (C) 3 (D) None

42. Let $f(x) = \begin{cases} \frac{[x^2] - 1}{x^2 - 1} & ; x^2 \neq 1 \\ 0 & ; x^2 = 1 \end{cases}$ then at x = 1, f(x) is –
(A) Differentiable
(B) Discontinuous
(C) Continuous not differentiable
(D) None of these

43. If $(a + bx)e^{y/x} = x$ then $\frac{1}{y_2}(xy_1 - y)^2 =$
(A) x^3 (B) $3x^2$ (C) $1/x^3$ (D) None

44. If f(x) is continuous function such that $\int_{n}^{n+1} f(x)dx = n^3 \; n \in Z$ then $\int_{-2}^{3} f(x)dx =$

(A) 16 (B) 0 (C) 2 (D) None

45. If $x^2 f(x) + f\left(\frac{1}{x}\right) = 2$ for all x except at x = 0 then

$\int_{1/3}^{3} f(x)dx =$

(A) 4/3 (B) 8/3 (C) 1/3 (D) None

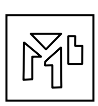
LOGICAL REASONING

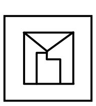
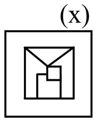
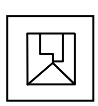
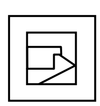
1. Fill in the blank spaces
6, 13, 28, . **?** . .
(A) 56 (B) 57 (C) 58 (D) 59

2. Choose the best alternative
Car : Petrol : : T.V. : ?
(A) Electricity (B) Transmission
(C) Entertainment (D) Antenna

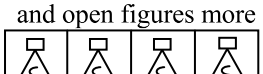
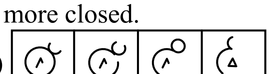
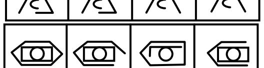
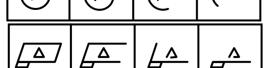
3. Pick the odd one out –
(A) Titan (B) Mercury
(C) Earth (D) Jupiter

4. **Direction :** In questions, find out which of the figures (A), (B), (C) and (D) can be formed from the pieces given in (x).

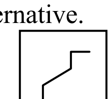

(x)

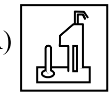
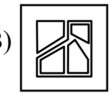
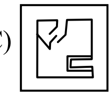
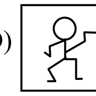
(A)  (B)  (C)  (D) 

5. **Directions** : In question, choose the set of figures which follows the given rule.
Rule : Closed figures become more and more open and open figures more and more closed.

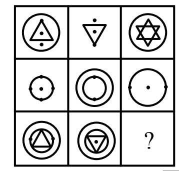
(A)  (B) 
(C)  (D) 

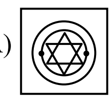
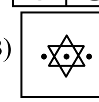
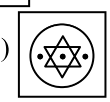
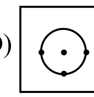
6. **Directions :** In question below, you are given a figure (X) followed by four figures (A), (B), (C) and (D) such that (X) is embedded in one of them. Trace out the correct alternative.


(x)

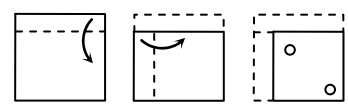
(A)  (B)  (C)  (D) 

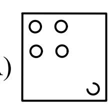
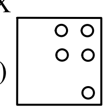
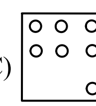
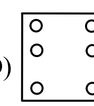
7. **Directions :** In following question, find out which of the answer figures (A), (B), (C) and (D) completes the figure – matrix ?



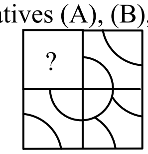
(A)  (B)  (C)  (D) 

8. **Directions :** The questions that follow contain a set of three figure X, Y and Z showing a sequence of folding of piece of paper. Fig. (Z) shows the manner in which the folded paper has been cut. These three figure are followed by four answer figure from which you have to choose a figure which would most closely resemble the unfolded form of figure. (Z)

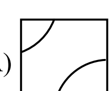
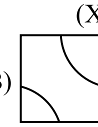
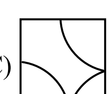
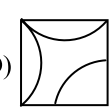

X Y Z

(A)  (B)  (C)  (D) 
A B C D

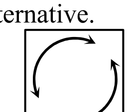
9. **Direction :** In following questions, complete the missing portion of the given pattern by selecting from the given alternatives (A), (B), (C) and (D).

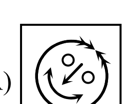
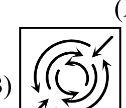
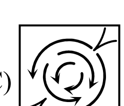


(X)

(A)  (B)  (C)  (D) 

10. **Directions :** In question below, you are given a figure (x) followed by four figures (A), (B), (C) and (D) such that (X) is embedded in one of them. Trace out the correct alternative.


(X)

(A)  (B)  (C)  (D) 

ENGLISH

1. Find the correctly spelt word –
(A) Geraff (B) Giraffe
(C) Giraf (D) Gerraffe

2. Find out that word where the spelling is wrong –
(A) Puncture (B) Puntuation
(C) Pudding (D) Pungent

3. Pick up the correct synonym for the following words
Plush :
(A) Luxurious (B) Delicious
(C) Comforting (D) Tasty

4. Choose the alternative which can replace the word printed in underline without changing the meaning of the sentence.
When he returned, he was accompanied by 'sprightly' young girl.
(A) Lively (B) Beautiful
(C) Sportive (D) Intelligent

5. Choose one alternative which is opposite in meaning to the given word :
Astute **:**
(A) Wicked (B) Impolite
(C) Cowardly (D) Foolish

6. Choose the word which is closest to the 'opposite' in meaning of the underlined word
Many snakes are 'innocuous' :
(A) Deadly (B) Ferocious
(C) Poisonous (D) Harmful

7. Choose the one which can be substituted for the given words/sentences :
Giving undue favours to one's kith and kin'
(A) Corruption (B) Worldliness
(C) Favouritism (D) Nepotism

8. Find out which one of the words given below the sentence can most appropriately replace the group of words underlined in the sentence :
The bus has to "go back and forth" every six hours.
(A) Cross (B) Shuttle
(C) Travel (D) Run

9. Read both the sentences carefully and decide on their correctness on the basis of the underlined words :
1. I am out of practise these days
2. I practice law
(A) Only 1 is correct
(B) Only 2 is correct
(C) Both the sentences 1 & 2 are correct
(D) Both the sentences 1 & 2 are incorrect

10. Which one of the two sentences given below is wrong on the basis of the underlined words :
1. He is a very "**ingenuous**" businessman.
2. I like him for his "**Ingenious**" nature.
(A) Sentence 1 is correct
(B) Sentence 2 is correct
(C) Both the sentences can be made correct by interchanging the underlined words.
(D) Both the sentences can not be interchanged hence, both are wrong

11. Choose from the given words below the two sentences, that word which has the same meaning and can be used in the same context as the part given underlined in both the sentences :
1. His "aloof" behaviour is an indication of his arrogance.
2. During our field visits we visited "remote" parts of Rajasthan.
(A) Far-off (B) Introvert
(C) Distant (D) Depressed

12. Find out which part of the sentence has an error. If there is no mistake, the answer is 'No error'.
"Meatless days" (a) / have been made (b) / into a film (c) / No Error (d)
(A) Meatless days (B) have been made
(C) into a film (D) No Error

13. Which part of the following sentence has an error ? If the sentence is correct, the answer will be 'No Error".
Looking forward (a) / to (b) / meet you here (c) / No Error (d)
(A) looking forward (B) to
(C) meet you here (D) No error

14. Choose the one which best expresses the meaning of the given Idiom/Proverb :
The '***pros and cons***'
(A) Good and Evil
(B) Former and Latter
(C) For and Against a thing
(D) Foul and Fair

15. Replace the underlined word with one of the given options :
The Second World War started in 1939.
(A) Broke out (B) Set out
(C) Took out (D) Went out

PHYSICS

1.[B] $V_2 = V_1 \dfrac{\alpha^2}{\beta}$

i.e. $[L_2T_2^{-1}] = [L_1T_1^{-1}]\ \dfrac{\alpha^2}{\beta}$ . . . (i)

$a_2 = a_1\alpha\beta$

i.e. $[L_2T_2^{-2}] = [L_1T_1^{-2}]\ \alpha\beta$ . . . (ii)

Also $F_2 = \dfrac{F_1}{\alpha\beta}$

i.e. $[M_2L_2T_2^{-2}] = [M_1L_1T_1^{-2}]\ \dfrac{1}{\alpha\beta}$ . . . (iii)

Dividing equation (iii) by equation (ii)

$M_2 = \dfrac{M_1}{(\alpha\beta)(\alpha\beta)} = \dfrac{M_1}{\alpha^2\beta^2}$

Squaring equation (i) and dividing by equation (ii)

$\dfrac{[L_2T_2T^2]}{[L_2T_2^{-2}]} = \dfrac{[L_1^2T_1^{-2}]}{[L_1T_1^{-2}]\alpha\beta}\ \dfrac{\alpha^4}{\beta^2}$ or $L_2 = L_1\dfrac{\alpha^3}{\beta^3}$

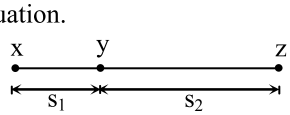
Dividing equation (i) by equation (ii)

$\dfrac{1}{T_2^{-1}} = \dfrac{1}{T_1^{-2}}\ \dfrac{\alpha^2}{\beta.\alpha\beta}$ or $T_2 = T_1\dfrac{\alpha}{\beta^2}$

2.[B] Let the driver apply brakes at y, then

$s_1 = 20 \times t$ . . . (1)

where t is the time taken by the driver to react to the situation.



Using $2as = v^2 - u^2$ we get

$-2 \times 2.5 \times S_2 = 0 - 20^2$ ($\because$ of retardation)

or $S_2 = \dfrac{400}{5} = 80$m

But $95 = s_1 + s_2$

or $s_1 = 95 - s_2 = 95 - 80 = 15$ m

From (1) $t = \dfrac{s_1}{20} = \dfrac{15}{20} = 0.75$ s

3.[A] Using $H = \dfrac{u^2 \sin\alpha}{2g}$ and $R = \dfrac{2u^2 \sin\alpha\cos\alpha}{g}$

We get $R^2 = \dfrac{4u^2}{g^2}\sin^2\alpha\cos^2\alpha$

Eliminating α_1,

$R^2 = \dfrac{4u^2}{g}\ \dfrac{2gH}{u^2}\left(1 - \dfrac{2gH}{u^2}\right) = \dfrac{8H}{g}(u^2 - 2gH)$

or $R = \left[\dfrac{8H}{g}(u^2 - 2gH)\right]^{1/2}$

$= \left[\dfrac{8\times 25}{9.8}(40^2 - 2\times 9.8\times 25)\right]^{1/2} = 150.5$ m

4.[D] Let P = Q = x and $R = \sqrt{2x}$ using $\vec{P} + \vec{Q} + \vec{R} = 0$,

we get $\vec{P} + \vec{Q} = -\vec{C}$

$(\vec{P} + \vec{Q}) \cdot (\vec{P} + \vec{Q}) = (-\vec{R}).(-\vec{R})$

Then $P^2 + Q^2 + 2PQ\cos\theta = R^2$

i.e., $x^2 + x^2 + 2x^2\cos\theta = 2x^2$

i.e. $\cos\theta = 0$, or $\theta = 90°$

Again $\vec{Q} + \vec{R} = -\vec{P}$

$(\vec{Q} + \vec{R})(\vec{Q} + \vec{R}) = (-\vec{P}) \cdot (-\vec{P})$

Then $Q^2 + R^2 + 2QR\cos\alpha = p^2$

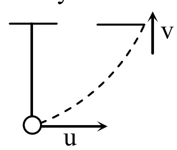
i.e., $x^2 + 2x^2 + 2\sqrt{2}\,x^2\cos\alpha = n^2$

i.e. $\cos\alpha = -\dfrac{1}{\sqrt{2}}$ or $\phi = 135°$

Third angle = 360 – (135 + 90) = 135°

5.[D] Here $v^2 - u^2 = -2g\ell$ . . . (i)

Since the velocities are mutually perpendicular, change in velocity



$\Delta v = \sqrt{u^2 - v^2} = \sqrt{u^2 + u^2 - 2g\ell}$

(Substituting the value of v^2 from (n)

or $\Delta v = \sqrt{2(u^2 - g\ell)}$

6.[C] Let a be the acceleration down the rough plane and a' be the acceleration down the frictionless plane. Taking L as the length of the inclined plane, we get

$a = g(\sin\theta - \mu\cos\theta)$

$= g\left(\frac{1}{\sqrt{2}} - \frac{\mu}{\sqrt{2}}\right)$ $(\because \theta = 45°)$

and $a' = g\sin\theta = g\frac{1}{\sqrt{2}}$

Then,

$L = \frac{1}{2}at_1^2 = \frac{1}{2}a'\,t_2^2$

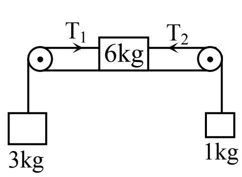
or $\frac{1}{2}g\left(\frac{1}{\sqrt{2}} - \frac{\mu}{\sqrt{2}}\right)t^2 = \frac{1}{2}\frac{g}{\sqrt{2}}\,t_2^2$

But $t_1 = nt_2$ . . . . (given)

$\therefore$ $\frac{1}{2}g\left(\frac{1}{\sqrt{2}} - \frac{\mu}{\sqrt{2}}\right)n^2t_2^2 = \frac{1}{2}\frac{g}{\sqrt{2}}\,t_2^2$

or $1 = (1-\mu)n^2$ or $\mu = \left(1 - \frac{1}{n^2}\right)$

7.[B]



Here $T_1 - T_2 = 6a$

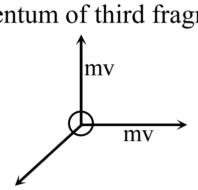
$T_2 - 1g = 1a$ and $3g - T_1 = 3a$

Addition of the above three equations give

$10a = 3g - 1g = 2g$

or $a = \frac{2}{10}g = \frac{2}{10} \times 10 = 2\ ms^{-2}$

8.[A] Here momentum of third fragment is



$P_3 = \sqrt{P_1^2 + P_2^2}$

or $P_3 = \sqrt{(mv)^2 + (mv)^2} = \sqrt{2}\,mv$

Final KE of the system

$= \frac{P_1^2}{2m} + \frac{P_2^2}{2m} + \frac{P_3^2}{2(2m)}$

$= \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + \frac{1}{2}mv^2 = \frac{3}{2}mv^2$

Since initial KE = 0 therefore energy released

$= \frac{3}{2}mv^2$

9.[A] In SHM, when acceleration is –ve maximum +ve maximum, the velocity is zero, so KE is also zero. Similarly for zero acceleration velocity is maximum so KE is also maximum.

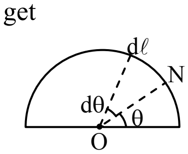
10.[D] Here $nT_1 = (n+1)T_2$

i.e. $\frac{n}{n+1} = \frac{T_2}{T_1} = \sqrt{\frac{\ell_2}{\ell_1}}$ $[\because T = 2\pi\sqrt{\frac{\ell}{g}}\,]$

$= \sqrt{\left(\frac{1}{1.44}\right)} = \frac{10}{12}$

or 2n = 10 i.e. n = 5 vibrations

11.[D] Let a unit mass be kept at O then taking $d\ell = rdQ$ as a small element and m/ℓ as mass per unit length, we get



$d\vec{E} = \frac{GM}{\ell}\frac{rd\theta}{r^2}(\hat{i}\cos\theta d\theta + \hat{j}\sin\theta d\theta)$

$\int_0^\pi d\vec{E} = \int_0^\pi \frac{GM}{\ell}\frac{rd\theta}{r^2}(\hat{i}\cos\theta d\theta + \hat{j}\sin d\theta)$

or $\vec{E} = \frac{2\pi GM}{\ell^2}$ along vertical (y axis) direction

12.[D] Here $X_{cm} = \frac{M \times 0 + m\ell/2}{m+M} = \frac{\ell m}{2(M+m)}$

13.[B] A rod is non uniform having mass per unit length as Here $X_{cm} = \frac{1}{M}\int_0^\ell ndm = \frac{1}{M}\int_0^\ell x(\mu dx)$

$= \frac{1}{M}\int_0^\ell x(ax)dx = \frac{a}{M}\int_0^\ell x^2dx = \frac{a\ell^3}{3M}$

Again $M = \int_0^{\ell} \mu dx = \int_0^{\ell} ax dx = \frac{a\ell^2}{2}$

$\therefore X_{cm} = \frac{a\ell^3 \times 2}{3(a\ell^2)} = \frac{2}{3}\ell$

14.[C] Using stress $= \frac{F}{A}$, we get

Stress at midpoint $= \frac{(m_2 g + \frac{m_1}{2} g)}{A}$

$= \frac{g(2m_2 + m_1)}{2A}$

15.[B] Comparing the given equation with

$y = A \sin \frac{2\pi}{\lambda}(vt + x)$

We find the v = 10 ms^{-1} but the wave is travelling along – ve x-axis because there is +ve sign between vt and x.

16.[A] Here $\frac{V_{51}}{V_{10}} = \frac{\nu_{51}}{\nu_{10}} = \sqrt{\frac{273+51}{273+10}} = \frac{18}{17}$

Since ν_{10} is less than ν_{51}, hence frequency of tuning for is less than frequency of air column

$\therefore\ \nu_{51} = \nu + 4$ and $\nu_{10} = \nu + 1$

$\therefore\ \frac{\nu+4}{\nu+1} = \frac{18}{17}$ i.e. $\nu = 50$

17.[D] Work done B to C = $P_2 (V_C - V_B)$

$= \mu_R (T_C - T_B)$

$= 6 \times R \times (2200 - 800)$

$= 6R \times 1400$

Work done D to A = $P_1(V_A - V_B)$

$= 6R \times (600 - 1200) = - 6R (600)$

Work done from A to B and B to C is zero because of a constant volume

$\therefore$ Total word done

$= 6R \times 1400 - 6R \times 600 = 6R (800)$

$= 50 \times 800 = 40000$ J

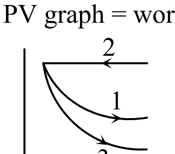
18.[D] Internal energy, $U = n\left[\frac{F}{2}RT\right]$

Where F is degree of freedom

Here $U = U_0 + U_{Ar}$

$= 2 \times \frac{5}{2}RT + 4 \times \frac{3}{2}RT = 11\ RT$

19.[A] Area under PV graph = work done



Here $area_2 > area_1 > area$

$\therefore\ W_2 > W_1 > W_3$

20.[D] Here $\frac{\pi p_1 A^4}{8\eta\ell} = \frac{\pi P_2 (2A)^4}{8\eta\ell}$

i.e. $P_1 = 16P_2$

Given that $P_1 + P_2 = 1$ m

$\therefore\ P_1 + \frac{P_1}{16} = 1$

or $P_1 = \frac{16}{17} = 0.94$ m

21.[B] Here $\left(\frac{T_1}{T_2}\right)^2 = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{r_1}{0.5r_1}\right)^3 = 8$

or $\frac{T_1}{T_2} = 2\sqrt{2}$

i.e. $T_2 = \frac{T_1}{2\sqrt{2}} = \frac{365}{2\sqrt{2}} = 129$ days

22.[B] Power $= \frac{\text{work done}}{\text{time}}$; $P = \frac{vq}{t}$

Here $V = mv = v \times 10^6$

and q/t = Q

$\therefore\ P = VQ \times 10^6$

23.[A] $E_x = -\frac{dV}{dx} = \frac{4-2}{(6-4)10^{-2}} = -100\ Vm^{-1}$

$E_y = \frac{dv}{dy} = \frac{2-4}{(2-1)10^{-2}} = 200\ Vm^{-1}$

24.[B] Side of plate = $\sqrt{A}$

Capacitance of air portion

$C_1 = \frac{\varepsilon_0 \sqrt{A}(\sqrt{A} - x)}{d} = \frac{\varepsilon_0 A - \varepsilon_0 \sqrt{A}x}{d}$

Capacitance = $C_1 + C_2$

$= \frac{\varepsilon_0 A}{d} - \frac{\varepsilon_0 \sqrt{A}x}{d} + \frac{\varepsilon_0 \varepsilon_r \sqrt{A}x}{d}$

$= \frac{\varepsilon_0}{d}(A - \sqrt{A}x + \varepsilon_r \sqrt{A}x)$

25.[D] Germanium is a semiconductor whereas copper is a metal conductor. A metal conductor has positive temperature coefficient of resistance whereas a semi-conductor has negative temperature coefficient of resistance. On cooling resistance of copper decreases whereas that of germanium increases.

26.[D] An ideal voltmeter has infinite resistance circuit current $I = \frac{60}{300+400} = \frac{3}{35}$ A

P.D. across 400 Ω is $\frac{3}{35} \times 400 = 34.3$ V

But the voltmeter reads 30 V across this resistor.
It simply mean that the voltmeter has error of 4.3 V

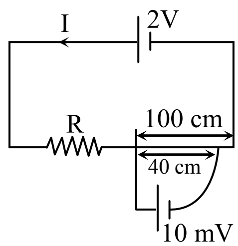
PD across 300 Ω = $300 \times \frac{3}{35} = 25.7$ V

Reading of same voltmeter = (25.7 – 4.3)
= 21.4 V

27.[A] Here $I = \frac{2}{10+R}$

Potential difference across 40 cm wire
= I × resistance of 40 cm of wire

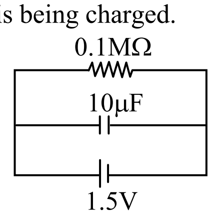
$= \frac{2}{10+R} \times 40 \left(\frac{10}{100}\right) = \frac{8}{10+R}$



But as per statement

$\frac{8}{10+R} = 10 \text{ mV} = 10 \times 10^{-3}$ or $R = 790\ \Omega$

28.[D] A parallel combination of 0.1 MΩ resistor and a 10 Here the capacitor is across 1.5 V and there is no resistance in series with capacitor while the capacitor is being charged.



Time constant RC is zero so time taken to get charge upto 0.75 V is nil.

29.[A] Magnetic field due to ab is zero because O lies on the extended wire itself.
Magnetic field due to infinite wire cd is

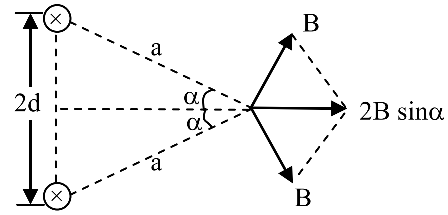
$B_1 = \frac{\mu_0}{4\pi r}(\sin 0^\circ + \sin 90^\circ) = \frac{\mu_0 i}{4\pi r}$

Magnetic field due to circular portion

$B_2 \frac{\mu_0}{4\pi} \frac{i\left(\frac{3}{4}2\pi r\right)}{r^2} = \frac{\mu_0 i}{4\pi r} \frac{3\pi}{2}$

$\therefore B = B_1 + B_2 = \frac{\mu_0 i}{4\pi r}\left(\frac{3}{2}\pi + 1\right)$

30.[D] Here $B_R = 2B \sin\alpha$ (∵ cos component cancel out)



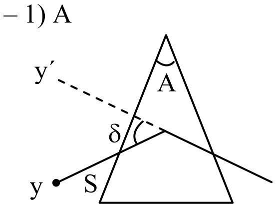
$= \frac{\mu_0 I}{2\pi a}\left(\frac{d}{a}\right) = \frac{\mu_0 I d}{\pi r^2}$

31.[B] Here τ = n.IAB sinθ, here θ is angle between magnetic induction and normal to the surface of loop. Here $A = \frac{1}{2} \times$ base × height

$= \frac{1}{2} \times 0.02 \times 0.02 \sin 60^\circ = 1.732 \times 10^{-4}$

$= 8.66 \times 10^{-1}$ Nm

32.[C] For a prism which in thin
$\delta = (\mu - 1) A$



Then $yy' = S \times \delta$ (∵ $\theta = \frac{\ell}{r}$)

$= S(\mu - 1)A = As(\mu - 1)$

33.[A] Here θ = 60s = 1′

$= \frac{1}{60} = \frac{\pi}{180} \times \frac{1}{60}$ rad.

Distance between persons $\ell = 3$ m using $v = \frac{\ell}{r}$

we get $v = \frac{\ell}{x} = \frac{3}{x}$

or $x = \frac{3}{v} = \frac{3 \times 180 \times 60}{\pi}$ or x = 10 km

34.[C] From the ray diagram of a compound microscope it is evident that intermediate image that is image formed by objective is real, inverted and magnified.

35.[D] Diffraction is observable if the width of slit is of the order of the wavelength of wave used. Since in the given problem wavelength of x-ray is too less than width of slit. So diffraction pattern will no be observed.

36.[B] Using $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$ when

$I_1 = I$ and $I_2 = 4I$

When $\phi = \frac{\pi}{2}$ (at A),

$I_A = I + 4I = 5I$

when $\phi = \pi$ (at B),

$I_B = I + 4I - 4I = I$ $\quad \therefore I_A - I_B = 4I$

37.[A] Using $(\mu - 1)t = \lambda$ we get

$(1.5 - 1)t = \lambda$ or $t = \frac{\lambda}{0.5} = 2\lambda$

38.[A] Using $P = \sqrt{2mE}$, we get

$$\frac{P_\alpha}{P_p} = \sqrt{\frac{2 \times 4m_p \times E_\alpha}{2 \times m_p \times \varepsilon_p}} = \sqrt{\frac{2 \times 4m_p \times E_\alpha}{2 \times m_p \times 16E_\alpha}} = \frac{1}{2}$$

But $\frac{\lambda_p}{\lambda_\alpha} = \frac{\lambda_\alpha}{P_p}$ $\therefore \frac{\lambda_P}{\lambda_a} = \frac{1}{2}$

39.[B] Using $E = \frac{nhc}{\lambda}$ we get

$$10^{-7} = \frac{n(6.6 \times 10^{-34})(3 \times 10^8)}{(5000 \times 10^{-10})}$$

$n = 2.5 \times 10^{11}$

40.[A] Using Moseley's law for $K\alpha$ line, we get

$$\frac{1}{\lambda} = \frac{3}{4}R(Z-1)^2$$

or $\frac{1}{0.76 \times 10^{-10}} = \frac{3}{4}(1.09 \times 107)(z-1)^2$

or $\frac{4 \times 10^3}{0.76} = 3 \times (1.09)(z-1)^2$

or $(z-1)^2 = \frac{4 \times 10^3}{0.76 \times 3 \times 1.09} \simeq 1000$ or $Z - 1 = 40$

or $Z = 41$

CHEMISTRY

1.[C] $mvr = \frac{nh}{2\pi} = 4 \times \frac{h}{2\pi} = \frac{2h}{\pi}$

2.[D] Meq. of Acid = Meq. of $Ba(OH)_2$

$\Rightarrow \frac{1.25}{M/2} \times 1000 = (0.25 \times 2) \times 25$

$\Rightarrow M = 200$

3.[B] $$\frac{r_{(H_2)}}{r_{(D_2)}} = \sqrt{\frac{M_{(D_2)}}{M_{(H_2)}}} = \sqrt{\frac{4}{2}} = \frac{\sqrt{2}}{1}$$

4.[A] From $K_p = K_c(RT)^{\Delta ng}$

$= 1.8 \times 10^{-4} \times (0.082 \times 298)^2 = 0.108$

5.[A] $\Delta H_{sublimation} = \Delta H_{fusion} + \Delta H_{vap}$

6.[D] In CH_3NH_2, N has one lone pair of electrons.

7.[D] $K_{sp} = 4s^3 = 4 \times 10^{-12} \Rightarrow s = 10^{-4}$ M

8.[A] Oxidant is the one whose O.N. decreases during the reaction. H_2SO_4 (O.N. of S = + 6) changes to SO_2 (O.N. of S = + 4)

9.[D] $$d = \frac{Z \times M}{a^3 \times N_A} = \frac{2 \times (3a \times 10^{-3})}{\left(\frac{4 \times 4.52 \times 10^{-3}}{2\sqrt{3}}\right)^3 \times 6.02 \times 10^{23}}$$

$= 900$ kg m^{-3}

10.[B] $$E_{cell} = E^0_{cell} + \frac{0.059}{n}\log\frac{[Cathode]}{[Anode]}$$

$$= [-0.0403 - (-0.763)] + \frac{0.059}{2}\log\frac{0.004}{0.2}$$

$$= +0.36 + \frac{0.059}{2}\log\frac{0.04}{2}$$

11.[D] $$\frac{\Delta P}{P^\circ} = \frac{W_B M_A}{M_B W_A}$$

or $M_B = \frac{W_B M_A}{W_A(\Delta P / P^\circ)}$

$\Rightarrow M_B = \frac{2.5 \times 78 \times 640}{39 \times 40} = 80$

12.[B] Adsorption is exothermic process due to attraction between adsorbate and adsorbent.

13.[A] $t = \frac{2.303}{k}\log\frac{a}{a-x}$

$= \frac{2.303}{6}\log\frac{0.5}{0.05}$

$= 0.384$ min

14.[B] 1 cm^3 H_2O = 1 g H_2O

No. of molecules in 1 g $H_2O = \frac{1 \times 6.023}{18} \times 10^{23}$

$= 3.3 \times 10^{22}$

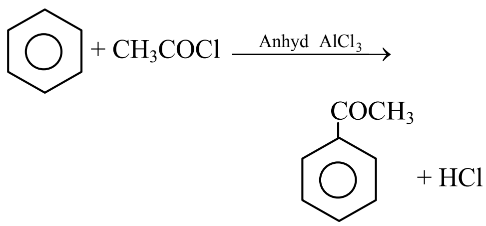
15.[D] Isocyanide test also known as carbylamine test.

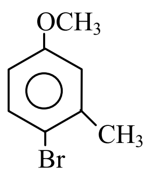
16.[A] 4-methyl benzene sulphonic acid is stronger than acetic acid thus it will release acetic acid from sodium acetate.

17.[A] $CH_3-CH_2-C\equiv CH + H_2O \xrightarrow[H_2SO_4]{HgSO_4}$
But–1–yne

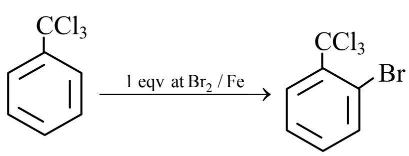
$CH_3-CH_2-\underset{\displaystyle OH}{\underset{|}{C}}=CH_2$

$\xrightarrow{\text{Keto-enol tautomerism}} CH_3-CH_2-\underset{\displaystyle O}{\underset{||}{C}}-CH_3$

18.[C] 

19.[B] 

20.[A] Libermann's reaction

21.[A] 

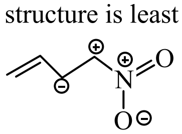
22.[B] $CH_2=CH_2 \xrightarrow{HOCl}$

$\underset{\displaystyle Cl}{\underset{|}{CH_2}}-\underset{\displaystyle OH}{\underset{|}{CH_2}} \xrightarrow{\text{aq } NaHCO_3} \underset{\displaystyle CH_2-OH}{\underset{|}{CH_2-OH}}$ (glycol)

23.[A] Free rotation around carbon-carbon bond takes place easily in alkanes. Now ethane and hexachloroethane both are alkanes, but in hexachloroethane bulky chlorine atom is present while ethane is least hindered.

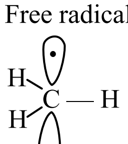
24.[C] Due to the presence of –Cl group which is a +M group.

25.[A] Due to similar charges on adjacent atom the structure is least stable.

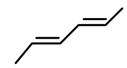


26.[B] $CH_3-CH_3 \xrightarrow[\text{bond fission}]{\text{Homolytic}} \underset{\text{methyl free radical}}{\dot{C}H_3+\dot{C}H_3}$

Free radical is formed which is sp^2 hybridised



27.[A] If atom or group of higher priority are on opposite direction at the double bond of each carbon atom then the configuration is known as E and if they are in same direction then the configuration is known as Z-configuration.

 (2E, 4E) – 2, 4-hexadiene

28.[C] The brown ring test for NO_2^- and NO_3^- is due to formation of $[Fe(H_2O)_5NO]^{2+}$

29.[A] The absorption of energy or observation of color in a complex transition compounds depend upon the charge of the metal ion and the nature of the ligand attached. The same metal ion with different ligands shows different absorption depending upon the type of ligand, the presence of weak field ligand make the central metal ion to absorb low energies i.e. of higher wavelength.

30.[C] The existance of Fe^{2+} and NO^+ in nitroprusside ion $[Fe(CN)_5NO]^{2-}$ can be established by measuring the magnetic moment of the solid compound which should correspond to $Fe^{2+} = 3d^6$ four unpaired electron.

31.[B] $LiNO_3$ on heating gives

$4LiNO_3 \xrightarrow{\Delta} 2Li_2O(s) + 4NO_2 + O_2$

32.[D] Three dimensional sheet structure are formed when three oxygen atoms of each $[SiO_4]^{4-}$ tetrahedral are shared.

33.[B] Due to oscillation of free electron Na metal shows metallic lusture.

34.[B] $Mn + 2HNO_3 \rightarrow Mn(NO_3)_2 + H_2$

35.[A] 'Lapis Lazuli' is the aluminium silicate present in the earth rocks as blue stone.

36.[B] B < C < N < O when we move from B to O in a periodic table the first ionization enthalpy increase due to the attraction of nucleus towards the outer most of electron and IE of N > O.

37.[B] $NO_2 \rightarrow sp$

$SF_4 \rightarrow sp^3d$

$PF_6^- \rightarrow sp^3d^2$

38.[A] Mg belongs to group 2. Therefore its size is less than that of Na.

39.[B] Alkali metal hydroxide KOH is highly soluble in water.

40.[B] $Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$

MATHEMATICS

1.[C] $y = 2x^2 - \log|x|$

$$\frac{dy}{dx} = 4x - \frac{1}{|x|} \times \frac{|x|}{x} = 4x - \frac{1}{x}$$

$$\frac{dy}{dx} = \frac{4(x+\frac{1}{2})(x-\frac{1}{2})}{x}$$

– + – +
–1/2 0 1/2

$\therefore$ y has minima at $x = -\frac{1}{2}$ and $x = \frac{1}{2}$ but x = 0 is not point of maxima as x = 0 is not in the domain.

2.[A] f(x) = 1 + x sin x [cos x]

$\because 0 < x \le \frac{\pi}{2} \Rightarrow 0 \le \cos x < 1$

$\Rightarrow [\cos x] = 0$

$\therefore f(x) = 1$

$\therefore$ f(x) is a constant function and hence continuous. It neither strictly increasing nor decreasing.

3.[B] It is given that $\left(\frac{Sr}{r}\right) \times 100 = 1$

$v = \frac{4}{3}\pi r^3 \Rightarrow \log v = \log \frac{4\pi}{3} + 3 \log r$

$\frac{1}{v}\delta v = \frac{3}{r}\delta r$

$\frac{\delta v}{v} \times 100 = \frac{3\delta r}{r} \times 100$

$= 3 \times 1 = 3$

Hence error in volume is with in 3 %

4.[C] Set A = {1, 2, 3} and R = {(1, 1), (2, 2)}

Since $(3, 3) \notin R$ it is not reflexive

Since R^{-1} = {(1, 1) (2, 2)} = R, R is symmetric

Since the situation in $(a, b), (b, c) \in R$ does not arise in R, R is also transitive.

Also $R \cap R^{-1} = \{(1, 1), (2, 2)\} \subset D_A = \{(1, 1) (2, 2) (3, 3)\}$

$\Rightarrow$ R is anti symmetric

Hence (ii) (iii) and (iv) are correct.

5.[C] $\{(A - B) \cup (B - C) \cup (C - A)\}^C = (A \cup B \cup C) - \{(A - B) \cup (B - C) \cup (C - A)\}$

$= A \cap B \cap C$ { $\because A \cup B \cup C$ = universal set}

6.[C] $(B^{-1}AB)^2 = (B^{-1}AB)(B^{-1}AB) = (B^{-1}ABB^{-1}AB)$

$= (B^{-1}AIAB) = (B^{-1}A^2B)$

$(B^{-1}AB)^3 = (B^{-1}AB)^2 (B^{-1}AB) = (B^{-1}A^2B)(B^{-1}AB)$

$= (B^{-1}A^2BB^{-1}AB) = (B^{-1}A^2IAB)$

$= (B^{-1}A^3B)$

Now $(B^{-1}AB)^4 = (B^{-1}AB)^3 (B^{-1}AB)$

$= (B^{-1}A^3B)(B^{-1}AB)$

$= B^{-1}A^4B$

7.[A] $\because g(0) = 0 \qquad \therefore \lim_{x\to 0} \frac{g(x)}{x} \left(\frac{0}{0}\right)$ form

$\therefore \lim_{x\to 0} g'(x) = g'(0) \qquad$ ... (1)

$$\because g(x) = \begin{vmatrix} f(x+\alpha) & f(x+2\alpha) & f(x+3\alpha) \\ f(\alpha) & f(2\alpha) & f(3\alpha) \\ f'(\alpha) & f'(2\alpha) & f'(3\alpha) \end{vmatrix}$$

$$\therefore g'(x) = \begin{vmatrix} f'(x+\alpha) & f'(x+2\alpha) & f'(x+3\alpha) \\ f(\alpha) & f(2\alpha) & f(3\alpha) \\ f'(\alpha) & f'(2\alpha) & f'(3\alpha) \end{vmatrix}$$

$\therefore g'(0) = 0$

$\lim_{x\to 0} \frac{g(x)}{x} = g'(0) = 0$

8.[A]
$$\Delta_1 = \begin{vmatrix} f & 2d & e \\ 2z & 4x & 2y \\ e & 2a & b \end{vmatrix} = -\begin{vmatrix} 2d & f & e \\ 4x & 2z & 2y \\ 2a & e & b \end{vmatrix} (C_1 \leftrightarrow C_2)$$

$$= \begin{vmatrix} 2d & e & f \\ 4x & 2y & 2z \\ 2a & b & e \end{vmatrix} (C_2 \leftrightarrow C_3)$$

$$= -\begin{vmatrix} 2a & b & e \\ 4x & 2y & 2z \\ 2d & e & f \end{vmatrix} (R_1 \leftrightarrow R_3)$$

$$= \begin{vmatrix} 2a & b & e \\ 2d & e & f \\ 4x & 2y & 2z \end{vmatrix} = \Delta_2 \; (R_2 \leftrightarrow R_3) \;\therefore \Delta_1/\Delta_2 = 1$$

9.[D] $\because$ All coins are identical

$\therefore$ First we will give 3 coin to each person so that every one has at least 3 rupee, now rest 5 coin we have to distribute among 5 person in such a way that any one can get any no. of coin.

$\therefore$ Total no. of ways

${}^{5+5-1}C_{5-1} = {}^9C_4 = 126$

{$\because$ No. of ways of distributing n identical thing among r person when any one can get any no. of thing is ${}^{n+r-1}C_{r-1}$

10.[C] $x_1 < x_2 \le x_3 < x_4 < x_5 \le x_6$ gives rise to the following four cases

$x_1 < x_2 < x_3 < x_4 < x_5 < x_6$

$x_1 < x_2 = x_3 < x_4 < x_5 < x_6$

$x_1 < x_2 < x_3 < x_4 < x_5 = x_6$

$x_1 < x_2 = x_3 < x_4 < x_5 = x_6$

$\therefore$ Total ways ${}^9C_6 + {}^9C_5 + {}^9C_5 + {}^9C_4$

$= {}^{10}C_6 + {}^{10}C_5 = {}^{11}C_6$

11.[D] $2\left\{1+\frac{a^2}{\underline{|2}}+\frac{a^4}{\underline{|4}}+....\right\} = e^a + e^{-a}$

$= e^{\ell n\, n} + e^{-\ell n\, n} = n + \frac{1}{n} = \frac{n^2+1}{n}$

12.[A] $\left(\sqrt{x}-\frac{2}{x}\right)^{18}$

Let $(r+1)^{th}$ term is independent of x

$\therefore r = \frac{18\times\frac{1}{2}-0}{\frac{1}{2}+1} = 6 \qquad \{\because r = \frac{n\alpha - m}{\alpha+\beta}\}$

$\therefore (r+1) = 7^{th}$ term is independ of x

$\therefore 7^{th}$ term is ${}^{18}C_6\,(\sqrt{x})^{18-6}\left(-\frac{2}{x}\right)^6$

$= {}^{18}C_6\, 2^6$

13.[C] $S = 1 + \frac{2}{3}.\frac{1}{2} + \frac{2.5}{3.6}\left(\frac{1}{2}\right)^2 + \frac{2.5.8}{3.6.9}\left(\frac{1}{2}\right)^3 + ...$

$= 1 + \frac{2/3}{1}\left(\frac{1}{2}\right) + \frac{(2/3)(5/3)}{\underline{|2}}\left(\frac{1}{2}\right)^2 + \frac{(2/3)(5/3)(8/3)}{\underline{|3}}\left(\frac{1}{2}\right)^3 + ...$

$= \left(1-\frac{1}{2}\right)^{-2/3} = \left(\frac{1}{2}\right)^{-\frac{2}{3}} = 2^{2/3} = 4^{1/3}$

14.[D] $\because \omega = \frac{-1+i\sqrt{3}}{2} \Rightarrow i\omega = \frac{-\sqrt{3}-i}{2}$

$\therefore \arg(i\omega) = \pi + \frac{\pi}{6}$

$\because \omega^2 = \frac{-1-i\sqrt{3}}{2} \Rightarrow i\omega^2 = \frac{\sqrt{3}-i}{2}$

$\therefore \arg(i\omega^2) = 2\pi - \frac{\pi}{6}$

$\therefore \arg i\omega + \arg i\omega^2 = 3\pi$

15.[A] $\because \frac{1}{\log_{2^r} 4} = \frac{1}{\frac{1}{r}\log_2 4} = \frac{r}{2}$

$\therefore \sum_{r=1}^{n}\frac{r}{2} = \frac{1}{2}\left(\frac{n(n+1)}{2}\right) = \frac{n(n+1)}{4}$

16.[C] $a_1 + a_8 + a_{15} = 3a_1 + 21d = 15$

$\Rightarrow a_1 + 7d = 5$

$a_2 + a_3 + a_8 + a_{13} + a_{14} = 5a_1 + 35d$

$= 5(a_1 + 7d)$

$= 5 \times 5 = 25$

17.[B] $\because b > 0 \qquad \therefore D \le 0$

$(a+c)^2 + 4b^2 - 4b(a+c) \le 0$

$\Rightarrow a^2 + c^2 + 2ac + 4b^2 - 4ab - 4bc \le 0$

$\Rightarrow (a + c - 2b)^2 \le 0$

$\Rightarrow 2b = a + c$ i.e. a, b, c are in A.P.

18.[C] $f(x) = (x-a_1)(x-a_3)(x-a_5) + 2(x-a_2)(x-a_4)(x-a_6) = 0$

$a_1 < a_2 < a_3 < a_4 < a_5 < a_6$

$f(a_1) = 2(a_1-a_2)(a_1-a_4)(a_1-a_6) < 0$

$f(a_2) = (a_2-a_1)(a_2-a_3)(a_2-a_5) > 0$

$\therefore$ At least one real root lies in (a_1, a_2)

Similarly, at least one real roots lies in each interval (a_3, a_4) and (a_5, a_6)

But f(x) is cubic, therefore there are only three roots.

Hence the equation f(x) = 0 has one real roots in each interval (a_1,a_2) (a_3,a_4) and (a_5,a_6)

19.[A] $xdx + zdy + (y+2z)dz = 0$

$\Rightarrow xdx + 2zdz + zdy + ydz = 0$

$xdx + 2zdz + d(yz) = 0$

$\frac{x^2}{2} + z^2 + yz = c$

20.[A] slope of tangent

$\frac{dy}{dx} = 2x + 1$

$\Rightarrow y = x^2 + x + C$

when x = 1, y = 2

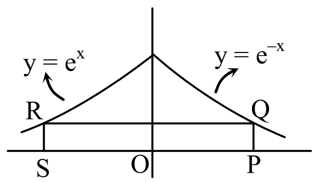
$\therefore 2 = 1 + 1 + C \Rightarrow C = 0$

$\therefore y = x^2 + x$

$\therefore$ Required area = $\int_0^1 (x^2 + x)\,dx$

$= \left[\frac{x^3}{3} + \frac{x^2}{2}\right]_0^1 = \frac{5}{6}$

21.[B]



$y = e^{-|x|} = \begin{cases} e^{-x} : x \ge 0 \\ e^{x} : x < 0 \end{cases}$

By symmetry

Let P = (t , 0) then

Q(t, e^{-t}), R = (–t, e^{-t})

and S = (– t, 0)

$\therefore$ Area of rectangle = $2te^{-t}$ = f(t) say

then $\frac{df}{dt} = 2\{-te^{-t} + e^{-t}\} = 0 \Rightarrow t = 1$

$\frac{d^2f}{dt^2} = 2\{-(1-t)e^{-t} - e^{-t}\} < 0$ for t = 1

Hence, maximum area 2/e

22.[C] $I = \int |\sin x|\,dx = \begin{cases} \int \sin x dx & \text{if } \sin x \ge 0 \\ -\int \sin x dx & \text{if } \sin x < 0 \end{cases}$

= – cos x + C if sin x ≥ 0

cos x + C if sin x < 0

= cos x . sgn (sinx) + C

$\{\because \text{sgn}(\sin x) = \frac{|\sin x|}{\sin x} = \begin{cases} 1 & ; \sin x > 0 \\ 0 & ; \sin x = 0 \\ -1 & ; \sin x < 0 \end{cases}$

23.[B] From the option $\frac{d}{dx}\frac{1}{2}\left(\log\frac{\phi(x)}{f(x)}\right)^2$

$= \log\left(\frac{\phi(x)}{f(x)}\right)\left\{\frac{f(x)\phi'(x) - \phi(x)f'(x)}{f(x)^2}\right\} \times \frac{f(x)}{\phi(x)}$

$= \frac{f(x)\phi'(x) - \phi(x)f'(x)}{f(x)\phi(x)} \times \log\left(\frac{\phi(x)}{f(x)}\right)$

$\therefore \int \frac{f(x)\phi' x - \phi(x)f'(x)}{f(x)\phi(x)} \log\frac{\phi(x)}{f(x)}\,dx$

$= \frac{1}{2}\left(\log\frac{\phi(x)}{f(x)}\right)^2 + C$

24.[D] $\frac{dy}{dx} = -\frac{c^2}{x^2}$

$\Rightarrow \left(\frac{dy}{dx}\right)_{(x',y')} = \frac{-c^2}{(x')^2} = -\frac{x'y'}{(x')^2} = -\frac{y'}{x'}$

$\therefore$ Equation of tangent at (x′,y′) is

$y - y' = -\frac{y'}{x'}(x - x')$

Which meets the co-ordinate axes at A and B (say) then A = (2x′, 0), B = (0, 2y′)

Mid point of AB is (x′, y′)

25.[D] D.R's of OP = a, a, ,a

$\therefore$ Equation of plane ⊥ to OP and passing through P is

a(x – a) + a(y – a) + a (z – a) = 0

$\Rightarrow$ x + y + z = 3a

Intercepts on axes made by the planes are

3a, 3a, 3a

$\therefore$ Sum of reciprocal of the intercepts

$= \frac{1}{3a} + \frac{1}{3a} + \frac{1}{3a} = \frac{1}{a}$

26.[C] $|\vec{a}|^2 = p^2 + 25 + 289 = p^2 + 314$

$|\vec{b}|^2 = 4q + 169 + 1 = 4q + 170$

According to question

$|\vec{a}|^2 = |\vec{b}|^2$

$\Rightarrow p^2 + 314 = 4q + 170$

$\Rightarrow p^2 = 4q - 144$

$= 4(q - 36)$

p, q are +ve integer

1 ≤ p, q ≤ 1000

p is even integer let p = 2 K then

$4K^2 = 4(q - 36) \Rightarrow K^2 = q - 36$

$\because 1 \le K^2 \le 964$

$\Rightarrow 1 \le K \le 31$

$\therefore$ Number of ordered pairs (p, q) = 31

27.[D] $\therefore |\vec{a} + \vec{b} + \vec{c}| = 1$

$\Rightarrow |\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 1$

$\Rightarrow \frac{1}{2} + \frac{1}{3} + \frac{1}{6} + 2(\vec{b}.\vec{a}) = 1 \quad \left\{\begin{matrix} \because \vec{c} = \lambda\vec{a} \times \vec{b} \\ \vec{c} \perp \vec{a} \text{ and } \vec{c} \perp \vec{b} \end{matrix}\right\}$

$\Rightarrow \vec{b}.\vec{a} = 0 \Rightarrow \vec{b} \perp \vec{a}$

$\therefore$ Angle between them is $\frac{\pi}{2}$

28.[D] $\frac{x^2}{8-a} + \frac{y^2}{a-2} = 1$ will represents an ellipse is

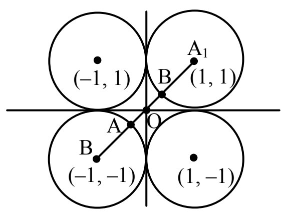
$8 - a > 0$, $a - 2 > 0$ and $8 - a \neq a - 2$

$\Rightarrow$ $a < 8$, $a > 2$ and $a \neq 5$

$\therefore$ $a \in (2, 8) - \{5\}$

29.[D] $y = x - 1$ is a focal chord of the parabola $y^2 = 4x$. Therefor tangent at its extremities are perpendiculars.

30.[D]



$A_1B_1 = 2\sqrt{2}$

$AB = 2\sqrt{2} - 2 = 2(\sqrt{2} - 1)$

$OA = \sqrt{2} - 1$

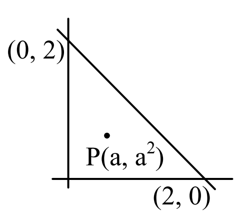
taking origin as centre and OA as radius circle will touches all four circle

$\therefore$ equation of circle is

$x^2 + y^2 = (\sqrt{2} - 1)^2$

$x^2 + y^2 = 3 - 2\sqrt{2}$

31.[A]



Clearly $a > 0$

Also P lies on that side of line $x + y = 2$

Where origin lies

$\therefore$ $a + a^2 - 2 < 0 \Rightarrow (a - 1)(a + 2) < 0$

$\Rightarrow$ $-2 < a < 1$ but $a > 0$

$\therefore$ $0 < a < 1$

$\therefore$ $a \in (0, 1)$

32.[D] Triangle is right angled at O(0, 0). Therefore orthocentre is O(0, 0) and circumcentre is mid point of hypotense i.e. $\left(\frac{a}{2}, \frac{b}{2}\right)$

$\therefore$ Distance between orthocentre and circumcentre

$= \frac{1}{2}\sqrt{a^2 + b^2}$

33.[B] Let $a = 3K$, $b = 7K$ and $c = 8K$

$\therefore$ $s = \frac{a+b+c}{2} = 9K$

there $\frac{R}{r} = \frac{abc}{4\Delta} \cdot \frac{s}{\Delta} = \frac{abcs}{4s(s-a)(s-b)(s-c)}$

$= \frac{3K.7K.8K}{4.6K\ 2K\ K} = \frac{7}{2} \Rightarrow \frac{R}{r} = \frac{7}{2}$

34.[D] $\sin x(\sin x + \cos x) = K$

$\Rightarrow$ $\sin^2 x + \sin x \cos x = K$

$\Rightarrow$ $\frac{1-\cos 2x}{2} + \frac{\sin 2x}{2} = K$

$\Rightarrow$ $\frac{1}{2}(\sin 2x - \cos 2x + 1) = K$

$\because$ $-\sqrt{2} \leq \sin 2x - \cos 2x \leq \sqrt{2}$

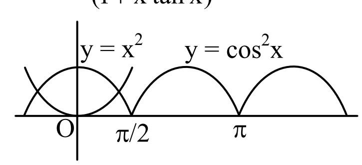
$\Rightarrow$ $\frac{1-\sqrt{2}}{2} \leq \frac{\sin 2x - \cos 2x + 1}{2} \leq \frac{\sqrt{2}+1}{2}$

$\Rightarrow$ $\frac{1-\sqrt{2}}{2} \leq K \leq \frac{\sqrt{2}+1}{2}$

35.[B] $y = f(x) = \frac{x}{1 + x\tan x}$

$\Rightarrow$ $\frac{dy}{dx} = \frac{1 + x\tan x - x(\tan x + x\sec^2 x)}{(1 + x\tan x)^2}$

$= \frac{1 - x^2\sec^2 x}{(1 + x\tan x)^2}$



$\frac{dy}{dx} = 0 \Rightarrow x^2 = \cos^2 x$

There is only one point in $(0, \frac{\pi}{2})$ say x, at which

$\frac{dy}{dx} = 0$

at $x_1 - h \Rightarrow x^2 < \cos^2 x$ $\therefore \frac{dy}{dx} > 0$

& at $x_1 + h \Rightarrow x^2 > \cos^2 x$ $\therefore \frac{dy}{dx} < 0$

$\therefore$ at x_1 slope change from + ve to – ve

$\therefore$ There is only one critical point

in $\left(0, \frac{\pi}{2}\right)$ at which f(x) has local maxima.

36.[B] $3\cos^2\theta - 2\sqrt{3}\sin\theta\cos\theta + 3\sin^2\theta = 0$

$(\sqrt{3}\cos\theta + \sin\theta)(\cos\theta - \sqrt{3}\sin\theta) = 0$

$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$ or $\tan\theta = -\sqrt{3}$

$\therefore \theta = n\pi + \frac{\pi}{6}$ or $\theta = n\pi - \frac{\pi}{3}$

$\therefore |r - s| = |-3 - 6| = 9$

37.[B] $\cot^{-1}\frac{n}{\pi} > \frac{\pi}{6} \Rightarrow \frac{\pi}{6} < \cot^{-1}\frac{n}{\pi} < \pi,\ n \in N$

$\{\because \cot^{-1}x \in 0\ (a, \pi)\}$

$\Rightarrow -\infty < \frac{n}{\pi} < \sqrt{3}$

$-\infty < n < \sqrt{3}\,\pi$

$-\infty < n < 5.4$

$\Rightarrow$ max. n = 5 $\{\because n \in N\}$

38.[A] $\therefore \tan\pi[x] = 0\ \forall\ x \in R$ since $[x] \in Z$

Period of $\{x\} = 1$

$\Rightarrow$ Period of $\sin 3\pi\{x\} = 1$

Hence period of f(x) = 1

39.[C] $f(x) = \cos^{-1}\sqrt{\log_{[x]}\left(\frac{|x|}{x}\right)}$

For domain $\frac{|x|}{x} > 0$

$\Rightarrow x \in (0, \infty)$

and $[x] > 0$ and $[x] \neq 1$

$\Rightarrow x \geq 2 \qquad \therefore x \in [2, \infty)$

$\Rightarrow \frac{|x|}{x} = 1$ then $\log_{[x]}\left(\frac{|x|}{x}\right) = 0$

$f(x) = \cos^{-1}0 = \frac{\pi}{2}$

40.[C] $\therefore f(a) = 0$

$\therefore \lim_{x\to a}\frac{\log_e\{1+6f(x)\}}{3f(x)}\ \left(\frac{0}{0}\right)$ form

$\Rightarrow \lim_{x\to a} 2\times\frac{\log_e\{1+6f(x)\}}{6f(x)} = 2\times 1 = 2$

$\because \lim_{x\to 0}\frac{\log_e\{1+x\}}{x} = 1$

41.[D] $\lim_{x\to 5^+}\frac{x^2-9x+20}{x-[x]}$

$= \lim_{h\to 0}\frac{(5+h)^2-9(5+h)+20}{5+h-[5+h]} = \lim_{h\to 0}\frac{h^2+h}{h} = 0$

$\lim_{x\to 4^-}\frac{x^2-9x+20}{x-[x]} = \lim_{h\to 0}\frac{(4-h)^2-9(4-h)+20}{4-h-[4-h]}$

$= \lim_{h\to 0}\frac{h^2+h}{1-h} = 0 \qquad \therefore P = 0$

42.[B] $f(1) = 0$

$f(1+0) = \lim_{h\to 0}\frac{[(1+h)^2]-1}{(1+h)^2-1} = \lim_{h\to 0}\frac{1-1}{2h+h^2} = 0$

$f(1-h) = \lim_{h\to 0}\frac{[(1-h)^2]-1}{(1-h)^2-1} = \lim_{h\to 0}\frac{0-1}{-2h+h^2} = \infty$

$\Rightarrow$ f(x) is discontinuous at x = 1

43.[A] $(a+bx)e^{y/x} = x$ ... (1)

Differentiating, w r.t. x we get

$be^{y/x} + (a+bx)e^{y/x}.\left(\frac{x.y_1 - y}{x^2}\right) = 1$

$\Rightarrow be^{y/x} + x.\left(\frac{xy_1-y}{x^2}\right) = 1\ \{\because (a+bx)e^{y/x} = x\}$

$\Rightarrow bxe^{y/x} + xy_1 - y = x$

$\Rightarrow xy_1 - y = x - bxe^{y/x}$

$\Rightarrow xy_1 - y = ae^{y/x}$ ... (2) (from (1))

$\Rightarrow xy_2 + y_1 - y_1 = ae^{y/x}\left[\frac{xy_1-y}{x^2}\right]$

$\Rightarrow x^3y_2 = ae^{y/x}(xy_1 - y) = (xy_1 - y)^2$ (from 2)

$\Rightarrow \frac{1}{y_2}(xy_1-y)^2 = x^3$

44.[B] $\int_{-2}^{3}f(x)dx = \int_{-2}^{-1}f(x)dxt\int_{-1}^{0}f(x)dx + \int_{0}^{1}f(x)dx$

$+\int_{1}^{2}f(x)dx + \int_{2}^{3}f(x)dx$

$= (-2)^3 + (-1)^3 + 0^3 + 1^3 + 2^3 = 0$

45.[B] $x^2f(x) + f\left(\frac{1}{x}\right) = 2$

$I = \int_{1/3}^{3}f(x)dx$ put $x = \frac{1}{t}$, $dx = -\frac{1}{t^2}dt$

$\Rightarrow I = -\int_{3}^{1/3}f\left(\frac{1}{t}\right).\frac{1}{t^2}dt = \int_{1/3}^{3}f\left(\frac{1}{x}\right).\frac{1}{x^2}dx$

$\Rightarrow 2I = \int_{1/3}^{3}\left(f(x)+\frac{1}{x^2}f\left(\frac{1}{x}\right)\right)dx$

$$= \int_{1/3}^{3} \left[x^2 f(x) + f\left(\frac{1}{x}\right) \right] \frac{1}{x^2} dx = \int_{1/3}^{3} \frac{2}{x^2} dx$$

$$= -2\left[\frac{1}{x}\right]_{1/3}^{3} = -2\left[\frac{1}{3} - 3\right] = \frac{16}{3}$$

$$\Rightarrow I = \frac{8}{3}$$

LOGICAL REASONING

1. [D] The pattern is $x^2 + 1, x^2 + 2, \ldots$
Missing number = 28 × 2 + 3 = 59

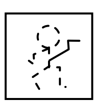
2. [A] A car runs on petrol and a television works by electricity.

3.[A] All except Titans are planets of the solar system.

4. [C]

5. [B]

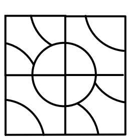
6. [D]



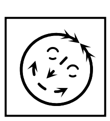
7.[B] The third figure in each row comprises of parts which are not common to the first two figure.

8. [A]

9. [C]



10.[A]



ENGLISH

1.[B] **Geraff :**
Incorrect spelling.
- 'e' should be replaced with 'i'
- The word should end with 'e' after 'ff'

Giraffe :
Correct spelling.
Giraf :
'fe' is to be added in the end.
Gerraffe :
- 'Ge' is to be replaced with 'Gi' to make the correct spelling.

2.[B] **Puncture :**
No error.
It makes the tyre flat.
Puntuation :
Error of spelling
Correct spelling is 'Punctuation'
Hence 'c' is missing.
Pudding :
No error
It is used as 'Dessert'
Pungent :
No Error
It is some what 'sharp' and 'shrill'.

3.[A] **Luxurious :** (Plush)
Something full of all 'amenities' making life 'cozy' and 'snug'.
Delicious : Irrelevant as it means 'something very tasty.'
Comforting : 'Irrelevant' as it means 'giving necessary comforts', whereas 'Plush' means more than comforts.
Tasty : (Irrelevant)
It means 'delicious'

4.[A] **Lively :** Correct synonym to 'sprightly' as both means, 'someone dashing/energetic/enthusiastic'.
Beautiful : (Irrelevant)
Sportive : (Irrelevant)
Intelligent : (Irrelevant)

5.[D] **Wicked :** It is almost a synonym to 'Astute'
Impolite : Irrelevant because it is the antonym of 'polite'.
Cowardly : Irrelevant as it is the opposite of 'bravely'.
Foolish : (It's the correct antonym of 'Astute' which itself means 'clever, shrewd'.

6.[D] **Deadly :** It means 'Fatal'.
Hence, this is not a proper antonym to 'innocuous'.
Ferocious : It means 'horrible'
Hence, irrelevant to the opposite of 'innocuous'.
Poisonous : It means 'venomous'.
Hence, an irrelevant 'antonym'.
Harmful : It is a perfect antonym of innocuous which itself means 'harmless'.

7.[D] **Corruption :**
Irrelevant
Worldliness :
Irrelevant
Favouritism :
Irrelevant

Nepotism : (Correct Answer) because
It's a kind of corruption in which the authority in power takes the advantage of giving opportunity to their relatives in their self interest.

8.[B] **Cross :** (to pass by, to intersect)
It means different
Hence, irrelevant.
Shuttle : (Proper answer)
It's a kind of "regular beats" of an air flight or bus service between the two stations.
Travel : It means to journey.
Hence, irrelavent.
Run : (to move regularly)
Hence, irrelevant.

9.[D] **Only 1 is correct :**
Inappropriate answer because sentence 1 can't be correct using 'practise' as it is a verb, whereas the required word should be a noun.
Only 2 is correct :
Sentence 2 is also wrong because the word 'practice' is wrongly used as a verb. It should be a verb like 'practise'. Hence, incorrect answer.
Both the sentences 1 and 2 are correct.
This is not relevant.
Both the sentences 1 and 2 are not correct.
Correct option, if both the words, i.e. 'practice' and 'practise' are interchanged respectively, it really makes a meaningful sentence.

10.[C] **Sentence 1 is correct :**
This option is wrong because the word 'ingenuous' means 'frank and simple' which is inappropriate.
Sentence 2 is correct :
This option is also wrong because the word 'ingenious' means 'clever or prudent' and this is inappropriate.
Both the words, i.e. 'ingenuous' and 'ingenious' if interchanged together respectively, it really makes both the sentences meaningful.
Hence, appropriate option.
Both the sentences can't be interchanged. This is an incorrect option because words have been misinterpreted together.
Incorrect option.

11.[C] **Far off :**
It can't be used in place of 'aloof' as far off' means long-long ago.
Hence, incorrect alternative .
Introvert : It means 'self-centred',
Hence, It is an incorrect alternative.
distance : This is an appropriate word because one of the meaning of 'aloof' is distant also while keeping distance between two nouns.
Depressed : (it means 'hopeless')
Hence, quite irrelevant.

12.[A] **"Meatless days"** This is the name of a novel. Hence, no error is there.
Have been made : (Erroneous)
Because 'have' should be replaced with 'has' because 'meatless days' is a singular noun.
Into a film :
No error in this part of the sentence.
No error : Incorrect option because there is an error in the sentence.

13.[C] **Looking forward :** (No error)
This is a phrase.
'to' (no error)
This is a preposition.
'Meet you here' (erroneous)
Because 'meet will be replaced with 'meeting'
Phrase 'looking forward to' is followed by present participle (V. I + ing) form of the Verb.
No error : (incorrect option)
Part 'C' is erroneous.

14.[C] **Good and Evil**
This is a wrong interpretation.
Former and Latter :
Wrong interpretation.
For and against a thing.
Appropriate option as it really suits the Idiom **ins and outs**.
Foul and Fair : (by hook or by crook)
This is an inappropriate option.

15.[A] **Broke out :** (to start suddenly)
'Correct and relevant' option because it is used for 'wars' and 'diseases' e.g. cholera broke out in Surat in 1985.
Set out : (to start)
it is different because it is used when one leaves for somewhere
e.g. He set out on his long voyage to Achilese.
took out : (incorrect use)
Because it means differently.
e.g. He took out a one rupee coin to give to the beggar.
Went out : (Incorrect use) Because meaning is different
e.g. : The light went out when I was preparing for my Board Exams.
Hence, inappropriate option.