BITSAT

Engineering Entrance Exam

Mathematics

1) If f: R $\rightarrow$ R and g : R $\rightarrow$ R are defined by f(x) = |x| and g(x) = [x - 3] for x$\in$ R, then

g f x $: -\frac{8}{5} < x < \frac{8}{5}$ is equal to

(a) {0, 1}

(b) {1, 2}

(c) {-3, -2}

(d) {2, 3}

2) For any integer n $\geq$ 1, the sum $\sum_{k=1}^{n} k\ k+2$ is equal to

(a) $\frac{n(n+1)(n+2)}{6}$

(b) $\frac{n(n+1)(2n+1)}{6}$

(c) $\frac{n(n+1)(2n+7)}{6}$

(d) $\frac{n(n+1)(2n+9)}{6}$

3) 9 balls are to be placed in 9 boxes and 5 of the balls cannot fit into 3 small boxes. The number of ways of arranging one ball in each of the boxes is

(a) 18720

(b) 18270

(c) 17280

(d) 12780

4) If ${}^{n}p_{r} = 30240$ and ${}^{n}C_{r} = 252$, then the ordered pair (n, r) is equal to

(a) (12, 6)

(b) (10, 5)

(c) (9, 4)

(d) (16, 7)

5) If $(1 + x + x^2 + x^3)^5 = \sum_{k=0}^{15} a_k x^k$ then $\sum_{k=0}^{7} a_{2k}$ is equal to

(a) 128

(b) 256

(c) 512

(d) 1024

6) If $a + P = -2$ and $a^3 + \beta^3 = -56$, then the quadratic equation whose roots are a and β is

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

(b) $x^2 + 2x + 15 = 0$

(c) $x^2 + 2x - 12 = 0$

(d) $x^2 + 2x - 8 = 0$

7) The cubic equation whose roots are thrice to each of the roots of $x^3 + 2x^2 - 4x + 1 = 0$ is

(a) $x^3 - 6x^2 + 36x + 27 = 0$

(b) $x^3 + 6x^2 + 36x + 27 = 0$

(c) $x^3 - 6x^2 - 36x + 27 = 0$

(d) $x^3 + 6x^2 - 36x + 27 = 0$

8) If $A = \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix}$ and $f(t) = t^2 - 3t + 7$, then

$f\ A\ +\ \begin{matrix} 3 & 6 \\ -12 & -9 \end{matrix}$ is equal to

(a) $\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}$

(b) $\begin{matrix} 0 & 0 \\ 0 & 0 \end{matrix}$

(c) $\begin{matrix} 0 & 1 \\ 1 & 0 \end{matrix}$

(d) $\begin{matrix} 1 & 1 \\ 0 & 0 \end{matrix}$

9) $\begin{matrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{matrix}$ is equal to

(a) 0

(b) a + b + c

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

(d) $(a + b + c)^3$

10) If co is a complex cube root of unity, then sin

$\omega^{10} + + \omega^{23}\ \pi - \frac{\pi}{4}$ is equal to

(a) $\frac{1}{\frac{}{2}}$

(b) $\frac{1}{2}$

(c) 1

(d) $\frac{\sqrt{3}}{2}$

11) $\sqrt{3}$ cosec 20° - sec 20° is equal to

(a) 2

(b) 2 sin 20° - cosec 40°

(c) 4

(d) 4 sin 20°, cosec 40°

12) If $\tan\theta + \tan(\theta + \frac{\pi}{3}) + \tan(\theta + \frac{2\pi}{3}) = 3$, then which of the following is equal to 1 ?

(a) $\tan 2\theta$

(b) $\tan 3\theta$

(c) $\tan^2\theta$

(d) $\tan^3\theta$

13) $\{x \in R: \cos 2x + 2\cos^2 x = 2\}$ is equal to

(a) $2n\pi + \frac{\pi}{3} : n \in Z$

(b) $n\pi \pm \frac{\pi}{6} : n \in Z$

(c) $n\pi + \frac{\pi}{3} : n \in Z$

(d) $2n\pi - \frac{\pi}{3} : n \in Z$

14) If $\sin^{-1}\frac{3}{x} + \sin^{-1}\frac{4}{x} = \frac{\pi}{2}$, then x is equal to

(a) 3

(b) 5

(c) 7

(d) 11

15) In ΔABC, *if* $\frac{1}{b+c} + \frac{1}{c+a} = \frac{3}{a+b+c}$, then C is equal to

(a) 90°

(b) 60°

(c) 45°

(d) 30°

16) In a triangle, if $r_1 = 2r_2 = 3r_3$, then $\frac{a}{b} + \frac{b}{c} + \frac{c}{a}$ is equal to

(a) $\frac{75}{60}$

(b) $\frac{155}{60}$

(c) $\frac{176}{60}$

(d) $\frac{191}{60}$

17) From the top of a hill h metres high the angles of depressions of the top and the bottom of a pillar are a and β respectively. The height (in metres) of the pillar is

(a) $\frac{h\tan\beta - \tan\alpha}{\tan\beta}$

(b) $\frac{h \tan\beta - \tan a}{\tan a}$

(c) $\frac{h \tan\beta + \tan a}{\tan\beta}$

(d) $\frac{h \tan\beta + \tan a}{\tan a}$

18) The position vectors of P and Q are respectively a and b, If R is a point on PQ PQ such that PR = 5 PQ, then the position vector of R is

(a) 5 b – 4 a

(b) 5 b + 4 a

(c) 4 b - 5a

(d) 4 b + 5a

19) If the position vectors of A, B and C are respectively 2ι - $\jmath$ + k, ι – 3$\jmath$ - 5k and 3ι – 4$\jmath$ - 4k, then $\cos^2$ A is equal to

(a) 0

(b) $\frac{6}{41}$

(c) $\frac{35}{41}$

(d) 1

20) Let a be a unit vector, b = 2ι + $\jmath$ - k and c = ι + 3k. Then, maximum value of [a b c] is

(a) -1

(b) $\sqrt{10} + \sqrt{6}$

(c) $\overline{10} - \overline{6}$

(d) $\overline{59}$

21) If A and B are independent events of a random experiment such that $P(A \cap B) = \frac{1}{6}$ and $P(A \cap \bar{B}) = \frac{1}{3}$, then P(A) is equal to (Here, $\bar{E}$ is the complement of the event E)

(a) $\frac{1}{4}$

(b) $\frac{1}{3}$

(c) $\frac{5}{7}$

(d) $\frac{2}{3}$

22) For k = 1, 2, 3 the box B_k contains k red balls and (k + 1) white balls, Let $P(B_1) = \frac{1}{2}$, $P(B_2) = 1$ and $P(B_3) = \frac{1}{6}$. A box is selected at random and a ball is drawn from it. If a red ball is drawn, then the probability that it has come from box B_2, is

(a) $\frac{35}{78}$

(b) $\frac{14}{39}$

(c) $\frac{10}{13}$

(d) $\frac{12}{13}$

23) If the sum of the distances of a point P from two perpendicular lines in a plane is 1, then the locus of P is a

(a) rhombus

(b) circle

(c) straight line

(d) pair of straight lines-

24) The transformed equation of $3x^2 + 3y^2 + 2xy = 2$. when the coordinate axes are rotated through an angle of 45°, is

(a) $x^2 + 2y^2 = 1$

(b) $2x^2 + y^2 = 1$

(c) $x^2 + y^2 = 1$

(d) $x^2 + 3y^2 = 1$

25) If l, m, n are in arithmetic progression, then the straight line lx + my + n = 0 will pass through the point

(a) (-1, 2)

(b) (1, -2)

(c) (1, 2)

(d) (2, 1)

26) A pair of perpendicular straight lines passes through the origin and also through the point of intersection of the curve $x^2 + y^2 = 4$ with x + y = a. The set containing the value of 'a' is

(a) {-2, 2}

(b) {-3, 3}

(c) {-4, 4}

(d) {-5, 5}

27) In Δ ABC the mid points of the sides AB, BC and CA are respectively (l, 0, 0), (0, m, 0) and (0, 0, n). Then,

$\frac{AB^2+BC^2+CA^2}{l^2+m^2+n^2}$ is equal to

(a) 2

(b) 4

(c) 8

(d) 16

28) If the lines 2x - 3y = 5 and 3x - 4y = 7 are two diameters of a circle of radius 7, then the equation of the circle is

(a) $x^2 + y^2 + 2x - 4y - 47 = 0$

(b) $x^2 + y^2 = 49$

(c) $x^2 + y^2 - 2x + 2y - 47 = 0$

(d) $x^2 + y^2 = 17$

29) The inverse of the point (1, 2) with respect to the circle $x^2 + y^2 - 4x - 6y + 9 = 0$, is

(a) $1, \frac{1}{2}$

(b) (2, 1)

(c) (0, 1)

(d) (1, 0)

30) If 2x + 3y + 12 = 0 and x - y + 4λ = 0 are conjugate with respect to the parabola y 2 = 8x, then λ is equal to

(a) 2

(b) - 2

(c) 3

(d) -3

31) The distance between the foci of the hyperbola $x^2 - 3y^2 - 4x - 6y - 11 = 0$ is

(a) 4

(b) 6

(c) 8

(d) 10

32) The radius of the circle with the polar equation $r^2 - 8r(\overline{3}\cos\theta + \sin\theta) + 15 = 0$ is

(a) 8

(b) 7

(c) 6

(d) 5

33) If $f : R \to R$ is defined by $f(x) = [x - 3] + |x - 4|$ for $x \in R$, then $\lim_{x \to 3} f\,x$ is equal to

(a) -2

(b) -1

(c) 0

(d) 1

34) If $f : R \to R$ is defined by

$f\ x\ = \begin{cases} \frac{\cos 3x - \cos x}{x^2} & , \ for\ x \neq 0 \\ \lambda & , \ for\ x = 0 \end{cases}$ and if f is continuous at x = 0, then λ is equal to

(a) -2

(b) -4

(c) -6

(d) -8

35) If f(2) = 4 and f'(2) = 1, then

$\lim_{x \to 2} \frac{x f\ 2\ - 2f\ x}{x-2}$ is equal to

(a) -2

(b) 1

(c) 2

(d) 3

36) If $x = a\ \cos\theta + \log\tan\ \frac{\theta}{2}$ *and* y = a sin θ, then $\frac{dy}{dx}$ is equal to

(a) cot θ

(b) tan θ

(c) sin θ

(d) cos θ

37) The equation of the normal to the curve $y^4 = ax^3$ at (a, a) is

(a) x + 2y = 3a

(b) 3x - 4y + a = 0

(c) $4x + 3y = 7a$

(d) $4x - 3y = 0$

38) The length of the sub tangent at (2, 2) to the curve $x^5 = 2y^4$ is

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

(b) $\frac{8}{5}$

(c) $\frac{2}{5}$

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

39) If $e^x \frac{1-\sin x}{1-\cos x} dx = f(x) +$ constant, then f(x) is equal to

(a) $e^x \cot \frac{x}{2} + c$

(b) $e^{-x} \cot \frac{x}{2} + c$

(c) $-e^x \cot \frac{x}{2} + c$

(d) $-e^{-x} \cot \frac{x}{2} + c$

40) If $\int e^x (1 + x) \cdot \sec^2 (xe^x) dx$

= f(x) + constant, then f(x) is equal to

(a) $\cos (xe^x)$

(b) $\sin (xe^x)$

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

(d) $\tan (x e^x)$

41) $\int_{-\pi/2}^{\pi/2} \sin x \, dx$ is equal to

(a) 0

(b) 1

(c) 2

(d) π

42) The area (in sq unit) of the region bounded by the curves $2x = y^2 - 1$ and $x = 0$ is

(a) $\frac{1}{3}$

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

(c) 1

(d) 2

43) The solution of the differential equation

$\frac{dy}{dx} = \frac{xy+y}{xy+x}$ is

(a) $x + y - \log \left| \frac{cy}{x} \right|$

(b) $x + y = \log (cxy)$

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

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

44) The solution of the differential equation

$\frac{dy}{dx} - y \tan x = e^x \sec x$ is

(a) $y = e^x \cos x + c$

(b) $y \cos x = e^x + c$

(c) $y = e^x \sin x + c$

(d) $y \sin x = e^x + c$

45) The solution of the differential equation

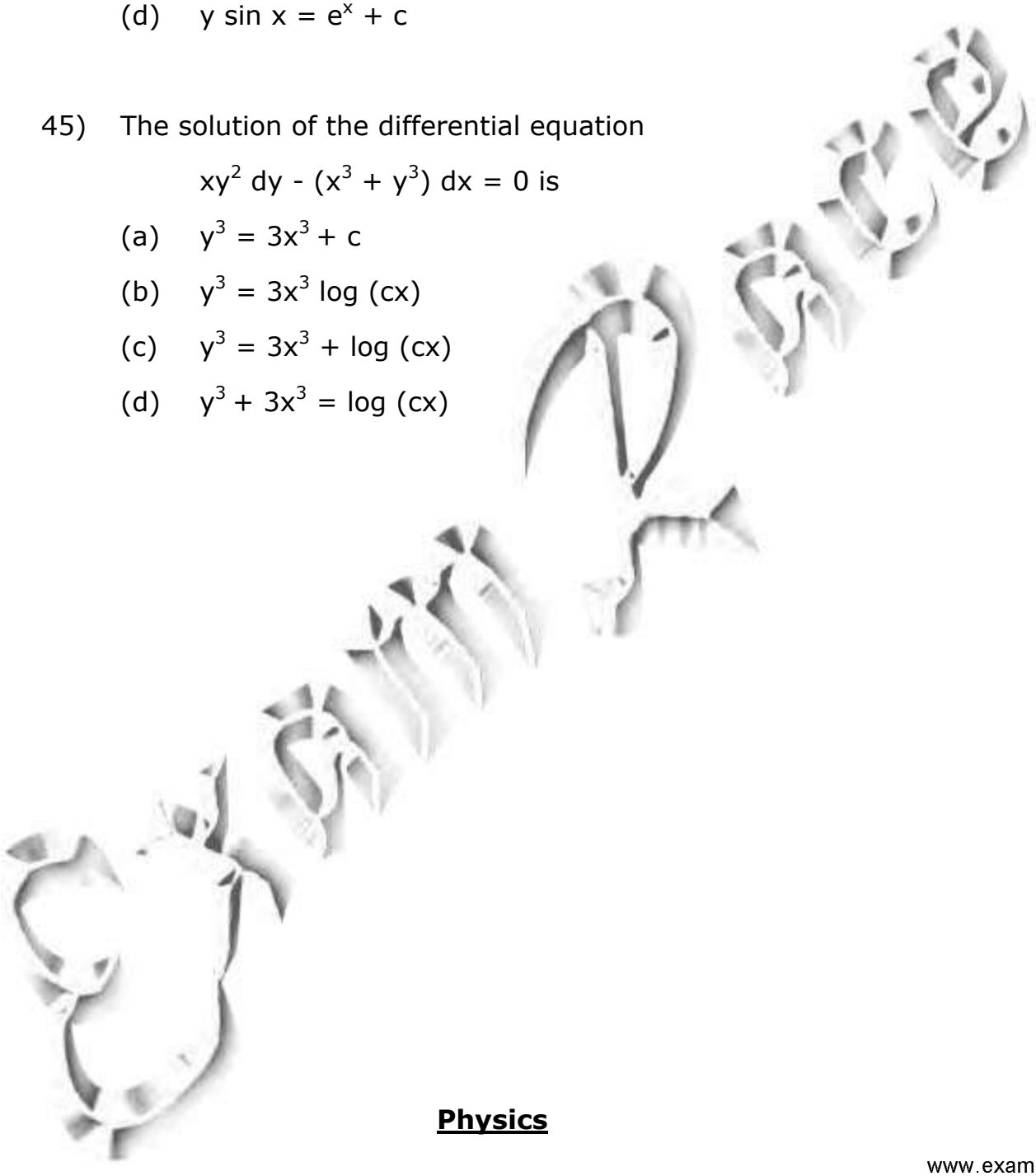
$xy^2\, dy - (x^3 + y^3)\, dx = 0$ is

(a) $y^3 = 3x^3 + c$

(b) $y^3 = 3x^3 \log (cx)$

(c) $y^3 = 3x^3 + \log (cx)$

(d) $y^3 + 3x^3 = \log (cx)$



Physics

46) The energy (E), angular momentum (L) and universal gravitational constant (G) are chosen as fundamental quantities. The dimensions of universal gravitational constant in the dimensional formula of Planck's constant (h) is

(a) Zero

(b) -1

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

(d) 1

47) The component of vector $A = a_x\, \iota + a_y\, \jmath + a_z\, k$ along the direction of $\iota - \jmath$ is

(a) $a_x - a_y + a_z$

(b) $a_x - a_y$

(c) $(a_x - a_y)/\ \overline{2}$

(d) $(a_x + a_y + a_z)$

48) A body thrown vertically up to reach its maximum height in t second. The total time from the time of projection to reach a point at half of its maximum height while returning (in second) is

(a) $\overline{2}\, t$

(b) $1 + \frac{1}{\overline{2}}\ t$

(c) $\frac{3t}{2}$

(d) $\frac{t}{\overline{2}}$

49) If a body is projected with an angle e to the horizontal, then

(a) its velocity is always perpendicular to its acceleration

(b) its velocity becomes zero at its maximum height

(c) its velocity makes zero angle with the horizontal at its maximum height

(d) the body just before hitting the ground, the direction of velocity coincides with the acceleration

50) A river of salty water is flowing with a velocity 2 m/s, If the density of the water is 1.2 g/cc, then the kinetic energy of each cubic metre of water is

(a) 2.4 J

(b) 24 J

(c) 2.4 kJ

(d) 4.8 kJ

51) A ball is dropped from a height h on a floor of coefficient of restitution e. The total distance covered by the ball just before second hit is

(a) $h(1 - 2e^2)$

(b) $h(1 + 2e^2)$

(c) $h(1 + e^2)$

(d) he^2

52) Two particles A and B initially at rest, move towards each other, under mutual force of attraction. At an instance when the speed of A is v and speed of B is 2v, the speed of centre of mass (CM) is

(a) Zero

(b) v

(c) 2.5v

(d) 4v

53) Starting from rest, the time taken by a body sliding down on a rough inclined plane at 45° with the horizontal is, twice the time taken to travel on a smooth plane of same inclination and same distance. Then the coefficient of kinetic friction is

(a) 0.25

(b) 0.33

(c) 0.50

(d) 0.75

54) A steel wire can withstand a load up to 2940 N. A load of 150 kg is suspended from a rigid support. The maximum angle through which the wire can be displaced from the mean position, so that the wire does not break when the load passes through the position of equilibrium, is

(a) 30°

(b) 60°

(c) 80°

(d) 85°

55) The moment of inertia of a thin circular disc about an axis passing through its centre and perpendicular to its plane is 1. Then, the moment of inertia of the disc about an axis parallel to its diameter and touching the edge of the rim is

(a) I

(b) 2 I

(c) $\frac{3}{2}$ I

(d) $\frac{5}{2}$ I

56) The orbit of geo-stationary satellite is circular, the time period of satellite depends on –

(i) mass of the satellite

(ii) mass of the earth

(iii) radius of the orbit

(iv) height of the satellite from the surface of earth

Which of the following is correct?

(a) (i) only

(b) (i) and (ii)

(c) (i), (ii) and (iii)

(d) (ii), (iii) and (iv)

57) A particle is executing simple harmonic motion with an amplitude A and time period T. The displacement of the particles after 2 T period from its initial position is

(a) A

(b) 4 A

(c) 8 A

(d) Zero

58) A load of 1 kg weight is a attached to one end of a steel wire of area of cross-section 3 mm^2 and Young's modulus 10^{11} N/m^2. The other end is suspended vertically from a hook on a wall, then the load is pulled horizontally and released. When the load passes through its lowest position the fractional change in length is ($g = 10\ m/s^2$)

(a) 0.3×10^{-4}

(b) 0.3×10^{-3}

(c) 0.3×10^{3}

(d) 0.3×10^{4}

59) The surface tension of soap solution is 0.03 N/m. The work done in blowing to form a soap bubble of surface area 40 cm^2, (in J), is

(a) 1.2×10^{-4}

(b) 2.4×10^{-4}

(c) 12×10^{-4}

(d) 24×10^{-4}

60) Two rain drops reach the earth with different terminal velocities having ratio 9: 4. Then the ratio of their volumes is

(a) 3 : 2

(b) 4 : 9

(c) 9 : 4

(d) 27 : 8

61) One litre of oxygen at a pressure of 1 atm and two litres of

nitrogen at a pressure of 0.5 atm, are introduced into a vessel of volume 1 L. If there is no change in temperature, the final pressure of the mixture of gas (in atm) is

(a) 1.5

(b) 2.5

(c) 2

(d) 4

62) There is some change W length when a 33000 N tensile force is applied on a steel rod of area of cross-section 10^{-3} m^2. The change of temperature required to produce the same elongation, if the steel rod is heated, is (The modulus of elasticity is $3 \times 10^{11} N/m^2$ and the coefficient of linear expansion of steel is $1.1 \times 10^{-5}/^oC$).

(a) 20°C

(b) 15°C

(c) 10°C

(d) 0°C

63) In the adiabatic compression, the decrease in volume is associated with

(a) increase in temperature and decrease in pressure

(b) decrease in temperature and increase in pressure

(c) decrease in temperature and decrease in pressure

(d) increase in temperature and increase in pressure

64) Which of the following is true in the case of an adiabatic process?

where $\gamma = C_p / C_v$?

(a) $p^{1-\gamma} T^{1-\gamma}$ = constant

(b) $p^{\gamma} T^{1-\gamma}$ = constant

(c) pT^{γ} = constant

(d) $p^{\gamma} T$ = constant

65) Two slabs A and B of equal surface area are placed one over the other such that their surfaces are completely in contact. The thickness of slab A is twice that of B. The coefficient of thermal conductivity or slab A is twice that of B. The first surface of slab A is maintained at 100°C, while the second surface of slab B is maintained at 25°C. The temperature at the contact of their surfaces is

(a) 62.5°C

(b) 45°C

(c) 55°C

(d) 85°C

66) When a sound wave or wavelength A. is propagating in a medium, the 'maximum velocity of the particle is equal to the wave velocity. The amplitude of wave is

(a) λ

(b) $\frac{\lambda}{2}$

(c) $\frac{\lambda}{2\pi}$

(d) $\frac{\lambda}{4\pi}$

67) A car is moving with a speed of 72 km/h towards a hill. Car blows horn at a distance of 1800 m from the hill. If echo is heard after 10 s, the speed of sound (in m/s) is

(a) 300

(b) 320

(c) 340

(d) 360

68) The refractive index of a material of a planoconcave lens is 5/3, the radius of curvature is 0.3 m. The focal length of the lens in air is

(a) - 0.45 m

(b) - 0.6 m

(c) - 0.75 m

(d) -1.0 m

69) **Statement (S):** Using Huygen's eye-piece measurements can be taken but are not correct.

Reason (R): The cross wires, scale .and final image are not magnified proportionately because the image of the object is magnified by two lenses, whereas the cross wire scale is magnified by one lens only.

Identify the correct one of the following

(a) Both (S) and (R) are true, (R) explains (S).

(b) Both (S) and (R) are true, but (R) canner explain (S).

(c) Only (S) is correct, but (R) is wrong.

(d) Both-(S) and (R) are wrong.

70) An achromatic combination of lenses produces –

(a) images in black and white

(b) coloured images ,

(c) images unaffected by variation of refractive index with wavelength

(d) highly enlarged images are formed

71) In Fraunhofer diffraction experiment, L is the distance between screen and the obstacle, b is the size of obstacle and A. is wavelength of incident light. The general condition for the applicability of Fraunhofer diffraction is

(a) $\frac{b^2}{L\lambda} \gg 1$

(b) $\frac{b^2}{L\lambda} = 1$

(c) $\frac{b^2}{L\lambda} \ll 1$

(d) $\frac{b^2}{L\lambda} \neq 1$

72) With a standard rectangular bar magnet 'the time period of a vibration magnetometer is 4 s. The bar magnet is cut parallel to its length into four equal pieces. The time period of vibration magnetometer when one piece is used (in second) (bar magnet breadth is, small) is

(a) 16

(b) 8

(c) 4

(d) 2

73) The magnetised wire of moment M and length l is bent in the form of semicircle of radius r. Then its magnetic moment is

(a) $\frac{2M}{\pi}$

(b) 2M

(c) $\frac{M}{\pi}$

(d) zero

74) A charge of 1 π C is divided into two parts such that their charges are in the ratio of 2: 3. These two charges are kept at a distance 1 m apart in vacuum. Then, the electric force between them (in N) is

(a) 0.216

(b) 0.00216

(c) 0.0216

(d) 2.16

75) Two charges +q and -q are kept apart. Then at any point on the right bisector of line joining the two charges

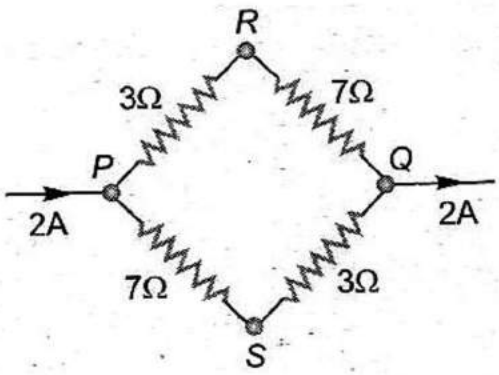
(a) The electric field strength is zero

(b) The electric potential is zero

(c) Both electric potential and electric field strength are zero

(d) Both electric potential and electric field strength are non-zero

76) A current of 2 A flows in an electric circuit as shown in figure. The potential difference (V_R - V_S), in volts (V_R and V_S are potentials at R and S respectively) is



(a) -4

(b) +2

(c) +4

(d) -2

77) When a battery connected across a resistor of 16Ω, the voltage across the resistor is 12 V. When the same battery is connected across a resistor of 10 Ω, voltage across it is 11 V. The internal resistance of the battery (in ohm) is

(a) $\frac{10}{7}$

(b) $\frac{20}{7}$

(c) $\frac{25}{7}$

(d) $\frac{30}{7}$

78) One junction of a certain thermoelectric couple is at a fixed temperature T, and the other junction is at temperature T. The thermo-electromotive force for this is expressed by

$E = k\ T - T_r\ \ T_0 - \frac{1}{2}\ T + T_2$. At temperature T = $\frac{1}{2}$ T_0, the thermoelectric power is

(a) 19 G

(b) $\frac{G}{19}$

(c) 20 G

(d) $\frac{G}{20}$

79) In a galvanometer 5% of the total current in the circuit passes through it. If the resistance of the galvanometer is G, the shunt resistance 5 connected to the galvanometer is

(a) 19 G

(b) $\frac{G}{19}$

(c) 20 G

(d) $\frac{G}{20}$

80) Two concentric coils of 10 turns each are placed in the same plane. Their radii are 20 cm and 40 cm and carry 0.2 A and 0.3 A. current respectively in opposite directions. The magnetic induction (in tesla) at the centre is

(a) $\frac{3}{4}\mu_0$

(b) $\frac{5}{4}\mu_0$

(c) $\frac{7}{4}\mu_0$

(d) $\frac{9}{4}\mu_0$

81) The number of turns in primary- and secondary coils of a transformer is 50 and 200 respectively. If the current in the primary coil is 4 A, then the current in the secondary coil is

(a) 1 A

(b) 2 A

(c) 4 A

(d) 5 A

82) X-rays of wavelength 0.140 nm are scattered' from a block of carbon. What will be the wave lengths of X-rays scattered at 90° ?

(a) 0.140 nm

(b) 0.142 nm

(c) 0.144 nm

(d) 0.146 nm

83) An X-ray tube produces a continuous spectrum of radiation with its shortest wavelength of 45×10^{-2} Å. The maximum energy of a photon in the radiation in eV is ($h = 6.62 \times 10^{-34}$ J-s, $c = 3 \times 10^{8}$ m/s)

(a) 27,500

(b) 22,500

(c) 17,500

(d) 12,500

84) F_{pp}, F_{nn} and F_{np} are the nuclear forces between proton-proton, neutron-neutron and neutron-proton respectively. Then relation between them is

(a) $F_{pp} = F_{nn} \neq P_{np}$

(b) $F_{pp} \neq F_{nn} = F_{np}$

(c) $F_{pp} = F_{nn} = F_{np}$

(d) $F_{pp} \neq F_{nn} \neq F_{np}$

85) Which of the following statements is not correct when a junction diode is in forward bias?

(a) The width of depletion region decreases.

(b) Free electrons on n-side will move towards' the junction.

(c) Holes on p-side move towards the junction.

(d) Electron on n-side and holes on p-side will move away from junction.

86) An electronic transition in hydrogen atom results - in the formation of H_a line of hydrogen in Lyman series, the energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are

(a) -313.6, - 34.84

(b) -313.6, -78.4

(c) -78.4, - 34.84

(d) -78.4, -19.6

87) The velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times the mass of A. The ratio of their de- Broglie's wavelength is

(a) 2 : 1

(b) -1: 4

(c) 1 : 1

(d) 4 : 1

88) If the mass defect of $_5B^{11}$ is 0.081 u, its average binding energy (in MeV) is

(a) 8.60

(b) 6.85

(c) 5.60

(d) 5.86

89) The atomic numbers of elements A, B, C and D are Z - 1, Z, Z + 1 and Z + 2, respectively. If 'B' is a noble gas, choose the correct answers from the following statements

(1) 'A' has higher electron affinity

(2) 'C" exists in +2 oxidation state

(3) 'D' is an alkaline earth metal

(a) (1) and (2)

(b) (2) and (3)

(c) (1) and (3)

(d) (1), (2) and (3)

90) The bond length of HCI molecule is 1.275 Å and its dipole moment is 1.03 D. The ionic character of the molecule (in percent) (charge of the electron = 4.8×10^{-10} esu) is

(a) 100

(b) 67.3

(c) 33.66

(d) 16.83

91) Which one of the following is a correct set?

(a) H_2O, Sp^3, angular

(b) BCl_3, Sp^3, angular

(c) NH^+_4, dsp^2, square planar

(d) CH_4, dsp^2, tetrahedral

92) Match the following:

	List-I		List-II (At STP)
(A)	10 g $CaCO_3$ $\xrightarrow[\text{decomposition}]{\Delta}$	(i)	0.224 L CO_2
(B)	1.06 g Na_2CO_3 $\xrightarrow{\text{Excess HCl}}$	(ii)	4.48 L CO_2
(C)	2.4 g C $\xrightarrow[\text{combustion}]{\text{Excess } O_2}$	(iii)	0.448 L CO_2
(D)	0.56 g CO $\xrightarrow[\text{combustion}]{\text{Excess } O_2}$	(iv)	2.24 L CO_2
		(v)	22.4 L CO_2

The correct match is

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

(c) iv i iii ii

(d) i iv ii iii

93) What is the temperature at which the kinetic energy of 0.3 moles of helium is equal to the kinetic energy of 0.4 moles of argon -at 400 K?

(a) 400 K

(b) 873 K

(c) 533 K

(d) 300 K

94) When 25 g of a non-volatile solute is dissolved in 100.g of water, the vapour pressure is lowered by 2.25×10^{-1} mm. If the vapour pressure of water at 20°C is 17.5 mm, what is the molecular weight of the solute?

(a) 206

(b) 302

(c) 350

(d) 276

95) 50 mL of H_2O is added to 50 mL of 1×10^{-3} M barium hydroxide solution. What is the pH of the resulting solution?

(a) 3.0

(b) 3.3

(c) 11.0

(d) 11.7

96) **Assertion (A):** The aqueous solution of CH_3COONa is alkaline in nature.

Reason (R): Acetate ion undergoes anionic hydrolysis

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.

97) When same quantity of electricity is passed through aqueous $AgNO_3$ and H_2SO_4 solutions connected in series, 5.04×10^{-2} g of H_2 is liberated. What is the mass of silver (in grams) deposited? (Eq. wts. of hydrogen = 1. 008, silver = 108)

(a) 54

(b) 0.54

(c) 5.4

(d) 10.8

98) When electric current is passed through acidified water for 1930 s, 1120 mL of H_2 gas is collected (at STP) at the cathode. What is the current passed in amperes?

(a) 0.05

(b) 0.50

(c) 5.0

(d) 50

99) For a crystal, the angle of diffraction (2θ) is 90° and the second order line has a d value of 2.28 Å. The wavelength (in Å) of X-rays used for Bragg's diffraction is

(a) 1.612

(b) 2.00

(c) 2.28

(d) 4.00

100) In a 500 mL flask, the degree of dissociation of PCl_5 at equilibrium is 40% and the initial amount is 5 moles. The value of equilibrium constant in mol L^{-1} for the decomposition of PCl_5 is

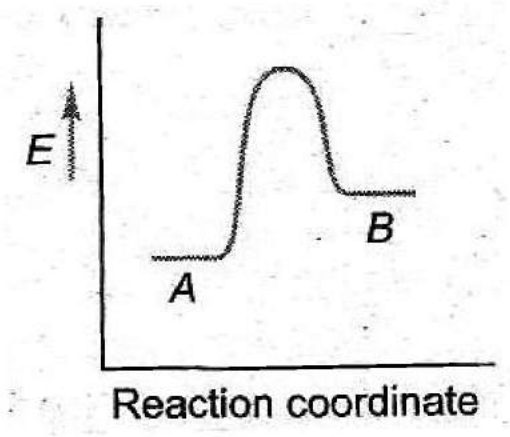
(a) 2.33

(b) 2.66

(c) 5.32

(d) 4.66

101) For a reversible reaction A ⇌ B, which one of the following statements is wrong from the given energy profile diagram?



(a) Activation energy of forward reaction is greater than backward reaction

(b) The forward reaction is endothermic

(c) The threshold energy is less than that of activation energy

(d) The energy of activation of forward reaction is equal to the sum of heat of reaction and the energy of activation of backward reaction

102) Calculate ΔH in kJ for the following reaction

$C(g) + O_2(g) \rightarrow CO_2(g)$

Given that,

$H_2O(g) + C(g) \rightarrow CO(g) + H_2(g)$;

$\Delta H = +131$ kJ

$CO\ g + \frac{1}{2} O_2\ g \rightarrow CO_2\ g$;

$\Delta H = -282$ kj

$H_2\ g + \frac{1}{2} O_2\ g \rightarrow H_2\ O\ g$;

$\Delta H = -242$ kj

(a) -393

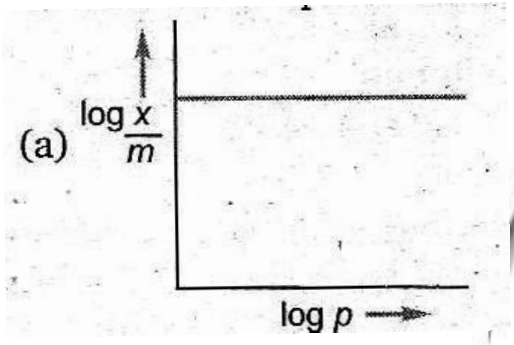
(b) +393

(c) +655

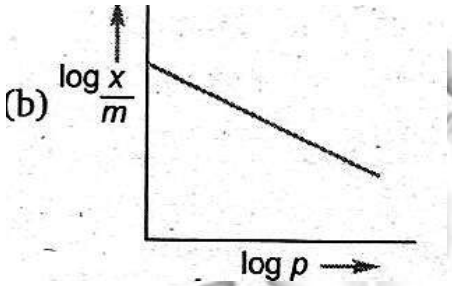
(d) -655

103) Which one of the following graphs represents "Freundlich adsorption isotherm?

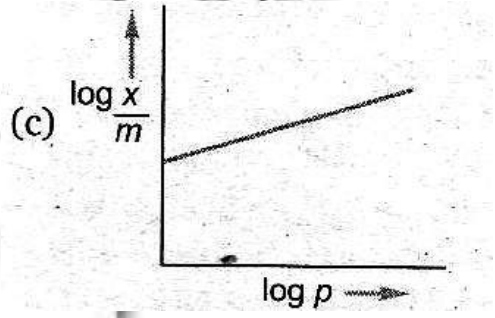
(a)

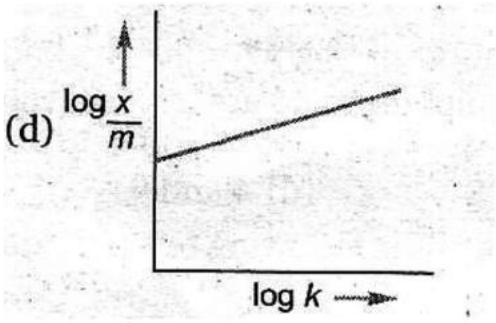


(b)



(c)



(d) 

104) Which one of the following reactions represents the oxidising property of H_2O_2?

(a) $2KMnO_4 + 3H_2O_4 + 5H_2O_2 \rightarrow$

$K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

(b) $2K_3[Fe(CN)_6] + 2KOH + H_2O_2 \rightarrow$

$2K_4[Fe(CN)_6] + 2H_2O + O_2$

(c) $PbO_2 + H_2O_2 \rightarrow PbO + H_2O + O_2$

(d) $2KI + H_2SO_4 + H_2O_2 \rightarrow K_2SO_4 + 12 + 2H_2O$

105) Which of-the following statements are correct for alkali metal compounds?

(i) Superoxides are paramagnetic in nature.

(ii) The basic strengths of hydroxides increases down the group.

(iii) The conductivity of chlorides in their aqueous solutions decreases down the group.

(iv) The basic nature of carbonates in aqueous solutions is due to cationic hydrolysis.

(a) (i), (ii) and (iii) only

(b) (i) and (ii) only

(c) (ii), (iii) and (iv) only

(d) (iii) and (iv) only

106) Boron halides behave as Lewis acids because of their nature.

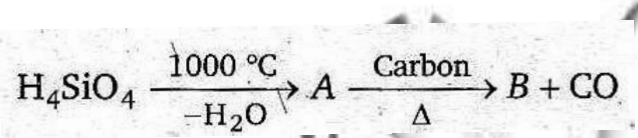
(a) proton donor

(b) covalent

(c) electron deficient

(d) ionising

107) Identify B in the following reaction



(a) corundum

(b) quartz

(c) silica

(d) carborundum

108) The correct order of reducing abilities of hydrides of V group elements is

(a) $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

(b) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

(c) $NH_3 < PH_3 > AsH_3 > SbH_3 > BiH_3$

(d) $SbH_3 > BiH_3 > AsH_3 > NH_3 > PH_3$

109) The number of sigma and pi bonds in peroxodisulphuric acid are, respectively

(a) 9 and 4

(b) 11 and 4

(c) 4 and 8

(d) 4 and 9

110) Which one of the following reactions does not occur?

(a) $F_2 + 2CI^- \rightarrow 2F^- + Cl_2$

(b) $Cl_2 + 2F^- \rightarrow 2CI^- + F_2$

(c) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$

(d) $Cl_2 + 2Br^- \rightarrow 2Cr + Br_2$

111) The compound in which the number of $d\pi$- $p\pi$ bonds are equal to those present in CIO^-_4

(a) XeF_4

(b) XeO_3

(c) XeO_4

(d) XeF_6

112) $[Co(NH_3)_5$ SO4] Br and $[Co(NH_3)_5$ Br) SO_4 are a pair of isomers.

(a) ionisation

(b) ligand

(c) coordination

(d) hydrate

113) Among the following compounds, which one is not responsible for depletion of ozone layer?

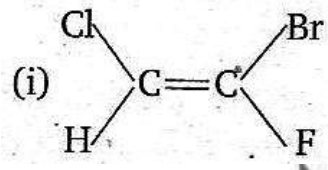
(a) CH_4

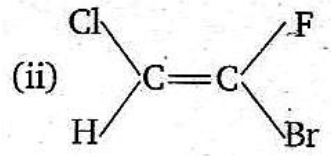
(b) $CFCl_3$

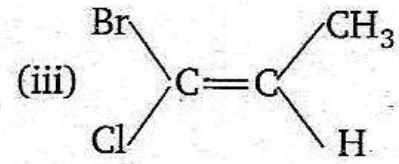
(c) NO

(d) Cl_2

114) Which of the following correspond (s) has 'Z' configuration?

(i) 

(ii) 

(iii) 

(a) (i) only

(b) (ii) only

(c) (iii) only

(d) (i) and (iii)

115) According to Cahn-Ingold-Prelog sequence rules, the correct order of priority for the given groups is

(a) $-COOH > -CH_2OH > -OH > -CHO$

(b) $-COOH > -CHO > -CH_2OH > -OH$

(c) $-OH > -CH_2OH > -CHO > -COOH$

(d) $-OH > -COOH > -CHO > -CH_2OH$

116) What are X and Y respectively in the following reaction?

Z - product $\xrightarrow{Y}$ butyne $\xrightarrow{X}$ product

(a) Na/NH_3(liq.) and $Pd/BaSO_4 + H_2$

(b) Ni/140°C and $Pd/BaSO_4 + H_2$

(c) Ni/140°C and Na/NH_3(liq.)

(d) $Pd/ BaSO_4 + H_2$ and Na/NH_3(liq.)

117) In which of the following reactions, chlorine acts as an oxidising agent?

(i) $CH_3CH_2OH + Cl_2 \rightarrow CH_3CHO + HCI$

(ii) $CH_3CHO + Cl_2 \rightarrow CCl_3 . CHO + HCI$

(iii) $CH_4 + Cl_2 \rightarrow CH_3CI + HCl$

The correct answer is

(a) (i) only

(b) (ii) only

(c) (i) and (iii)

(d) (i), (ii) and (iii)

118) The correct order of reactivity of hydrogen halides with ethyl alcohol is

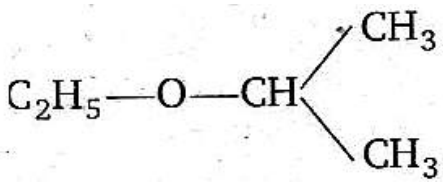
(a) HF > HCI > HBr > HI

(b) HCl > HBr > HF > HI

(c) HBr > HCl > HI > HF

(d) HI > HBr > HCl > HF

119) The IUPAC name of



is

(a) ethoxy propane'

(b) 1, 1-dimethyl ether

(c) 2-ethoxy isopropane

(d) 2-ethoxy propane

120) Acetone on addition to methyl magnesium bromide forms a complex, which on decomposition with acid gives X and Mg(OH)Br. Which one of the following is X?

(a) CH_3OH

(b) $(CH_3)_3COH$

(c) $(CH_3)_2$ CHOH

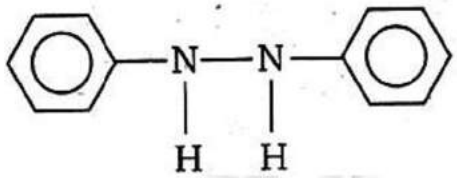
(d) CH_3CH_2OH

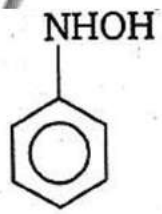
121) Identify A and B in the following reaction

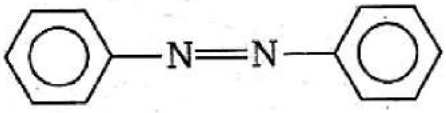
$$CH_3—CH_3 \xleftarrow{B} CH_3COOH \xrightarrow{A} CH_3CH_2OH$$

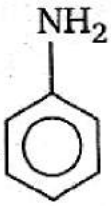
	A	B
(a)	HI + red P	$LiAlH_4$
(b)	NV /Δ	$LiAlH_4$
(c)	$LiAlH_4$	HI + red P
(d)	Pd-$BaSO_4$	Zn+ HCl

122) The structure of the compound formed, when nitrobenzene is reduced by lithium aluminum hydride ($LiAlH_4$) is

(a) 

(b) 

(c) 

(d) 

123) Match the following:

	List-I		List-II
(A)	Oxyhemoglobin	(i)	Analgesic
(B)	Aspirin	(ii)	Oxygen carrier
(C)	Hemoglobin	(iii)	Photosynthesis

(D) Chlorophyll (iv) Oil of winter green

(v) Fe^{2+} paramagnetic

The correct match is

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

124) If $\overline{M}_W$ is the weight average molecular weight and $\overline{M}_n$ is the number average molecular weight of a polymer, the poly dispersity index (PDI) of the polymer is given by

(a) $\frac{\overline{M}_n}{M_w}$

(b) $\frac{\overline{M}_W}{M_n}$

(c) $\overline{M}_w \times \overline{M}_n$

(d) $\frac{1}{\overline{M}_w \times \overline{M}_n}$

125) Hydrolysis of sucrose with dilute aqueous sulphuric acid yields

(a) 1: 1 D - (+)- glucose; D-(-)-fructose

(b) 1: 2 D - (+)-glucose; D-(-)-fructose

(c) 1: 1 D-H-glucose; p- (+) -fructose

(d) 1: 2 D-(-)-glucose; D- (+) -fructose

English & Reasoning

Directions: In each of the following questions, choose the most appropriate alternative to fill in the blank.

126) The teacher ordered Kamal to leave the room …… him to return.

(a) stopped

(b) refused

(c) forbade

(d) callenged

127) I hope you must have ……. by now that failures are the stepping stones to success

(a) know

(b) felt

(c) decided

(d) realised

128) In a little published deal, Pepsi Cola has the entire soft drink market in Afghanistan.

(a) conquered

(b) swallowed

(c) captured

(d) occupied

Directions: In each of the following questions, put the parts P, Q, R and S in their proper order to produce the correct sentence.

129) The Bible,

(P) has in many respects

(Q) the sacred book of all Christians

(R) among all the books of the world

(S) a unique character and position

(a) QPSR

(b) QRPS

(c) RPQS

(d) RQPS

130) The ultimate hope

(P) will force the nations

(Q) that the destructive nature of weapons

(R) to give up war

(S) has not been fulfilled

(a) PQRS

(b) PRQS

(c) QPRS

(d) RSQP

131) It was

(P) in keeping with my mood

(Q) a soft summer evening,

(R) as I walked sedately

(S) in the direction of the new house

(a) QPRS

(b) QRPS

(c) SQPR

(d) SRPQ

Directions: In each of the following questions, choose the alternative which is most nearly the some in meaning to the "word given in capitol letters.

132) EPHEMERAL

(a) Uneral

(b) Mythical

(c) Short-living

(d) Artificial

133) STUBBORN

(a) Easy

(b) Obstinate

(c) Willing

(d) Pliable

134) PROGNOSIS

(a) Indentification

(b) Preface

(c) Forecast

(d) Scheme

Directions: In each of the following questions, choose the alternative which is opposite in meaning to the word given in capitol letters.

135) INFALLIBLE

(a) Erring

(b) Untrustworthy

(c) Dubious

(d) Unreliable

136) GATHER

(a) Separate

(b) Suspend

(c) Scatter

(d) Spend

137) EXALT

(a) Depreciate

(b) Ennoble

(c) Glorify

(d) Simplify

Directions: In each of the following questions, choose the alternative which can be substituted for the' given words/sentence.

138) Elderly woman in charge of a girl on social occasions

(a) Spinster

(b) Matron

(c) Chaperon

(d) Chandler

139) Land so surrounded by water as to be almost an island

(a) Archipelago

(b) Isthmus

(c) Peninusula

(d) Lagoon

140) A Place adjoining kitchen, for washing dishes etc.

(a) Cellar

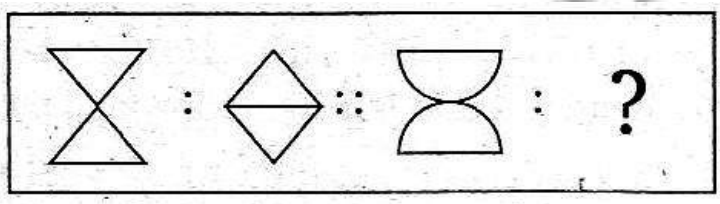
(b) Wardrobe

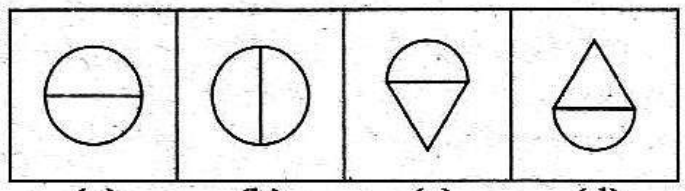
(c) Scullery

(d) Pantry

Direction: In each of these questions, two figure/words are given to the left of the sign:: and one figures word to the right of the sign:: with four alternatives under it out of which one of the alternatives has the same relationship with the figures/words to the right of the sign:: as between the two figures/words to the left of the sign (::). Find the correct alternative.

141)





142) **Direction:** In the question, three words are given. They are followed by four words one of which stands for the class to which these three words belong. Identify that word.

Newspaper, Hoarding. Television

(a) Press

(b) Media

(c) Broadcast

(d) Rumour

143) **Direction:** Find out the number which will come next in the series.

2, 5, 14, 122, 365

(a) 1029

(b) 1094

(c) 1059

(d) 1000

144) **Direction:** In the given question, some statements are followed by one or more inferences. The inference or inferences may be wrongly or correctly drawn. Select one of the alternatives which contains the correctly drawn inference or inferences.

Which of the conclusions drawn from the given statements are correct?

Given statements

Foreigners in Jordon without a valid work permit will be deported. A few Indian emplyees in the building industry in jordon do not possess valid work permits.

Inferences

(1) All Indians engaged in building industry in Jordon will be deported to India.

(2) A few Indians in building industry in Jordon will be deported.

(3) A bulk of Indians in Jordon will be deported to India.

(4) Indian employees in building industry without work permit will be deported from Jordon.

The inferences correctly drawn are

(a) 1 and 3

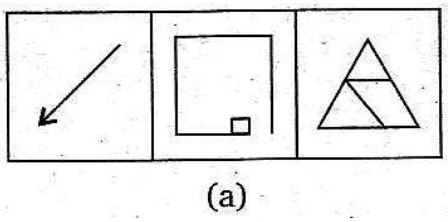
(b) -3 and 4

(c) -2 and 4

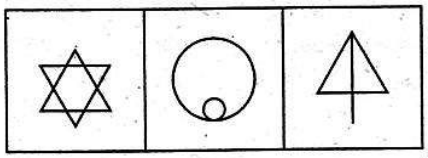
(d) 1 and 2

145) Select the series which obeys the given rule:

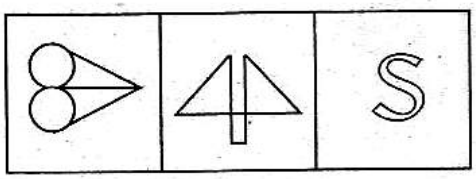
Any figure can be traced by a single unbroken line without retracing



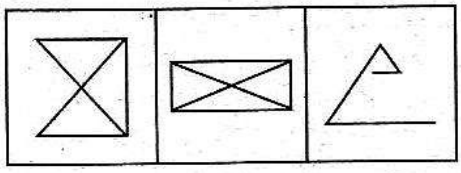
(a)



(b)

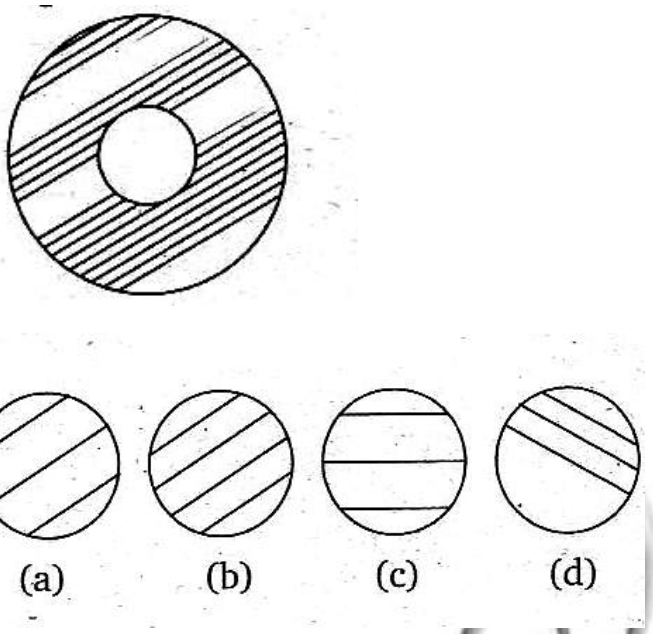


(c)

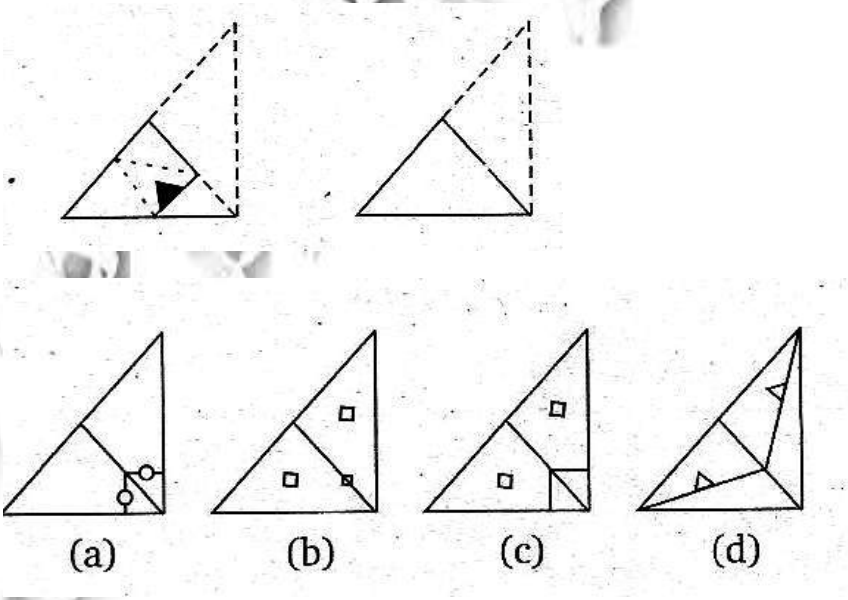


(d)

146) Select from amongst the four alternative figures, the one which complete the pattern in the problem figure.

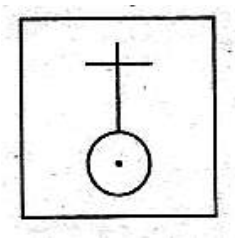


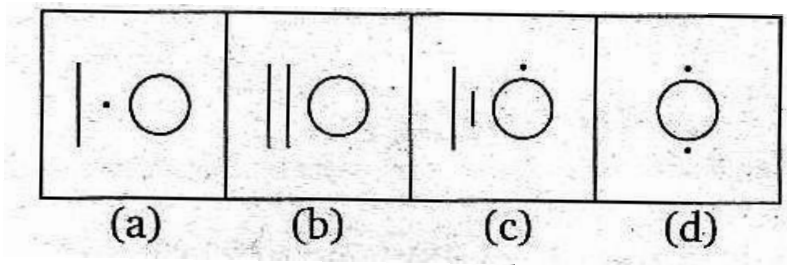
147) **Direction:** In the following question a piece of paper is folded, cut and unfolded. One of the four figures given below is exactly like this unfolded paper. Find this out.



148) **Direction:** In the question a figure is given, its components are

given in one of the four alternative figures. Find this one





149) **Direction:** In the given question, four numbers/number-pairs are given. Select the one which is different from the other three.

(a) 1234

(b) 2345

(c) 4567

(d) 7896

Direction: Find the group of letters from the four alternative which is obtained by applying the same rule to this given word to the right of the sign ::

150) FILM: ADGH:: MILK: ?

(a) ADGF

(b) HDGE

(c) HDGF

(d) HEGF

ANSWERS

MATHEMATICS

1. (c)	2. (c)	3. (c)	4. (b)	5. (c).	6. (d)
7. (d)	8. (b)	9. (d)	10. (a)	11. (c)	12. (b)
13. (b)	14. (b)	15. (b)	16. (d)	17. (a)	18. (a)
19. (c)	20. (d)	21. (b).	22. (b)	23. (a)	24. (b)

25. (b)	26. (a)	27. (c)	28. (c)	29. (c)	30. (d)
31. (c)	32. (b)	33. (c)	34. (b)	35. (c)	36. (b)
37. (c)	38. (b)	39. (c)	40. (d)	41. (c)	42. (b)
43. (d)	44. (b)	45. (b)			

PHYSICS

46. (a)	47. (c)	48. (b)	49. (c)	50. (c)	51. (b)
52. (a)	53. (d)	54. (b)	55. (d)	56. (d)	57. (d)
58. (a)	59. (b)	60. (d)	61. (c)	62. (c)	63. (d)
64. (a)	65. (a)	66. (c)	67. (c)	68. (a)	69. (a)
70. (c)	71. (c)	72. (c)	73. (a)	74. (b)	75. (b)
76. (c)	77. (b)	78. (a)	79. (b)	80. (b)	81. (a)
82. (b)	83. (a)	84. (c)	85. (d)		

CHEMISTRY

86. (b)	87. (a)	88. (b)	89. (c)	90. (d)	91. (a)
92. (a)	93. (c)	94. (c)	95. (c)	96. (a)	97. (c)
98. (c)	99. (a)	100. (b)	101. (c)	102. (a)	103. (c)
104. (d)	105. (b)	106. (c)	107. (d)	108. (a)	109. (b)
110. (b)	111. (b)	112. (a)	113. (a)	114. (d)	115. (d)
116. (a)	117. (d)	118. (d)	119. (d)	120. (b)	121. (c)
122. (c)	123. (a)	124. (b)	125. (a)		

ENGLISH & REASONING

126. (c)	127. (d)	128. (c)	129. (a)	130. (c)	131. (a)
132. (c)	133. (b)	134. (c)	135. (a)	136. (c)	137. (a)
138. (c)	139. (c)	140. (c)	141. (a)	142. (b)	143. (b)
144. (c)	145. (b)	146. (b)	147. (a)	148. (c)	149. (d)
150. (c)					

Hints and Solutions

Mathematics

1) Given that, f (x) = |x| and g(x) = [x – 3]

For $-\frac{8}{5} < x < \frac{8}{5}, 0 \leq f\ x\ < \frac{8}{5}$

Now, for 0 < f(x) < 1,

g(f(x)) = [f(x) – 3]

= –3 $\because -3 \leq f\ x\ - 3 < -2$

Again, for 1 < f(x) < 1.6

g(f(x)) = –2

$\because -2 \leq f\ x\ - 3 < -1.4$

hence, required set is {–3, –2}.

2) Now, $\sum_{k=1}^{n} k(k+2)$

$= \sum_{k=1}^{n} k^2 + 2k = \sum_{k=1}^{n} k^2 + 2k \sum_{k=1}^{n} k$

$= \frac{n\ n+1\ \ 2n+1}{6} + \frac{2.n\ n+1}{2}$

$= n(n+1)\ \frac{2n+1}{6} + 1$

$= \frac{n\ n+1\ \ 2n+7}{6}$

3) Required number of arrangements

$= {}^{6}P_5 \times 4!$

= 17280

4) Given that, ${}^{n}P_r = 30240$ and ${}^{n}C_r = 252$

$\Rightarrow \frac{n!}{n-r\ !} = 30240$ and $\frac{n!}{n-r\ !r!} = 252$

$\Rightarrow r! = \frac{30240}{252} = 120$

$\Rightarrow r = 5$

$\therefore \frac{n!}{n-5\ !} = 30240$

$\Rightarrow n(n-1)(n-2)(n-3)(n-4) = 30240$

$\Rightarrow n(n-1)(n-2)(n-3)(n-4)$

$= 10\ (10-1)(10-2)(10-3)(10-4)$

$\Rightarrow n = 10$

Hence, required ordered pair is (10, 5).

5) Given, $(1 + x + x^2 + x^3)^5 = \sum_{k=0}^{15} a_k x^k$

$\Rightarrow [(1 + x) + x\ (1 + x)]^5 = \sum_{k=0}^{15} a_k x^k$

$\Rightarrow (1 + x)^{10} = a_0x^0 + a_1x + a_2x^2 + \ldots + a_{15}x^{15}$

$\Rightarrow {}^{10}C_0 + {}^{10}C_1x + {}^{10}C_2x^2 + \ldots + {}^{10}C_{10}x^{10}$

$= a_0 + a_1x + a_2x^2 + a_3x^3 + \ldots + a_{15}x^{15}$

On equating the coefficient of constant and even powers of x, we get

$a_0 = {}^{10}C_0,\ a_2 = {}^{10}C_2,$

$a_4 = {}^{10}C_4, \ldots,\ a_{10} = {}^{10}C_{10},$

$a_{12} = a_{14} = 0$

$= 2^{10-1} = 29$

$= 512$

6) Given that, $\alpha + \beta = -2$ and $\alpha^3 + \beta^3 = -56$

$\Rightarrow \quad (\alpha + \beta)(\alpha^2 + \beta^2 - \alpha\beta) = -56$

$\Rightarrow \quad \alpha^2 + \beta^2 - \alpha\beta = 28$

Now, $\quad (\alpha + \beta)^2 = (-2)^2$

$\Rightarrow \quad \alpha^2 + \beta^2 + 2\alpha\beta = 4$

$\Rightarrow \quad 28 + 3\alpha\beta = 4$

$\Rightarrow \quad \alpha\beta = -8$

$\therefore$ Required equation is

$x^2 - (-2)x + (-8) = 0$

$\Rightarrow \quad x^2 + 2x - 8 = 0$

7) Given equation is

$x^3 + 2x^2 - 4x + 1 = 0$

Let α, β and γ be the roots of the given equation

$\therefore \quad \alpha + \beta + \gamma = -2, \alpha\beta + \beta\gamma + \gamma\alpha = -4$

and $\quad \alpha\beta\gamma = -1$

Let the required cubic equation has the roots 3α, 3β and 3γ.

$\Rightarrow \quad 3\alpha + 3\beta + 3\gamma = -6,$

$3\alpha \cdot 3\beta + 3\beta + 3\gamma + 3\gamma \cdot 3\alpha = 36$

and $\quad 3\alpha \cdot 3\beta \cdot 3\gamma = -27$

$$x^3 - (-6)x^2 + (-36)x - (-27) = 0$$

$$\Rightarrow \quad x^3 + 6x^2 - 36x + 27 = 0$$

8) Given that,

$A = \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix}$ and $f(t) = t^2 - 3t + 7$

Now, $A^2 = \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix} \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix}$

$$= \begin{matrix} -7 & -12 \\ 24 & 17 \end{matrix}$$

Now, $f(A) = A^2 - 3A + 7$

$$= \begin{matrix} -7 & -12 \\ 24 & 17 \end{matrix} - 3 \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix} + 7 \begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}$$

$$= \begin{matrix} -3 & -6 \\ 12 & 9 \end{matrix}$$

$$\therefore f(A) + \begin{matrix} 3 & 6 \\ -12 & -9 \end{matrix} = \begin{matrix} -3 & -6 \\ 12 & 9 \end{matrix} + \begin{matrix} 3 & 6 \\ -12 & -9 \end{matrix}$$

$$= \begin{matrix} 0 & 0 \\ 0 & 0 \end{matrix}$$

9) Let $\Delta = \begin{matrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{matrix}$

Applying $R_1 \to R_1 + R_2 + R_3$ and taking common (a + b + c) from R_1

$$= (a + b + c) \begin{matrix} 1 & 1 & 1 \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{matrix}$$

Applying $C_2 \to C_2 \to C_1$ and $C_3 \to C_3 \to C_1$,

$= (a + b + c) \begin{vmatrix} 2b & -b-c-a & 0 \\ 2c & 0 & -a-b-c \end{vmatrix}$

$= (a + b + c)[(- b - c - a)(- a - b - c)]$

$= (a + b + c)$

10) Since, ω is a cube root of unity,

$\therefore \sin \quad \omega^{10} + \omega^{23} \ \pi - \frac{\pi}{4}$

$= \sin \quad \omega + \omega^2 \ \pi - \frac{\pi}{4}$

$= \sin \quad -\pi - \frac{\pi}{4} \qquad (\because 1 + \omega + \omega^2 = 0)$

$= \sin \quad -\pi - \frac{\pi}{4} \ = \sin \frac{\pi}{4}$

$= \frac{1}{\sqrt{2}}$

11) $\sqrt{3}$ cosec 20° – sec 20°

$= \frac{\tan 60^o}{\sin 20^o} - \frac{1}{\cos 20^o}$

$= \frac{\sin 60^o \cos 20^o - \sin 20^o \cos 60^o}{\cos 60^o \sin 20^o \cos 20^o}$

$= \frac{\sin 40^o}{\cos 60^o \sin 20^o \cos 20^o}$

$= \frac{2 \sin 20^o \cos 20^o}{\frac{1}{2} \sin 20^o \cos 20^o} = 4$

12) Given,

$\tan \theta + \tan \quad \theta + \frac{\pi}{3} \ + \tan \quad \theta + \frac{2\pi}{3} \ = 3$

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

$\Rightarrow$ $\tan\theta + \frac{8\tan\theta}{1-3\tan^2\theta} = 3$

$\Rightarrow$ $\frac{9\tan\theta - 3\tan^2\theta}{1-3\tan^2\theta} = 3$

$\Rightarrow$ $3\tan 3\theta = 3$ $\Rightarrow$ $\tan 3\theta = 1$

Hence, option (b) is correct.

13) Given equation is

$\cos 2x + 2\cos^2 x = 2$

$\Rightarrow$ $2\cos^2 x - 1 + 2\cos^2 x = 2$

$\Rightarrow$ $4\cos^2 x = 3$

$\Rightarrow$ $\cos^2 x = \frac{3}{4}$

$\Rightarrow$ $\cos x = \pm\frac{\sqrt{3}}{2}$

$\therefore$ $x = n\pi \pm \frac{\pi}{6} : n \in Z$

14) Given that,

$\sin^{-1}\frac{3}{x} \sin^{-1}\frac{4}{x} = \frac{\pi}{2}$

$\therefore$ $\sin^{-1}\frac{3}{x} = \frac{\pi}{2} - \sin^{-1}\frac{4}{x}$

$\Rightarrow$ $\sin^{-1}\frac{3}{x} = \cos^{-1}\frac{4}{x}$

$\Rightarrow$ $\sin^{-1}\frac{3}{x} = \sin^{-1}\frac{\sqrt{x^2-16}}{x}$

$\Rightarrow$ $\frac{3}{x} = \frac{\sqrt{x^2-16}}{x}$

$\Rightarrow \quad x = \pm 5$

$\Rightarrow \quad x = 5$

($\because$ –5 is not satisfied the given equation)

15) Given that,

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

$\Rightarrow \quad 1+\frac{b}{a+c}+1+\frac{a}{b+c}=3$

$\Rightarrow \quad b(b + c) + a(a + c) = (a + c)(b + c)$

$\Rightarrow \quad b^2 + bc + a^2 + ac = ab + ac + bc + c^2$

$\Rightarrow \quad a^2 + b^2 - c^2 = ab$

We know that, $\cos C = \frac{a^2+b^2-c^2}{2ab} = \frac{ab}{2ab} = \frac{1}{2}$

$\Rightarrow \quad C = 60^\circ$

16) Given that, $r_1 = 2r_2 = 3r_3$

$\therefore \quad \frac{\Delta}{s-a} = \frac{2\Delta}{s-b} = \frac{3\Delta}{s-c} = \frac{\Delta}{k}$ (say)

Then, $s - a = k$, $s - b = 2k$, $s - c = 3k$

$\Rightarrow \quad 3x - (a + b + c) = 6k \quad \Rightarrow \quad s = 6k$

$\therefore \quad \frac{a}{5} = \frac{b}{4} = \frac{c}{3} = k$

Now, $\frac{a}{b}+\frac{b}{c}+\frac{c}{a}=\frac{5}{4}+\frac{4}{3}+\frac{3}{5}$

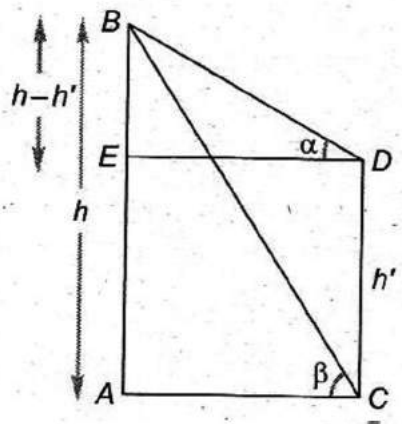
$= \frac{75+80+36}{60} = \frac{191}{60}$

17) Let AB be a hill whose height is h metres and CD be a pillar of height h′ metres.

In ΔEDB,

$$\tan\alpha = \frac{h-h'}{ED} \qquad \ldots\ldots \text{(i)}$$

and in ΔACB,



$$\tan\beta = \frac{h}{AC} = \frac{h}{ED} \qquad \ldots\ldots \text{(ii)}$$

Eliminate ED from Eqs. (i) and (ii), we get

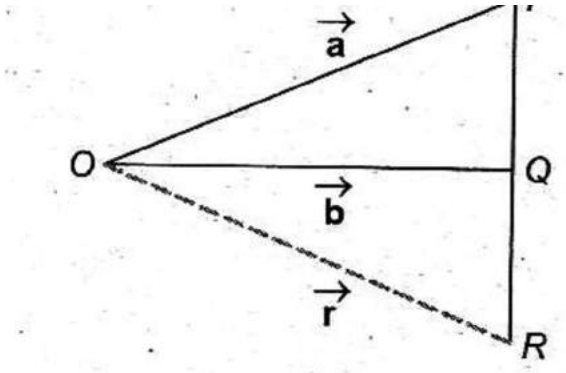
$$\tan\alpha = \frac{h-h'}{\frac{h}{\tan\beta}}$$

$$\Rightarrow \quad h\frac{\tan\alpha}{\tan\beta} = h - h'$$

$$\Rightarrow \quad h' = \frac{h\tan\beta - \tan\alpha}{\tan\beta}$$

18) Given that,

$$PR = 5PQ$$



It mean R divides PQ externally in the ratio 5 : 4.

$\therefore$ Position vector of R $= \frac{5b-4a}{5-4}$

$= 5b - 4a$

19) Let $OA = 2\imath - \jmath + k$, $OB = \imath - 3\jmath - 5k$ and $OC = 3\imath - 4\jmath - 4k$

$\therefore$ a = OA = $\overline{6}, b =$ OB = $\overline{35}$

and c = OC = $\overline{41}$

$\therefore$ cos A $= \frac{b^2+c^2-a^2}{2bc}$

$= \frac{\overline{35}^{\,2} + \overline{41}^{\,2} - \overline{6}^{\,2}}{2\ \overline{35}\ \overline{41}}$

$\Rightarrow$ cos A $= \frac{70}{2\ \overline{35}\ \overline{41}} = \frac{\overline{35}}{41}$

$\Rightarrow$ $\cos^2$ A $= \frac{35}{41}$

20) Given that,

$b = 2\imath + \jmath - k$ and $c = \imath + 3k$

Now, $b \times c = \begin{matrix} 2 & 1 & -1 \\ 1 & 0 & 3 \end{matrix}$

$= \iota(3 - 0) - \jmath(6 + 1) + k(0 - 1)$

$= 3\iota - 7\jmath - k$

Now, $a\,b\,c = a.\ b \times c$

$= a\ \ b \times c\ \cos\theta$

$= 1\ \ \overline{3^2 + 7^2 + 1^2}\ \cos\theta$

$= \overline{59}\cos\theta$

$\Rightarrow a\,b\,c_{\ max} = \overline{59} \cdot 1$

(∵ maximum value of $\cos\theta$ is 1)

Hence, maximum value is $\overline{59}$.

21) Given that, $P(A \cap B) = \frac{1}{6}$ and $P\ \overline{A} \cap \overline{B} = \frac{1}{3}$

Since, A and B are independent.

$\therefore P(A)P(B) = \frac{1}{6}$ and $P(\overline{A})P(\overline{B}) = \frac{1}{3}$

$\Rightarrow [1 - P(A)][1 - P(B)] = \frac{1}{3}$

$\Rightarrow 1 - [P(A) + P(B)] + P(A)P(B) = \frac{1}{3}$

$\Rightarrow 1 + \frac{1}{6} - \frac{1}{3} = P(A) + P(B)$

$\Rightarrow P(A) + P(B) = \frac{5}{6}$

$\Rightarrow P(A) = \frac{1}{2}, P(B) = \frac{1}{3}$

and $P(A) = \frac{1}{3}, P(B) = \frac{1}{2}$

22) In a box,

B_1 = 1R, 2W

B_2 = 2R, 3W

and B_3 = 3R, 4W

Also, given that,

$P(B_1) = \frac{1}{2}$, $P(B_2) = \frac{1}{3}$ and $P(B_3) = \frac{1}{6}$

$\therefore P\ \frac{B_2}{R}$

$$= \frac{P\ B_2\ P\ \frac{R}{B_2}}{P\ B_1\ P\ \frac{R}{B_1} + P\ B_2\ P\ \frac{R}{B_2} + P\ B_3\ P\ \frac{R}{B_3}}$$

$$= \frac{\frac{1}{3}\times\frac{2}{5}}{\frac{1}{2}\times\frac{1}{3}+\frac{1}{3}\times\frac{2}{5}+\frac{1}{6}\times\frac{3}{7}} = \frac{\frac{2}{15}}{\frac{1}{6}+\frac{2}{15}+\frac{1}{14}}$$

$$= \frac{\frac{2}{15}}{\frac{35+28+15}{210}} = \frac{2}{15}\times\frac{210}{78} = \frac{14}{39}$$

23) The sum of the distance of a point P from two perpendicular lines in a plane is 1, then the locus of P is a rhombus.

24) Since, the axes are rotated through an angle 45°, then we replace (x, y) by

$(x \cos 45^\circ - y \sin 45^\circ, x \sin 45^\circ + y \cos 45^\circ)$

in the given equation $3x^2 + 3y^2 + 2xy = 2$

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

$\Rightarrow \quad 4x^2 = 2y^2 = 2$

$\Rightarrow \quad 2x^2 + y^2 = 1$

25) Since, l, m, n are in AP.

$\therefore \quad 2m = l + n$

Given equation of line is

$lx + my + n = 0$

Now, assume that the point (1, –2) satisfy the given equation.

$\therefore \quad l - 2m + n = 0$

$\Rightarrow \quad 2m = l + n$

$\Rightarrow$ l, m, n are in AP.

Hence, option (b) is correct.

26) To make the given curves $x^2 + y^2 = 4$ and $x + y = a$ homogenous.

$\therefore \quad x^2 + y^2 - 4\left(\frac{x+y}{a}\right)^2 = 0$

$\Rightarrow \quad a^2(x^2 + y^2) - 4(x^2 + y^2 + 2xy) = 0$

$\Rightarrow \quad x^2(a^2 - 4) + y^2(a^2 - 4) - 8xy = 0$

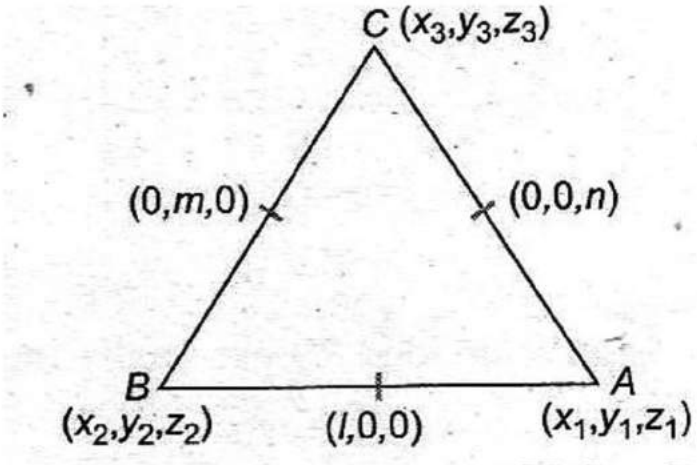
Since, this is a perpendicular pair of straight lines.

$\therefore \quad a^2 - 4 + a^2 - 4 = 0$

$\Rightarrow \quad a^2 = 4 \Rightarrow a = \pm 2.$

Hence, required set of a is {–2, 2}.

27) From the figure,



$x_1 + x_2 = 2l$, $y_1 + y_2 = 0$, $z_1 + z_2 = 0$,

$x_2 + x_3 = 0$, $y_2 + y_3 = 2m$, $z_2 + z_3 = 0$

and $x_1 + x_3 = 0$, $y_1 + y3 = 0$, $z_1 + z_3 = 2n$

On solving, we get

$x_1 = l$, $x_2 = l$, $x_3 = -l$,

$y_1 = -m$, $y_2 = m$, $y_3 = m$

and $z_1 = n$, $z_2 = -n$, $z_3 = n$

$\therefore$ Coordinates are A(l, –m, n), B(l, m, –n) and C(–l, m, n)

$\therefore \quad \frac{AB^2+BC^2+CA^2}{l^2+m^2+n^2}$

$= \frac{4m^2+4n^2 + 4l^2+4n^2 +(4l^2+4m^2)}{l^2+m^2+n^2}$

$= 8$

28) Since, the lines $2x - 3y = 5$ and $3x - 4y = 7$ are the diameters of a circle. Therefore, the point of intersection is the centre of

–1 i.e., the centre of the circle.

Required equation of circle is

$$(x - 1)^2 + (y + 1)^2 = 72$$

$$\Rightarrow \quad x^2 + y^2 - 2x + 2y + 2 = 49$$

$$\Rightarrow \quad x^2 + y^2 - 2x + 2y - 47 = 0$$

29) The equation of pole w.r.t. the point (1, 2) to the circle $x^2 + y^2 - 4x - 6y + 9 = 0$ is

$$x + 2y - 2(x + 1) - 3(y + 2) + 9 = 0$$

$$\Rightarrow \quad x + y - 1 = 0$$

Since, the inverse of the point (1, 2) is the foot (α, β) of the perpendicular from the point (1, 2) to the line $x + y - 1$.

$$\therefore \quad \frac{\alpha-1}{1} = \frac{\beta-2}{1} = -\frac{1.1+1.2-1}{1^2+1^2}$$

$$\Rightarrow \quad \alpha - 1 = \beta - 2 = -1$$

$$\Rightarrow \quad \alpha = 0, \beta = 1$$

Hence, required point is (0, 1).

30) Using the condition that if two lines $l_1x + m_1y + n_1 = 0$ and $l_2x + m_2y + n_2 = 0$ are conjugate w.r.t. parabola $y^2 = 4ax$, then

$$l_1n_2 + l_2n_1 = 2am_1m_2 \qquad \ldots\ldots (i)$$

Given conjugate lines are $2x + 3y + 12 = 0$ and $x - y + 4\lambda = 0$ and equation of parabola is $y^2 = 8x$.

Here, $l_1 = 2$, $m_1 = 3$, $n_1 = 12$; $l_2 = 1$, $m_2 = -1$,

$n_2 = 4\lambda$ and $a = 2$

$$2 \times 4\lambda + 1 \times 12 = 2 \times 2 \times 3 \times (-1)$$

$$8\lambda = -12 - 12 \quad \Rightarrow \quad \lambda = -3$$

31) Given, equation of hyperbola is

$$x^2 - 3y^2 - 4x - 6y - 11 = 0$$

$$\Rightarrow \quad (x^2 - 4x + 4) - 3(y^2 + 2y + 1) - 11 = 4 - 3$$

$$\Rightarrow \quad (x-2)^2 - 3(y+1)^2 = 12$$

$$\Rightarrow \quad \frac{(x-2)^2}{12} - \frac{(y+1)^2}{4} = 1$$

Now, $e = \sqrt{1 + \frac{4}{12}} = \frac{2}{\sqrt{3}}$

$\therefore$ Distance between foci

$$= 2ae = 2 \times \sqrt{12} \times \frac{2}{\sqrt{3}} = 8$$

32) Given polar equation of circle is

$$r^2 - 8(\sqrt{3}\cos\theta + \sin\theta) + 15 = 0$$

or $r^2 - 8(\sqrt{3}\, r\cos\theta + r\sin\theta) + 15 = 0$

where $r\cos\theta = x$ and $y = r\sin\theta$.

It can be rewritten in cartesian form

$$x^2 + y^2 - 8\left(\sqrt{3}x + y\right) + 15 = 0$$

$$\Rightarrow \quad x^2 + y^2 - 8\sqrt{3}x - 8y + 15 = 0$$

Now, radius = $4^2 + 4^2 - 15$

$= \sqrt{48 + 16 - 15} = 7$

33) Given that,

$f(x) = [x - 3] + |x - 4|$

$\therefore \lim_{x \to 3^-} f(x) = \lim_{x \to 3^-} |x - 3| + |x - 4|$

$= \lim_{h \to 0} |3 - h - 3| + |3 - h - 4|$

$= \lim_{h \to 0} |-h| + 1 + h$

$= -1 + 1 + 0 = 0$

34) Given that,

$$f(x) = \begin{cases} \frac{\cos 3x - \cos x}{x^2} & for\ x \neq 0 \\ \lambda & for\ x = 0 \end{cases}$$

Now, LHL $= \lim_{x \to 0^-} f(x)$

$= \lim_{x \to 0^-} \frac{\cos 3x - \cos x}{x^2}$

$= \lim_{h \to 0} \frac{\cos 3(0-h) - \cos(0-h)}{(0-h)^2}$

$= \lim_{h \to 0} \frac{\cos 3h - \cos h}{h^2}$

$= \lim_{h \to 0} \frac{-3\sin 3h + \sin h}{2h}$

(using L' Hospitals' rule)

$= \frac{-9+1}{2} = -4$

Since, f(x) is continuous at x = 0

$\therefore \lim_{x \to 0^-} f(x) = f(0)$

35. Given that, f(2) = 4 and f′(2) = 1

$\therefore \quad \lim_{x\to 2} \frac{xf\ 2\ -2f(x)}{x-2}$

$= \lim_{x\to 2} \frac{xf\ 2\ -2f\ 2\ +2f\ 2\ -2f\ x}{x-2}$

$= \lim_{x\to 2} f\ 2\ - 2\lim_{x\to 2} \frac{f\ x\ -f\ 2}{x-2}$

= f(2) – 2f′(2)

= 4 – 2(1)

= 2

36) Given that,

x = a $cos\ \theta + log\ tan\ \frac{\theta}{2}$ and y = a sin θ

On differentiating w.r.t. θ respectively, we get

$\frac{dx}{d\theta} = a\ -sin\ \theta + \frac{1}{tan\ \frac{\theta}{2}} . sec^2 \frac{\theta}{2} . \frac{1}{2}$

$= a\ -sin\ \theta + \frac{1}{sin\ \theta}\ = \frac{a\ cos^2\theta}{sin\ \theta}$

and $\frac{dy}{d\theta}$ = a cos θ

$\therefore \quad \frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{a\ cos\ \theta}{a\ cos^2\theta/sin\ \theta}$

= tan θ

37. Given curve is $y^4 = ax^3$

$$4y^3 \frac{dy}{dx} = 3ax^2$$

$\Rightarrow$ $\left(\frac{dy}{dx}\right)_{a,a} = \frac{3a^3}{4a^3} = \frac{3}{4}$

$\therefore$ Equation of normal at point (a, a) is

$$y - a = -\frac{4}{3}(x - a)$$

$\Rightarrow$ $4x + 3y = 7a$

38. Given that,

$$2y^4 = x^5$$

On differentiating w.r.t. x, we get

$$8y^3 \frac{dy}{dx} = 5x^4$$

$\Rightarrow$ $\left(\frac{dy}{dx}\right)_{2,2} = \frac{5\ 2^4}{8\ 2^3} = \frac{5}{4}$

$\therefore$ Length of subtangent $= \frac{y}{dy/dx}$

$$= \frac{2}{5/4} = \frac{8}{5}$$

39. $\int e^x \frac{1-\sin x}{1-\cos x}\, dx$

$$= \int e^x \frac{1-2\sin\frac{x}{2}\cos\frac{x}{2}}{2\sin^2\frac{x}{2}}\, dx$$

$$= \frac{1}{2}\int e^x \operatorname{cosec}^2\frac{x}{2}\, dx - \int e^x \cot\frac{x}{2}\, dx$$

$$= \frac{1}{2}\left[-e^x \cot\frac{x}{2}.2 + \int e^x \cot\frac{x}{2}\, 2dx\right]$$

$= -e^x cot\frac{x}{2} + c$

40. Given that,

$e^x\ 1 + x\ .sec^2\ xe^x\ dx = f\ x\ +$ constant

Put $xe^x = t$ in LHS

$\Rightarrow$ $(e^x + xe^x)\ dx = dt$

$\therefore$ LHS = $sec^2 t\ dt$

= tan t + constant

$\Rightarrow$ tan (xe^x) + constant = f(x) + constant

$\Rightarrow$ f(x) = tan (xe^x)

41. Let $I = \int_{-\pi/2}^{\pi/2} sin\ x\ dx$

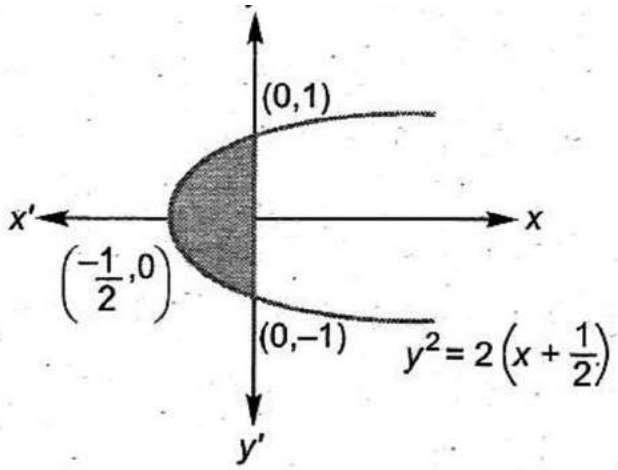
$= 2\int_{-\pi/2}^{\pi/2} sin\ x\ dx$

$= 2\ -cos\ x\ _0^{\pi/2}$

= 2

42. Given curve can be rewritten as

$y^2 = 2\ x + \frac{1}{2}$



$\therefore$ Required area $= \int_{-1}^{1} x\,dy$

$= 2\int_{0}^{1} \frac{y^2-1}{2}\,dy$

$= \left(\frac{y^3}{3} - y\right)_0^1$

$= \frac{1}{3} - 1 = \frac{2}{3}$ sq unit

43. Given differential equation is

$$\frac{dy}{dx} = \frac{xy+y}{xy+x}$$

$\Rightarrow$ $\frac{dy}{dx} = \frac{y\,1+x}{x\,1+y}$

$\Rightarrow$ $\frac{1+y}{y}dy = \frac{1+x}{x}dx$

$\Rightarrow$ $\left(\frac{1}{y}+1\right)dy = \left(\frac{1}{x}+1\right)dx$

$\Rightarrow$ log ydy dx+ y = log x + x + log c

$\Rightarrow$ y – x = log $\frac{cx}{y}$

$$\frac{dy}{dx} - y \tan x = e^x \sec x$$

$\therefore$ IF $= e^{-\tan x\, dx} = e^{-\log \sec x}$

$$= \frac{1}{\sec x}$$

$\therefore$ Complete solution is

$$y \cdot \frac{1}{\sec x} = e^x \sec x . \frac{1}{\sec x} dx$$

$\Rightarrow$ $\frac{y}{\sec x} = e^x + c$

$\Rightarrow$ $y \cos x = e^x + c$

45. Given differential equation can be rewritten as

$$\frac{dy}{dx} = \frac{x^3+y^3}{xy^2}$$

It is a homogeneous differential equation.

Put $y = vx \Rightarrow \frac{dy}{dx} = v + x\frac{dv}{dx}$

$\therefore$ $x\frac{dv}{dx} + v = \frac{x^3+v^3x^3}{x^3v^2}$

$\Rightarrow$ $x\frac{dv}{dx} + v = \frac{1+v^3}{v^2}$

$\Rightarrow$ $x\frac{dv}{dx} = \frac{1}{v^2} \Rightarrow v^2 dv = \frac{dx}{x}$

On integrating both sides, we get

$$\frac{v^3}{3} = \log x + \log c$$

$\Rightarrow$ $\frac{1}{3}\left(\frac{y}{x}\right)^3 = \log x + \log c$

$\Rightarrow$ $y^3 = 3x^3 \log cx$

Physics

46. h $G^xL^yE^z$

$[M^1L^2T^{-1}][M^{-1}L^3T^{-2}]^x[M^1L^2T^{-1}]^y[M^1L^2T^{-2}]^z$

$[M^1L^2T^{-1}][M^{-1}L^3T^{-2}]^x[M^1L^2T^{-1}]^y[M^1L^2T^{-2}]^z$

Comparing the power, we get

$1 = -x + y + z$ ... (i)

$2 = 3x + 2y + 2z$ ... (ii)

$-1 = -2x - y - 2z$ ... (iii)

On solving Eq. (i), (ii) and (iii), we get

$x = 0$

47. Let $B = \iota - J$

$= \frac{A.B}{B}$

$= \frac{a_x\iota + a_yJ + a_zk \ . \ \iota - J}{\iota - J}$

$= \frac{a_x - a_y}{\overline{2}}$

48. The ball is thrown vertically upwards then according to equation of motion

$(0)^2 - u^2 = -2gh$ ... (i)

From Eqs. (i) and (ii),

$$h = \frac{gt^2}{2}$$

When the ball is falling downwards after reaching the maximum height

$$s = ut' + \frac{1}{2} g(t')^2$$

$$\frac{h}{2} = (0)t' + \frac{1}{2} g(t')^2$$

$$\Rightarrow \quad t' = \sqrt{\frac{h}{g}}$$

$$t' = \frac{t}{\sqrt{2}}$$

Hence, the total time from the time of projection to reach a point at half of its maximum height while returning = t + t′

$$= t + \frac{t}{\sqrt{2}}$$

49. Direction of velocity is always tangent to the path so at the top of trajectory, it is in horizontal direction.

50. Given, velocity of river, (v) = 2 m/s

Density of water $\rho = 1.2$ g/cc

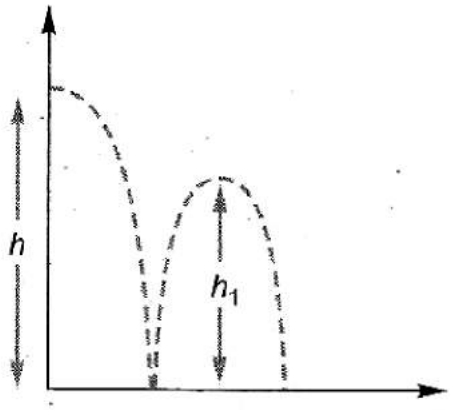
Mass of each cubic metre

$$m = \frac{1.2 \times 10^{-3}}{10^{-2} \times 3} = 1.2 \times 10^3 \text{ kg}$$

$\therefore$ Kinetic energy $= \frac{1}{2} mv^2$

$$= \frac{1}{2} \times 1.2 \times 10^3 \times (2)^2$$

51.



Total distance travelled by the ball before its second hit is

$H = h + 2h_1$

$= h[1 + 2e^2]$ $[\because h_1 = he^2]$

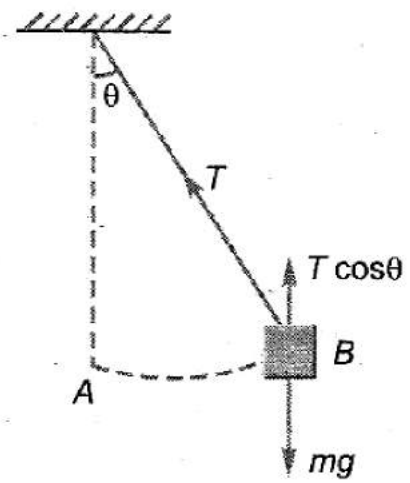
52. As initially both the particles were at rest therefore velocity of centre of mass was zero and there is no external force on the system so speed of centre of mass remains constant i.e., it should be equal to zero.

53. $\mu = \tan\theta \left(1 - \frac{1}{n^2}\right)$

Here, $\theta = 45^\circ$ and $n = 2$

$\therefore \quad \mu = \tan 45^\circ \left(1 - \frac{1}{2^2}\right)$

$= 1 - \frac{1}{4} = \frac{3}{4} = 0.75$



In equilibrium,

$$T \cos \theta = mg$$

$$\Rightarrow \quad \cos \theta = \frac{150 \times 9.8}{2940}$$

$$\Rightarrow \quad \cos \theta = 0.5$$

$$\Rightarrow \quad \theta = 60^{\circ}$$

55. Moment of inertia of a circular disc about an axis passing through centre of gravity and perpendicular to its plane

$$I = \frac{1}{2} MR^2 \qquad \ldots\ldots. \text{(i)}$$

From Eq. (i) $MR^2 = 2\ I$

Then, moment of inertia of disc about tangent in a plane

$$= \frac{5}{4} MR^2$$

$$= \frac{5}{4} (2I)$$

$$= \frac{5}{2} I$$

56. Time period of satellite

$T \frac{1}{M^{1/2}}$, where M is mass of earth.

$\propto (R + h)^{3/2}$ where R is radius of the orbit, h is the height of satellite from the earth's surface.

57. It is the least interval of time after which the periodic motion of a body repeats itself. Therefore, displacement will be zero.

58. $Y = \frac{mgl}{A\,\Delta l}$

$\Rightarrow \quad \frac{\Delta l}{l} = \frac{mg}{AY}$

$\therefore \quad \frac{\Delta l}{l} = \frac{1 \times 10}{3 \times 10^{-6} \times 10^{11}}$

$= 0.3 \times 10^{-4}$

59. In case of soap bubble

$W = T \times 2 \times \Delta A$

$= 0.03 \times 2 \times 40 \times 10^{-4}$

$= 2.4 \times 10^{-4}$ J

60. Terminal velocity, $v_T \propto r^2$

Or $\frac{v_{T_1}}{v_{T_2}} = \frac{r_1^2}{r_2^2}$

$\therefore \quad \frac{9}{4} = \frac{r_1}{r_2}$

r_2 2

$\therefore$ $V = \frac{4}{3}\pi r^3$

Or $\frac{v_1}{v_2} = \frac{r_1^3}{r_2^3} = \frac{27}{8}$

61. Ideal gas equation is given by

$pV = nRT$ ... (i)

For oxygen, p = 1 atm, V =1 L, n = n_O

Therefore Eq. (i) becomes

$\therefore$ $1 \times 1 = n_{O_2}RT$

$\Rightarrow$ $n_{O_2} = \frac{1}{RT}$

For nitrogen p = 0.5 atm, V = 2 L, n = nN

$\therefore$ $0.5 \times 2 = n_{N_2}RT$

$\Rightarrow$ $n_{N_2} = \frac{1}{RT}$

For mixture of gas

$p_{mix}V_{mix} = n_{mix}RT$

Here, $n_{mix} = nO + n_{N_2}$

$\therefore$ $\frac{p_{mix}V_{mix}}{RT} = \frac{1}{RT} + \frac{1}{RT}$

$\Rightarrow$ $p_{mix}V_{mix} = 2$

62. Modulus of elasticity = $\frac{Force}{Area} \times \frac{l}{\Delta l}$

$3 \times 10^{11} = \frac{33000}{10^{-3}} \times \frac{l}{\Delta l}$

$l \quad 10^{-3} \quad 3\times10^{11}$

$$= 11 \times 10^{-5}$$

Change in length, $\frac{\Delta l}{l} = \alpha\ \Delta T$

$$11 \times 10^{-5} = 1.1 \times 10^{-5} \times \Delta T$$

$\Rightarrow \quad \Delta T = 10$ K or $10^{\circ}C$

63. In adiabatic compression temperature and hence internal energy of the gas increases. In compression pressure will increase.

64. For adiabatic change equation of state is

$$pV^{\gamma} = \text{constant}$$

It can also be re-written as

$$TV^{\gamma-1} = \text{constant} \quad as\ p = \frac{nRT}{V}$$

and $p^{1-\gamma}T^{\gamma} = \text{constant} \quad as\ V = \frac{nRT}{p}$

65. The temperature at the contact of the surface

$$= \frac{K_1 d_2 \theta_1 + K_2 d_1 \theta_2}{K_1 d_2 + K_2 d_1}$$

$$= \frac{2K_2 d_2 \times 100 + 2d_2 \times K_2 \times 25}{2K_2 d_2 + K_2 2d_2}$$

$$= \frac{200+50}{4} = 62.5^{\circ}C$$

66. $v_{max} = v$

$\Rightarrow \quad A\omega = v$

Or $A = \frac{\lambda}{2\pi}$

67. The speed of the car is 72 km/h

$= 72 \times \frac{5}{18} = 20$ m/s

The distance travelled by car in 10 s

$= 10 \times 20 = 200$ m

Hence, the distance travelled by sound in reaching the hill and coming back to the moving driver

$= 1800 + (1800 - 200)$

$= 3400$ m

So, the speed of sound $= \frac{3400}{10} = 340$ m/s

68. Lens maker's formula

$$= \frac{1}{f} = \mu - 1 \quad \frac{1}{R_1} - \frac{1}{R_2}$$

where, $R_2 = \infty$, $R_1 = 0.3$ m

$$\therefore \quad \frac{1}{f} = \frac{5}{3} - 1 \quad \frac{1}{0.3} - \frac{1}{\infty}$$

$$\Rightarrow \quad \frac{1}{f} = \frac{2}{3} \times \frac{1}{0.3}$$

Or $f = 0.45$ m

69. Using Huygen's eye-piece, measurements can be taken but not accurately due to the reason given.

70. The image of an object in white light formed by a lens is usually coloured and blurred. This defect of image is called chromatic aberration and arises due to the fact that focal length of a lens is different for different colours. In case of two thin lenses in contact, the combination will be free from chromatic aberration. The lens combination which satisfies this condition are called achromatic lenses.

71. The general condition for Froun hofer diffraction is $\frac{b^2}{L\lambda} << 1$.

72. Time period of magnet, $T = 2\pi \sqrt{\frac{I}{MB}}$

When magnet is cut parallel to its length into four equal pieces. Then new

magnetic moment, $M' = \frac{M}{4}$

New moment of inertia, $I' = \frac{I}{4}$

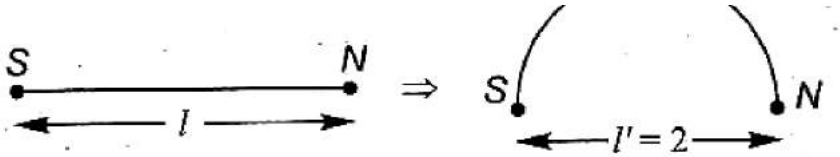
$\therefore$ New time period, $T' = 2\pi \sqrt{\frac{I'}{M'B'}}$

$\Rightarrow$ $T = T' = 4s$

73. On bending a wire its pole strength remains unchanged whereas its magnetic moment changes.

New magnetic moment,

$M' = m(2r) = m\frac{2l}{\pi} = \frac{3M}{\pi}$



74. Ratio of charges = 2:3

$\therefore \quad q_1 = \frac{2}{5} \times 1\ \mu C \quad$ and $\quad q_2 = \frac{3}{5} \times 1\ \mu C$

Electrostatic force between the two charges

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

$$= \frac{9\times10^9\times2\times10^{-6}\times3\times10^{-6}}{5\times5\times 1^{\,2}}$$

$$= 2.16 \times 10^{-3}\ N$$

75. At equatorial point

$$E_e = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$$

(directed from +q to −q) and $V_e = 0$,

76. Current through each arm

PRQ and PSQ = 1 A

$V_P - V_R = 3V$ ... (i)

$V_P - V_S = 7\ V$ ... (ii)

From Eqs. (i) and (ii), we get

$V_R - V_S = +\ 4\ V$

77. Here, $V < E$

$\therefore$ $E = V + Ir$

For first case

$$E = 12 + \frac{12}{16} r \quad \text{... (i)}$$

For second case

$$E = 11 + \frac{11}{10} r \quad \text{... (ii)}$$

From Eqs. (i) and (ii),

$$12 + \frac{12}{16} r = 11 + \frac{11}{10} r$$

$\Rightarrow$ $r = \frac{20}{7} \Omega$

78. We know that thermoelectric power

$$S = \frac{dE}{dT}$$

Given, $E = K(T - T_r)\ T_0 - \frac{1}{2}\ T + T_r$

By differentiating the above equation w.r.t. T and putting $T = \frac{1}{2}$ T_0, we get $S = \frac{1}{2} kT_0$

79. Shunt of an ammeter,

$$S = \frac{I_g \times G}{I - I_g}$$

$$= \frac{5 \times G}{100 - 5}$$

$$= \frac{G}{19}$$

80. Two coils carry currents in opposite directions, hence net magnetic field at centre will be difference of the two fields.

ie, $B_{net} = \frac{\mu_0}{4\pi} \cdot 2\pi N \ \frac{i_1}{r_1} - \frac{i_2}{r_2}$

$= \frac{10\mu_0}{2} \ \frac{0.2}{0.2} - \frac{0.3}{0.4}$

$= \frac{5}{4} \mu_0$

81. In a transformer

$\frac{N_P}{N_S} = \frac{I_S}{I_P}$

$\frac{50}{200} = \frac{I_S}{4}$

$\Rightarrow \quad I_S = 1$ A

82. For $\phi = 90^\circ$, $\cos \phi = 0$

So, $\lambda' = \lambda + \frac{h}{m_e c}$

$= 0.140 \times 10^{-9} + \frac{6.63 \times 10^{-34}}{9.1 \times 10^{-31} \ 3 \times 10^8}$

$= (0.140 \times 10^{-9} + 2.4 \times 10^{-12})$m

$= 0.142$ nm

83. $E = \frac{hc}{\lambda}$

$= \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{45 \times 10^{-12}}$

$= \frac{0.44 \times 10^{-14}}{1.6 \times 10^{-19}}$

$= 0.275 \times 10^5$ eV

84. Nuclear force between two particles is independent of charges of particles.

$\Rightarrow \quad F_{pp} = F_{nn} = F_{np}$

85. In forward biasing both electrons and protons move towards the junction and hence the width of depletion region decreases.

Chemistry

86. Energy of an electron in n^{th} orbit,

$$E_n = -\frac{2\pi^2 k^2 m Z^2 e^4}{n^2 h^2}$$

On substituting the values of k, m, e and h, we get

$$E_n = -\frac{2.172 \times 10^{-18} Z^2}{m^2} \text{ J atom}^{-1}$$

or $$= -\frac{1311.8 Z^2}{n^2} \text{ kJ mol}^{-1}$$

or $$= -\frac{313.52 Z^2}{n^2} \text{ kcal mol}^{-1}$$

[$\because$ 1 kcal = 4.184 kJ]

For H-atom, $Z = 1$

For Lyman series, $n_1 = 1$, $n_2 = 2$

Energy of electron in n_1 orbit

1^2 kcal mol

$= -313.52 \text{ kcal mol}^{-1}$

$= -313.6 \text{ kcal mol}^{-1}$

Energy of electron in n_2 orbit

$= -\frac{313.52 \times 1^2}{2^2} \text{ kcal mol}^{-1}$

$= -\frac{313.52}{4} \text{ kcal mol}^{-1}$

$= -78.38 \text{ kcal mol}^{-1}$

87. Given, velocity of particle A = 0.05 ms^{-1}

Velocity of particle B = 0.02 ms^{-1}

Let the mass of particle A = x

$\therefore$ The mass of particle B = 5x

de-Broglie's equation is

$$\lambda = \frac{h}{mv}$$

For particle A

$$\lambda_A = \frac{h}{x \times 0.05} \quad \text{... (i)}$$

For particle B

$$\lambda = \frac{h}{5x \times 0.02} \quad \text{... (ii)}$$

Eq (i)/(ii)

$$\frac{\lambda_A}{\lambda_B} = \frac{5x \times 0.02}{x \times 0.05}$$

$$\frac{\lambda_A}{\lambda_B} = \frac{2}{1}$$

88. Given, Δm for $_5B^{11}$ = 0.0821 u

Number of nucleons = 11

Binding energy = 931 × Δm MeV

= 931 × 0.081

= 75.411 MeV

Average binding energy

$$= \frac{binding\ energy}{number\ of\ nucleons}$$

$$= \frac{75.411}{11}$$

= 6.85 MeV

89. Given,

Atomic number of element B = Z

(∵ noble gas ∴ belong to zero group)

Atomic number of element A = Z − 1

(ie, halogens)

Atomic number of element C = Z + 1

(ie, group IA)

Atomic number of element D = Z + 2

(ie, group IIA)

∵ Element B is a noble gas

affinity.

and element C must be an alkali metal and exist in +1 oxidation state.

and element D must be an alkaline earth metal with +2 oxidation state.

90. Given,

observed dipole moment = 1.03 D

Bodn length of HCl molecule, d = 1.275 Å

$= 1.275 \times 10^{-8}$ cm

Charge of electrons, $e^- = 4.8 \times 10^{-10}$ esu

Percentage ionic character = ?

Theoretical value of dipole moment = e × d

$= 4.8 \times 10^{-10} \times 1.275 \times 10^{-8}$ esu – cm

$= 6.12 \times 10^{-18}$ esu – cm

= 6.12 D

Percentage ionic character

$$= \frac{observed\ dipole\ moment}{theoretical\ value\ of\ dipole\ moment} \times 100$$

$$= \frac{1.03}{6.12} \times 100$$

= 16.83 %

91.

Molecule	bp + lp	Hybridisation	Shape
H_2O	2+2	sp^3	angular
BCl_3	3+0	sp^2	trigonal planar
NH_4^+	4+0	sp^3	tetrahedral
CH_4	4+0	sp^3	tetrahedral

92. $A\ \underset{100g}{CaCO_3} \xrightarrow[decomposition]{\Delta} CaCO + \underset{22.4L}{CO_2}$

∵ 100 g $CaCO_3$ on decomposition gives = 22.4 L CO_2

∴ 10 g $CaCO_3$ on decomposition will give

$= \frac{22.4 \times 10}{100}$ L CO_2

= 2.24 L CO_2

$B\ \underset{106g}{Na_2CO_3} \xrightarrow{Excess\ HCl} 2NaCl + H_2O + \underset{22.4L}{CO_2}$

106 g Na_2CO_3 gives = 22.4 L CO_2

1.06 g Na_2CO_3 will give

$= \frac{22.4 \times 1.06}{106}$ L CO_2

= 0.224 L CO_2

$C\ \underset{12\,g}{C} \xrightarrow[combustion]{Excess\ O_2} \underset{22.4L}{CO_2}$

12 g carbon on combustion gives = 22.4 L CO_2

2.4 g carbon on combustion will give

$= \frac{22.4 \times 2.4}{12}$ L CO_2

= 4.48 L CO_2

$$D \quad \underset{\substack{2\,[12+16] \\ 56\ g}}{2CO} \quad \xrightarrow[combustion]{Excess\ O_2} \quad \underset{2\times 22.4L}{CO_2}$$

56 g carbon monoxide on combustion gives = 2 × 22.4 L CO_2

0.56 g carbon monoxide on combustion will give

= $\frac{2\times 22.4\times 0.56}{56}$ L CO_2

= 0.448 L CO_2

Hence, A—(iv), B—(i), C—(ii), D—(iii)

93. Number of moles of helium = 0.3

Number of moles of argon = 0.4

We know that KE = nRT

KE of helium = 0.3 × R × T … (i)

KE of argon = 0.4 × R × 400 … (ii)

According to question

KE of helium = KE of argon

0.3 × R × T = 0.4 × R × 400

T = 533 K

94. Given,

Weight of non-volatile solute,

w = 25 g

Weight of solvent, W = 100 g

$p^o - p_s = 0.225$ mm

Vapour pressure of pure solvent,

$p^o = 17.5$ mm

Molecular weight of solvent (H_2O), M = 18 g

Molecular weight of solute, m = ?

According to Raoult's law

$$\frac{p^o - p_s}{p^o} = \frac{w \times M}{m \times W}$$

$$\frac{0.225}{17.5} = \frac{25 \times 18}{m \times 100}$$

$$m = \frac{25 \times 18 \times 17.5}{22.5}$$

$$= 350 \text{ g}$$

95. In water, barium hydroxide is hydrolysed as follows,

$$Ba(OH)_2 \rightleftharpoons Ba^{2+} + 2OH^-$$

conc. of $Ba^{2+} = 1 \times 10^{-3}$ M

conc. Of $[OH^-] = 2 \times 1 \times 10^{-3}$ M

$= 2 \times 10^{-3}$ M

$pOH = -\log [OH^-]$

$= -\log (2 \times 10^{-3})$

$= 2.69$

$pH + pOH = 14$

$pH = 14 - pOH$

$= 11.3$

≈ 11.0

96. $CH_3COONa + H_2O \rightarrow CH_3COOH + NaOH$

The above process takes place in following steps

$$\underset{}{CH_3COONa} \xrightarrow[\text{in aqueous solution}]{\text{Ionisation}} \underset{\text{strong base}}{CH_3COO^-} + Na^+$$

$CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$

Acetate ion undergoes hydrolysis and the resulting solution is slightly basic due to excess of OH^- ions. Hence, both (A) and (R) are true and (R) is the correct explanation of (A).

97. Given, weight of hydrogen liberated

$= 5.04 \times 10^{-2}$ g

Eq. wt. of hydrogen = 1.008

Eq. wt. of silver = 108

Weight of silver deposited, w =?

According to Faraday's second law of electrolysis

$$\frac{\textit{weight of silver deposited}}{\textit{weight of hydrogen liberated}} = \frac{\textit{eq. wt. of silver}}{\textit{eq. wt. of hydrogern}}$$

$$\frac{w}{5.04\times10^{-2}} = \frac{108}{1.008}$$

$$w = \frac{108\times5.04\times10^{-2}}{1.008} = 5.4 \text{ g}$$

$$H_2O \rightleftharpoons \underset{\text{cathode}}{H^+} + \underset{\text{anode}}{OH^-}$$

At anode

$$OH^- \xrightarrow{\text{Oxidation}} OH + e^-$$

$$4OH \longrightarrow 2H_2O + O_2$$

At cathode

$$2H^+ + 2e^- \xrightarrow{\text{Reduction}} H_2$$

Given, time, t = 1930 s

Number of moles of hydrogen collected

$= \frac{1120\times10^{-3}}{22.4}\ moles$

= 0.05 moles

∵ 1 mole of hydrogen is deposited by = 2 moles of electrons

∴ 0.05 moles of hydrogen will be deposited by = 2 × 0.05

= 0.10 mole of electrons

Charge, Q = nF

= 0.1 × 96500

Charge, Q = it

0.1 × 96500 = i × 1930

$i = \frac{0.1\times96500}{1930}$

= 5.0A

99) Given, angle of diffraction (2 θ) = 90° θ

= 45°

n = 2 [∵ second order diffraction]

Bragg's equation is

$n\lambda = 2d \sin\theta$

$2 \times \lambda = 2 \times 2.28 \times \sin 45°$

$\lambda = 1.612$

100)

PCl_5	$\rightleftharpoons$	PCl_3 +	Cl_2	
5		0	0	initial moles
$5(1-\alpha)$		5α	5α	moles at equilibrium
$\frac{5(1-\alpha)}{0.5}$		$\frac{5\alpha}{0.5}$	$\frac{5\alpha}{0.5}$	conc at equilibrium

$\alpha = 40\%$

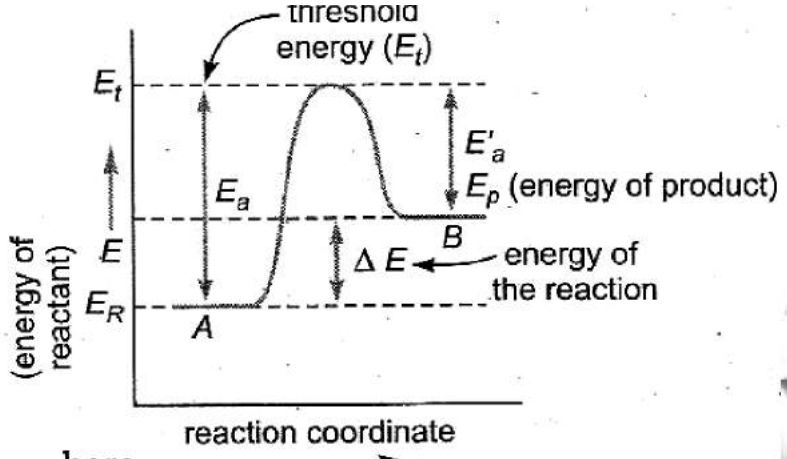
$= 0.4$

$$K_c = \frac{PCl_3 \; Cl_2}{PCl_5}$$

$$= \frac{\frac{5\times0.4}{0.5} \; \frac{5\times0.4}{0.5}}{\frac{5\times0.6}{0.5}} = \frac{16}{6}$$

$$= 2.66\, mol/L$$

101)



where,

where,

E_a = activation energy of forward reaction

E_a = activation energy of backward reaction

The above energy profile diagram shows that

$$E_a > E'_a$$

The potential energy of the product is greater than that of the reactant, so the reaction is endothermic.

$$E_a = E_a' + \Delta E$$

$$E_t = E_a \text{ or } E_t > E_a'$$

102) Given,

$H_2O\ (g) + C(g) \rightarrow CO(g) + H_2(g);$

$\Delta H = 131$ kJ ..... (i)

$CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g);$

$\Delta H = -2S2$ kJ ..... (ii)

$\frac{1}{2}$

$\Delta H = -242$ kJ ..... (iii)

$C(g) + O_2(g) \rightarrow CO_2(g);$ $\Delta H = ?$ ..... (iv)

On adding Eqs (i), (ii) and (iii), we get Eq (iv)

$H_2O(g) + C(g) \rightarrow CO(g) + H_2(g);$

$\Delta H = +131$ kJ

$CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g);$

$\Delta H = -282$ kJ

$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(g);$

$C\ g + O_2\ g \rightarrow CO_2\ g$

$\Delta H = (131 - 282 - 242)$ kj

$= -393$ kj

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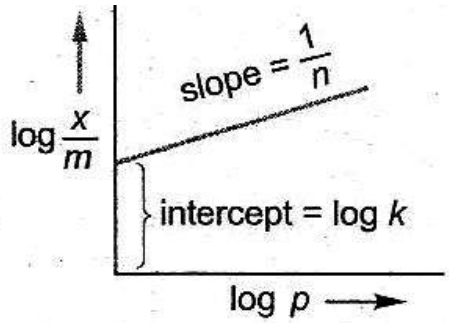
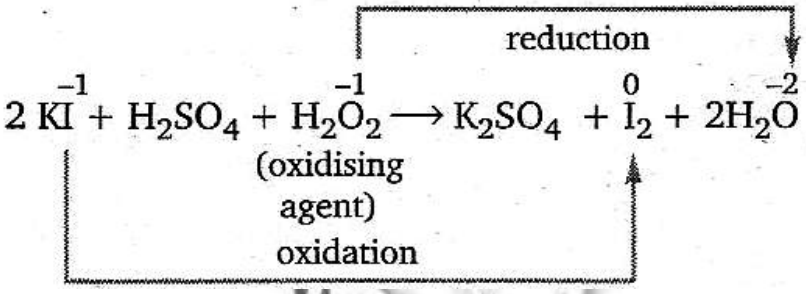
103) When we plot a graph between log (x/m) and log p, a straight line with positive slope will be obtained. This graph represents the Freundlich adsorption isotherm.



Graph of Freundlich adsorption isotherm.

104) The reaction in which H_2O_2 is reduced while the other reactant is oxidised, represents the oxidising property of H_2O_2.



105) (i) The alkali metal superoxides contain O^-_2 ion, which has an unpaired electron, hence they are paramagnetic in nature.

(ii) The basic character of alkali metal hydroxides increases on moving down the group.

(iii) The conductivity of alkali metal chlorides in their aqueous solution increases on moving down the group because in aqueous solution alkali metal chlorides ionise to give alkali metal ions. On moving down the group the size of alkali metal ion increases, thus degree of hydration decreases, due to this reason their conductivity in aqueous solution increases on moving down the group.

(iv) $M_2CO_3 \underset{\text{aq solution}}{\rightleftharpoons} 2M^+ + CO_3^{2-}$

$CO_3^{2-} + 2H_2O \longrightarrow H_2CO_3 + 2OH^-$

Thus, basic nature of carbonates in aqueous solution is due to anionic hydrolysis.

106) According to Lewis, the compound which can accept a lone pair of electron, are called acids.

Boron halides, being electron deficient compounds, can accept a lone pair of electrons, so termed as Lewis acid.

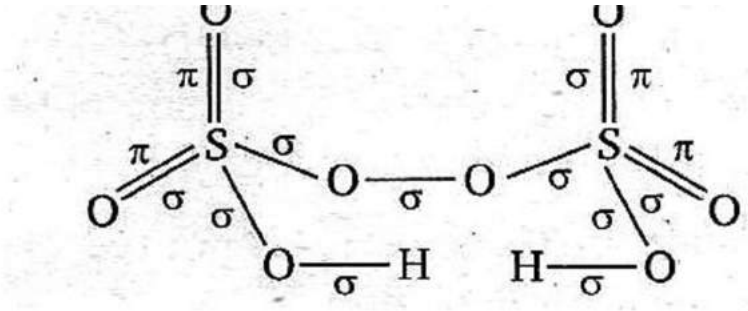
107) Orthosilicic acid (H_4SiO_4), on heating at high temperature, loses two water molecules and gives silica (SiO_2) which on reduction with carbon gives carborundum (SiC) and CO.

$$H_4SiO_4 \xrightarrow[-2H_2O]{1000^\circ C} SiO_2 \xrightarrow[\Delta]{C} \underset{\text{carborundum}}{SiC} + CO$$

108) The reducing character of the hydrides of group V elements depends upon the stability of hydrides. With progressive decrease in stability, the reducing character of hydrides increases as we move down the group. Thus, ammonia, being stable, has least reducing ability. The order of reducing abilities of V group hydrides is

$NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

109) The structure of peroxodisulphuric acid ($H_2S_2O_8R$) is



Hence, it contains 11σ and 4π bonds.

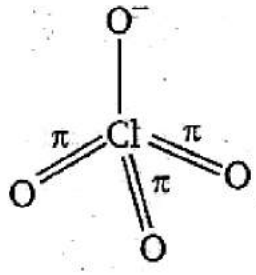
110) With progressive increase in atomic number, the reduction potential of halogens decreases, thus oxidising power also decreases, Hence, a halogen with lower atomic number will oxidise the halide ion of higher atomic number and therefore, will liberate them from their salt solution.

Hence, the reaction

$$Cl_2 + 2F^- \rightarrow 2Cl^- + F_2$$

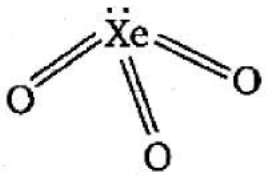
is not possible.

111) The structure of ClO^-_4 is



Thus, it contains 3 dπ - pπ bonds,

XeO_3 also contains 3 dπ- pπ bonds as



112) $[Co(NH_3)_5\ SO_4]Br \rightleftharpoons [Co(NH_3)_5\ SO_4]^+ + Br^-$

$[Co(NH_3)_5\ Br]SO_4 \rightleftharpoons [CO(NH_3)_5\ Br]^{2+} + SO^{2-}{}_4$ the molecular formula of both of the above compounds is same but on ionisation they give different ions in solution, so they are called ionisation isomers.

113) In stratosphere the following reactions takes place which are responsible for depletion of ozone layer.

$NO + O_3 \rightarrow NO_2 + O_2$

$CF_2Cl_2 \xrightarrow{h\nu} C^{\bullet}F_2Cl + C^{\bullet}I$

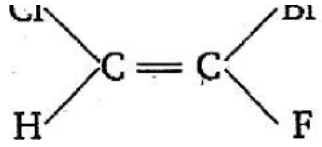
$CFCl_3 \xrightarrow{h\nu} C^{\bullet}FCl_2 + C^{\bullet}I$

$C^{\bullet}I + O_3 \rightarrow ClO^{\bullet} + O_2$

$Cl^{\bullet}O + O \rightarrow C^{\bullet}I + O_2$

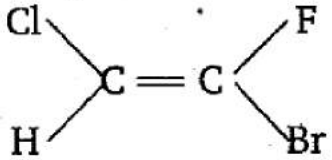
Hence, methane (CH_4) is not responsible for ozone layer depletion.

114) When the groups with higher priority (ie, with high atomic number) are present on same side of double bond, then the configuration is Z but when present on opposite side of double bond, the configuration is E.

(i) 

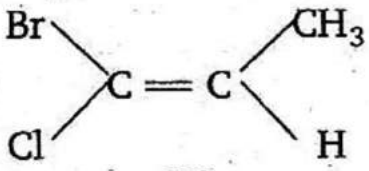
(Z)

(Priority : Cl > H and Br > F)

(ii) 

(E)

(Priority : Cl > H and Br > F)

(iii) 

(Z)

(Priority: Br > CI and CH_3 > H)

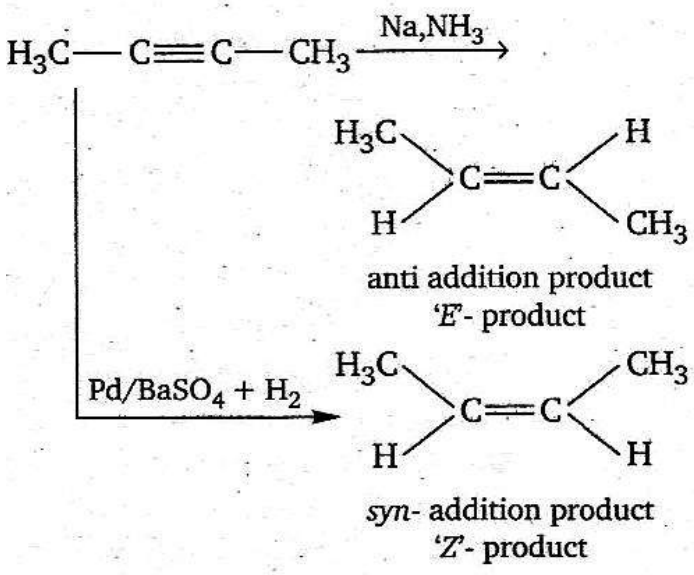
Hence, compound (i) and (iii) have (Z) configuration.

115) According to Cahn-Ingold-Prelog sequence rules, the priority of groups is decided by the atomic number of their atoms. When the atom -(which is directly attached to the asymmetric carbon atom) of a group has higher atomic number, then the group gets higher priority. Groups with atoms of comparable atomic number having double or triple bond, have high priority than those have single bond

Hence, the order of priority of groups is

— OH> — COOH > — CHO > — CH_2OH

116)

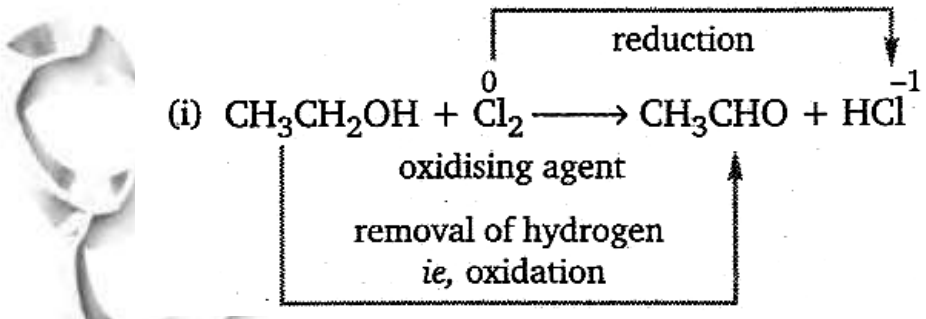


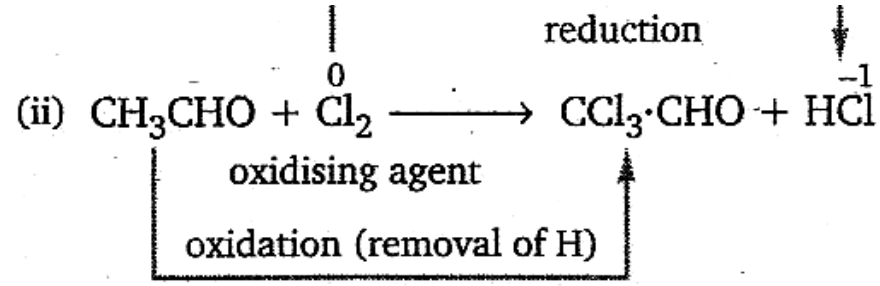
Hence, reagent X and Yare respectively

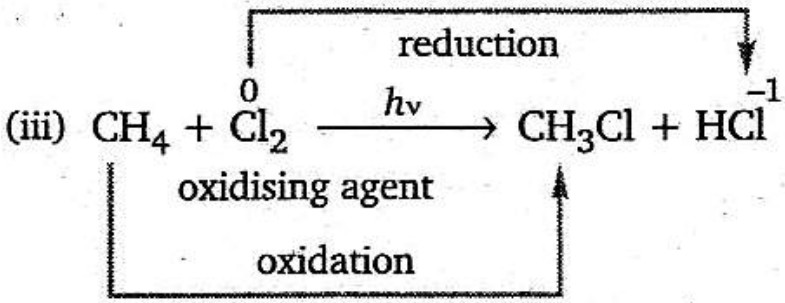
Na, NH_3 and $Pd/BaSO_4 + H_2$.

117) In a reaction, the reagent, which is reduced or remove hydrogen from the other reactant

(reagent), is termed as oxidising agent.





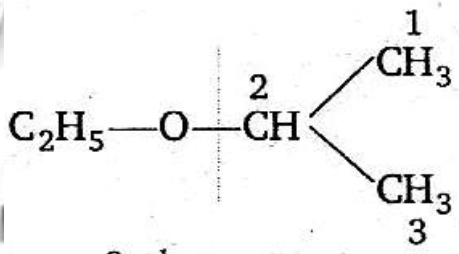


Hence, in all of the above reactions, chlorine acts as an oxidising agent.

118) Among hydrogen halides, as the size of halide ion increases, its reactivity towards ethyl alcohol also increases. Thus, the order of reactivity of hydrogen halides is

HI> HBr > HCI> HF

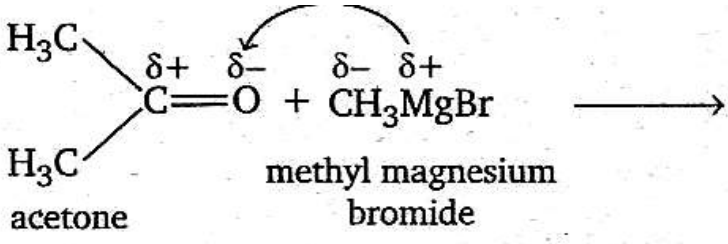
119)

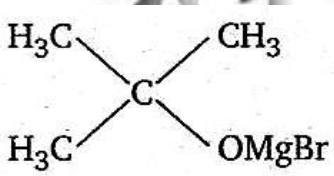


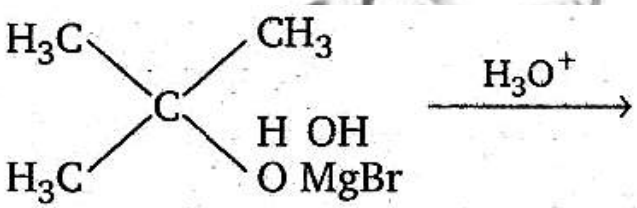
2-ethoxy propane

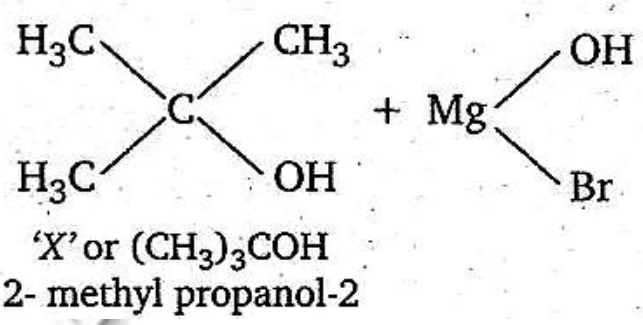
alkoxy alkane. Oxy is attached with the lower group. Hence, the IUPAC name of above compound is 2-ethoxy propane.

120)

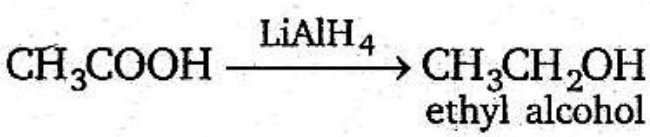


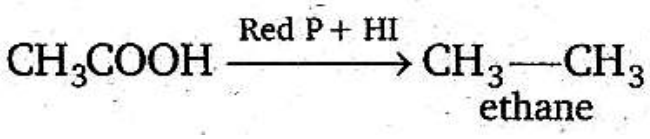






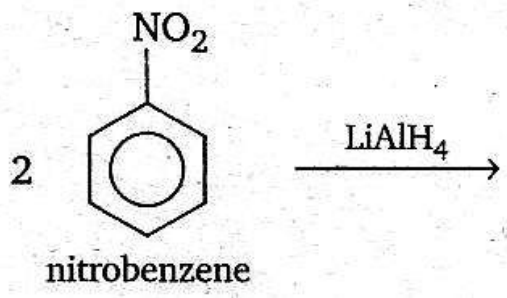
121) Acetic acid on reduction with lithium aluminiumhydride ($LiAlH_4$) gives ethyl alcohol while on reduction with HI and red P gives

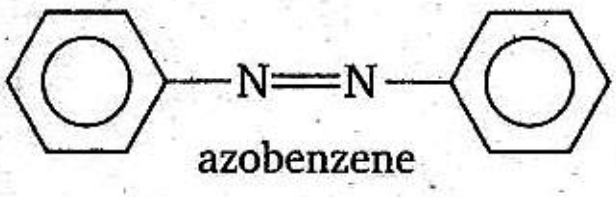




Hence, reagent A and B are respectively $LiAlH_4$ and Hi/red P.

122) Nitrobenzene on reduction with lithium aluminium hydride ($LiAlH_4$) gives azobenzene.





123) Aspirin is used as analgesics as well as antipyretics, ie, it serve a dual purpose.

Chlorophyll is used in photosynthesis. Oxyhaemoglobin contains Fe^{2+} ion, so it is paramagnetic and haemoglobin works as oxygen carrier.

Hence, A-(v), B-(i), C-(ii), D-(iii).

124) The ratio of weight average molecular weight and the number average molecular weight is called poly dispersity index (PDI).

$$\text{PDI} = \frac{\overline{M}_w}{M_n}$$

where,

$\overline{M}_w$ = weight average molecular weight

$\overline{M}_n$ = number average molecular weight

PDI is unity for natural monodispersed polymer but for synthetic polymers it is always greater than unity.

125) On hydrolysis with dilute aqueous sulphuric acid, sucrose gives a equimolar mixture of D-(+) glucose and D-(-)-fructose.

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H_2SO_4}$$

$$\underset{\text{D-(+) glucose}}{C_6H_{12}O_6} + \underset{\text{D-(–) fructose}}{C_6H_{12}O_6}$$

1 : 1

Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose, laevorotatory fructose is more, so the mixture is laevorotatory.