PHYSICS

1. If the amplitude of a damped oscillator becomes half in 2 minutes, the amplitude of oscillation w.r.t. initial one after 6 minutes is

(A) $\frac{1}{27}$ (B) $\frac{1}{8}$ (C) $\frac{1}{18}$ (D) $\frac{1}{64}$

2. An infinite number of spring having force constants as k, 2k, 4k, 8k ..... ∞ and respectively are connected in series; then equivalent spring constant is

(A) k (B) 2k (C) k/2 (D) ∞

3. A point particle of mass 0.1 kg is executing SHM of amplitude 0.1 m when the particle passes through the mean position. Its kinetic energy is 8×10^{-3} J. The equation of motion of this particle when the initial phase of oscillation is 45º can be given by

(A) $0.1 \cos\left(4t+\frac{\pi}{4}\right)$ (B) $0.1 \sin\left(4t+\frac{\pi}{4}\right)$

(C) $0.4 \sin\left(t+\frac{\pi}{4}\right)$ (D) $0.2 \sin\left(\frac{\pi}{2}+2t\right)$

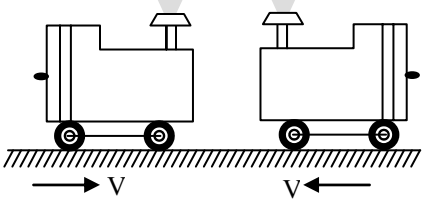
4. A mass m is moving with constant velocity along a line parallel to x-axis away from the origin. It angular momentum with respect to origin.

(A) is zero (B) remains constant
(C) goes on increasing (D) goes on decreasing

5. A vessel containing oil (density = 0.8g/cm^3) over mercury (density = 13.6 g/cm^3) has a homogeneous sphere floating with half of its volume immersed in mercury and other half in oil. The density of material of sphere in g/cm^3 is

(A) 3.3 (B) 6.4
(C) 7.2 (D) 2.8

6. Two trains move towards each other with the same speed, speed of sound is 340 ms^{-1}. If the pitch of the tone of the whistle of one is heard on the other changes by 9/8 times then the speed of each train is

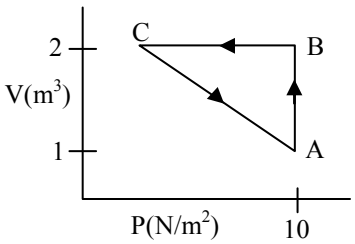


(A) 2 ms^{-1} (B) 2000 ms^{-1}
(C) 20 ms^{-1} (D) 200 ms^{-1}

7. A sound level I differ by 4 dB from another sound of intensity 10 nW cm^{-2}. The absolute value of intensity of sound level I in Wm^{-2} is

(A) 2.5×10^{-4} (B) 5.2×10^{-4}
(C) 2.5×10^{-2} (D) 5.2×10^{-2}

8. An ideal gas is taken through the cycle A → B → C → A as shown. If the net heat supplied to the gas in the cycle 5J, the work done by the gas in the process C → A



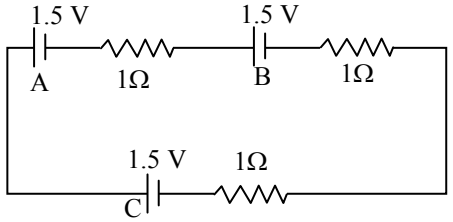
(A) – 5 J (B) – 15 J (C) – 10 J (D) –20 J

9. There are n electrons of charge e on a drop of oil of density ρ. It is in equilibrium in an electric field E. Then radius of drop is

(A) $\left(\frac{2neE}{4\pi\rho g}\right)^{1/2}$ (B) $\left(\frac{neE}{\rho g}\right)^{1/2}$

(C) $\left(\frac{3neE}{4\pi\rho g}\right)^{1/3}$ (D) $\left(\frac{2neE}{\pi\rho g}\right)^{1/3}$

10. Two identical cells of emf 1.5 V and internal resistance 1 Ω are in series. A third cell of similar parameters is connected in parallel to the combination. The terminal voltage of the cells A, B, C are



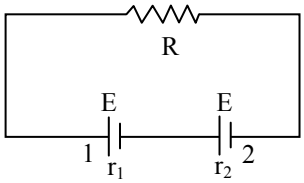
(A) 1, 1, 2 (B) 1.5, 1.5, 1.5
(C) 1.5, 0, 0 (D) 2, 1, 1

11. A wire has resistance of R ohm at T kelvin. At what temperature the resistance of wire be 2R ohm when temperature coefficient of resistance is α per degree centigrade.

(A) $\frac{(273-T)\alpha+1}{2\alpha}$ (B) $\frac{(273-T)\alpha-1}{2\alpha}$

(C) $\frac{(273-T)\alpha-1}{\alpha}$ (D) $\frac{(273-T)2\alpha+1}{\alpha}$

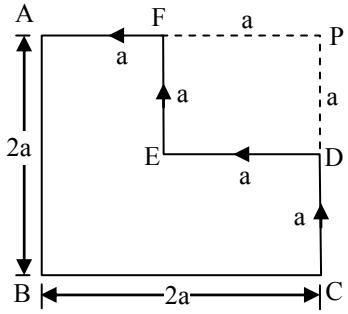
12. Two cells each of same emf but of internal resistance r_1 and r_2 are joined to form a series circuit through an external resistance R. Value of R in term of r_1 and r_2 for which cell 1 has zero p.d. across it is



(A) $R = r_1 - r_2$ (B) $R = r_1 + r_2$

(C) $\frac{r_1 r_2}{r_1 + r_2} = R$ (D) $\frac{r_1 + r_2}{r_1 r_2} = R$

13. A current i flows in the network shown. Resulting mangnetic induction at point p is



(A) $\frac{\mu_0 i}{4\pi a}$ (B) $-\frac{\sqrt{2}\mu_0 i}{8\pi a}$

(C) $-\frac{8}{\sqrt{2}}\frac{\mu_0 i}{\pi a}$ (D) $\frac{2}{8}\frac{\mu_0 i}{\pi a}$

14. An alpha particle and a proton have same velocity when they enter a uniform magnetic field. The period of rotation of proton will be

(A) double of that of α particle

(B) four times that of α particle

(C) one half time that of α particle

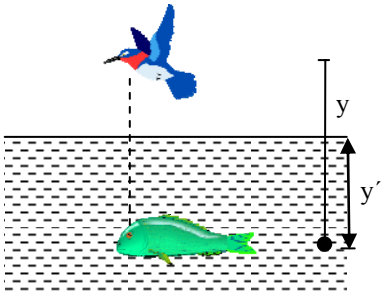
(D) same as that of α particle

15. A coil of inductance 8.4 mH and resistance 6 Ω is connected to a 12 V battery. The current in the coil is 1A at approximate time

(A) 500 s (B) 20 s

(C) 35 ms (D) 1 ms

16. A fish rising vertically up towards the surface with speed $3ms^{-1}$ observe a bird diving vertically down towards it with speed 9 m/s. The actual velocity of bird is



(A) $4.5\ ms^{-1}$ (B) $5.4\ ms^{-1}$

(C) $3.0\ ms^{-1}$ (D) $3.4\ ms^{-1}$

17. A concave lens of glass, refractive index 1.5 has both surface of same radius of curvature R. on immersion in a medium of refractive index 1.75, it will behave as a

(A) convergent lens of focal length 3.5 R

(B) convergent lens of focal length 3R

(C) divergent lens of focal length 3.5 R

(D) divergent lens of focal length 3 R

18. I is the intensity due to source of light at any point P on the screen if light reaches the point P via two different paths (a) direct (b) after reflection from a plane mirror then path difference between two paths is $3\lambda/2$, the intensity at P is

(A) I (B) zero (C) 2I (D) 4I

19. The surface of some material is radiated, in turn, by waves of $\lambda = 3.4 \times 10^{-7}$ m and $\lambda = 5.4 \times 10^{-7}$ m respectively. The ratio of stopping potential in two cases is 2 : 1, the work function is

(A) 2.05 eV (B) 1.05 eV

(C) 3.05 eV (D) None

20. A X-ray tube has a working voltage of 40×10^3 V. The continuous spectrum limit of the emitted x-rays is

(A) 0.17 Å (B) 0.13 Å (C) 0.13 Å (D) 0.31 Å

21. The number of alpha and beta deca $_{88}Ra^{222}$ experiences before turning into stable Pb^{206} isotope is

(A) 4, 2 (B) 2, 4 (C) 1, 3 (D) 6, 10

22. The displacement of interfering light waves are $y_1 = 4 \sin \omega t$ and $y_2 = 3 \sin (\omega t + \pi/2)$. The amplitude of resultant wave is

(A) 5 (B) 7 (C) 1 (D) 0

23. A beam of light of wavelength 600 nm from a distance source falls on a single slit 1 mm wide and resulting diffraction pattern is observed on a screen 2m away. Distance between first dark fringe on either side of the central bright fringe.

(A) 1.2 mm (B) 3.2 mm

(C) 2.4 mm (D) 4.2 mm

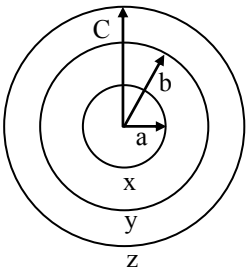
24. The intensity of light from one source is double of the other coherent source in a double slit experiment. The ratio of destructive to constructive interference in the obtained pattern is
(A) 34 (B) 1/34 (C) 17 (D) 1/17

25. Two radioactive material of half life T are produced at different instants. Their activities area found to be A_1 and A_2 respectively when $A_2 < A_1$. Their age difference is

(A) $0.44\ T \log \frac{A_2}{A_1}$ (B) $1.44\ T \log \frac{A_1}{A_2}$

(C) $4.44\ T \log \frac{A_2}{A_1}$ (D) $5.44\ T \log \frac{A_2}{A_1}$

26. Three concentric conducting spherical shell x, y and z have radii a, b and c respectively such that c > b > a, their surface charge density are σ, –σ and σ respectively. Then potential V_x is given by



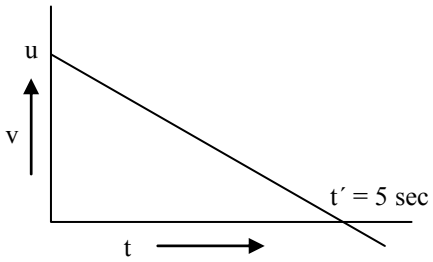
(A) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2}{c} - b + c\right]$ (B) $\frac{\sigma}{\varepsilon_0}[a - b + c]$

(C) $\frac{\sigma}{\varepsilon_0}[a + b + c]$ (D) $-\frac{\sigma}{\varepsilon_0}[a + b - c]$

27. A certain physical quantity is calculated from the formula $\frac{\pi}{3}(a^2 - b^2)h$, where h, a and b are all lengths. The quantity being calculated is
(A) velocity (B) length
(C) area (D) volume

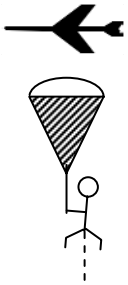
28. The potential energy of a particle varies with distance x from a fixed origin as $U = \frac{A\sqrt{x}}{x^2 + B}$, where A and B are dimensional constant then dimensional formula for AB is
(A) $M\,L^{7/2}\,T^{-2}$ (B) $M\,L^{11/2}\,T^{-2}$
(C) $M^2\,L^{9/2}\,T^{-2}$ (D) $M\,L^{13/2}\,T^{-3}$

29 A particle leaves the origin at t = 0 and moves in the +ve x axis direction. Velocity of the particle at any instant is given by $v = u\left(1 - \frac{t}{t'}\right)$. If u = 10 m/s and t′ = 5 sec. Find the x coordinate of the particle at an instant of 10s.



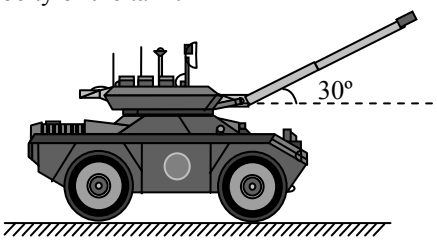
(A) 0 (B) 10 m (C) 20 m (D) –10 m

30. An aero-plane drops a parachutist. After covering a distance of 40 m, he opens the parachute and retards at 2 ms^{-2}. If he reaches the ground with a speed of $2ms^{-1}$, he remains in the air for about



(A) 16 s (B) 3 s (C) 13 s (D) 10 s

31. A tank moves uniformly along x-axis. It fires a shot from origin at an angle of 30º with horizontal while moving along positive x-axis & the second shot is also fired similarly that the tank moved along negative x-axis. If the respectively range of the shots are 250 m and 200 m along x-axis, the velocity of the tank.

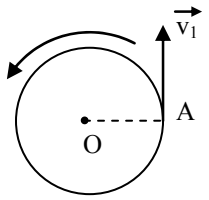


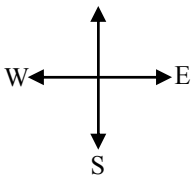
(A) 9.4 m/s (B) 4.9 m/s
(C) 3.9 m/s (D) 5.9 m/s

32. A large number of particles are moving with same magnitude of velocity v but having random directions. The average relative velocity between any two particles average over all the pairs is

(A) $\frac{\pi}{4}v$ (B) $\frac{\pi}{2}v$ (C) $\frac{3}{\pi}v$ (D) $\frac{4}{\pi}v$

33. A body is moving with uniform speed v on an horizontal circle from A as shown in the fig. Change in the velocity in the first quarter revolution is

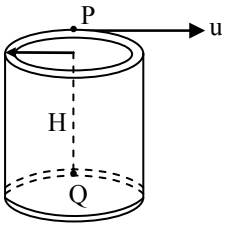




(A) v^2 north (B) $\sqrt{2}$ v south west

(C) $\sqrt{2}$ v north-west (D) 2v west

34. A hollow vertical drum of radius r and height H has a small particle in contact with smooth inner surface of the upper rim at point P. The particle is given a horizontal speed u tangential to the rim. It leaves the lower rim at Q vertically below P. Taking n as an integer for number of revolution we get



(A) $n = \dfrac{2\pi r}{H}$ (B) $\dfrac{2\pi r}{\sqrt{2H/g}}$

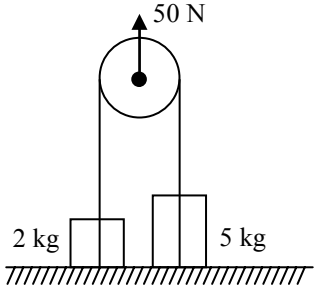
(C) $n = \dfrac{2\pi r}{u\sqrt{2H/g}}$ (D) $n = \dfrac{u}{2\pi r}\sqrt{2H/g}$

35. A balloon is descending at a constant acceleration **a**. The mass of the balloon is M. When a mass m is released from the balloon is starts rising with acceleration **a**. Assuming that volume does not change when the mass is released, what is the value of m.

(A) $\dfrac{2a}{(a+g)}M$ (B) $\left(\dfrac{a+g}{2a}\right)M$

(C) $\dfrac{2a}{(a+g)M}$ (D) $\dfrac{Ma}{a+g}$

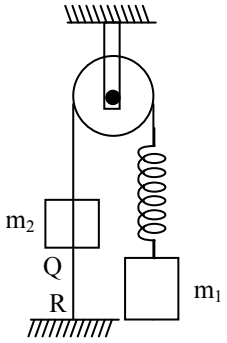
36. Two blocks of masses 2 kg and 5 kg are at rest on ground. The masses are connected by a string passing over a frictionless pulley which in under the influence of a constant upward force F = 50 N. The accelerations of 5 kg and 2 kg masses are



(A) 0, 2.5 ms^{-2} (B) 0, 0

(C) 2.5 m/s^2, 2.5 m/s^2 (D) 1 m/s^2, 2.5 m/s^2

37. In the shown system $m_1 > m_2$. Thread QR is holding the system. If this thread is cut, then just after cutting



(A) Acceleration of mass m_1 is zero and that of m_2 is directed upward

(B) Acceleration of mass m_2 is zero and that of m_2 is directed downward

(C) Acceleration of both the block will be same

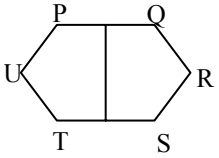
(D) Acceleration of system is given by $\left(\dfrac{m_1 - m_2}{m_1 + m_2}\right)$ kg, when k is the spring factor

38. A car of mass M accelerates starting from rest. Velocity of the car is given by $v = \left(\dfrac{2pt}{M}\right)^{1/2}$, where p is the constant power supplied by the engine. The position of car as a function of time is given as

(A) $\left(\dfrac{8p}{9M}\right)^{1/2} t^{3/2}$ (B) $\left(\dfrac{9p}{8M}\right)^{1/2} t^{3/2}$

(C) $\left(\dfrac{8p}{9M}\right)^{1/2} t^{2/3}$ (D) $\left(\dfrac{9p}{8M}\right) t^3$

39. Six identical uniform rods PQ, QR, RS and ST, TV, UP each weighing w are freely joined at their ends to form a hexagon. The rod PQ is fixed in a horizontal position and middle points of PQ and ST are connected by a vertical string. The tension in string is



(A) W (B) 3W (C) 2W (D) 4W

40. A body of mass 2 kg is being dragged with a uniform velocity of 2 ms^{-1} on a horizontal plane. The cofficient of friction between the body and the surface is 0.2. Work in 5 sec. is -

(A) 39.2 J (B) 9.32 J (C) 23.9 J (D) 93.2 J

CHEMISTRY

1. 100 kg of iron ore (Fe_2O_3) containing 20% impurities on reduction with CO give iron equal to -
(A) 112 kg (B) 80 kg
(C) 100 kg (D) 56 kg

2. Given : The mass of electron is 9.11×10^{-31} kg, Planck's constant is 6.626×10^{-34} Js, the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is -
(A) 5.79×10^{7} ms^{-1} (B) 5.79×10^{8} ms^{-1}
(C) 5.79×10^{5} ms^{-1} (D) 5.79×10^{6} ms^{-1}

3. The van der Waal equation for 0.5 mol of real gas is -
(A) $\left(P + \frac{a}{4V^2}\right)\left(\frac{V-b}{2}\right) = RT$
(B) $\left(P + \frac{a}{4V^2}\right)(2V - b) = RT$
(C) $\left(P + \frac{a}{4V^2}\right) = \frac{RT}{2(V-2b)}$
(D) $\left(P + \frac{a}{4V^2}\right) = \frac{2RT}{(2V-b)}$

4. One mole of N_2O_4 is enclosed in a 5L container. At equilibrium, the container has 0.5 mol of N_2O_4. The equilibrium constant for the decomposition of N_2O_4 [$N_2O_4(g) \rightleftharpoons 2NO_2(g)$] is-
(A) 1 (B) $\frac{2}{5}$ (C) 3 (D) $\frac{1}{5}$

5. Which one is the strongest Bronsted Lowry base out of the following -
(A) ClO^- (B) ClO_2^- (C) ClO_3^- (D) ClO_4^-

6. The pH of a solution obtained by mixing 50 mL of 0.4 M HCl with 50 ml of 0.2 N NaOH is -
(A) – log 2 (B) $-\log 2 \times 10^{-1}$
(C) 1.0 (D) 2.0

7. Oxidation number of sulphur in H_2SO_5 is -
(A) +2 (B) + 4 (C) +8 (D) +6

8. Equivalent mass of FeC_2O_4 in the reaction $FeC_2O_4 \rightarrow Fe^{3+} + CO_2$ is -
(M.wt of FeC_2O_4 = M)
(A) M (B) M/2 (C) M/3 (D) 2M/3

9. The fraction of total volume occupied by the atoms in a simple cube is -
(A) $\frac{\pi}{4}$ (B) $\sqrt{2}\,\frac{\pi}{8}$ (C) $\sqrt{2}\,\frac{\pi}{6}$ (D) $\frac{\pi}{6}$

10. In the diagram given below the value X is -

$$Cu^{2+} \xrightarrow{+0.15V} Cu^{+} \xrightarrow{+0.50V} Cu$$
$$\text{E°} = \text{X Volt}$$

(A) 0.325 V (B) 0.65 V
(C) – 0.35 V (D) – 0.65 V

11. For a first order reaction, A → B, $t_{1/2}$ = 1 hr. What fraction of the initial conc. of A reacts in 4 hrs ?
(A) $\frac{15}{16}$ (B) $\frac{1}{16}$
(C) $\frac{7}{8}$ (D) $\frac{1}{8}$

12. An azeotropic solution of two liquids has boiling point lower than that of either of them if it -
(A) shows a –ve deviation from Raoult's Law
(B) shows a +ve deviation from Raoult's Law
(C) shows no deviation from Raoult's Law
(D) is saturated

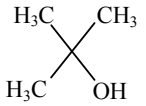
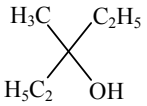
13. In multi-molecular colloidal solution atoms or molecules are held together by -
(A) Hydrogen bonding
(B) Strong attraction forces
(C) Van der Waal's forces
(D) Strong electrical forces

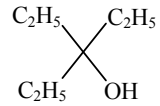
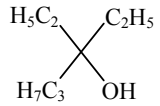
14. Given : $C + 2S \rightarrow CS_2$; $\Delta H° = +117$ kJ
$C + O_2 \rightarrow CO_2$; $\Delta H° = -393$ kJ
$S + O_2 \rightarrow SO_2$; $\Delta H° = -297$ kJ
The value of $\Delta H_{combustion}$ of CS_2 in kJ mol^{-1} is
(A) – 1104 (B) + 1104 (C) + 807 (D) – 807

15. Aspirin is chemically -
(A) Methyl salicylate
(B) Ethyl salicylate
(C) Acetyl salicylic acid
(D) o-hydroxy benzoic acid

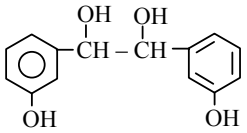
16. Aniline when diazotized in cold and then treated with dimethyl aniline gives a colored product. It's structure would be -
(A) $(CH_3)_2N$–C$_6$H$_4$–N = N–C$_6$H$_5$
(B) $(CH_3)_2N$–C$_6$H$_4$–NH–C$_6$H$_5$
(C) CH_3NH–C$_6$H$_4$–N = N–C$_6$H$_4$–$NHCH_3$
(D) CH_3–C$_6$H$_4$–N = N–C$_6$H$_4$–NH_2

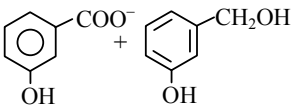
17. Ethyl ester $\xrightarrow[\text{Excess}]{CH_3MgBr}$ P. The product P will be -

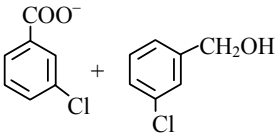
(A)  (B) 

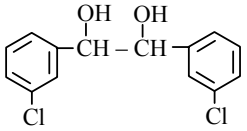
(C)  (D) 

18. When m-chlorobenzaldehyde is treated with 50% KOH solution, the product(s) obtained is -

(A) 

(B) 

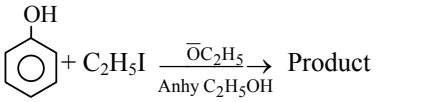
(C) 

(D) 

19. Phenol is less acidic than -

(A) Acetic acid (B) p-Nitrophenol

(C) Both (A) & (B) (D) None of these

20. 

In the above reaction product is -

(A) $C_6H_5OC_2H_5$ (B) $C_2H_5OC_2H_5$

(C) $C_6H_5OC_6H_5$ (D) C_6H_5I

21. When acetylene is passed through dilute H_2SO_4 containing Hg^{2+} ions, the product formed is -

(A) Acetone (B) Acetic acid

(C) Acetaldehyde (D) Formaldehyde

22. Among the following statements on the nitration of aromatic compounds, the false one is -

(A) The rate of nitration of benzene is almost the same as that of hexadeuterobenzene

(B) The rate of nitration of toluene is greater than that of benzene

(C) The rate of nitration of benzene is greater than that of hexadeuterobenzene

(D) Nitration is an electrophilic substitution reaction

23. Which one is electrophilic addition -

(A) $CH_3 - CH_3 + Cl_2 \rightarrow C_2H_5Cl + HCl$

(B) $CH_3CH = O + HCN \rightarrow (CH_3)_2C(OH)CN$

(C) $(CH_3)_2C = O + HCN \rightarrow (CH_3)_2C(OH)CN$

(D) $CH_3 = CH_2 + Br_2 \rightarrow CH_2BrCH_2Br$

24 Which one of the following conformation of cyclohexane is chiral -

(A) Twist boat (B) Rigid

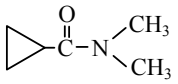
(C) Chair (D) Boat

25. The dipole moment is the highest for -

(A) Trans-2-butene (B) 1,3- dimethyl benzene

(C) Acetophenone (D) Ethanol

26. IUPAC name of the following compound -



(A) N, N-dimethylcyclo propanecarboxamide

(B) N-methylcyclopropanamide

(C) Cyclopropanamide

(D) None of the above

27. When a mixture of solid NaCl, solid $K_2Cr_2O_7$ is heated with conc. H_2SO_4 orange red vapours are obtained of the compound –

(A) Chromous Chloride (B) Chromyl Chloride

(C) Chromic Chloride (D) Chromic sulphate

28. Which of the following will give a pair of enantiomorphs -

(A) $[Co(NH_3)_4Cl_2]\ NO_2$ (B) $[Cr(NH_3)_6]\ [Co(CN)_6]$

(C) $[Co(en)_2Cl_2]Cl$ (D) $[Pt(NH_3)_4]\ [Pt\ Cl_6]$

29. In following reaction

$$yMnO_4^- + xH^+ + C_2O_4^{2-} \rightarrow yMn^{++} + 2CO_2 + \frac{x}{2}H_2O$$

x and y are

(A) 2 and 16 (B) 16 and 2

(C) 8 and 16 (D) 5 and 2

30. A reduction in atomic size with increase in atomic number is a characteristic of element of -

(A) High atomic mass (B) d-block

(C) f – block (D) Radioactive series

31. Which statement is not correct for nitrogen –

(A) It has a small size

(B) It does not readily react with O_2

(C) It is a typical non-metal

(D) d-orbitals available for bonding

32. Which one of the following is not an amphoteric substance -

(A) HNO_3 (B) HCO_3^- (C) H_2O (D) NH_3

33. Which reaction cannot be used for the production of halogen acid –

(A) $2KBr + H_2SO_4 \rightarrow K_2SO_4 + 2HBr$

(B) $NaHSO_4 + NaCl \rightarrow Na_2SO_4 + HCl$

(C) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

(D) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

34. $B(OH)_3 + NaOH \rightleftharpoons NaBO_2 + Na[B(OH)_4] + H_2O$

How can this reaction is made to proceed in forward direction -

(A) Addition of cis 1, 2-diol

(B) Addition of borax

(C) Addition of trans 1, 2-diol

(D) Addition of Na_2HPO_4

35. Sodium thiosulphate is prepared by -

(A) Reducing Na_2SO_4 solution with H_2S

(B) Boiling Na_2SO_3 solution with S in alkaline medium

(C) Neutralising $H_2S_2O_3$ solution with NaOH

(D) Boiling Na_2SO_3 solution with S in acidic medium

36. The critical temperature of water is higher than that of O_2 because H_2O molecule has -

(A) Fewer electrons than oxygen

(B) Two covalent bond

(C) V-shape

(D) Dipole moment

37. Zone refining is a technique used primarily for which one of the following process -

(A) Alloying (B) Tempring

(C) Sintering (D) Purification

38. Which one of the following elements has the highest ionization energy –

(A) $[Ne]\ 3s^2\ 3p^1$ (B) $[Ne]\ 3s^2\ 3p^2$

(C) $[Ne]\ 3s^2\ 3p^3$ (D) $[Ar]\ 3d^{10}\ 4s^2\ 4p^2$

39. The correct order of dipole moment is -

(A) $CH_4 < NF_3 < NH_3 < H_2O$

(B) $NF_3 < CH_4 < NH_3 < H_2O$

(C) $NH_3 < NF_3 < CH_4 < H_2O$

(D) $H_2O < NH_3 < NF_3 < CH_4$

40. If N_x is the number of bonding orbitals of an atom and N_y is the no. of the antibonding orbitals, then the molecule/atom will be stable if -

(A) $N_x > N_y$ (B) $N_x = N_y$

(C) $N_x < N_y$ (D) $N_x \le N_y$

MATHEMATICS

1. Consider the sequence (angles are measured in radians) $\sin \log_{10}2$, $\sin \log_{10}3$, $\sin \log_{10}4$ ….then -

(A) all the terms of this sequence are positive

(B) all the terms of this sequence are negative

(C) 1001^{th} term is negative

(D) 10001^{th} term is negative

2. The order relation between x, $\sin^{-1} x$ & $\tan^{-1}x$ $x \in (0, 1)$ is -

(A) $\tan^{-1}x < x < \sin^{-1}x$ (B) $\sin^{-1}x < \tan^{-1}x < x$

(C) $x < \sin^{-1}x < \tan^{-1}x$ (D) None

3. The smallest positive valve of x satisfying the equation $\log_2 \cos x + \log_2 (1 - \tan x) + \log_2(1 + \tan x) - \log_2 \sin x = 1$ is -

(A) $\pi/8$ (B) $\pi/6$ (C) $\pi/4$ (D) $\pi/6$

4. A pole stands at a point A on the boundary of a circular park of radius r and subtends an angle α at another point B on boundary. If arc AB subtends an angle α at the centre of the path, the height of the pole is -

(A) $r \sin \alpha/2 \tan \alpha$ (B) $2r \sin \alpha/2 \tan \alpha$

(C) $2r \sin \alpha/2 \cot \alpha$ (D) None of these

5. The base of a triangle lies along the line x = a and is of length 2a. The area of the triangle is a^2. If the third vertex lies on the line -

(A) x = 0 (B) x = – a

(C) x = 2a, or x = 0 (D) x = 0 or x = – 2a

6. If y = mx bisects an angle between the lines

$ax^2 - 2hxy + by^2 = 0$ then $\frac{m^2 - 1}{m} =$

(A) $\frac{b-a}{h}$ (B) $\frac{b-b}{h}$ (C) $\frac{a+b}{h}$ (D) None

7. If the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ passes through all the four quadrant then -

(A) g = – b (B) C > 0 (C) C < 0 (D) None

8. The equation of the circle which has two normals (x–1) (y – 2) = 0 and a tangent 3x + 4y = 6 is

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

(B) $x^2 + y^2 + 2x - 4y + 5 = 0$

(C) $x^2 + y^2 = 5$

(D) $(x-3)^2 + (y-4)^2 = 5$

9. Circles drawn on the diameter as focal distance of any point lying on the parabola $x^2 - 4x + 6y + 10 = 0$ will touch a fixed line whose equation is

(A) y = 2 (B) y = –1

(C) x + y = 2 (D) x – y = 2

10. The foci of a hyperbola coincide with the foci of the ellipse $\frac{x^2}{25} + \frac{y^2}{9} = 1$. If eccentricity of the hyperbola is 2, then its equation is
(A) $x^2 - 3y^2 - 12 = 0$ (B) $3x^2 - y^2 - 12 = 0$
(C) $x^2 - y^2 - 4 = 0$ (D) None of these

11. $\vec{\alpha}$ and $\vec{\beta}$ are two mutually perpendicular unit vector $a\vec{\alpha} + a\vec{\beta} + c(\vec{\alpha} \times \vec{\beta})$, $\vec{\alpha} + (\vec{\alpha} \times \vec{\beta})$ and $c\vec{\alpha} + c\vec{\beta} + b(\vec{\alpha} \times \vec{\beta})$ are coplaner then c is
(A) A.M. of a & b (B) G.M. of a & b
(C) H.M. of a & b (D) None of these

12. The point of contact of the spheres
$x^2 + y^2 + z^2 + 2x - 4y - 4z - 7 = 0$
$x^2 + y^2 + z^2 + 2x - 4y - 16z + 65 = 0$
(A) (1, 2, 6) (B) (1, 2, –6)
(C) (1, –2, 6) (D) (–1, 2, 6)

13. If $f(x) = 3 - 4\{x^2 - 4x + 8\}^{-1}$ then range of f(x) is
(A) $(-\infty, 1) \cup (3, \infty)$ (B) (2, 3)
(C) [2, 3] (D) None of these

14. If $x > 0$ and g is a bounded function then
$\lim_{n\to\infty} \frac{f(x)e^{nx} + g(x)}{e^{nx} + 1}$ is
(A) 0 (B) f(x) (C) g(x) (D) None

15. If $a_1 = 1$ and $a_n = n(1 + a_{n-1})\ \forall\ n \geq 2$ than
$\lim_{n\to\infty}\left(1+\frac{1}{a_1}\right)\left(1+\frac{1}{a_2}\right)...\left(1+\frac{1}{a_n}\right) =$
(A) 1 (B) e (C) 1/e (D) None

16. Let $f(x) = |2 \text{ sgn } 2x| + 2$ then f(x) has
(A) removable discontinuity
(B) infinte discontinuity
(C) No discontinuity
(D) essential discontinuity

17. If $f(x) = \cos\left\{\frac{\pi}{2}[x] - x^3\right\}$, $1 < x < 2$ and [.] = G.I.F. then $f'\left(\sqrt[3]{\frac{\pi}{2}}\right)$ is
(A) 0 (B) $3(\pi/2)^{2/3}$
(C) $-3(\pi/2)^{2/3}$ (D) None of these

18. If $ye^x = \cos x$ then, $y_4/\ y =$
(A) –1 (B) 2 (C) –4 (D) None

19. Let f & g be differentiable function satisfying $g'(a) = 2$, $g(a) = b$ and $fog = I$ (Identity function), then $f''(b)$ is equal to
(A) 1/2 (B) 2 (C) 2/3 (D) None

20. Tangents are drawn from origin to the curve $y = \sin x$ points of contact lie on the curve
(A) $x^2 + y^2 = x^2y^2$ (B) $x^2 - y^2 = xy$
(C) $x^2 - y^2 = x^2y^2$ (D) None of these

21. Two positive numbers whose sum is 16 and sum of whose cubes is maximum are given by
(A) 8, 8 (B) no such number exist
(C) 0, 16 (D) None of these

22. Let $f(x) = \frac{1}{x^2}$, $g(x) = \frac{1}{x}$ on [a, b], $0 < a < b$. Let $\frac{f(b) - f(a)}{g(b) - g(a)} = \frac{f'(c)}{g'(c)}$ for same $a < c < b$ then c is
(A) A.M. of a & b (B) G. M. of a & b
(C) H.M. of a & b (D) None of these

23. $\int \sqrt{1 + \cos^2 x}\ .\ \sin 2x \cos 2x\ dx =$
(A) $\frac{2}{5}(1 + \cos^2x)^{3/2}(3 - 2\cos^2x)^2 + c$
(B) $\frac{2}{5}(1 + \cos^2x)^{3/2}(3 - 2\cos^2x) + c$
(C) $\frac{2}{5}(1 + \cos^2x)^{3/2}(3 + 2\cos^2x) + c$
(D) None of these

24. $\int\left(1 - \frac{x^2}{\lfloor 2} + \frac{x^4}{\lfloor 4} ....\right)dx$
(A) sin x (B) – sin x (C) cos x (D) None

25. $\lim_{x\to\frac{\pi}{2}} \frac{\int_{\pi/2}^{x}(2^{-\cos t} - 1)dt}{\int_{\pi^2/4}^{x^2}(\sqrt{t} - \pi/2)dt} =$
(A) $\frac{\log_e 2}{\pi}$ (B) $\frac{\ell n2}{2\pi}$ (C) $\frac{2\ell n2}{\pi}$ (D) None

26. $\lim_{n\to\infty}\left(1+\frac{1}{n^2}\right)^{2/n^2}\left(1+\frac{2^2}{n^2}\right)^{4/n^2}\left(1+\frac{3^2}{n^2}\right)^{6/n^2}$
$....\left(1+\frac{n^2}{n^2}\right)^{2n/n^2} =$
(A) 4/e (B) 3/e (C) 2/e (D) None

27. The area bounded by the curves $y = 2x^2$ & $y = \frac{|x|}{x}$ and $x = 0$ is equal to

(A) $\frac{2}{3}$ (B) $\frac{2\sqrt{2}}{6}$ (C) $\frac{\sqrt{2}}{6}$ (D) None

28. Order and degree of the differential equation $\sqrt{y''} = (y' + 3)^{1/3}$ are respectively

(A) 2, 2 (B) 2, 3 (C) 3, 2 (D) None

29. If $x^{18} = y^{21} = z^{28}$ then 3, 3 $\log_y x$, 3 $\log_z y$, 7 $\log_x z$ are in

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

30. If $\log_2 x + \log_2 y \geq 6$ then least possible value of $x + y$ is

(A) 32 (B) 16 (C) 8 (D) None

31. No. of real roots of the equation $x^3 + x^2 + 10x + \sin x = 0$ is

(A) 1 (B) 2 (C) 3 (D) ∞

32. The roots of the equation $ax^2 + bx + c = 0$, $a \in R^+$ are two consecutive odd positive integers then

(A) $|b| \leq 4a$ (B) $|b| \geq 4a$
(C) $|b| \geq 2a$ (D) None of these

33. The sum of the terms of an infinitely decreasing G.P. is equal to the greatest value of the function $f(x) = x^3 + 3x - 9$ on the interval $[-2, 3]$ and the difference between the first two terms is $f'(0)$ then sum of first terms is

(A) 19 or – 37 (B) 19
(C) –37 (D) None of these

34. If the complex number $z_1 = a + i$, $z_2 = 1 + ib$, $z_3 = 0$ form an equilateral triangle (a, b are real number between 0 & 1) then :

(A) $a = \sqrt{3} - 1$, $b = \sqrt{3}/2$

(B) $a = 2 - \sqrt{3}$, $b = 2 - \sqrt{3}$

(C) $a = \frac{1}{2}$, $b = \frac{3}{4}$

(D) None of these

35. $\sum_{r=0}^{n} (-1)^r \, {}^nC_r \left(\frac{1}{2^r} + \frac{3^r}{2^{2r}} + \frac{7^r}{2^{3r}} + ...\infty \right)$ is equal to

(A) $\frac{1}{2^n - 1}$ (B) $\frac{3}{2^n - 1}$ (C) $\frac{2}{2^n - 1}$ (D) None

36. The coefficient of x^3y^4z in the expansion of $(1 + x + y - z)^9$ is

(A) $2 \cdot {}^9C_7 \cdot {}^7C_4$ (B) $-2 \cdot {}^9C_2 \cdot {}^7C_3$
(C) ${}^9C_7 \cdot {}^7C_4$ (D) None of these

37. If $\frac{e^x}{1-x} = B_0 + B_1x + B_2x^2 + ...$ then $B_n - B_{n-1} = ?$

(A) $\frac{1}{n}$ (B) $\frac{1}{\lfloor n}$ (C) $\frac{1}{\lfloor n-1}$ (D) None

38. The number of point (x, y, z) in space whose each coordinate is a negative integer such that $x + y + z + 12 = 0$ is

(A) 55 (B) 110 (C) 75 (D) None

39. Six boys and six girls sit along a line alternatively with probability P_1 & along a circle (again alternatively) with probability P_2 then P_1/P_2 is equal to

(A) 1 (B) 1/5 (C) 6 (D) None

40. If f(x) is a polynomial satisfying

$$f(x) = \frac{1}{2}\begin{vmatrix} f(x) & f\left(\frac{1}{x}\right) - f(x) \\ 1 & f\left(\frac{1}{x}\right) \end{vmatrix} \text{ and } f(2) = 17$$

then the value of f(5) is

(A) 624 (B) –124 (C) 626 (D) 126

41. If $A = \begin{bmatrix} 1 & x \\ 0 & 2 \end{bmatrix}$ is idempotent then x =

(A) 0 (B) 2
(C) no such x exist (D) None of these

42. Let R be a relation on the set of integers given by a R b if $a = 2^k b$ for some integer k then R is

(A) an equivalence relation
(B) reflexive and symmetric but not transitive
(C) reflexive and transitive but not symmetric
(D) symmetric and transitive but not reflxive

43. Minimum value of $\frac{b+c}{a} + \frac{c+a}{b} + \frac{a+b}{c}$, (for real +ve numbers a, b, c) is

(A) 1 (B) 2 (C) 4 (D) 6

44. From mean value theorem $f(b) - f(a) = (b - a) f'(x_1)$; $a < x_1 < b$ if $f(x) = \frac{1}{x}$ then x_1 =

(A) $\sqrt{ab}$ (B) $\frac{a+b}{2}$ (C) $\frac{2ab}{a+b}$ (D) $\frac{b-a}{a+b}$

45. If $f(x) = \int \cot^4 x \, dx + \frac{1}{3}\cot^3 x - \cot x$ and $f\left(\frac{\pi}{2}\right) = \frac{\pi}{2}$ then f(x) is -

(A) $\pi - x$ (B) $x - \pi$ (C) x (D) None

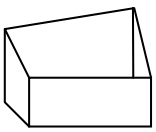
LOGICAL REASONING

1. Fill in the blank spaces.
11, 12, 17, 18, 23, 24, (?)
(A) 12 (B) 29
(C) 30 (D) 35

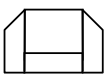
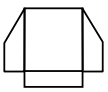
2. Choose the best alternative.
Dum-Dum : Calcutta : : Palam : ?
(A) Kerala (B) Delhi
(C) Madras (D) Bombay

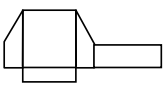
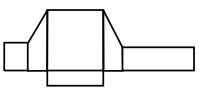
3. Pick the odd one out –
(A) Wheat (B) Paddy
(C) Towar (D) Mustard

4. Which of the following figures (A), (B), (C) and (D) when folded along the lines, will produce the given figure (X) ?

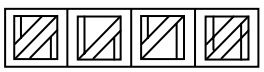
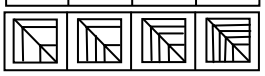
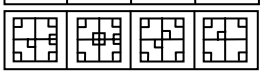
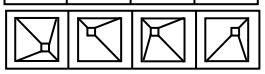


(X)

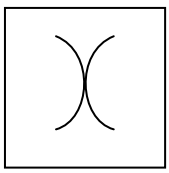
(A)  (B) 

(C)  (D) 

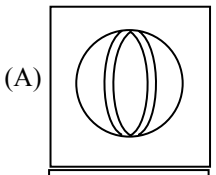
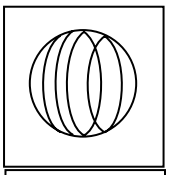
5. In each of the following questions, choose the set of figures which follows the given rule.
Rule : The series becomes complex as it proceeds :

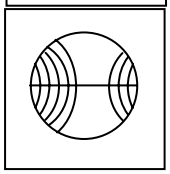
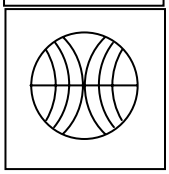
(A) 
(B) 
(C) 
(D) 

6. In following 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.

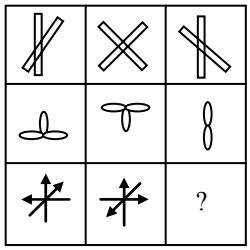


(X)

(A)  (B) 

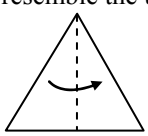
(C)  (D) 

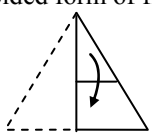
7. In the following question, find out which of the answer figures (A), (B), (C) and (D) completes the figure-matrix ?

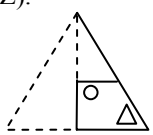


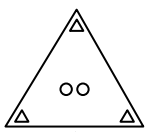
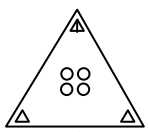
(A)  (B)  (C)  (D) 

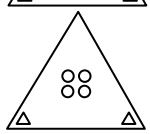
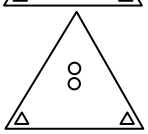
8. The question that follow contain a set of three figures X, Y and Z showing a sequence of a piece of paper. Fig. (Z) shows the manner in which the folded paper has been cut. These three figures are followed by four answer figures from which you have to choose a figure which would most closely resemble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


X

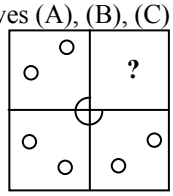

Y


Z

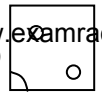
(A)  (B) 

(C)  (D) 

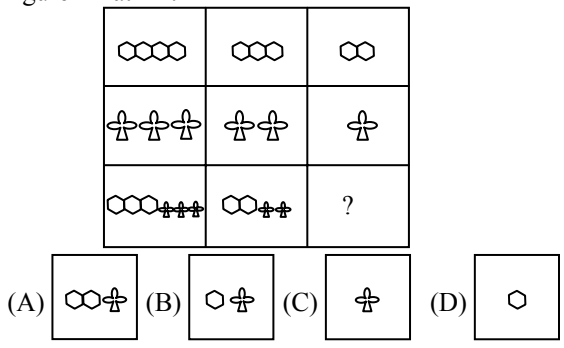
9. In the following question, complete the missing portion of the given pattern by selecting from the given alternatives (A), (B), (C) and (D).



(X)

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

10. In the following question, find out which of the answer figures (A), (B), (C) and (D) complete the figure - matrix ?



ENGLISH

1. Choose the one which best expresses the meaningful concept :
The state's duty is to . . . . the safety of its Citizens.
(A) assure (B) ensure (C) insure (D) accept

2. Choose the one which best expresses the meaningful concept :
The company went . . . . in the 1990's recession.
(A) burst (B) bust (C) bursted (D) busted

3. Choose the one which best expresses the meaningful concept :
What can we . . . . from this evidence, Watson ?
(A) deduce (B) deduct
(C) reduce (D) conduce

4. Choose the one which best expresses the meaningful concept in opposite meaning :
Zenith :
(A) Sky (B) Firmament
(C) nadir (D) naive

5. Pick up the correct Synonym for the following word
Voracious :
(A) Hungry (B) Wild
(C) Quick (D) Angry

6. **One who travels from place to place :**
(A) Journey man (B) Tramp
(C) Itinerant (D) Mendicant

7. Choose the one which best expresses the meaning of the given idiom/proverb :
To fly off the candle :
(A) To dislocate (B) To lose one's temper
(C) To take off (D) To be indifferent

8. Fill in the blanks with one of the options given below:
Gandhi Ji . . . . . smoking in his youth.
(A) took to (B) took for
(C) took in (D) took up

9. Select the one which best expresses the same sentence in Passive or Active Voice.
Get the box broken.
(A) Get someone to break the box.
(B) They have broken the box
(C) Have the broken box
(D) Break the box

10. Choose the one which best expresses the correct answer in the speech :
He said, "How shabby you are looking!"
(A) He asked how shabby I was looking
(B) He exclaimed with disgust that I was looking very shabby
(C) He exclaimed with sorrow that they were looking much shabby
(D) He told that I was looking much shabby

11. Pick out the mis-spelt word –
(A) Neigh (B) Rein
(C) Neice (D) Neither

12. Find out which part of the sentence has an error :
I wonder (a) / what he has done with the book (b) /
I lend him (c) / No Error (d)
(A) Wonder
(B) What he has done with the book
(C) I lend him
(D) No Error

13. Pick out the most appropriate pair to fill in the blanks in the same order, to make the sentence meaningfully complete :
She was . . . . . because all her plans had gone . . . .
(A) distraught, awry
(B) Frustrated, Magnificently
(C) Elated, wild
(D) Dejected, splendidly

14. Pick out the most effective word from the given words to fill in the blanks to make the sentence meaningfully complete :
Most of the issues discussed in the meeting were trivial and only a few were :
(A) Interesting (B) Practical
(C) Complex (D) significant

15. Pick out the most appropriate pair to fill in the blanks in the same order, to make the sentence meaningfully complete :
The . . . . . of glory lead but to the . . . . .
(A) Paths, grave
(B) Ways, happiness
(C) Acts, Prosperity
(D) Achievements, Suffering

MOCK TEST # 2

PHYSICS

1.[B] In case of damped vibrations, amplitude decreases exponentially with time

$\therefore \quad A = A_0 e^{-bt}$ or $\frac{A}{A_0} = e^{-bt}$

or $\frac{1}{2} = e^{b\times 2}$ and $\frac{A'}{A_0} = e^{-b\times b}$

or $\frac{A'}{A_0} = (e^{-2b})^3 = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

2.[C] Here $\frac{1}{k_e} = \frac{1}{k} + \frac{1}{2k} + \frac{1}{4k} + ... \infty$

$= \frac{1}{k}\left(\frac{1}{1}+\frac{1}{2}+\frac{1}{4}+.....\infty\right)$

$= \frac{1}{k}\left(\frac{1}{1-1/2}\right) = \frac{2}{k}$ i.e. $k_e = \frac{k}{2}$

3.[B] $KE_{max} = \frac{1}{2}kA^2 = \frac{1}{2}M\omega^2A^2$

$8 \times 10^{-3} = \frac{1}{2} \times 1 \times \omega^2 \times (0.1)^2$

$\underline{\omega} = 4$ rad/sec

$y = A \sin(\omega t + \phi)$ or $y = 0.1 \sin(4t + \pi/4)$

4.[B] Here $\vec{L} = m(\vec{r} \times \vec{v}) = m\, v\, y(-\vec{k})$

(Where y is the vertical distance of particle from x axis)

Here m,v and y all are fixed so $\vec{L}$. remains constant.

5.[B] Using, weight of floating body = weight of liquid displaced.

we get $V\rho g = \left(\frac{V}{2}\right)(13.6)\, g - \frac{V}{2}(0.8g)$

(buoyant forces of mercury and oil act in opposite direction)

Then, $\rho = \frac{13.6 - 0.8}{2} = 6.4$

6.[C] $v' = \frac{v + v_0}{v - v_s} v$ We get $\frac{v'}{v} = \frac{v - v_0}{v - v_s}$

i.e. $\frac{9}{8} = \frac{340 + v'}{340 - v'} \quad \therefore (v_0 = v_s = v')$

i.e. $v' = 20\ ms^{-1}$

7.[A] $I_{log} = \frac{I_2}{I_1}$ dB; i.e. $4 = 10 \log \frac{I_2}{(10\times 10^{-9} \times 10^4)}$

Then $I_2 = 2.5 \times 10^{-4}\ Wm^{-2}$

8.[A] Here work done = pdv and area under the curve given work done

$\therefore \quad 10 + W_{CA} = 5$ or $W_{CA} = -5$ J

9.[C] For equilibrium

$F = qE = mg$

or $neE = \frac{4}{3}\pi r^3 \rho g$ or $r = \left(\frac{3neE}{4\pi\rho g}\right)^{1/3}$

10.[A] $i = \frac{1.5 + 1.5 - 1.5}{1+1+1} = 0.5$ A

As the current has to from A to C to B,

for kirchhoff's law,

$V_A = 0.5 \times 1 + 1.5 = 1V$ $(\because v = E - ir)$

$V_B = 0.5 \times 1 + 1.5 = 1V$

$V_C = 0.5 \times 1 - (-1.5) = 2V$

11.[D] $R = R_1 + (273 - T)\alpha$ ...(i)

or $2R = R_0[1 + T'\alpha]$ ...(ii)

Deciding (i) by (ii) $\frac{1}{2} = \frac{1(273 - T)\alpha}{1 + T'\alpha}$

or $1 + T'\alpha = 2 + (273 - T)2\alpha$

or $T' = \frac{(273 - T)2\alpha + 1}{\alpha}$

12.[A] Current, $I = \frac{2E}{R + r_1 + r_2}$

P.O. across cell 1 = $Ir_1 = \frac{2Er_1}{R + r_1 + r_2}$

For zero p.d. the fall of potential should be equal to in emf.

$E = \frac{2Er_1}{R + r_1 + r_2}$ i.e. $R = r_1 - r_2$

13.[B] Point P lies on the arms CD and AF so inclusion at P due to them is zero.

Magnetic induction at p due to currents in AB and BC is given by

$B_1 = B_2 = \frac{\mu_0 i}{4\pi(2a)} \sin 45^\circ$

$= \frac{\mu_0 i}{8\sqrt{2}\pi a}$ $(\because$ distance of p from AB or BC is 2a)

similarly due to DE and EF

$B_3 = B_4 = \frac{\mu_0 i}{4\pi a} \sin 45^\circ = \frac{\mu_0 i}{4\sqrt{2}\pi a}$ ⊗

Net induction = $2(B_1 - B_3)$

$$= 2\frac{\mu_0 i}{8\sqrt{2}\pi a} - \frac{\mu_0 i}{4\sqrt{2}\pi a} = -\frac{\sqrt{2}\mu_0 i}{8\pi a}$$

14. [C] $v = r\omega = r \times \frac{2\pi}{T}$

or $T = \frac{2\pi r}{v} = \frac{2\pi m}{qB} = \frac{km}{q}$

Now $m_\alpha = 4m_p$ and $q_\alpha = 2qv$

$T_p = k\frac{m_p}{q_\alpha}$ and $T_\alpha = k\frac{m_\alpha}{q_\alpha}$

$= k\frac{4m_P}{2q_P} = 2k\frac{m_P}{q_\alpha}$

$\Rightarrow T_\alpha = 2T_p$ or $T_p = \frac{1}{2}T_\alpha$

15. [D] $i = i_0(1 - e^{-t/\tau})$

$$i = \frac{v}{R}\left(1 - e^{-t/\frac{L}{R}}\right) = \frac{12}{6}\left(1 - e^{-t/\frac{8\,4\times10^{-3}}{6}}\right) = 1$$

($\because$ i = 1A given)

$\Rightarrow$ $t = 0.97 \times 10^{-3}$ s , i.e. $t \approx 1$ms

16. [A] Optical distance between fish and the bird is Differentiating w r.t.t.

$$\frac{ds}{dt} = \frac{dy'}{dt} + \frac{\mu dy}{dt}$$

i.e. $9 = 3 + \frac{4}{3}\frac{dy}{dt}$

or $\frac{dx}{dt} = 6 \times \frac{3}{4} = 4.5\ ms^{-1}$

17. [A] $\frac{1}{f} = \left(\frac{\mu_g}{\mu_m} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$$\frac{1}{f} = \left(\frac{1.5}{1.75} - 1\right) \times \left(\frac{1}{-R} - \frac{1}{R}\right) = \frac{1}{3.5R}$$

i.e. f = 3.5 R.

In the medium it behaves as a convergent lens.

18. [D] Reflection of light from plane mirror gives additional path difference of $\lambda/2$ between two waves.

$\therefore$ Total path difference = $\frac{3\lambda}{2} + \frac{\pi}{2} = 2\lambda$

which satisfy the condition of maxima.

Resultant intensity $\propto (A^2 + A^2)$ [$\because I \propto A^2$]

$4A^2 = 4I$

19. [B] Here $\frac{\lambda_2}{\lambda_1}\frac{(\lambda_0 - \lambda_1)}{(\lambda_0 - \lambda_2)} = \frac{2}{1}$

or $\frac{5.4}{3.7}\frac{(\lambda_0 - 3.5\times10^{-7})}{(\lambda_0 - 5.4\times10^{-7})} = \frac{2}{1}$

or $\lambda_0 = 11.8 \times 10^{-7}$ m

But $\omega = \frac{hc}{\lambda_0} = \frac{(6.6\times10^{-34})(3\times10^8)}{(11.8\times10^{-7})(1.6\times10^{-19})} = 1.05$ eV

20. [D] Let whole the energy of electrons be converted in x-rays. $eV = h\nu$

or $eV = \frac{hc}{\lambda}$

or $\lambda = \frac{hc}{eV} = \frac{(6.6\times10^{-34})(3\times10^8)}{(1.0\times10^{-19})(40\times10^3)}$

i.e. $\lambda = 3.1 \times 10^{-11}$ m or $\lambda = 0.31$ Å

21. [A] Here $_{88}Ra^{222} \xrightarrow{\alpha} {}_{86}R^{218} \xrightarrow{\beta^-} {}_{87}Fr^{218}$

$\xrightarrow{\alpha} {}_{85}Al^{214} \xrightarrow{\beta^-} {}_{80}Rn^{214} \xrightarrow{\alpha} {}_{84}PO^{210}$

$\xrightarrow{\alpha} {}_{82}Pb^{206}$

4α deceys and 2β decays.

22. [A] $A_1 = 4$, $A_2 = 3$ and $\theta = \frac{\pi}{2} = 90^o$

$\therefore$ Resultant amplitude,

$$A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos 90^o} = \sqrt{A_1^2 + A_2^2}$$

$$= \sqrt{4^2 + 3^2} = \sqrt{25} = 5 \text{ unit}$$

23. [C] Using $d \sin\theta = n\lambda$

$\sin\theta = \theta = \frac{\lambda}{D}$

$\therefore$ $\frac{dy}{D} = n\lambda$ or $y = \frac{nD}{d}\lambda$

i.e. $\frac{1\times2\times(6\times10^{-7})}{1\times10^{-3}} = 1.2 \times 10^{-3} = 1.2$ mm

Distance between first minima on either side of centrar maxima $\Delta y = 2y = 2.4$ mm

24. [B] For constructive inteference

$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = \left(\sqrt{2I} + \sqrt{I}\right)^2$

For destuctive interference

$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2 = \left(\sqrt{2I} - \sqrt{I}\right)^2$

Then $\frac{I_{min}}{I_{max}} = \frac{(\sqrt{2I} - \sqrt{I})^2}{(\sqrt{2}I + \sqrt{I})^2} = \left(\frac{\sqrt{2}-1}{1+\sqrt{2}}\right)^2 = \frac{1}{34}$

25. [B] Using decay equation

$A_2 = A_1e^{-\lambda t}$

or $e^{-\lambda t} = \frac{A_2}{A_1}$ or $\lambda t = \log\frac{A_1}{A_2}$

$$\text{time } t = \frac{\log A_1/A_2}{\lambda} = 1.44T \log_e\left(\frac{A_1}{A_2}\right)$$

26. [B] $V_x = k\frac{(4\pi a^2)\sigma}{a} - \frac{k(4\pi b^2)\sigma}{b} + \frac{k(4\pi c^2)\sigma}{b}$

$$= 4\pi \frac{1}{4\pi\varepsilon_0}\sigma(a - b + c)\left(\because k = \frac{1}{4\pi\varepsilon_0}\right)$$

$$= \frac{\sigma}{\varepsilon_0}(a - b + c)$$

27. [D] Let the given quantity be x_1 then,

$$x = \frac{\pi}{3}(a^2 - b^2)h = \frac{\pi}{3}(a^2h - b^2h)$$

$$= \frac{\pi}{3}a^2h - \frac{\pi}{3}b^2h$$

Each term has the dimension of x_1 then
$[x] = [a^2h] = [L^2L] = [L^3]$ and also
$[x] = [b^2h] = [L^2L] = [L^3]$ quantity is volume.

28. [B] $U = \frac{A\sqrt{x}}{x^2 + B}$ or $A = \frac{U(x^2 + B)}{\sqrt{x}}$

Here dimensions of x^2 and B should be same.
i.e. $[B] = [x^2] = [L^2]$

Also $[A] = \left[\frac{ML^2T^{-2}}{L^{1/2}}\right][L^2] = [ML^{7/2}T^{-2}]$

Then $[AB] = [ML^{7/2}T^{-2}][L^2] = [ML^{11/2}T^{-2}$

29. [A] $v = u\left(1 - \frac{t}{t'}\right)$ or $\frac{dx}{dt} = u\left(1 - \frac{t}{t'}\right)$

integrating, $x = u\left(t - \frac{t^2}{2t'}\right) + C$

at $t = 0$, $n = 0$ and $c = 0$

$\therefore \quad x = u\left(t - \frac{t^2}{2t'}\right) = 10t\left(t - \frac{t'}{10}\right)$

Putting $t = 10$

$x = 10 \times 10\left(1 - \frac{10}{10}\right) = 0$

30. [A] using $h = \frac{1}{2}gt^2$, we get $t_1 = \sqrt{\frac{2h}{g}}$

let t_1 be the time taken from instants of jumping to the opening of parachute, then

$$t_1 = \sqrt{\frac{2\times 40}{9.8}} = 2.86 \text{ sec}$$

His velocity at this point is given by

$v_1^2 = 2gh_1 = 2 \times 9.8 \times 40$
$= 784$ or $v_1 = 28 \text{ ms}^{-1}$

for the remaining journey,

$v = v_1 + at_2$

or $t_2 = \frac{v - u}{a} = \frac{2 - 28}{-2} = 13\text{sec}$

$\therefore$ total time $= t_1 + t_2 = 2.86 + 13$
$= 15.86 \cong 16$ s

31. [B] Let u be the velocity of projectile w.r.t. tanks velocity v then

$u_x = u\cos 30 + v$; $u_y = u \sin 30^\circ$

and $T = \frac{2u \sin 30^\circ}{g}$

Range, $R_1 = u_xT = \frac{2u \sin 30^\circ}{g}(u \cos 30^\circ + v)$

for y axis

$u_x = u \cos 30^\circ - v$ and $u_y = u \sin 30^\circ$

$T = \frac{2u \sin 30^\circ}{g}$

Range e, $R_2 = Tu'_x$

$$= \frac{2u \sin 30^\circ}{g}(u \cos 30^\circ - v)$$

Then $R_1 + R_2 = \frac{4u^2}{g}(\sin 30^\circ \cos 30^\circ)$

$R_1 - R_2 = \frac{4u}{g} v \sin 30^\circ$

Eliminating u we get

$$v^2 = \frac{g}{4\tan 30}\frac{(R_1 - R_2)^2}{(R_1 + R_2)}$$

$$= \frac{10}{4\tan 30}\frac{(250 - 200)^2}{(250 + 200)} = 24 \text{ m}^2\text{s}^{-2}$$

$\Rightarrow \quad 4.9 \text{ ms}^{-1}$

32. [D] Let α be the angle between velocities of pair of particles then relative velocity is given by

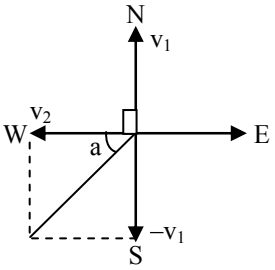
$$v_r = \sqrt{v^2 + v^2 - 2v \times v \times \cos\alpha} = 2v \sin\frac{\alpha}{2}$$

$$\text{average } v_r = \frac{\int_0^{2\pi} \frac{2v(\sin\alpha/2)}{2\pi} d\alpha}{\int_0^{2\pi} d\alpha} = \frac{4}{\pi}v$$

33. [B] For quarter revolution

$\Delta\vec{V} = \vec{V}_2 - \vec{V}_1$

angle between $\vec{V}_1$ and $\vec{V}_2$ is 90º



$\therefore \quad \Delta v = \sqrt{v_2^2 + v_1^2} = \sqrt{v^2 + v^2} = \sqrt{2}\ V$

Also $\tan^{-1}\frac{v}{v} = 45^\circ$

$\therefore \quad \Delta \vec{v} = \sqrt{2}$ v south west

34. [D] For vertical motion

$H = \frac{1}{2} gt^2$ or $t = \sqrt{2H/g}$

For horizontal motion, distance covered is given by

$2\pi rn = ut$

or $2\pi rn = u\sqrt{2H/g}$

or $u = \frac{4}{2\pi r}\sqrt{2H/g}$

35. [A] On descending

$(Mg - f) - Ma = 0$

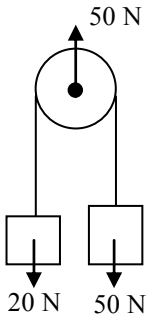
(where f is the upthrust due to buoyancy)

On ascending,

$f - (M - m)g - (M - m)a = 0$

$m = \left(\frac{2a}{a+g}\right) M$

36. [A] The masses will be lifted if the tension of the string is more than the gravitational pull of mass.



$50 - 2T = 0$ or $T = 25N$

So, 5 kg weight cannot be lifted but 2 kg weight will be lifted

$25 - 20 = 2a$ or $a = \frac{5}{2} = 2.5\ ms^{-2}$

37. [A] On cutting of string QR, the resultant force on m_1 remains zero because its weight mg is balanced by the tension is the spring but on block m_2 a resultant upward Force $(m_1 - m_2)g$ is den sped. The block m_1 will have no resultant acceleration where as m_2 does have an upward acceleration given by $\frac{(m_1 - m_2)g}{m_2}$

38. [A] Here $v = \left(\frac{2pt}{M}\right)^{1/2}$

or $\frac{ds}{dt} = \left(\frac{2pt}{M}\right)^{1/2}$

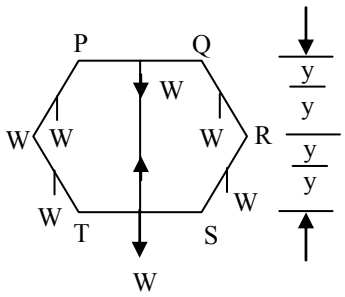
or $ds = \left(\frac{2pt}{M}\right)^{1/2} dt$

integrating $s = \left(\frac{2p}{M}\right)^{1/2} \frac{2}{3} t^{3/2} + C$

at t = 0, S = 0, so c = 0

$S = \left(\frac{8p}{9M}\right)^{1/2} t^{3/2}$

39. [B] Let a small displacement be given to the system in vertical plane of frame such that ST remains horizontal then let vertical displacement of centres of rods up and QR be y then vertical displacment of centres of VT and RS will be 3y and that of TS will be 4y. Equating total vertical work to zero we get



$(w + w)\delta y + (w + w)3\ \delta y + w(4\delta y) - T(4\delta y) = 0$

or $2w + 6w + 4w = 4T$ or $T = 3w$

40.[A] Normal reaction $R = mg = 2 \times 9.8$ N

Frictional force,

$F = \mu R = 0.2 \times 2 \times 9.8 = 3.92$ N

Distance traveled

$2 \times 5 = 10$ m

$\therefore$ Work done $= f \times s = 3.92 \times 10$

$= 39.2$ J

CHEMISTRY

1.[D] $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

160 g 112 g

Pure Fe_2O_3 in ore = $\frac{100\times80}{10}$ = 80 kg

Iron produced from 80 kg of Fe_2O_3

= $\frac{112}{160} \times 80 = 56$ kg

2.[D] $\Delta v = \frac{h}{4\pi m(\Delta x)}$

$= \frac{6.626\times10^{-34}}{4(3.14)(9.11\times10^{-31})(10^{-10}\times0.1)}$

$= 5.79 \times 10^6$ ms^{-1}

3.[B] Given n = 0.5

Then $\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$

$\Rightarrow \quad [P + \frac{(0.5)^2a}{V^2}]\,[V - 0.5b] = 0.5\,RT$

$\Rightarrow \quad \left(P + \frac{a}{4V^2}\right)(2V - b) = RT$

4.[B] $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

n_0 : 1 0

n_e : 1 – 0.5 2×0.5

= 0.5 1

C_e : $\frac{0.5}{5}$ M $\frac{1}{5}$

= 0.1 M = 0.2 M

then $K_C = \frac{[NO_2]^2}{[N_2O_4]} = \frac{(0.2)^2}{(0.1)} = \frac{0.04}{0.1} = 0.4$

5.[A] $\underset{\text{Acidic strength}}{\xrightarrow{HClO < HClO_2 < HClO_3 < HClO_4}}$

Weakest acid has strongest conjugate base.

6.[C] HCl : $N_A \times V_A = (0.4 \times 1) \times 50 = 20$ meq.

NaOH : $N_B \times V_B = (0.2) \times 50 = 10$ meq.

$\because N_AV_A > N_BV_B$

$\therefore [H^+] = \frac{N_AV_A - N_BV_B}{V_A + V_B} = \frac{20-10}{100}$

$= 0.1$ M $= 10^{-1}$ M, $\therefore$ pH = 1

7.[D]

$$\overset{(+1)}{H}-\underset{(-1)}{O}-\underset{(-1)}{O}-\overset{(+x)}{\underset{\underset{(-2)}{O}}{\overset{(-2)}{\underset{\underset{(-2)}{O}}{S}}}}-\underset{(-2)}{O}-\overset{(+1)}{H}$$

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

$\Rightarrow x = +6$

8.[C]

$$\overset{(+2)(+3)}{FeC_2O_4} \rightarrow \overset{3+}{Fe^{3+}} + \overset{(+4)}{CO_2}$$

(–1e and –2e)

$\therefore$ Valence factor (FeC_2O_4) = 1 + 2 = 3

$\therefore$ E(FeC_2O_4) = $\frac{M}{3}$

9.[D] The fractional of total volume occupied in simple cube

$= \frac{\text{volume of particles}}{\text{volume of cube}} = \frac{\frac{4}{3}\pi\left(\frac{a}{2}\right)^3}{a^3} = \frac{\pi}{6}$

10.[A] $Cu^{2+} + e^- \rightarrow Cu^+$; $E_1^0 = 0.15$ V

$\therefore \Delta G_1^0 = -1 \times 0.15 \times F = -0.15$ F

$Cu^+ + e^- \rightarrow Cu$; $E_2^0 = 0.5$ V

$\therefore \Delta G_2^0 = -1 \times 0.5 \times F = -0.5$ F

$Cu^{2+} + 2e^- \rightarrow Cu$; $E_3^0 = ?$

$\therefore \Delta G_3^0 = -2 \times E_3^0 \times F = -2F\ E_3^0$

Also, $\Delta G_3^0 = \Delta G_1^0 + \Delta G_2^0$

$= -0.15$ F + (– 0.5 F)

$= -0.65$ F

Now – $2E_3^0F = -0.65$ F

or $E_3^0 = \frac{0.65}{2} = 0.325$ F

11.[A] 4hrs = 4 half lives

1

$\xrightarrow{t_{1/2}} \frac{1}{2} \xrightarrow{t_{1/2}} \frac{1}{4} \xrightarrow{t_{1/2}} \frac{1}{8} \xrightarrow{t_{1/2}} \frac{1}{16}$

fraction left after 4 half lives = $\frac{1}{16}$ or $\left(\frac{1}{2}\right)^4$

fraction reacted in 4 half lives = $1 - \frac{1}{16} = \frac{15}{16}$

12.[B] A solution showing +ve deviation has higher vapour pressure and lower boiling point.

13.[C] In multi molecular solutions the different layers hold each other through van der Waal's forces.

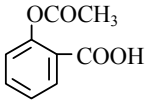
14.[A] $CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$; $\Delta_rH = ?$

$\Delta_rH^\circ = \Sigma\Delta_fH^0_{(P)} - \Sigma\Delta_fH^0_{(R)}$

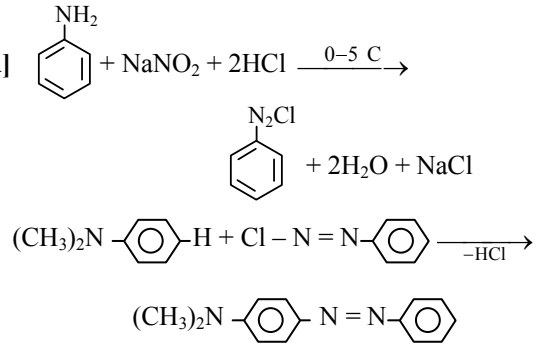
$= [2(-297) + (-393)] - (117)$

$= -1104$ kJ mol^{-1}

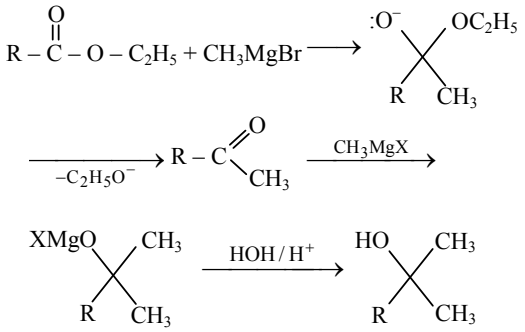
15.[C] Aspirin chemically acetyl salicylic acid



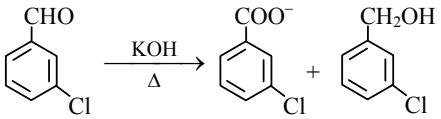
16.[A]



17.[A]

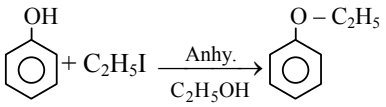


18.[C] It is cannizzaro reaction

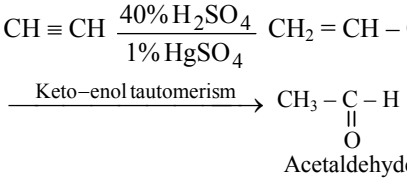


19.[C] Phenol is less acidic than acetic acid and p-nitrophenol.

20.[A]



21.[C]



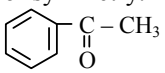
Acetaldehyde

22.[C] The rate of nitration is greater in hexadeuterobenzene

23.[D] Halogenation on alkene occurs by electrophilic addition.

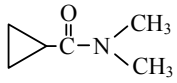
24.[A] Twisted boat is chiral as it does not have plane of symmetry.

25.[C]



Acetophenone has highest dipole moment.

26.[A]



N,N-dimethyl cyclopropane carboxamide.

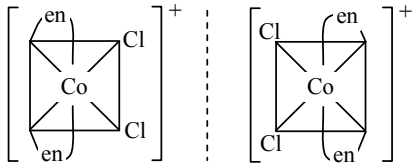
27.[B] $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

$K_2Cr_2O_7 + 2H_2SO_4 \rightarrow 2KHSO_4 + 2CrO_3 + H_2O$

$CrO_3 + 2HCl \rightarrow CrO_2Cl_2$

orange red vapour

28.[C]



Cis-d-isomer Cis-ℓ-isomer

29.[B] $2MnO_4^- + 16H^+ + C_2O_4^- \longrightarrow 2Mn^{2+} + 2CO_2 + 8H_2O$

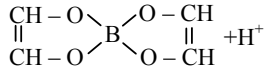
30.[C] Lanthanoid contraction takes place.

31.[D] In nitrogen d orbital is absent.

32.[A] HNO_3 is acidic in nature.

33.[A] $2KBr + H_2SO_4 \rightarrow K_2SO_4 + 2HBr$

34.[A] Due to formation of chelate compound it act as strong acid and proceed in forward direction.



35.[B] $Na_2SO_3 + S \xrightarrow{NaOH} \underset{\text{Sod. thiosulphate}}{Na_2S_2O_3}$

36.[D] Critical temperature of water is more than O_2 due to its dipole moment (Dipole moment of water = 1.84 D, Dipole moment of O_2 = 0D.)

37.[D] By the process of zone refining, semiconductors like Si, Ge and Ga are purified.

38.[C] Half filled orbitals are more stable in comparison of partial filled.

39.[A] The dipole moment of

$CH_4 = 0$

$NF_3 = 0.2$ D

$NH_3 = 1.47$ D

$H_2O = 1.85$ D

40.[A] Molecule existance is possible in such case when no. of bonding electron is greater than antibonding.

MATHEMATICS

1.[D] Clearly all term can Neither be positive nor negative

$T_{1001} = \sin \log_{10}1000 = \sin 3 > 0$

$T_{10001} = \sin \log_{10}10000 = \sin 4 > 0$

$\therefore (0 < 2 < \pi \ \& \ \pi < 4 < 2\pi)$

2. [A] $\sin x < x < \tan x$ in $(0, 1) \Rightarrow \tan^{-1}x < x < \sin^{-1} x$

Altiter :

$f(x) = \sin^{-1}x - x$

$f'(x) = \dfrac{1}{\sqrt{1-x^2}} - 1 > 0 \ \forall \qquad x \in (0, 1)$

$\therefore$ f(x) is increasing function

$\therefore x > 0 \Rightarrow f(x) > f(0) = 0$

$\Rightarrow \sin^{-1} x > x$

Similarly $g(x) = x - \tan^{-1} x$ is increasing fu^n and $x > 0 \Rightarrow x - \tan^{-1}x > 0$

3.[A] $\log_2 \cos x + \log_2(1 - \tan x) + \log_2(1 + \tan x) - \log_2 \sin x = 1$

$\Rightarrow \log_2(1 - \tan^2 x) - \log_2 \tan x = 1$

$(\cos x > 0, \sin x > 0, -1 < \tan x < 1)$

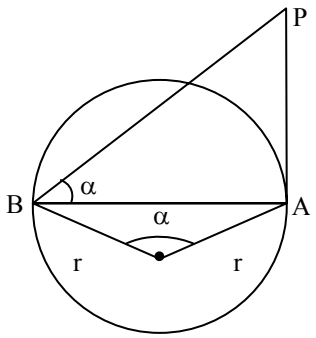
$\Rightarrow (1 - \tan^2 x) \times \dfrac{1}{\tan x} = 2$

$\tan^2 x + 2 \tan x - 1 = 0$

$\tan x = -1 \pm \sqrt{2}$

$\tan x = \sqrt{2} - 1 \ (\because 0 < \tan x < 1) \quad \Rightarrow x = \pi/8$

4. [B]



$AB = 2r \sin \alpha/2$

$h = AB \tan \alpha = 2r \sin \dfrac{\alpha}{2} \tan \alpha$

5.[C] Let vertex P be (h, k), then perpendicular distance of P from the base x = a is |h – a|

$\therefore$ Since length of the base is 2a, we have

$\dfrac{1}{2} \times 2a|h - a| = a^2$

$\Rightarrow |h - a| = a \ (a \neq 0)$

So $h - a = -a \qquad$ or $h - a = a$

$\therefore h = 0 \quad$ or $\quad h = 2a$

$\therefore$ locus of P is x = 0 or x = 2a

6. [B] Equation of angle bisector of the pair of straight lines is $\dfrac{x^2 - y^2}{a - b} = \dfrac{xy}{-h}$

$\Rightarrow hx^2 + (a - b)xy - hy^2 = 0$

$\Rightarrow \quad h + (a - b)\dfrac{y}{x} - h\left(\dfrac{y}{x}\right)^2 = 0$

Now, y = mx is one of the bisector

$\therefore \quad hm^2 - (a - b)m - h = 0$

$h(m^2 - 1) = (a - b)m$

$\Rightarrow \quad \dfrac{m^2 - 1}{m} = \dfrac{a - b}{h}$

7.[C] $x^2 + y^2 + 2gx + 2fy + c = 0$ passes through all the four quadrants

$\Rightarrow$ origin in an interior point

$\Rightarrow c < 0$

8. [A] two normal are x – 1 = 0 and y – 2 = 0, their point of intersection (1, 2) is the centre & radius of circle perpendicular distance from centre (1, 2) on tangent 3x + 4y = 6

$= \dfrac{3 + 4.2 - 6}{\sqrt{9+16}} = 1$

$\therefore$ equation of circle is

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

$\Rightarrow \quad x^2 + y^2 - 2x - 4y + 4 = 0$

9.[B] $x^2 - 4x + 6y + 10 = 0$

$\Rightarrow (x - 2)^2 = -6(y + 1)$

tangent to the vertex is y + 1 = 0

circle drawn on focal distance as diameter always touch the tangent at the vertex i.e. the line y + 1 = 0.

10. [B] Given ellipse is $\dfrac{x^2}{25} + \dfrac{y^2}{9} = 1$

$a^2 = 25, b^2 = 9, e = \dfrac{\sqrt{a^2 - b^2}}{a} = \dfrac{4}{5}$

$\Rightarrow ae = 4$

$\therefore$ Foci of ellipse are $(\pm ae, 0) = (\pm 4, 0)$

For hyperbola e = 2

$\Rightarrow 2a = 4 \quad \Rightarrow a = 2$

Also $b^2 = a^2(e^2 - 1)$

$\Rightarrow b^2 = 4 \times 3 = 12$

$\therefore$ equation of hyperbola

$\dfrac{x^2}{4} - \dfrac{y^2}{12} = 1$

$\Rightarrow 3x^2 - y^2 - 12 = 0$

11.[B] $\therefore \ \vec{\alpha}$ & $\vec{\beta}$ are two mutually perpendicular unit vector.

$\therefore \ \vec{\alpha} \times \vec{\beta}$ is a unit vector perpendicular to both $\vec{\alpha}$ & $\vec{\beta}$. So we can consider $\vec{\alpha}$, $\vec{\beta}$, $\vec{\alpha} \times \vec{\beta}$ as $\hat{i}$, $\hat{j}$ & $\hat{k}$.

Given vector are coplanar so

$$\begin{vmatrix} a & a & c \\ 1 & 0 & 1 \\ c & c & b \end{vmatrix} = 0$$

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

12. [D] $S_1 = x^2 + y^2 + z^2 + 2x - 4y - 4z - 7 = 0$
centre $C_1 = (-1, 2, 2)$ and radius $r_1 = 4$
$S_2 = x^2 + y^2 + z^2 + 2x - 4y - 16z + 65 = 0$
centre $C_2 = (-1, 2, 8)$ radius $r_2 = 2$
$C_1C_2 = 6$; $r_1 + r_2 = 6$
$\therefore$ sphere S_1 & S_2 touches externaly
$\therefore$ point of contact divides C_1C_2 in the ratio 4 : 2
$\therefore$ point of contact = $(-1, 2, 6)$

13.[D] $y = f(x) = 3 - \dfrac{4}{x^2 - 4x + 8}$

$\Rightarrow (3 - y)x^2 - 4(3 - y)x + 20 - 8y = 0$
$x \in R \ \ \therefore D \geq 0$
$\Rightarrow 16(3 - y)^2 - 4(3 - y)(20 - 8y) \geq 0, \ y \neq 3$
$\Rightarrow \ -y^2 + 5y - 6 \geq 0; \ y \neq 3$
$\Rightarrow \ (y - 2)(y - 3) \leq 0 \ \Rightarrow \qquad 2 \leq y < 3$

14. [B] $x > 0$, $g(x)$ is bounded

$$\therefore \ \lim_{n\to\infty} \frac{f(x)e^{nx} + g(x)}{1 + e^{nx}}$$

$$\lim_{n\to\infty} \frac{f(x) + g(x)/e^{nx}}{1 + 1/e^{nx}} = f(x)$$

$$\left[g(x) \text{ is bounded} \Rightarrow \frac{g(x)}{e^{nx}} \Rightarrow \frac{\text{finite}}{\text{infinte}} = 0\right]$$

15.[B] $a_1 = 1, \ a_n = n(1 + a_{n-1})$

$$\Rightarrow 1 + a_{n-1} = \frac{a_n}{n}$$

$$\therefore \ \lim_{n\to\infty} \left(1 + \frac{1}{a_1}\right)\left(1 + \frac{1}{a_2}\right)....\left(1 + \frac{1}{a_n}\right)$$

$$\lim_{n\to\infty} \left(\frac{1 + a_1}{a_1}\right)\left(\frac{1 + a_2}{a_2}\right) .... \left(\frac{1 + a_n}{a_n}\right)$$

$$= \lim_{n\to\infty} \frac{a_2}{2} \cdot \frac{a_3}{3} ..... \frac{a_n + 1}{n + 1} \cdot \frac{1}{a_1 a_2 ... a_n}$$

$$= \lim_{n\to\infty} \frac{a_{n+1}}{\lfloor n+1} = \lim_{n\to\infty} \frac{(1 + a_n)(1 + n)}{\lfloor n+1}$$

$$= \lim_{n\to\infty} \left(\frac{1}{\lfloor n} + \frac{a_n}{\lfloor n}\right) = \lim_{n\to\infty} \left(\frac{1}{\lfloor n} + \frac{1}{\lfloor n-1} + \frac{a_{n-1}}{\lfloor n-1}\right)$$

$$= \lim_{n\to\infty} \left\{\frac{1}{\lfloor n} + \frac{1}{\lfloor n-1} + ... \frac{1}{\lfloor 2} + \frac{1}{\lfloor 1} + \frac{a_1}{\lfloor 1}\right\}$$

$$= \lim_{n\to\infty} \left\{1 + \frac{1}{\lfloor 1} + \frac{1}{\lfloor 2} + ... \frac{1}{\lfloor n}\right\} \qquad \{\because a_1 = 1\}$$

$= e$

16.[A] $2 \operatorname{sgn} 2x = \begin{cases} -2 & ; \ x < 0 \\ 0 & ; \ x = 0 \\ 2 & ; \ x > 0 \end{cases}$

$f(x) = |2 \operatorname{sgn} 2x| + 2 = \begin{cases} 4 & x \neq 0 \\ 2 & x = 0 \end{cases}$

$\therefore$ By defining $f(0) = 4$, $f(x)$ will become continuous function at $x = 0$ as then
$f(0 - 0) = f(0 + 0) = 4$
Hence at $x = 0$ $f(x)$ has removable discontinuity

17.[A] $\because \ \ 1 < x < 2 \Rightarrow [x] = 1$

$$\therefore \ f(x) = \cos\left(\frac{\pi}{2} - x^3\right) = \sin x^3$$

$f'(x) = \cos x^3 \cdot 3x^2$

$$\Rightarrow f'\left(\sqrt[3]{\frac{\pi}{2}}\right) = 3 \cos\frac{\pi}{2} \cdot \left(\frac{\pi}{2}\right)^{2/3} = 0$$

18.[C] $ye^x = \cos x$ ...(1)
$ye^x + y_1e^x = -\sin x$ ...(2)
again differentiating
$ye^x + y_1e^x + y_1e^x + y_2e^x = -\cos x$
$ye^x + 2y_1e^x + y_2e^x = -ye^x$ (from (1))
$\Rightarrow \ 2y + 2y_1 + y_2 = 0$ ...(3)
again differentiating
$2y_1 + 2y_2 + y_3 = 0$
again differentiating
$2y_2 + 2y_3 + y_4 = 0$ ...(4)
from (1) (2) & (3)
$4y + y_4 = 0$

$$\therefore \ \frac{y_4}{y} = -4$$

19.[A] $fog = I \Rightarrow fog(x) = I(x) = x$
$\therefore \ fg(x) = x$
$\Rightarrow f'g(x) \times g'(x) = 1$
$\Rightarrow f'g(a) \times g'(a) = 1$
$\Rightarrow \ f'(b) \times 2 = 1$

$$\Rightarrow \ f'(b) = \frac{1}{2}$$

20.[C] Let P(h, k) be one of point of contact then
$k = \sin h$ ...(1)
equation of tangent is $y - k = \cos h\,(x - h)$
which parries through origin
$\therefore\ k = h \cos h$ ...(2)
from (1) & (2)

$$\frac{k^2}{h^2} + k^2 = \sin^2 h + \cos^2 h = 1$$

$\Rightarrow k^2 + k^2h^2 = h^2 \quad \Rightarrow x^2 - y^2 = x^2y^2$
$\therefore$ locus of (h, k) is $x^2 - y^2 = x^2y^2$

21.[B] $x + y = 16, \qquad x, y > 0$
$s = x^3 + y^3 = x^3 + (16 - x)^3$

$$\frac{ds}{dx} = 3x^2 - 3(16 - x)^2$$

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

$\Rightarrow x^2 = 256 - 32x + x^2 \Rightarrow x = 8$

$$\frac{d^2s}{dx^2} = 6x - 6(16 - x) = 6[2x - 16]$$

at $x = 8$

$$\frac{d^2s}{dx^2} = 0 \text{ and } \frac{d^3s}{dx^3} = 12 \neq 0$$

Hence there in no minimum exist.

22.[C]
$$\frac{\frac{1}{b^2} - \frac{1}{a^2}}{\frac{1}{b} - \frac{1}{a}} = \frac{-\frac{2}{c^3}}{-\frac{1}{c^2}} = \frac{2}{c}$$

$$\Rightarrow \quad \frac{1}{b} + \frac{1}{a} = \frac{2}{c}$$

$$\Rightarrow \quad c = \frac{2ab}{a + c}$$

$\therefore$ c is H.M. of a & b

23.[B] $I = \int \sqrt{1 + \cos^2 x}\ \sin 2x \cos 2x\, dx$

put $1 + \cos^2 x = t^2$
$\Rightarrow -2\sin x \cos x\, dx = 2t\,dt$
$\Rightarrow \ -\sin 2x\, dx = 2t\,dt$

$$\therefore \quad I = -\int \sqrt{t^2}.(2t\,dt).(2\cos^2 x - 1)$$

$$= -\int t.2t.(2t^2 - 3)\,dt$$

$$= -2\left[\frac{2t^5}{5} - \frac{3t^3}{3}\right] + c$$

$$= -\frac{4}{5}(1 + \cos^2 x)^{5/2} + 2(1 + \cos^2 x)^{3/2} + c$$

$$= (1 + \cos^2 x)^{3/2}\left[-\frac{4}{5}(1 + \cos^2 x) + 2\right] + c$$

$$= \frac{2}{5}(1 + \cos^2 x)^{3/2}(3 - 2\cos^2 x) + c$$

24.[A] $1 - \frac{x^2}{\lfloor 3} + \frac{x^4}{\lfloor 4} - \ldots\ldots\ldots = \cos x$

$$\therefore \quad I = \int \cos x\ dx = \sin x$$

25.[A]
$$\lim_{x \to \frac{\pi}{2}} \frac{\int_{\pi/2}^{x} (2^{-\cos t} - 1)\ dt}{\int_{\pi^2/4}^{x^2} \left(\sqrt{t} - \frac{\pi}{2}\right) dt} \qquad \left(\frac{0}{0}\right)$$

$$\lim_{x \to \frac{\pi}{2}} \frac{2^{-\cos x} - 1}{\left(x - \frac{\pi}{2}\right).2x} = \lim_{x \to \frac{\pi}{2}} \frac{2^{-\cos x}\,\ell n 2.\sin x}{4x - \pi} = \frac{\ell n 2}{\pi}$$

26.[A]
$$y = \lim_{n \to \infty} \left(1 + \frac{1}{n^2}\right)^{\frac{2}{n^2}} \left(1 + \frac{2^2}{n^2}\right)^{\frac{4}{n^2}} \left(1 + \frac{3^2}{n^2}\right)^{\frac{6}{n^2}}$$

$$\ldots\ldots \left(1 + \frac{n^2}{n^2}\right)^{\frac{2n}{n^2}}$$

$$\log y = \lim_{n \to \infty} \sum_{r=1}^{n} \log\left(1 + \frac{r^2}{n^2}\right).\frac{2r}{n^2}$$

$$= \lim_{n \to \infty} \sum_{r=1}^{n} \log\left(1 + \frac{r^2}{n^2}\right).\frac{2r}{n}.\frac{1}{n}$$

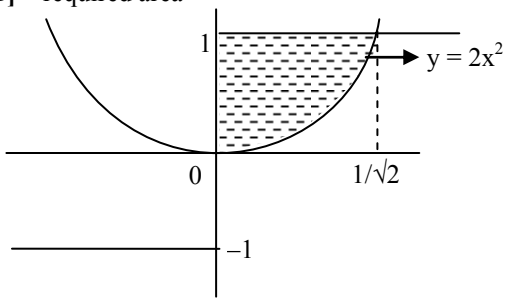
$$= \int_0^1 2x \log(1 + x^2)\,dx$$

$$= \int_1^2 \log t\ dt = \left(t \log t - t\right)_1^2$$

$$= 2 \log 2 - 1 = \log \frac{4}{e}$$

$\Rightarrow \ y = 4/e$

27.[B] required area



$$\frac{1}{\sqrt{2}} - \int_0^{1/\sqrt{2}} 2x^2 dx$$

$\Rightarrow \quad \frac{1}{\sqrt{2}} - \frac{2}{3}[x^3]_0^{1/\sqrt{2}}$

$\Rightarrow \quad \frac{1}{\sqrt{2}} - \frac{2}{3} \cdot \frac{1}{2\sqrt{2}} = \frac{2}{3\sqrt{2}} = \frac{2\sqrt{2}}{6}$

28.[B] $\sqrt{y''} = (y' + 3)^{1/3} \Rightarrow (y'')^3 = (y' + 3)^2$

$\Rightarrow \quad \left(\frac{d^2y}{dx^2}\right)^3 - \left(\frac{dy}{dx}\right)^2 - 6\frac{dy}{dx} - 9 = 0$

$\therefore$ order is 2 & degree = 3

29.[A] $x^{18} = y^{21} = z^{28}$

$\Rightarrow$ $18 \log x = 21 \log y = 28 \log z$

$\Rightarrow$ $\log_y x = 7/6, \log_z y = 4/3, \log_x z = 9/14$

Now, $3, 3 \log_y x, 3 \log_z 7, 7 \log_x 2$

$= 3, \frac{7}{2}, 3 \times \frac{4}{3}, \quad 7 \times \frac{9}{14}$

$= 3, \frac{7}{2}, 4, \frac{9}{2}$

which are in A.P.

30.[B] $\log_2 x + \log_2 y \geq 6$

Here $x > 0, y > 0$

$\therefore \log_2 xy \geq 6 \Rightarrow xy \geq 2^6$

$\Rightarrow xy \geq 64$

Now, A.M $\geq$ G.M.

$\therefore \quad \frac{x+y}{2} \geq (xy)^{1/2}$

$\Rightarrow x + y \geq 2(64)^{1/2}$

$x + y \geq 2 \times 8$

$\Rightarrow x + y \geq 16$

$\therefore \quad (x + y)_{min} = 16$

31.[A] $f(x) = x^3 + x^2 + 10x + \sin x$

$f'(x) = 3x^2 + 2x + 10 + \cos x$

$= 3\left(x + \frac{1}{3}\right)^2 + \frac{29}{3} + \cos x > 0 \ \forall \ x$

$\Rightarrow$ f(x) is strictly increasing

Also $x \to \infty \Rightarrow f(x) \to \infty$,

$x \to -\infty \Rightarrow f(x) \to -\infty$

$\therefore$ f(x) has only one real root.

32.[B] Let roots be $(2k - 1)$ & $(2k + 1)$ $k \in N$

the Sum of roots : $4k = -\frac{b}{a}$

$\because a \in R^+, b < 0$ as $k \geq 1$

We have $-b = 4ak \Rightarrow -b \geq 4a$

$\Rightarrow |b| \geq 4a \qquad \{b < 0 \ \therefore |b| = -b\}$

33.[B] Let G.P. be $a + ar + ar^2$ .....

G.P is infinite so $-1 < r < 1$

G.P. is decreasing

$\Rightarrow r > 0$ so $0 < r < 1$ and therefore $a > 0$

$f'(x) = 3x^2 + 3 > 0$

$\Rightarrow$ f(x) is strictly increasing function

$\therefore \quad f(x)_{max}$ on $[-2, 3]$ is $f(3) = 27$ & $f'(0) = 3$

$\therefore \quad \frac{a}{1-r} = 27 \qquad \& \quad a - ar = 3$

$\Rightarrow \quad r = \frac{2}{3} \text{ or } \frac{4}{3} \quad \because r < 1$

$\therefore \quad r = \frac{2}{3} \quad \& \qquad \text{if } r = \frac{2}{3}; a = 9$

$\therefore$ Sum of first three terms = 9 + 6 +4 = 19

34.[B] If z_1, z_2 & z_3 vertex of equilateral triangle then

$z_1^2 + z_2^2 + z_3^2 = z_1z_2 + z_2z_3 + z_3z_1$

$\therefore (a + i)^2 + (1 + ib)^2 + 0 = (a + i)(1 + ib) + 0 + 0$

$\Rightarrow a^2 - 1 + 2ia + 1 - b^2 + 2ib = a + iba + i - b$

$\Rightarrow a^2 - b^2 + i(2a + 2b) = a - b + i(ab + 1)$

on comparing

$a^2 - b^2 = a - b$ and $2a + 2b = ab + 1$

$\Rightarrow (a - b)(a + b - 1) = 0 \ \& \ 2a + 2b = ab + 1$

$\Rightarrow a = b \text{ or } a + b = 1 \qquad ....(1)$

$\Rightarrow 2a + 2b = ab + 1 \qquad .... (2)$

Now from (1) take $a = b$ put in (2)

$2a + 2a = a^2 + 1$

$\Rightarrow a^2 - 4a + 1 = 0 \Rightarrow a = 2 \pm \sqrt{3}$

$\because a < 1 \Rightarrow a = 2 - \sqrt{3}$

$\because \quad a = 2 - \sqrt{3} \ \& \ a = b = 2 - \sqrt{3}$

It we take $a + b = 1$ & put in (2) then it becomes $ab = 0$ which not possible because a & b lies between 0 and 1

35.[A] $S = \sum_{r=0}^{n} (-1)^r \left[\left\{\frac{1}{2^r} + \left(\frac{3}{4}\right)^r + \left(\frac{7}{8}\right)^r + ...\right\}\right] {}^nC_r$

$= \sum_{r=0}^{n} (-1)^r \frac{1}{2^r} \cdot {}^nC_r + \sum_{r=0}^{n} (-1)^r \left(\frac{3}{4}\right)^r \cdot {}^nC_r$

$+ \sum_{r=0}^{n} (-1)^r \left(\frac{7}{8}\right)^r \cdot {}^nC_r + ...$

$= \left(1 - \frac{1}{2}\right)^n + \left(1 - \frac{3}{4}\right)^n + \left(1 - \frac{7}{8}\right)^n + ...$

$= \frac{1}{2^n} + \frac{1}{2^{2n}} + \frac{1}{2^{3n}} + ... = \frac{1}{2^n - 1}$

36.[B] The general term in the expansion of $(x_1 + x_2 + ...x_n)^n$ given.... $\frac{\lfloor n}{\lfloor p_1 \lfloor p_2 \cdots \lfloor p_n} . x_1^{p_1} x_2^{p_2} ... x_m^{p_m}$,

$p_1 + p_2 + p_3 .... + p_m = n$

Now in $(1 + x + y - z)^9$, coefficient of x^3y^4z

= coeft of $u^0x^3.y^4z^1$ in $(u + x + y - z)^9$

$= \frac{\lfloor 9}{\lfloor 0 \lfloor 3 \lfloor 4 \lfloor 1} \times (-1)^1 = -2 . {}^9C_2 . {}^7C_3$

37.[B] $\frac{e^x}{1-x} = B_0 + B_1x + B_2x^2 + ...$

$\Rightarrow e^x = B_0 - B_0x + B_1x - B_1x^2 + B_2x^2 - B_2x^2 + ...$

$\Rightarrow e^x = B_0 + (B_1 - B_0)x + (B_2 - B_1)x^2 + ...$

$\Rightarrow 1 + x + \frac{x^2}{\lfloor 2} + \frac{x^3}{\lfloor 3} + \frac{x^4}{\lfloor 4} + ...$

$= B_0 + (B_1 - B_0)x + (B_2 - B_1)x^2 + ...$

$\therefore$ $B_n - B_{n-1}$ is coeff. of x^n

On comparing coeff. of $x^n = \frac{1}{\lfloor n}$

38.[A] $x + y + z + 12 = 0$

x, y, z are negative integers

Let $x = -a, y = -b, z = -c$,

a, b, c are +ve integer then required number of points (x, y, z)

= Number of positive integral solution of

$a + b + c = 12$

$= {}^{12-1}C_{3-1} = {}^{11}C_2 = 55$

39.[A] $p_1 = \frac{2\lfloor 6 \lfloor 6}{\lfloor 12}$ $\quad p_2 = \frac{\lfloor 5 \lfloor 6}{\lfloor 11}$

$\frac{p_1}{p_2} = \frac{2\lfloor 6 \lfloor 6}{\lfloor 12 \lfloor 5 \lfloor 6} \times \lfloor 11 = 1$

40.[C] $2f(x) = \begin{vmatrix} f(x) & f(1/x) - f(x) \\ 1 & f(1/x) \end{vmatrix}$

$= f(x) . \left(\frac{1}{x}\right) - f\left(\frac{1}{x}\right) + f(x)$

$\Rightarrow f(x) + f\left(\frac{1}{x}\right) = f(x) . f\left(\frac{1}{x}\right)$

$\Rightarrow f(x) = 1 \pm x^n$

$f(2) = 17$

$\Rightarrow 1 \pm 2^n = 17 \Rightarrow \pm 2^4 = 16$

$\therefore$ +ve sign will be take

$\Rightarrow 2^n = 16 \Rightarrow n = 4$

Now, $\therefore f(x) = 1 + x^4$

$\Rightarrow f(5) = 5^4 + 1 = 626$

41.[C] A is idenpotent $\Rightarrow A^2 = A$

$A^2 = \begin{bmatrix} 1 & x \\ 0 & 2 \end{bmatrix} \begin{bmatrix} 1 & x \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 1 & 3x \\ 0 & 4 \end{bmatrix} \neq A$

$\therefore$ not possible for any x

42.[A] for any $a \in z \Rightarrow a = 2^0a$

$\Rightarrow$ a R a $\forall$ a $\in$ z

$\therefore$ R is reflexive

a R b $\Rightarrow a = 2^kb, k \in z \Rightarrow b = a.2^{-k}, -k \in z$

$\Rightarrow$ b R a

$\therefore$ R is symmetric

Let a R b, b R c $\Rightarrow a = 2^{k_1} b$, $b = 2^{k_2} c$

$a = 2^{k_1} 2^{k_2} c = 2^{k_1+k_2} c$, $k_1 + k_2 \in z$

$\Rightarrow$ a R c

$\therefore$ R is transitive

Hence R is an equivalence Relation.

43.[D] $\because$ A.m $\geq$ G.m

$\therefore \frac{1}{2}\left(\frac{a}{b} + \frac{b}{a}\right) \geq \sqrt{\frac{b}{a}.\frac{a}{b}} = 1 \Rightarrow \frac{a}{b} + \frac{b}{a} \geq 2$

Similarly $\frac{b}{c} + \frac{c}{b} \geq 2$ & $\frac{a}{c} + \frac{c}{a} \geq 2$

Adding we get

$\frac{a}{b} + \frac{b}{a} + \frac{b}{c} + \frac{c}{b} + \frac{a}{c} + \frac{c}{a} \geq 6$

$\Rightarrow \frac{b+c}{a} + \frac{c+a}{b} + \frac{a+b}{c} \geq 6$

$\therefore$ minimum value is 6.

44.[A] $f(x) = \frac{1}{x} \Rightarrow f'(x) = -\frac{1}{x^2}$

$\therefore \frac{f(b) - f(a)}{b - a} = f'(x_1)$

$\Rightarrow \frac{1}{b} - \frac{1}{a} = (b - a)\left(-\frac{1}{x_1^2}\right)$;

$a < x_1 < b$

$\Rightarrow x_1^2 = ab \Rightarrow x_1 = \sqrt{ab}$

45.[C] $\int \cot^4 x \, dx = \int \cot^2 x \, (\operatorname{cosec}^2 x - 1)dx$

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

$= -\frac{1}{3}\cot^3 x + \cot x + x + c$

$\therefore f(x) = -\frac{1}{3}\cot^3 x + \cot x + x + c + \frac{1}{3}\cot^3 x - \cot x$

$= x + c$

$\therefore f\left(\frac{x}{2}\right) = \frac{\pi}{2} + c \Rightarrow \frac{\pi}{2} = \frac{\pi}{2} + c$

$\Rightarrow c = 0$

$\therefore f(x) = x$

LOGICAL REASONING

1.[B] The given sequence is a combination of two series:
I series : 11, 17, 23, (?)
II series : 12, 18, 24
Pattern in both is + 6
So, missing number = 23 + 6 = 29

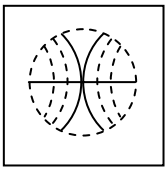
2.[B] Dum Dum is an airport in calcutta and Palam is an airport in Delhi.

3. [D] All except mustard are food grains, while mustarel is an oilseed.

4.[C]

5. [B]

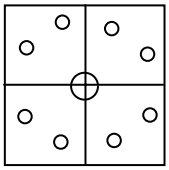
6.[D]



7.[C] The 3rd figure in each row comprises of parts which are not common to the first two figures.

8. [C]

9.[D]



10.[B] The number of each type of figures decrease by 1 at each step from left to eight in each row.

ENGLISH

1.[B] **Assure :** (persuade that all is well)
Hence, irrelevant meaning.
Ensure : (guarantee)
This is a relevant option as it properly suits to the meaningful expression.
Insure : (to cover against any loss)
Hence, irrelevant meaning.
Accept :
Irrelevant meaning in respect of the sentence.

2.[B] **burst :** (punctured)
Irrelevant meaning.
bust : (collapsed)
Quite relevant meaning. Hence, correct option.
bursted : irrelevant because this is an improper form of the verb 'burst'.
busted :
Irrelevant because this is an incorrect form of the verb 'bust'

3.[A] **deduce :** (to conclude) (to infer)
This word really suits to the given sentence making it a meaningful one.
deduct : (to take away)
Irrelevant, because it means something else.
e.g. Tax is 'deducted' from his salary every year.
reduce : (to decrease)
Different meaning makes the sentence meaningless. Hence, this is an incorrect option.
Conduce : (to suit)
Irrelevant word.

4.[C] **Sky (Firmament)**
Irrelevant 'opposite'
Firmament :
irrelevant 'opposite'.
nadir : (lowest point)
'Zenith' means highest point'.
Hence this is the most suitable word in opposite,
naive (Simple)
Irrelevant word that doesn't serve any purpose.

5.[A] **Hungry :** (a voracious eater) (a voracious reader)
Wild : (Irrelevant)
It's Synonym is 'Savage'.
Quick : (Soon) therefore, irrelevant.
Angry : (furious) Hence, irrelevant.

6.[C] **Journey man :** (Irrelevant)
Because it is a person who journeys regularly on a particular route.
Tramp : (Irrelevant)
because it means 'a vagabond' who gets about purposelessly.
Itinerant : (Relevant)
It's a person who moves from one place to another during his travel.
Mendicant : (Irrelevant)
It's a religious preacher who goes from place to place in the form of a beggar.

7.[B] **To dislocate :**
irrelevant meaning.
To lose one's temper :
Quite Relevant
It's often used when a person is about to get angry.
To take off :
irrelevant
To be indifferent :
Irrelevant

8.[A] **took to :** (to be accustomed to/to be addicted to)
Correct because it suits to the sentence when Gandhi Ji was addicted to smoking.
took for : (to be mistaken while recognising)
irrelevant
took in : (to deceive someone)
irrelevant
took up : (to adopt)
irrelevant

9.[A] **Get someone to break the box.**
Correct answer because :
- The given sentence is in Passive Voice which requires its answer in Active Voice.
- The given verb is Causatives in Imperative.
- This option is Causative Active Voice in imperative form.

They have broken the box.
Incorrect Answer : Because
- The given verb is not causative.
- The given sentence is not imperative.

Have the broken box.
Incorrect : Because
- The verb is not causatives.
- 'Broken' has been used as an adjective in this option.

Break the box
Incorrect because :
- The subject 'you' (implied) wan't break it but will get someone to break it.

10.[B] **He asked how shabby I was looking.**
(Incorrect option) because :
The required answer (type of sentence) is wrong.
He exclaimed with disgust that I was looking very shabby.
(Correct answer because)
- This option is exclamatory.
- Past Indefinite Tense has been used.
- The mood of the speaker is correct.

He exclaimed with sorrow that they were looking much shabby.
(Incorrect option because) :
- Mood of exclamatory sentence is wrong.
- 'much' will be replaced with 'very'
- 'They' won't be used as a singular subject is required.

He told that I was looking much shabby.
Incorrect answer because –
- Type of sentence is assertive whereas the required type is 'exclamatory'.
- 'much' is to be replaced with 'very'.

11.[C] **Neigh :** Correct spelling as it means 'the cry of horse'.
Reign : Correct spelling as it means 'the controlling chord of an animal.'
Niece : Incorrect spelling as the correct one is 'niece'. (Opposite of 'Nephew').
Neither : Correct spelling. It is a conjunction to be used with 'nor' for one of two options.

12.[C] **I wonder :**
No error in it.
What he has done with the book.
No error
I lend him
(Erroneous) because there is an error of 'Tenses'. The word 'lend' is to be 'lent'.
No error :
There is an error.

13.[A] **Distraught, awry :**
Correct answer : 'Distraught' means to 'get upset' and 'awry' means in 'disorder'.
Frustrated, Magnificently :
Both are opposite. One is positive and the other one is negative. Therefore, no meaningful sentence.
Elated, Wild :
No co-ordination, therefore incorrect answer.
Dejected, splendidly :
No co-ordination, therefore incorrect answer.

14.[D] **Interesting :**
" . . . and only a few were . . . . " phrase shows that something opposite is required here. The given option is not opposite to 'trivial'. Hence, Irrelevant option.
Practical :
Like aforesaid logic, this option also is irrelevant.
Complex :
'Complex' can't be opposite to 'trivial'. Therefore, can't be relevant.
Significant :
This is the relevant option making the sentence quite meaningful with two contradictory words, i.e. trivial and 'Significant connected with the phrase ". . . . . and only a few were . . . . . "

15.[A] **Paths, grave :**
It is a meaningful pair of words to make the sentence idiomatically correct.
Ways, happiness :
Not a meaningful pair. Hence, irrelevant option.
Acts, prosperity :
Not a meaningful pair. Hence, irrelevant option.
Achievements, Suffering :
Not a meaningful pair. Hence, irrelevant option.