

BITSAT Solved Paper 2021

1. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then Q/q equals:

(A) -1 (B) 1
(C) $-\frac{1}{\sqrt{2}}$ (D) $-2\sqrt{2}$

Correct Option: D

Solution:

It is given that $\vec{F}_A + \vec{F}_B + \vec{F}_D = 0$

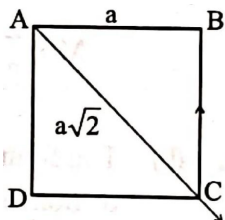
where $\vec{F}_A$, $\vec{F}_B$ and $\vec{F}_D$ are the forces applied by charges placed at A, B and D on the charge placed at C.

$$\Rightarrow \vec{F}_B + \vec{F}_D = -\vec{F}_A$$

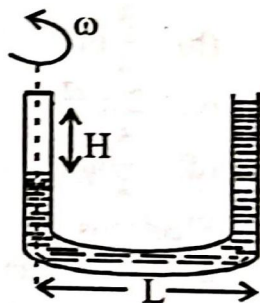
$$|\vec{F}_B + \vec{F}_D| = \sqrt{2} \frac{KqQ}{a^2}$$

$$\Rightarrow |\vec{F}_A| = \frac{KQ^2}{2a^2}$$

$$\therefore \sqrt{2} \frac{KqQ}{a^2} = -\frac{KQ^2}{2a^2} \Rightarrow \frac{Q}{q} = -2\sqrt{2}$$



2. A U-shaped tube contains a liquid of density ρ and it is rotated about the left dotted line as shown in the figure. Find the difference in the levels of liquid column.



(A) $\frac{\omega^2 L^2}{2g}$
(B) $\frac{\omega^2 L^2}{2\sqrt{2}g}$
(C) $\frac{2\omega^2 L^2}{g}$
(D) $\frac{2\sqrt{2}\omega^2 L^2}{g}$

Correct Option: A

Solution:

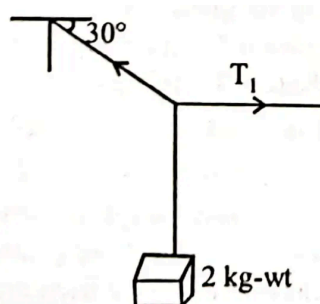
3. The angle of dip at a place is 37° and the vertical component of the earth's magnetic field is 6×10^{-5} T. The earth's magnetic field at this place is ($\tan 37^\circ = \frac{3}{4}$)

(A) 7×10^{-5} T (B) 6×10^{-5} T
(C) 5×10^{-5} T (D) 10^{-4} T

Correct Option: D

Solution:

4. A body of weight 2 kg is suspended as shown in the figure. The tension T_1 in the horizontal string (in kgwt) is



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

Correct Option: C

Solution:

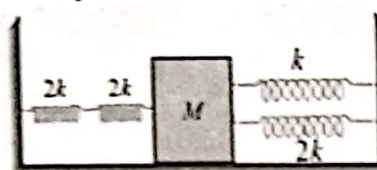
5. A solenoid is 2m long and 3cm in diameter. It has 5 layers of winding of 1000 turns each and carries a current of 5 A. What is the magnetic field at its centre? Use the standard value of μ_0 .

(A) 1.57×10^{-4} T (B) 2.57×10^{-3} T
(C) 1.57×10^{-2} T (D) 3.57×10^{-6} T

Correct Option: C

Solution:

6. Four massless springs with force constants $2k$, $2k$, k and $2k$ respectively are connected to a mass M kept on a frictionless plane



shown in figure. If the mass M is displaced in the horizontal direction, then the frequency of the system is?

(A) $\frac{1}{2\pi} \sqrt{\frac{k}{4M}}$

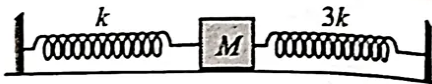
(B) $\frac{1}{\pi} \sqrt{\frac{k}{M}}$

(C) $\frac{1}{2\pi} \sqrt{\frac{k}{7M}}$

(D) $\frac{1}{2\pi} \sqrt{\frac{7k}{M}}$

Correct Option: B**Solution:**

The equivalent system is shown in figure.



The equivalent force constant of which

$$k_e = k + 3k = 4k$$

$$\therefore \omega = \sqrt{\frac{k_e}{m}} = \sqrt{\frac{4k}{m}} = 2\sqrt{\frac{k}{m}}$$

$$\text{and } f = \frac{\omega}{2\pi} = \frac{2}{2\pi} \sqrt{\frac{k}{m}} = \frac{1}{\pi} \sqrt{\frac{k}{m}}.$$

0

7. A gun fires two bullets at 60° and 30° with horizontal. The bullets strike at some horizontal distance. The ratio of maximum height for the two bullets is in the ratio of

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

Correct Option: B**Solution:**

8. A proton moving with a velocity 3×10^5 m/s enters a magnetic field of 0.3 tesla at an angle of 30° with the field. The radius of curvature of its path will be (e/m for proton = 10^8 C/kg)

(A) 2 cm (B) 0.5 cm (C) 0.02 cm (D) 1.25 cm

Correct Option: B**Solution:**

$$r = \frac{mv \sin \theta}{Be} = \frac{3 \times 10^5 \sin 30^\circ}{0.3 \times 10^8}$$

$$\frac{3 \times 10^5 \times \frac{1}{2}}{3 \times 10^7} = 0.5 \times 10^{-2} \text{ m} = 0.5 \text{ cm}.$$

9. The electric potential V is given as a function of distance x (metre) by $V = 5x^2 + 10x - 4$ volt. Value of electric field at $x = 1$ m is

(A) -23 V/m (B) 11 V/m (C) 6 V/m (D) -20 V/m

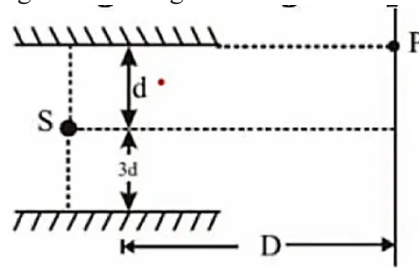
Correct Option: D**Solution:**

$$V = 5x^2 + 10x - 4$$

$$E = -\frac{dV}{dx} = -(10x + 10).$$

$$\text{At } x = 1 \text{ m, } E = -20 \text{ V/m}.$$

10. Consider the optical system shown in Fig. The point source of light S is having wavelength equal to λ . The light is reaching screen



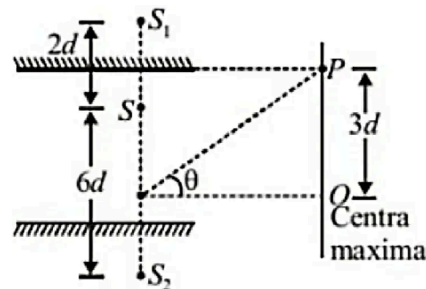
only after reflection. For point P to be second maximum the value of λ would be ($D \gg d$ and $d \gg \lambda$)

(A) $\frac{12d^2}{D}$

(B) $\frac{6d^2}{D}$

(C) $\frac{3d^2}{D}$

(D) $\frac{24d^2}{D}$

Correct Option: A**Solution:**

$$\text{At } P, \Delta x = \frac{(8d) \times 3d}{D}$$

$$\text{For 2nd maxima, } \Delta x = 2\lambda$$

$$\Rightarrow \frac{24d^2}{D} = 2\lambda$$

$$\Rightarrow \lambda = \frac{12d^2}{D}$$

11. The compressibility of water is 4×10^{-5} per unit atmospheric pressure. The decrease in volume of 100 cm^3 of water under a pressure of 100 atmosphere will be

(A) 0.4 cm^3

(B) $4 \times 10^{-5} \text{ cm}^3$

(C) 0.025 cm^3

(D) 0.004 cm^3 **Correct Option: A****Solution:**

$$\text{Compressibility} = \frac{1}{B} = \frac{\Delta V/V}{P}$$

Here, $P = 100 \text{ atm}$

$$\text{Compressibility} = 4 \times 10^{-5} \text{ and } V = 100 \text{ cm}^3$$

$$\text{Hence, } \Delta V = 0.4 \text{ cm}^3$$

12. A plane electromagnetic wave is incident on a plane surface of area A , normally and is perfectly reflected. If energy E strikes the surface in time t then force exerted on the surface is (c = speed of light)

- (A) $\frac{2E}{Atc}$ (B) $\frac{E}{2c}$
(C) $\frac{2E}{ct}$ (D) zero

Correct Option: C**Solution:**

$$\text{Incident momentum, } p = \frac{E}{c}$$

For perfectly reflecting surface with normal incidence

$$\Delta p = 2p = \frac{2E}{c}; F = \frac{\Delta p}{\Delta t} = \frac{2E}{ct}$$

13. A point particle is held on the axis of a ring of mass m and radius r at a distance r from its centre C . When released, it reaches C under the gravitational attraction of the ring. Its speed at C will be

- (A) $\sqrt{\frac{2Gm}{r}(\sqrt{2}-1)}$
(B) $\sqrt{\frac{Gm}{r}}$
(C) $\sqrt{\frac{2Gm}{r}(1-\frac{1}{\sqrt{2}})}$
(D) $\sqrt{\frac{2Gm}{r}}$

Correct Option: C**Solution:**

Let 'M' be the mass of the particle

$$\text{Now, } E_{\text{initial}} = E_{\text{final}}$$

$$\text{i.e. } \frac{GMm}{\sqrt{2}r} + 0 = \frac{GMm}{r} + \frac{1}{2}MV^2$$

$$\text{or, } \frac{1}{2}MV^2 = \frac{GMm}{r} \left[1 - \frac{1}{\sqrt{2}}\right]$$

$$\Rightarrow \frac{1}{2}V^2 = \frac{Gm}{r} \left[1 - \frac{1}{\sqrt{2}}\right] \text{ or,}$$

$$V = \sqrt{\frac{2Gm}{r} \left(1 - \frac{1}{\sqrt{2}}\right)}$$

14. Electrons are accelerated through a potential difference V and protons are accelerated through a potential difference $4V$. The de-Broglie wavelengths are λ_e and λ_p for electrons and protons respectively. The ratio of $\frac{\lambda_e}{\lambda_p}$ is given by: (given m_e is mass of electron and m_p is mass of proton).

- (A) $\sqrt{\frac{m_p}{m_e}}$
(B) $\sqrt{\frac{m_e}{m_p}}$
(C) $\frac{1}{2}\sqrt{\frac{m_e}{m_p}}$
(D) $2\sqrt{\frac{m_p}{m_e}}$

Correct Option: D**Solution:**

$$\text{Energy} = \text{charge} \times \text{potential diff.}$$

$$E_{\text{electron}} = q_e V \text{ and } E_{\text{proton}} = q_p 4V$$

$$\text{de-Broglie wavelength } \lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$$

$$\lambda_e = \frac{h}{\sqrt{2m_e eV}} \text{ and } \lambda_p = \frac{h}{\sqrt{2m_p e4V}} \because (q_e = q_p)$$

$$\therefore \frac{\lambda_e}{\lambda_p} = \frac{\frac{h}{\sqrt{2m_e eV}}}{\frac{h}{\sqrt{2m_p e4V}}} = 2\sqrt{\frac{m_p}{m_e}}$$

15. An ideal gas at atmospheric pressure is adiabatically compressed so that its density becomes 32 times of its initial value. If the final pressure of gas is 128 atmospheres, the value of ' γ ' of the gas is :

- (A) 1.5 (B) 1.4 (C) 1.3 (D) 1.6

Correct Option: B**Solution:**

$$\text{Volume } v = \frac{m}{d} \text{ and using } PV^\gamma = \text{constant}$$

$$\frac{P'}{P} = \frac{V}{V'} = \left(\frac{d'}{d}\right)^\gamma$$

$$\text{or } 128 = (32)^\gamma$$

$$\therefore \gamma = \frac{7}{5} = 1.4$$

16. The displacement y of a particle in a medium can be expressed as, $y = 10^{-6} \sin(100t + 20x + \frac{\pi}{4})$ m where t is in second and x in meter. The speed of the wave is

- (A) 20 m/s (B) 5 m/s
(C) 2000 m/s (D) 5π m/s

Correct Option: B

Solution:

From equation given,

$$\omega = 100$$

and $k = 20$;

$$v = \frac{\omega}{k} = \frac{100}{20} = 5 \text{ m/s}$$

17. Monochromatic light of wavelength 667 nm is produced by a helium neon laser. The power emitted is 9 mW. The number of photons arriving per sec on the average at a target irradiated by this beam is:

- (A) 3×10^{16} (B) 9×10^{15}
(C) 3×10^{19} (D) 9×10^{17}

Correct Option: A

Solution:

$$\lambda = 667 \times 10^{-9} \text{ m}, P = 9 \times 10^{-3} \text{ W}$$

$$P = \frac{Nhc}{\lambda}, N = \text{No. of photons emitted/sec.}$$

$$N = \frac{9 \times 10^{-3} \times 667 \times 10^{-9}}{6.6 \times 10^{-34} \times 3 \times 10^8} = 3 \times 10^{16} / \text{sec}$$

18. The two ends of a rod of length L and a uniform cross-sectional area A are kept at two temperatures T_1 and T_2 ($T_1 > T_2$). The rate of heat transfer, $\frac{dQ}{dt}$ through the rod in a steady state is given by:

- (A) $\frac{k(T_1 - T_2)}{LA}$
(B) $kLA(T_1 - T_2)$
(C) $\frac{kA(T_1 - T_2)}{L}$
(D) $\frac{kL(T_1 - T_2)}{A}$

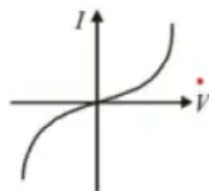
Correct Option: C

Solution:

$$\frac{dQ}{dt} = \frac{kA(T_1 - T_2)}{L}$$

[$(T_1 - T_2)$ is the temperature difference]

19. The I-V characteristics shown in figure represents



- (A) ohmic conductors (B) non-ohmic conductors
(C) insulators (D) superconductors

Correct Option: B

Solution:

The figure is showing I – V characteristics of non ohmic or non linear conductors.

20. The frequency of whistle of an engine appears to be $(\frac{4}{5})^t$ of initial frequency when it crosses a stationary observer. If the velocity of sound is 330 m/s, then the speed of engine will be

- (A) 30 m/s (B) 36.6 m/s
(C) 40 m/s (D) 330 m/s

Correct Option: B

Solution:

$$n' = \frac{nv}{v - v_s} \dots (1)$$

$$n'' = \frac{nv}{v + v_s} \dots (2)$$

$$\text{From (1) and (2), } \frac{n'}{n''} = \frac{v + v_s}{v - v_s} \dots (3)$$

$$\text{According to question, } \frac{n'}{n''} = \frac{5}{4}$$

$$v_s = ?, v = 330 \text{ m/s} \dots (4)$$

From eq. (3) and (4)

$$\frac{5}{4} = \left[\frac{330 + v_s}{330 - v_s} \right] \Rightarrow 9v_s = 330$$

$$\therefore v_s = 36.6 \text{ m/s}$$

21. A moving coil galvanometer has resistance of 10Ω and full scale deflection of 0.01 A. It can be converted into voltmeter of 10 V full scale by connecting into resistance of

- (A) 9.90Ω in series (B) 10Ω in series
(C) 990Ω in series (D) 0.10Ω

Correct Option: C

Solution:



Let G be resistance of galvanometer and i_g the current through it. Let V is maximum potential difference, then from Ohm's law

$$i_g = \frac{V}{G+R}$$

$$\Rightarrow R = \frac{V}{i_g} - G$$

Given, $G = 10\Omega$, $i_g = 0.01$ A

$V = 10$ volt

$$\therefore R = \frac{10}{0.01} - 10 = 990\Omega$$

Thus, on connecting a resistance R of 990Ω in series with the galvanometer, the galvanometer will become a voltmeter of range zero to 10 V .

For the voltmeter, a high resistance is series with the galvanometer and so the resistance of a voltmeter is very high compared to that of galvanometer.

22. In a simple pendulum of length l the bob is pulled aside from its equilibrium position through an angle θ and then released. The bob passes through the equilibrium position with speed

- (A) $\sqrt{2gl(1 + \cos \theta)}$ (B) $\sqrt{2gl \sin \theta}$
(C) $\sqrt{2gl}$ (D) $\sqrt{2gl(1 - \cos \theta)}$

Correct Option: D

Solution:

If l is length of pendulum and θ be angular amplitude then from principle of conservation of energy

(Initial total energy) $0 + mgh = \frac{1}{2}mv^2 + 0$ (Final total energy)

$$\Rightarrow v = \sqrt{2gh} = \sqrt{2gl(1 - \cos \theta)}$$

23. A zener diode of voltage $V_Z (= 6$ V) is used to maintain a constant voltage across a load resistance $R_L (= 1000\Omega)$ by using a series resistance $R_s (= 100\Omega)$. If the e.m.f. of source is $E (= 9$ V), what is the power being dissipated in Zener diode ?

- (A) 0.144 watt (B) 0.324 watt
(C) 0.244 watt (D) 0.544 watt

Correct Option: A

Solution:

Here, $E = 9$ V; $V_Z = 6$; $R_L = 1000\Omega$

and $R_s = 100\Omega$,

Potential drop across series resistor

$$V = E - V_Z = 9 - 6 = 3$$
 V

Current through series resistance R_s is

$$I = \frac{V}{R} = \frac{3}{100} = 0.03$$
 A

Current through load resistance R_L is

$$I_L = \frac{V_Z}{R_L} = \frac{6}{1000} = 0.006$$
 A

Current through Zener diode is

$$I_Z = I - I_L = 0.03 - 0.006 = 0.024$$
 amp.

Power dissipated in Zener diode is

$$P_Z = V_Z I_Z = 6 \times 0.024 = 0.144$$
 Watt

24. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto **2 m** height further find the magnitude of the force. (Consider $g = 10$ m/s²).

- (A) 4 N (B) 16 N (C) 20 N (D) 22 N

Correct Option: D

Solution:

Let the velocity of the ball just when it leaves the hand be u then applying, $v^2 - u^2 = 2as$ for the upward journey

$$\Rightarrow -u^2 = 2(-10) \times 2$$

$$\Rightarrow u^2 = 40$$

Again applying $v^2 - u^2 = 2as$ as for the upward journey of the ball, when the ball is in the hands of the thrower,

$$v^2 - u^2 = 2as$$

$$\Rightarrow 40 - 0 = 2(a)(0.2)$$

$$\Rightarrow a = 100 \text{ m/s}^2$$

$$\therefore F = ma = 0.2 \times 100 = 20$$
 N

$$\Rightarrow N - mg = 20$$

$$\Rightarrow N = 20 + 2 = 22$$
 N

25. The significant result deduced from the Rutherford's scattering experiment is that

- (A) whole of the positive charge is concentrated at the centre of atom
 (B) there are neutrons inside the nucleus
 (C) α - particles are helium nuclei
 (D) electrons are embedded in the atom

Correct Option: A

Solution:

The significant result deduced from the Rutherford's scattering is that whole of the positive charge is concentrated at the centre of atom i.e. nucleus.

26. A wire of a certain material is stretched slowly by ten per cent. Its new resistance and specific resistance become respectively:

- (A) 1.2 times, 1.3 times (B) 1.21 times, same
 (C) both remain the same (D) 1.1 times, 1.1 times

Correct Option: B

Solution:

Let we have a wire of length l , cross-sectional area A , and Resistivity ρ

Then Resistance of wire is

$$R = \rho \frac{l}{A} \quad \text{--- (1)}$$

The volume of cylindrical wire is the product of its length and cross-sectional area.

$$V = l \cdot A$$

If length is increased by 10 percent, the new length l' is

$$l' = l + 10\% \text{ of } l = 1.1l \quad \text{--- (2)}$$

After stretching the cross-sectional area will also change, as volume remains constant. Let the new cross-sectional area be A'

$$V = l' \cdot A' = l \cdot A \quad \text{--- (3)}$$

Putting (2) in (3) we have

$$1.1l \cdot A' = l \cdot A$$

$$A' = \frac{A}{1.1} \quad \text{--- (4)}$$

So, the Resistance of this stretched wire is

$$R = \rho \frac{l}{A} \quad \text{--- (5)}$$

Putting (2) and (4) in (5)

$$\begin{aligned} R' &= \rho \left(\frac{1.1l}{A/1.1} \right) \\ \Rightarrow R &= \rho \left(\frac{1.1 \times 1.1l}{A} \right) \\ \Rightarrow R &= \rho \left(\frac{1.21l}{A} \right) \\ \Rightarrow R &= 1.21 \left(\rho \frac{l}{A} \right) \quad \text{--- (6)} \end{aligned}$$

Comparing Eq(6) and Eq(1) We get $R' = 1.21R$

So, the resistance increases 1.21 times.

27. Three specimens A, B, C of same radioactive element have activities 1 microcurie, 1 rutherford and 1 becquerel respectively. Which specimen has maximum mass?

- (A) A (B) B
 (C) C (D) all have equal masses

Correct Option: B

Solution:

$$1 \text{ becquerel} = 1 \text{ dis/s}$$

$$1 \text{ rutherford} = 10^6 \text{ dis/s}$$

$$1 \text{ curie} = 3.7 \times 10^{10} \text{ dis/s}$$

28. Suppose the law of gravitational attraction suddenly changes and becomes an inverse cube law i.e. $F \propto \frac{1}{r^3}$, but still remaining a central force. Then

- (A) Kepler's law of area still holds
 (B) Kepler's law of period still holds
 (C) Kepler's law of area and period still holds
 (D) neither the law of area, nor the law of period still holds

Correct Option: A

Solution:

According to kepler's law of area

$$\frac{dA}{dt} = \frac{L}{2m}$$

For central forces, torque = 0

$$\therefore L = \text{constant}$$

$$\therefore \frac{dA}{dt} = \text{constant}$$

29. Green light of wavelength $5460 \text{ \AA}$ is incident on an air-glass interface. If the refractive index of glass is 1.5, the wavelength of light in glass would be ($c = 3 \times 10^8 \text{ ms}^{-1}$)

- (A) $3640 \text{ \AA}$ (B) $5460 \text{ \AA}$
(C) $4861 \text{ \AA}$ (D) None of the above

Correct Option: A

Solution:

$$\lambda_{\text{glass}} = \frac{\lambda_{\text{air}}}{\mu} = \frac{5460}{1.5} = 3640 \text{ \AA}$$

30. An alternating voltage $V = V_0 \sin \omega t$ is applied across a circuit. As a result, a current $I = I_0 \sin(\omega t - \frac{\pi}{2})$ flows in it. The power consumed per cycle is

- (A) zero
(B) $0.5 V_0 I_0$
(C) $0.707 V_0 I_0$
(D) $1.414 V_0 I_0$

Correct Option: A

Solution:

The phase angle between voltage V and current I is $\frac{\pi}{2}$.

Therefore, power factor $\cos \phi = \cos(\frac{\pi}{2}) = 0$.

Hence the power consumed is zero.

31. A balloon is rising vertically up with a velocity of 29 ms^{-1} . A stone is dropped from it and it reaches the ground in 10 seconds. The height of the balloon when the stone was dropped from it, was ($g = 9.8 \text{ ms}^{-2}$)

- (A) 100 m (B) 200 m (C) 400 m (D) 150 m

Correct Option: B

Solution:

For stone to be dropped from rising balloon of velocity 29 m/s , $u = -29 \text{ m/s}$, $t = 10 \text{ sec}$.

$$\therefore h = -29 \times 10 + \frac{1}{2} \times 9.8 \times 100$$

$$= -290 + 490 = 200 \text{ m.}$$

32. A metal disc of radius 100 cm is rotated at a constant angular speed of 60 rad/s in a plane at right angles to an external field of magnetic induction 0.05 Wb/m^2 . The emf induced between the centre and a point on the rim will be

- (A) 3 V (B) 1.5 V (C) 6 V (D) 9 V

Correct Option: B

Solution:

Induced emf produced between the centre and a point on the disc is given by $e = \frac{1}{2} \omega B R^2$

$$\omega = 60 \text{ rad/s}, B = 0.05 \text{ Wb/m}^2$$

$$\text{and } R = 100 \text{ cm} = 1 \text{ m}$$

$$\text{We get } e = \frac{1}{2} \times 60 \times 0.05 \times (1)^2 = 1.5 \text{ V}$$

33. If force (F), length (L) and time (T) are assumed to be fundamental units, then the dimensional formula of the mass will be

- (A) $[FL^{-1} T^2]$
(B) $[FL^{-1} T^{-2}]$
(C) $[FL^{-1} T^{-1}]$
(D) $[FL^2 T^2]$

Correct Option: A

Solution:

$$\text{Let } m = K F^a L^b T^c$$

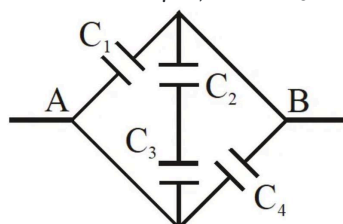
Substituting the dimensions of

$$[F] = [MLT^{-2}], [L] = [L] \text{ and } [T] = [T] \text{ and}$$

$$\text{comparing both side, we get } m = FL^{-1} T^2$$

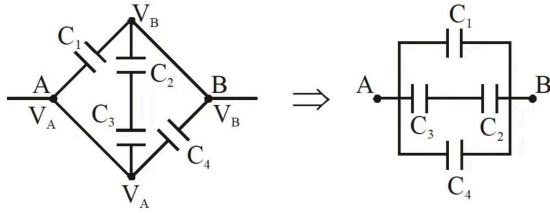
34. In a given network the equivalent capacitance between A and B is

$$C_1 = C_4 = 1 \mu\text{F}, C_2 = C_3 = 2 \mu\text{F}:$$



- (A) $3 \mu\text{F}$ (B) $6 \mu\text{F}$
(C) $4.5 \mu\text{F}$ (D) $2.5 \mu\text{F}$

Correct Option: A

Solution:

$$C_{eq} = 3\mu F$$

35. A spherical drop of radius R is divided into eight equal droplets. If surface tension is T , then the work done in this process is

- (A) $2\pi R^2 T$ (B) $3\pi R^2 T$
(C) $4\pi R^2 T$ (D) $2\pi R T^2$

Correct Option: C**Solution:**

Volume of 8 small droplets = Volume of 1 big drop

$$\Rightarrow \frac{4}{3}\pi r^3 \times 8 = \frac{4}{3}\pi R^3 \Rightarrow r = \frac{R}{2}$$

Work done = (Change in area) $\times$ surface tension

$$= (4\pi r^2 \times 8 - 4\pi R^2) T$$

$$= \left\{ 4\pi \left(\frac{R^2}{4} \right) \times 8 - 4\pi R^2 \right\} T = 4\pi R^2 T$$

36. A round disc of moment of inertia I_2 about its axis perpendicular to its plane and passing through its centre is placed over another disc of moment of inertia I_1 rotating with an angular velocity ω about the same axis. The final angular velocity of the combination of discs is

- (A) $\frac{I_2 \omega}{I_1 + I_2}$
(B) ω
(C) $\frac{I_1 \omega}{I_1 + I_2}$
(D) $\frac{(I_1 + I_2) \omega}{I_1}$

Correct Option: C**Solution:**

According to conservation of angular momentum

$$\therefore I_1 \omega_1 = I_2 \omega_2 \Rightarrow I_1 \omega = (I_1 + I_2) \omega_2 \Rightarrow \omega_2 = \frac{I_1 \omega}{I_1 + I_2}$$

37. For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exhibits resonance. The quality factor, Q is given by :

- (A) $\frac{\omega_0 L}{R}$

(B) $\frac{CR}{\omega_0}$

(C) $\frac{R}{(\omega_0 C)}$

(D) $\frac{\omega_0 R}{L}$

Correct Option: A**Solution:**

$$\text{Quality factor} = \frac{\omega_0 L}{R}$$

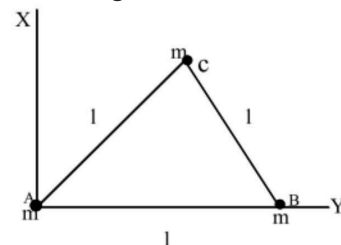
38. The temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K the root mean square velocity of the gas molecules is v , at 480 K it becomes:

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

Correct Option: B**Solution:**

$$\text{Use } v \propto \sqrt{T}$$

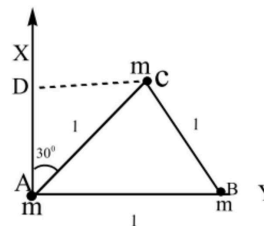
39. Three particles, each of mass m grams are situated at the vertices of an equilateral triangle ABC of side l cm (as shown in the figure). The moment of inertia of the system about a line AX perpendicular to AB and in the plane of ABC in g-cm² units will be:



- (A) $\left(\frac{3}{4}\right) ml^2$ (B) $2ml^2$
(C) $\left(\frac{5}{4}\right) ml^2$ (D) $\left(\frac{3}{2}\right) ml^2$

Correct Option: C**Solution:**

Moment of inertia of the system about 'AX' is given by:



Moment of inertia

$$m_A r_A^2 + m_B r_B^2 + m_C r_C^2$$

where

$$\begin{cases} r_A = 0 \\ r_B = l \\ r_C = l \sin 30^\circ \end{cases}$$

Therefore,

$$m(0)^2 + m(l)^2 + m(l \sin 30^\circ)^2 = ml^2 + \frac{ml^2}{4} = \frac{5}{4}ml^2$$

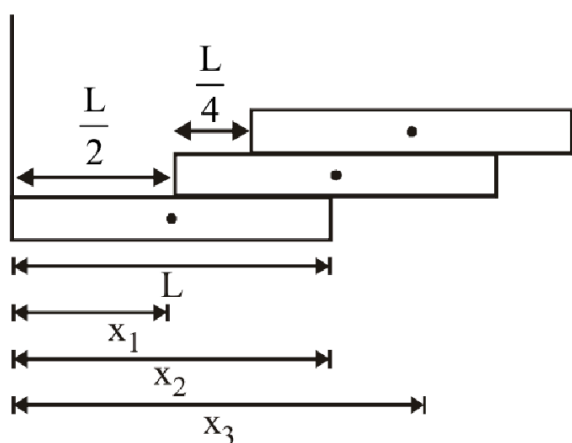
40. Three bricks each of length L and mass M are arranged as shown from the wall. The distance of the centre of mass of the system from the wall is



- (A) $L/4$ (B) $L/2$ (C) $(3/2)L$ (D) $(11/12)L$

Correct Option: D

Solution:



$$x_1 = \frac{L}{2}, x_2 = L, x_3 = \frac{5L}{4}$$

$$\therefore X_{CM} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3}{m_1 + m_2 + m_3}$$

$$= \frac{M \times \frac{L}{2} + M \times \frac{5L}{4}}{M + M + M} = \frac{11L}{12}$$

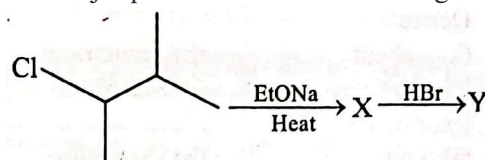
41. Biochemical oxygen demand (BOD) value can be a measure of water pollution caused by the organic matter. Which of the following statements is correct?
- (A) Polluted water has BOD value higher than 10 ppm
- (B) Aerobic bacteria decreases the BOD value

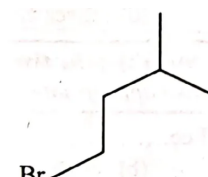
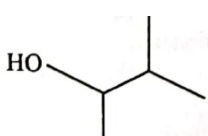
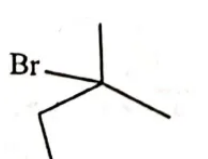
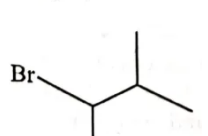
- (C) Anaerobic bacteria increases the BOD value
- (D) Clean water has BOD value higher than 10 ppm

Correct Option: A

Solution:

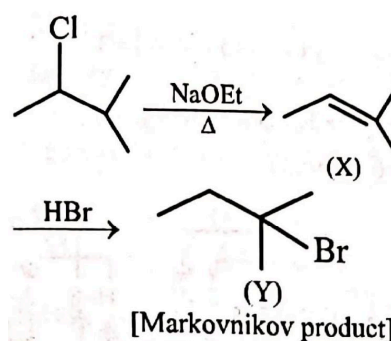
42. The major product 'Y' in the following reaction is:



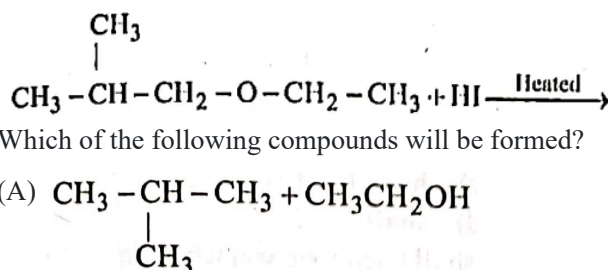
- (A) 
- (B) 
- (C) 
- (D) 

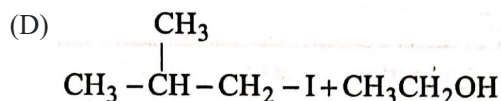
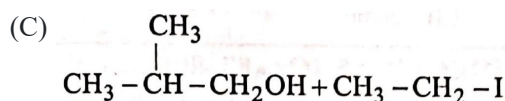
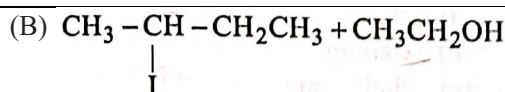
Correct Option: C

Solution:



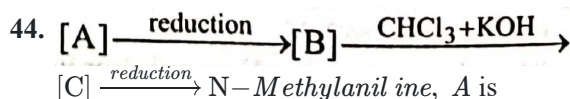
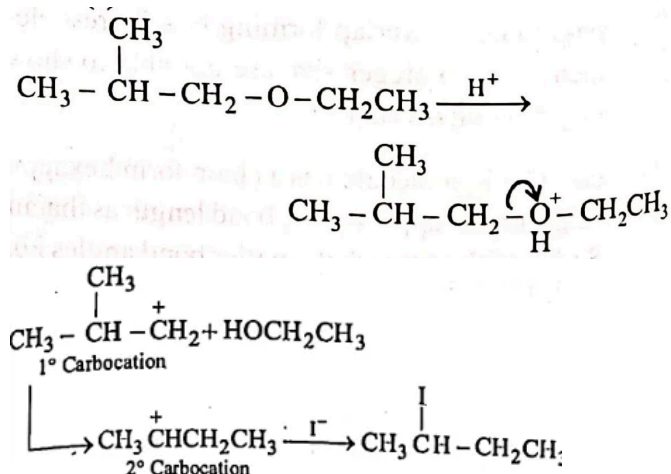
43. In the reaction:





Correct Option: B

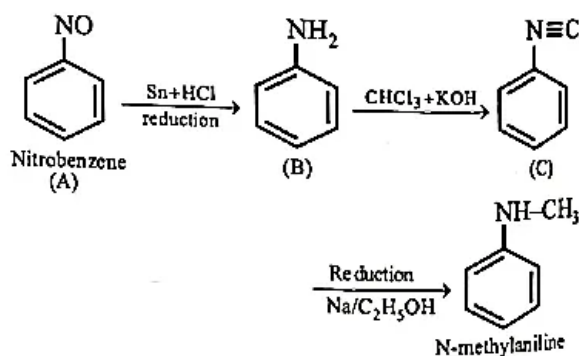
Solution:



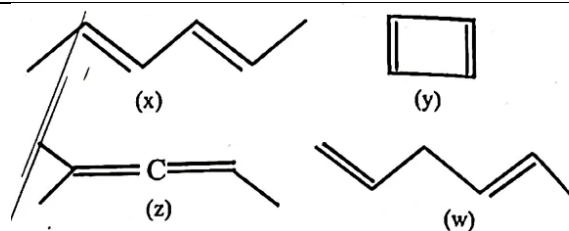
- (A) Formaldehyde (B) Trichloromethane
 (C) Nitrobenzene (D) Toluene

Correct Option: C

Solution:



45. The correct stability order of following species is -



- (A) $x > y > w > z$
 (B) $y > x > w > z$
 (C) $x > w > z > y$
 (D) $z > x > y > w$

Correct Option: C

Solution:

46. Identify the incorrect statement :

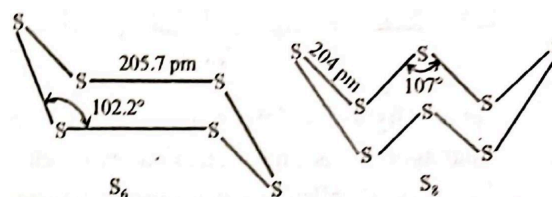
- (A) The S-S-S bond angles in the S_8 and S_6 rings are the same.
 (B) Rhombic and monoclinic sulphur have S_8 molecules
 (C) S_2 is paramagnetic like oxygen
 (D) S_8 ring has a crown shape.

Correct Option: A

Solution:

The S_6 molecule has a chair-form hexagon ring with the approx same bond length as that in S_8 , but with some what smaller bond angles i.e.

bond lengths are approx same but angles are different.

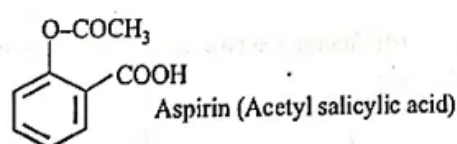


47. Aspirin is known as :

- (A) acetyl salicylic acid (B) phenyl salicylate
 (C) acetyl salicylate (D) methyl salicylic acid

Correct Option: A

Solution:



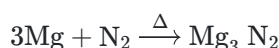
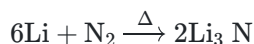
48. Two elements A and B have similar chemical properties. They don't form solid hydrogencarbonates, but react with nitrogen to form nitrides. A and B , respectively, are :

(A) Na and Rb (B) Na and Ca (C) Cs and Ba (D) Li and Mg

Correct Option: D

Solution:

Li and Mg do not form solid bicarbonate, but react with N_2 to give nitrides.



49. For the reaction: $\text{NH}_3 + \text{OCl}^- \rightarrow \text{N}_2\text{H}_4 + \text{Cl}^-$ in basic medium, the coefficients of NH_3 , OCl^- and N_2H_4 for the balanced equation are respectively

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

Correct Option: C

Solution:

The balanced equation :



50. PCl_5 is dissociating 50% at 250°C at a total pressure of P atm. If equilibrium constant is K_p , then which of the following relation is numerically correct -

(A) $K_p = 3P$
 (B) $P = 3K_p$
 (C) $P = \frac{2K_p}{3}$
 (D) $K_p = \frac{2P}{3}$

Correct Option: B

Solution:

	PCl_5	$\rightarrow$	PCl_3	$+$	Cl_2
Moles at equilibrium	$\frac{1}{2}$		$\frac{1}{2}$		$\frac{1}{2}$
Mole fraction at equilibrium	$\frac{1}{3}$		$\frac{1}{3}$		$\frac{1}{3}$
Partial pressure at equilibrium	$\frac{P}{3}$		$\frac{P}{3}$		$\frac{P}{3}$

$$K_p = \frac{\frac{P}{3} \times \frac{P}{3}}{\frac{P}{3}} = \frac{P}{3}$$

51. Work out the heat change (cal) when 40 g of He gas at 27°C undergoes isothermal and reversible compression from initial pressure of 1 atm to 10 atm ($R =$

$$2\text{calK}^{-1}\text{mol}^{-1}).$$

(A) 13.818 kcal (B) -13.818 kcal
 (C) 55.272 kcal (D) -55.272 kcal

Correct Option: B

Solution:

$$q = -w_{\text{rev}} = -(-2.303nRT \log \frac{P_1}{P_2})$$

$$= 2.303 \times \frac{40}{4} \times 2 \times 300 \log \frac{1}{10} = -13.82\text{kcal}$$

52. X mL of H_2 gas effuses through a hole in a container in t_1 seconds. The time taken for the effusion of the same volume of the gas specified below under identical condition is :

(A) 10 seconds : He (B) 20 seconds: O_2
 (C) 25 seconds: CO (D) 55 seconds: CO_2

Correct Option: B

Solution:

Under identical conditions, $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

As rate of diffusion is also inversely proportional to time, we will have, $\frac{t_2}{t_1} = \sqrt{\frac{M_2}{M_1}}$

(a) Thus, For He, $t_2 = \sqrt{\frac{4}{2}}(5\text{ s}) = 5\sqrt{2}\text{ s} \neq 10\text{ s};$

(b) For O_2 , $t_2 = \sqrt{\frac{32}{2}}(5\text{ s}) = 20\text{ s}$

(c) For CO, $t_2 = \sqrt{\frac{28}{2}}(5\text{ s}) \neq 25\text{ s};$

(d) For CO_2 , $t_2 = \sqrt{\frac{44}{2}}(5\text{ s}) \neq 55\text{ s}$

53. Which of the following has minimum melting point?

(A) CsF (B) HCl (C) HF (D) LiF

Correct Option: B

Solution:

Ionic compounds have high melting point. Greater the ionic character, more is melting point. HCl has least ionic character because of maximum electronegativity difference between the two constituent elements, (H and Cl) among CsF, HCl, HF and LiF

$\therefore$ HCl has minimum melting point.

54. Which of the following acts as an antioxidant in edible oils

- (A) Vitamin B (B) Vitamin C (C) Vitamin D (D) Vitamin E

Correct Option: D

Solution:

Vitamin E is an antioxidant present in edible oils.

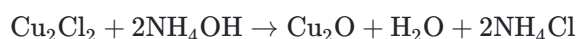
55. When C_2H_2 , CH_4 and C_2H_4 pass through a test tube which has ammonical Cu_2Cl_2 , find out which gas comes out unaffected from test tube?

- (A) C_2H_2 and CH_4
(B) C_2H_2 and C_2H_4
(C) C_2H_4 and CH_4
(D) C_2H_2

Correct Option: C

Solution:

C_2H_2 forms copper acetylide with ammonical Cu_2Cl_2



56. Fructose reduces Tollen's reagent due to:

- (A) enolisation of fructose followed by conversion to glucose (having aldehydic group) by the base present in Tollen's reagent
(B) asymmetric carbons
(C) primary alcoholic group
(D) secondary alcoholic group

Correct Option: A

Solution:

57. The solubility of silver bromide in hypo solution involves the formation of:

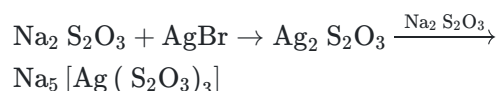
- (A) Ag_2SO_3
(B) $Ag_2S_2O_3$
(C) Ag^+
(D) NH_4^+

Correct Option: B

Solution:

Hypo solution is $Na_2S_2O_3$ solution which is used in photography for fixing films & prints. Photographic emulsions are made of $AgBr$. After developing, the film is

put into hypo solution. This forms soluble complex with Ag .



58. Calculate the wavelength (in nanometer) associated with a proton moving at $1.0 \times 10^3 \text{ ms}^{-1}$.
(Mass of proton = $1.67 \times 10^{-27} \text{ kg}$ and $h = 6.63 \times 10^{-34} \text{ Js}$)

- (A) 0.40 nm (B) 2.5 nm (C) 14.0 nm (D) 0.32 nm

Correct Option: A

Solution:

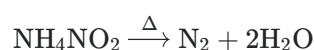
$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 1 \times 10^3} = 3.97 \times 10^{-10} \text{ meter} = 0.397 \text{ nanometer} \approx 0.40 \text{ nm}$$

59. Nitrogen is obtained by the thermal decomposition of:

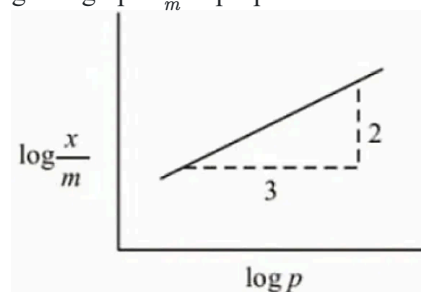
- (A) NH_4NO_2
(B) NH_4NO_3
(C) $AgNO_3$
(D) $Pb(NO_3)_2$

Correct Option: A

Solution:



60. Adsorption of a gas follows Freundlich adsorption isotherm. x is the mass of the gas adsorbed on mass m of the adsorbent. The plot of $\frac{x}{m}$ versus $\log p$ is shown in the given graph. $\frac{x}{m}$ is proportional to:



- (A) $p^{2/3}$ (B) $p^{3/2}$
(C) p^3 (D) p^2

Correct Option: A

Solution:

According to Freundlich adsorption isotherm

$$\frac{x}{m} \propto p^{\frac{1}{n}}; \frac{x}{m} = kp^{\frac{1}{n}}$$

$$\text{Slope} = \frac{2}{3}$$

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

$$\text{Slope} = \frac{1}{n} = \frac{2}{3}$$

$$\frac{x}{m} \propto p^{\frac{2}{3}}$$

61. Arsenic containing medicine used for the treatment of syphilis, is

(A) erythromycin (B) ofloxacin
(C) tetracycline (D) salvarsan

Correct Option: D

Solution:

62. Which one of the following molecules will form a linear polymeric structure due to hydrogen bonding?

(A) NH_3 (B) H_2O
(C) HCl (D) HF

Correct Option: D

Solution:

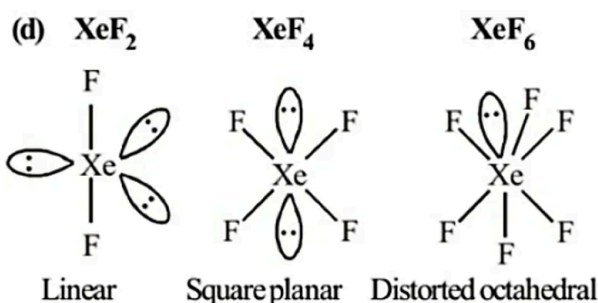
HF form linear polymeric structure due to hydrogen bonding.

63. In XeF_2 , XeF_4 , XeF_6 the number of lone pairs on Xe are respectively

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

Correct Option: D

Solution:



64. Which of the following chemicals can be added for sweetening of food items at cooking temperature and does not provides calories?

(A) Sucrose (B) Glucose (C) Aspartam (D) Sucralose

Correct Option: D

Solution:

Sucralose is trichloro derivative of sucrose. It is stable at cooking temperature. It does not provide calories.

65. Cetyltrimethyl ammonium bromide is a popular
(A) anionic detergent (B) cationic detergent
(C) non-ionic detergent (D) sweetener

Correct Option: B

Solution:

Cetyltrimethyl ammonium bromide which is a germicide, is a popular cationic detergent.

66. The frequency of radiation emitted when the electron falls from $n = 4$ to $n = 1$ in a hydrogen atom will be (Given : ionization energy of $H = 2.18 \times 10^{-18} \text{ J atom}^{-1}$ and $h = 6.625 \times 10^{-34} \text{ Js}$)
(A) $1.54 \times 10^{15} \text{ s}^{-1}$
(B) $1.03 \times 10^{15} \text{ s}^{-1}$
(C) $3.08 \times 10^{15} \text{ s}^{-1}$
(D) $2.00 \times 10^{15} \text{ s}^{-1}$

Correct Option: C

Solution:

$$v = \frac{1}{h} \times IE \times \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

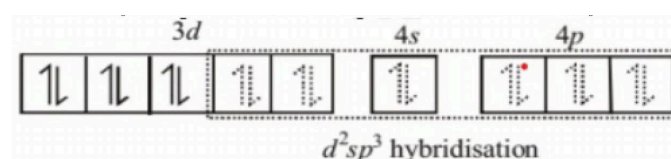
$$= \frac{2.18 \times 10^{-18}}{6.625 \times 10^{-34}} \times \left[\frac{1}{1} - \frac{1}{16} \right] = 3.08 \times 10^{15} \text{ s}^{-1}$$

67. $[\text{Fe}(\text{en})_2(\text{H}_2\text{O})_2]^{2+} + \text{en} \rightarrow \text{complex (X)}$. The correct statement about the complex (X) is -
(A) it is a low spin complex (B) it is diamagnetic
(C) it shows geometrical isomerism (D) (a) and (b) both

Correct Option: D

Solution:

Complex X is $[\text{Fe}(\text{en})_3]^{2+}$; as 'en' is a strong field ligand pairing of electrons will take place. $[\text{Fe}(\text{en})_3]^{2+}$:



Hence, hybridisation is d^2sp^3 and complex is diamagnetic. As it has 3 bidentate symmetrical 'en' ligands so it will not show geometrical isomerism.

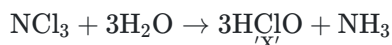
68. Hydrolysis of NCl_3 gives NH_3 and X. Which of the following is X?

- (A) HClO_4 (B) HClO_3
(C) HOCl (D) HClO_2

Correct Option: C

Solution:

Completing the reaction, we get



69. Which of the following set contains species having same angle around the central atom?

- (A) SF_4 , CH_4 , NH_3
(B) NF_3 , BCl_3 , NH_3
(C) BF_3 , NF_3 , AlCl_3
(D) BF_3 , BCl_3 , BBr_3

Correct Option: D

Solution:

BF_3 , BCl_3 , BBr_3 are sp^2 hybridised. So, all have same structure and bond angle i.e. 120° .

70. Which of the following does not contain any coordinate bond?

- (A) H_3O^+ (B) BF_4^-
(C) HF_2^- (D) SO_2^-

Correct Option: C

Solution:

HF_2 is the only compound among the given options which does not contain any coordinate bond because it has hydrogen bonding.

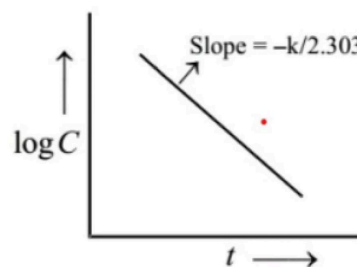


71. In a 1st order reaction, reactant concentration C varies with time t as :

- (A) $\frac{1}{C}$ increases linearly with t
(B) $\log C$ decreases linearly with t
(C) C decreases with $\frac{1}{t}$
(D) $\log C$ decreases with $\frac{1}{t}$

Correct Option: B

Solution:



72. Which of the following represents the correct order of **C** O bond lengths in ClO^- , ClO_2^- , ClO_3^- , ClO_4^- ?

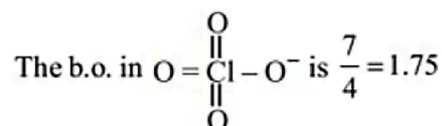
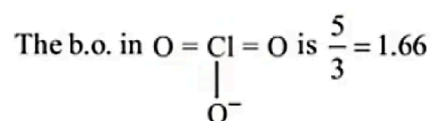
- (A) $\text{ClO}_4^- = \text{ClO}_3^- = \text{ClO}_2^- = \text{ClO}^-$
(B) $\text{ClO}^- < \text{ClO}_2^- < \text{ClO}_3^- < \text{ClO}_4^-$
(C) $\text{ClO}_4^- < \text{ClO}_3^- < \text{ClO}_2^- < \text{ClO}^-$
(D) $\text{ClO}_3^- < \text{ClO}_4^- < \text{ClO}_2^- < \text{ClO}^-$

Correct Option: C

Solution:

The b.o in $\text{Cl} - \text{O}^-$ is 1

The b.o in $\text{O} = \text{Cl} - \text{O}^-$ is 1.5



The bond length increases as b.o. decreases.

73. Which one of the following ions has the maximum magnetic moment?

- (A) Sc^{3+} (B) Ti^{3+}
(C) Cr^{3+} (D) Fe^{3+}

Correct Option: D

Solution:

Fe^{3+} (d^5) has 5 unpaired electrons therefore magnetic moment $= \sqrt{n(n+2)} = \sqrt{5(5+2)} = 5.91$ which is maximum among given options. As Sc^{3+} , Ti^{3+} , Cr^{3+} and V^{3+} contain 0, 1, 3, and 2 number of unpaired electrons respectively.

74. The difference in the number of unpaired electrons of a metal ion in its high-spin and low-spin octahedral complexes is two. The metal ion is

- (A) Fe^{2+} (B) Co^{2+}
(C) Mn^{2+} (D) Ni^{2+}

Correct Option: B

Solution:

75. Element 'B' forms ccp structure and 'A' occupies half of the octahedral voids, while oxygen atoms occupy all the tetrahedral voids. The structure of bimetallic oxide is

- (A) A_2BO_4
(B) $\text{A}_2\text{B}_2\text{O}$
(C) $\text{A}_4\text{B}_2\text{O}$
(D) AB_2O_4

Correct Option: D

Solution:

$$Z_B = 4, Z_A = 4 \times \frac{1}{2} = 2, Z_O = 8$$

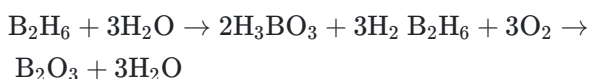
Formula; $\text{A}_2\text{B}_2\text{O}_8 \equiv \text{AB}_2\text{O}_4$.

76. Diborane (B_2H_6) reacts independently with O_2 and H_2O to produce, respectively

- (A) HBO_2 and H_3BO_3
(B) H_3BO_3 and B_2O_3
(C) B_2O_3 and H_3BO_3
(D) B_2O_3 and $[\text{BH}_4]^-$

Correct Option: C

Solution:



77. Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapour pressures of pure A and pure B are 7×10^3 Pa and 12×10^3 Pa, respectively. The composition of the vapor in equilibrium with a solution containing 40 mole percent of A at this temperature is:

- (A) $x_A = 0.37; x_B = 0.63$
(B) $x_A = 0.28; x_B = 0.72$
(C) $x_A = 0.76; x_B = 0.24$

(D) $x_A = 0.4; x_B = 0.6$

Correct Option: B

Solution:

$$y_A = \frac{P_A}{P_{Total}} = \frac{P_A^0 x_A}{P_A^0 x_A + P_B^0 x_B} = \frac{7 \times 10^3 \times 0.4}{7 \times 10^3 \times 0.4 + 12 \times 10^3 \times 0.6} = \frac{2.8}{10} = 0.28$$

$$y_B = 0.72$$

78. Which one of the following coordination compounds is used to inhibit the growth of tumours?

- (A) trans-Platin
(B) EDTA complex of calcium
(C) $[(\text{Ph}_3\text{P})_3 \text{RhCl}]$
(D) cis-Platin

Correct Option: D

Solution:

cis-Platin i.e. $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$ is used as antitumor agent in the treatment of cancer.

79. At 25°C , the molar conductance at infinite dilution for the strong electrolytes NaOH , NaCl and BaCl_2 are 248×10^{-4} , 126×10^{-4} and $280 \times 10^{-4} \text{ Sm}^2 \text{ mol}^{-1}$ respectively.

$\Lambda_m^0 \text{Ba}(\text{OH})_2$ in $\text{Sm}^2 \text{ mol}^{-1}$ is

- (A) 52.4×10^{-4} (B) 524×10^{-4}
(C) 402×10^{-4} (D) 262×10^{-4}

Correct Option: B

Solution:

$$\Lambda_{\text{Na}^+}^0 + \Lambda_{\text{OH}^-}^0 = 248 \times 10^{-4} \text{ Sm}^2 \text{ mol}^{-1}$$

$$\Lambda_{\text{Na}^+}^0 + \Lambda_{\text{Cl}^-}^0 = 126 \times 10^{-4} \text{ Sm}^2 \text{ mol}^{-1}$$

$$\Lambda_{\text{Ba}^{2+}}^0 + \Lambda_{2\text{Cl}^-}^0 = 280 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

$$\text{Now, } \Lambda_{\text{Ba}(\text{OH})_2}^0 = \Lambda_{\text{BaCl}_2}^0 + 2\Lambda_{\text{NaOH}}^0 - 2\Lambda_{\text{NaCl}}^0$$

$$\Lambda_{\text{Ba}(\text{OH})_2}^0 = 280 \times 10^{-4} + 2 \times 248 \times 10^{-4} - 2 \times 126 \times 10^{-4}$$

$$\Lambda_{\text{Ba}(\text{OH})_2}^0 = 524 \times 10^{-4} \text{ Sm}^2 \text{ mol}^{-1}.$$

80. Which of the following has the highest $p\pi - p\pi$ bond order tendency?



(A) N (B) P (C) As (D) Sb

Correct Option: A

Solution:

Nitrogen due to small size is able to show $p\pi - p\pi$ lateral overlap forming $N \equiv N$, rest elements due to bigger size are not able to show $p\pi - p\pi$ lateral overlap.

81. He is not in the office _____ the moment.

(A) from (B) with (C) for (D) at

Correct Option: C

Solution:

82. Exorbitant

(A) odd (B) ridiculous
(C) excessive (D) threatening

Correct Option: D

Solution:

83. Deflect

(A) cheat (B) frustrate (C) pervert (D) depress

Correct Option: C

Solution:

84. Amenities:

(A) pageantries (B) privileges
(C) facilities (D) courtesies

Correct Option: D

Solution:

85. the earth _____ round the Sun.

(A) move (B) moves (C) moved (D) moving

Correct Option: B

Solution:

86. "Men ignorant of the past" means the persons who

(A) do not learn from experience (B) ignore the lessons of history
(C) are not aware of history. (D) have no respect for the past

Correct Option: C

Solution:

According to the passage the persons who are not aware of history are the men ignorant of the past. Therefore option

(c) is correct.

87. 'The less active and important people' are the

(A) lazy people
(B) uncommitted people
(C) common people
(D) people who are in position of power

Correct Option: C

Solution:

According to the passage common people may be described as the less active and important people. Therefore option (c) is close to correct answer.

88. Our world has heritage of culture means

(A) a richness of tradition
(B) an inherited cultural tradition
(C) too many cultural
(D) cultures which are now extinct

Correct Option: B

Solution:

According to the passage, our world has a heritage of culture means, we have an inherited cultural tradition. Therefore option (b) is correct.

89. People were alarmed.....the tiger.

(A) at (B) in (C) on (D) for

Correct Option: A

Solution:

'at' is used for things at rest.

90. She is very affectionate..... her children.

(A) upon (B) with (C) towards (D) over

Correct Option: C

Solution:

'towards' is used to show the sense of direction.

91. I shall telephone you when he.....back.

(A) comes (B) coming
(C) shall come (D) came

Correct Option: A

Solution:

Simple present tense is also used, instead to the simple future tense, therefore option (a) is correct.

92. I..... him only one letter up to now.

- (A) sent (B) have sent
(C) have been sending (D) shall send

Correct Option: B**Solution:**

The simple past is used to indicate an action completed in the past. Therefore option(b) is correct.

93. 1. If you feed a dog or tame a bear by hand,
P : or until they succeed in getting it
Q : and tear and pull at it.
R : they get their teeth into the meat
S : until they bite a piece off, all out of your hand.
The correct sequence should be

- (A) PSRQ (B) SQRQ (C) RPSQ (D) RQSP

Correct Option: D**Solution:**

The correct sequence is If you feed a dog or tame a bear by hand, they get their teeth into the meat and tear and pull at it until they bite a piece of or until they succeed in getting it all out of our hand'.

Therefore correct combination is (d).

94. 1. It was all
P: that seemed
Q: and glamorous here
R: very wonderful
S: in the old places
6. so ordinary
The correct sequence should be

- (A) QSPR (B) SPRQ (C) RQSP (D) PRSQ

Correct Option: C**Solution:**

The correct sequence is 'It was all very wonderful and glamorous here in the old places that seemed so ordinary'.
Therefore correct combination is c.

95. 1. If Socrates
P : innocent St. Joan was at
Q : the age of seventy
R : it may be imagined how
S : was innocent at
6. the age of seventeen

The correct sequence should be

- (A) QRSP (B) RPSQ (C) PRSQ (D) SQRQ

Correct Option: D**Solution:**

The correct sequence is 'If Socrates was innocent at the age of seventy it may be imagined now innocent St. John was at the age of seventeen'.

Therefore the correct combination is d.

96. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives:

1	$\frac{1}{2}$	$\frac{2}{3}$
2	$\frac{2}{3}$	$\frac{8}{3}$
3		$\frac{19}{5}$

- (A) $\frac{1}{2}$ (B) $\frac{2}{3}$
(C) $\frac{3}{4}$ (D) $\frac{4}{5}$

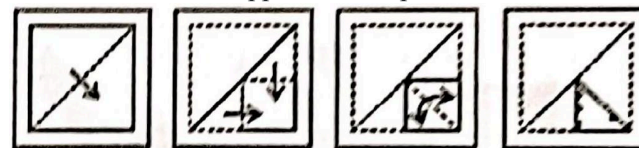
Correct Option: D**Solution:**

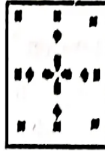
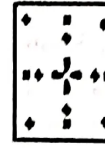
97. In the word FLOURISH, all the vowels are first arranged alphabetically and then all the consonants are arranged alphabetically and then all the vowels are replaced by the previous

- (A) I (B) S (C) M (D) V

Correct Option: A**Solution:**

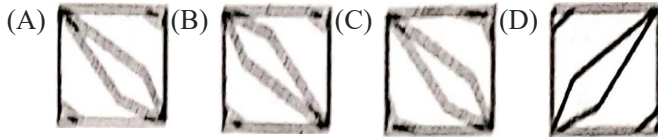
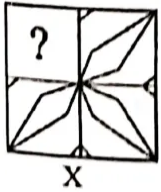
98. A piece of paper is folded and punched as shown below in the question figures. From the given answer figure indicate how it will appear when opened.



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

Correct Option: C**Solution:**

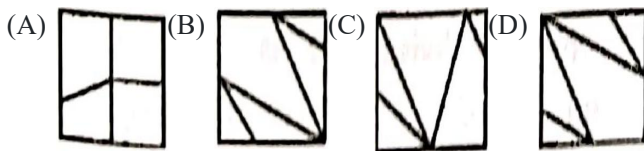
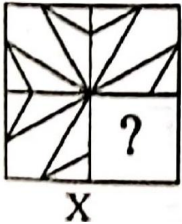
99. Question Figure:



Correct Option: A

Solution:

100. Question Figure:

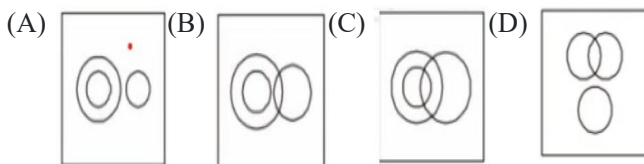


Correct Option: D

Solution:

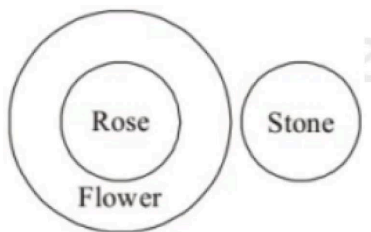
101. Identify the diagram that best represents the relationship among the given classes.

Rose, Flower, Stone



Correct Option: A

Solution:



All roses are flower. Stone is neither Flower nor Rose.

102. Which of the following indicates similar relationship as PNLJ : 2468, then QOKL : ?

- (A) 3591 (B) 1367 (C) 1276 (D) 1376

Correct Option: D

Solution:

$$P \Rightarrow 2$$

$$N \Rightarrow 4$$

$$L \Rightarrow 6$$

$$J \Rightarrow 8$$

$$P \xrightarrow{+1} Q \Rightarrow Q = 2 - 1 = 1$$

$$N \xrightarrow{+1} O \Rightarrow O = 4 - 1 = 3$$

$$J \xrightarrow{+1} K \Rightarrow K = 8 - 1 = 7$$

$$L = 2 \text{ (Given)}$$

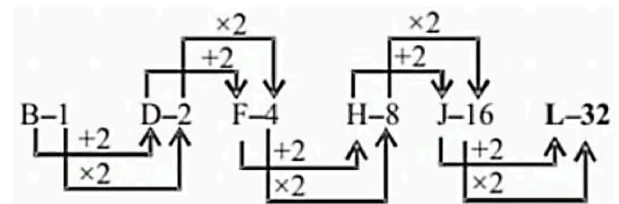
103. A series is given, with one term missing. Choose the correct alternative from the given ones that will complete the series.

B - 1, D - 2, F - 4, H - 8, J - 16, ?

- (A) K - 64 (B) L - 32
(C) M - 32 (D) L - 64

Correct Option: B

Solution:



104. In a joint family, there are father, mother, 3 married sons and one unmarried daughter. Of the sons two married sons have 2 daughters each, and one has a son. How many female members are there in the family?

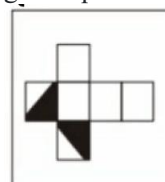
- (A) 2 (B) 3 (C) 6 (D) 9

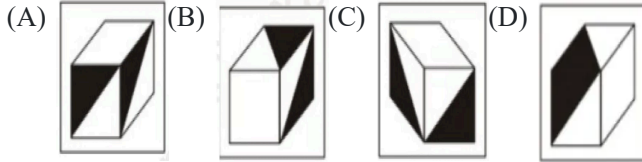
Correct Option: D

Solution:

The female members in the family are mother, wives of 3 married son's unmarried daughter and 2 daughters of each of the two sons. $(1 + 3 + 1 + 2 \times 2) = 9$

105. Choose the cube which will be formed on folding the given question figure.





Correct Option: B

Solution:



106. If $\int \frac{3x+1}{(x-3)(x-5)} dx = \int \frac{-5}{(x-3)} dx + \int \frac{B}{(x-5)} dx$, then the value of B is

- (A) 3 (B) 4 (C) 6 (D) 8

Correct Option: D

Solution:

107. $\lim_{x \rightarrow 0} \sqrt{\frac{x - \sin x}{x + \sin^2 x}}$ is equal to

- (A) 1 (B) 0
(C) ∞ (D) None of these

Correct Option: B

Solution:

108. The statement p : For any real numbers x, y , if $x = y$, then $2x + a = 2y + a$ when $a \in \mathbb{Z}$.

- (A) is true (B) is false
(C) its contrapositive is not true (D) None of these

Correct Option: A

Solution:

109. If $\vec{a}$ is a vector of magnitude 50, collinear with the vector $\vec{b} = 6\hat{i} - 8\hat{j} - \frac{15}{2}\hat{k}$ and makes an acute angle with the positive direction of Z -axis, then $\vec{a}$ is equal to

- (A) $-24\hat{i} + 32\hat{j} + 30\hat{k}$
(B) $24\hat{i} - 32\hat{j} - 30\hat{k}$
(C) $-12\hat{i} + 16\hat{j} - 15\hat{k}$
(D) $12\hat{i} - 16\hat{j} - 15\hat{k}$

Correct Option: A

Solution:

110. The value of $\cos(2\cos^{-1}x + \sin^{-1}x)$ at $x = \frac{1}{5}$ is

- (A) $-\frac{2\sqrt{6}}{5}$ (B) $-2\sqrt{6}$

(C) $-\frac{\sqrt{6}}{5}$

(D) None of these

Correct Option: A

Solution:

111. If $A + B + C = \frac{\pi}{2}$ then

- (A) $\tan A \tan B + \tan B \tan C + \tan C \tan A = 1$
(B) $\cot A + \cot B + \cot C = \cot A \cot B \cot C$
(C) $\cos 2A + \cos 2B + \cos 2C = 1 + 4 \sin A \sin B \sin C$
(D) All three are correct

Correct Option: D

Solution:

112. $\int \frac{e^x(1+x)}{\cos^2(e^x x)} dx$ equals

- (A) $-\cot(e^x x) + C$ (B) $\tan(xe^x) + C$
(C) $\tan(e^x) + C$ (D) $\cot(e^x) + C$

Correct Option: B

Solution:

113. The general solution of the differential equation $(\tan^{-1} y - x) dy = (1 + y^2) dx$ is

- (A) $x = (\tan^{-1} y + 1) + Ce^{-\tan^{-1} y}$
(B) $x = (\tan^{-1} y - 1) + Ce^{-\tan^{-1} y}$
(C) $x = (\tan^{-1} x - 1) + Ce^{-\tan^{-1} x}$
(D) $x = (\tan^{-1} x + 1) + Ce^{-\tan^{-1} x}$

Correct Option: B

Solution:

114. Coefficient of x^{13} in the expansion of $(1 - x)^5 (1 + x + x^2 + x^3)^4$ is

- (A) 4 (B) 6 (C) 32 (D) 5

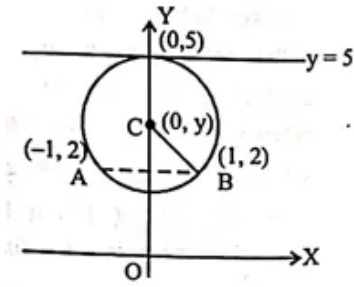
Correct Option: A

Solution:

115. The equation of the circle, which touches the line $y = x$ and passes through $(-1, 2)$ and $(1, 2)$ is

- (A) $9x^2 + 9y^2 - 60y + 75 = 0$ (B) $9x^2 + 9y^2 - 60x - 75 = 0$
(C) $9x^2 + 9y^2 + 60y - 75 = 0$ (D) $9x^2 + 9y^2 + 60x - 75 = 0$

Correct Option: A

Solution:

The centre of the circle is on the perpendicular bisector of the line joining $(-1, 2)$ and $(1, 2)$, which is the y-axis. The ordinate of the centre is given by

$$(5 - y)^2 = 1 + (y - 2)^2 \Rightarrow y = \frac{10}{3}$$

Hence, eq. of the circle is :

$$x^2 + \left(y - \frac{10}{3}\right)^2 = \left(\frac{5}{3}\right)^2$$

$$\Rightarrow 9x^2 + 9y^2 - 60y + 75 = 0$$

116. $f(x) = \frac{e^{2x}-1}{e^{2x}+1}$ is

- (A) an increasing function (B) a decreasing function
(C) an even function (D) None of these

Correct Option: A**Solution:**

117. $\frac{d}{dx} (\tan^{-1} \sqrt{\frac{1+\cos \frac{x}{2}}{1-\cos \frac{x}{2}}})$ is equal to

- (A) $-\frac{1}{4}$ (B) $\frac{1}{4}$
(C) $-\frac{1}{2}$ (D) $\frac{1}{2}$

Correct Option: A**Solution:**

118. The area bounded by the curves $x + 2y^2 = 0$ and $x + 3y^2 = 1$ is

- (A) 1 sq. unit (B) $\frac{1}{3}$ sq. units
(C) $\frac{2}{3}$ sq. units (D) $\frac{4}{3}$ sq. units

Correct Option: D**Solution:**

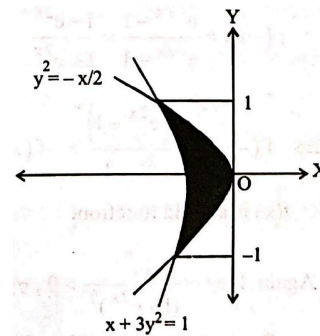
We have, $x + 2y^2 = 0$

$$\Rightarrow y^2 = -\frac{x}{2} \dots (i)$$

a parabola with vertex $(0, 0)$ and $x + 3y^2 = 1$

$$\Rightarrow y^2 = \frac{1-x}{3} = -\left(\frac{x-1}{3}\right) \dots (ii),$$

a parabola with vertex $(1, 0)$ Solving (i) and (ii), we get $y = \pm 1$



$$A = \int_{-1}^1 ((1 - 3y^2) - (-2y^2)) dy$$

119. $\int_{-a}^4 (x^8 - x^4 + x^2 + 1) dx = 2 \int_0^4 (x^8 - x^4 + x^2 + 1) dx$
then $a =$

- (A) 3 (B) 4 (C) 6 (D) 8

Correct Option: B**Solution:**

120. If z is a complex number such that $z^2 = (\bar{z})^2$, then

- (A) z is purely real
(B) iz is purely imaginary
(C) either z is purely real or purely imaginary
(D) None of these

Correct Option: C**Solution:**

121. If the radius of a sphere is measured as 9 cm with an error of 0.03 cm then find the approximating error in calculating its volume.

- (A) $2.46\pi \text{ cm}^3$ (B) $8.62\pi \text{ cm}^3$
(C) $9.72\pi \text{ cm}^3$ (D) $7.6\pi \text{ cm}^3$

Correct Option: C**Solution:**

122. If $x = \frac{1-t^2}{1+t^2}$ and $y = \frac{2t}{1+t^2}$ then $\frac{dy}{dx}$ is equal to:

- (A) $-\frac{y}{x}$ (B) $\frac{y}{x}$
(C) $-\frac{x}{y}$ (D) $\frac{x}{y}$

Correct Option: C**Solution:**

123. If $2^x + 2y = 2^y x + (y)$ then $\frac{dy}{dx}$

- (A) $2^{x-y} \frac{2^y-1}{0}$
 (B) $2^{x-y} \cdot \frac{2^y-1}{4 \pm 2^x}$
 (C) $\frac{2^x+2^y}{2^x-2^y}$
 (D) None of these

Correct Option: D

Solution:

124. The coefficient of the term independent of x in

$$\left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)^{10} \text{ is?}$$

- (A) $\frac{5}{4}$ (B) $\frac{7}{4}$
 (C) $\frac{9}{4}$ (D) None of these

Correct Option: C

Solution:

125. If $y = \frac{2 \sin \alpha}{1 + \cos \alpha + \sin \alpha}$, then the value of $\frac{1 - \cos \alpha + \sin \alpha}{1 + \sin \alpha}$ is?

- (A) $\frac{y}{3}$ (B) y
 (C) $2y$ (D) $\frac{3}{2}y$

Correct Option: B

Solution:

126. If the slope of the tangent to the curve at any point $P(x, y)$ is $\frac{y}{x} - \cos^2 \frac{y}{x}$, then the equation of a curve passing through $2 + (1, \frac{\pi}{4})^{-1}$ is

- (A) $\tan\left(\frac{y}{x}\right) + \log x = 1$
 (B) $2 \tan\left(\frac{y}{x}\right) + \log y = 1$
 (C) $\tan\left(\frac{x}{y}\right) + \log x = 1$
 (D) $\tan\left(\frac{x}{y}\right) + \log y = 1$

Correct Option: B

Solution:

127. The value of $\int \cos(\log x) dx$.

- (A) $\frac{x}{2} [\sin(\log x) + \cos(\log x)] + C$
 (B) $\frac{1}{2} [\sin(\log x) - \cos(\log x)] + C$
 (C) $\frac{x}{2} + [\sin(\log x) - \cos(\log x)] + C$
 (D) $\frac{x}{2} [\sin(\log x) - \cos(\log x)]$

Correct Option: B

Solution:

128. The points $(0, 7, 10)$, $(-1, 6, 6)$ and $(-4, 9, 6)$ form

- (A) a right angled isosceles triangle
 (B) a scalene triangle
 (C) a right angled triangle
 (D) an equilateral triangle

Correct Option: A

Solution:

129. The domain of the function

$$f(x) = \frac{1}{\sqrt{x^{12}-x^4+x^4-x+1}}$$

- (A) $(-\infty, 1)$ (B) $(-1, \infty)$
 (C) $[1, 1)$ (D) $(-\infty, \infty]$

Correct Option: D

Solution:

130. If $\int \frac{\sin x}{\sin(x) - \alpha} dx = Ax + B \log \sin(x) - \alpha + C$, then value of (A, B) is

- (A) $(-\cos \alpha, \sin \alpha)$ (B) $(\cos \alpha, \sin \alpha)$
 (C) $(-\sin \alpha, \cos \alpha)$ (D) $(\sin \alpha, \cos \alpha)$

Correct Option: B

Solution:

131. Value of $\lim_{x \rightarrow 0} \frac{a^{\sin x} - 1}{\sin x}$ is idv

- (A) $\log a$ (B) $\sin x$
 (C) $\log(\sin x)$ (D) $\cos x$

Correct Option: A

Solution:

132. The distance between the parallel lines $3x - 4y + 7 = 0$ and $3x - 4y + 5 = 0$ is $\frac{a}{b}$. Find the values of a and b .

- (A) 2 (B) 5 (C) 7 (D) 3

Correct Option: C

Solution:

133. If the sum of a certain number of terms of the A.P. 2, 22, 19, is 116, then find the last term is.

- (A) 0 (B) 2 (C) 4 (D) 6

Correct Option: C

Solution:

134. If $z_1 = \sqrt{2} [\cos \frac{\pi}{4} + i \sin \frac{\pi}{4}]$ and $z_2 = \sqrt{3} [\cos \frac{\pi}{3} + i \sin \frac{\pi}{3}]$, then $|z_1 z_2|$ is equal to $\sqrt{m}$. Value of m is

(A) 6 (B) 3 (C) 2 (D) 5

Correct Option: A

Solution:

$$z_1 = \sqrt{2} [\cos \frac{\pi}{4} + i \sin \frac{\pi}{4}] = \sqrt{2} [\frac{1}{\sqrt{2}} + i \frac{1}{\sqrt{2}}] = 1 + i$$

$$|z_1| = \sqrt{2}$$

$$\text{and } z_2 = \sqrt{3} [\cos \frac{\pi}{3} + i \sin \frac{\pi}{3}] = \sqrt{3} [\frac{1}{2} + i \frac{\sqrt{3}}{2}]$$

$$|z_2| = \sqrt{\frac{3}{4} + \frac{9}{4}} = \sqrt{3}$$

$$|z_1 z_2| = |z_1| |z_2| = \sqrt{2} \cdot \sqrt{3} = 6$$

135. The mean and variance of a random variable X having binomial distribution are 4 and 2 respectively, then $P(X = 1)$ is

(A) $\frac{1}{4}$ (B) $\frac{1}{32}$
(C) $\frac{1}{16}$ (D) $\frac{1}{8}$

Correct Option: B

Solution:

$$np = 4$$

$$npq = 2$$

$$\Rightarrow q = \frac{1}{2}, p = \frac{1}{2}, n = 8$$

$$P(X = 1) = {}^8C_1 \left(\frac{1}{2}\right) \left(\frac{1}{2}\right)^7 = 8 \cdot \frac{1}{2^8} = \frac{1}{2^5} = \frac{1}{32}$$

136. A line makes angles of 45° and 60° with the positive axes of X and Y respectively. The angle made by the same line with the positive axis of Z , is.

(A) 30° or 60° (B) 60° or 90°
(C) 90° or 120° (D) 60° or 120°

Correct Option: D

Solution:

$$\text{Given } \alpha = 45^\circ, \beta = 60^\circ, \gamma = ?$$

$$\therefore \cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$$

$$\therefore \cos^2 \gamma = 1 - \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$

$$\Rightarrow \gamma = 60^\circ \text{ or } 120^\circ$$

137. If the tangent at $P(1, 1)$ on $y^2 = x(2 - x)^2$ meets the curve again at Q , then Q is

(A) $(2, 2)$
(B) $(-1, -2)$
(C) $(\frac{9}{4}, \frac{3}{8})$
(D) None of these

Correct Option: C

Solution:

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

$$\Rightarrow 2y \frac{dy}{dx} = 3x^2 - 8x + 4$$

$$\Rightarrow \frac{dy}{dx} = \frac{3x^2 - 8x + 4}{2y}$$

$$\Rightarrow \left[\frac{dy}{dx}\right]_P = \frac{3-8+4}{2} = -\frac{1}{2}$$

$$\therefore \text{Equation of tangent at P is: } y - 1 = -\frac{1}{2}(x - 1)$$

$$\Rightarrow x + 2y - 3 = 0$$

$$\text{Using } y = \frac{3-x}{2} \text{ in (i), we get: } \left(\frac{3-x}{2}\right)^2 = x^3 - 4x^2 + 4x$$

$$\Rightarrow 4x^3 - 17x^2 + 22x - 9 = 0$$

which has two roots 1, 1 (Because of (ii) being tangent at (1, 1)).

$$\text{Sum of 3 roots} = \frac{17}{4}$$

$$\therefore 3^{\text{rd}} \text{ root} = \frac{17}{4} - 2 = \frac{9}{4}$$

$$\text{Then, } y = \frac{3-\frac{9}{4}}{2} = \frac{3}{8}$$

$$\therefore Q \text{ is } \left(\frac{9}{4}, \frac{3}{8}\right)$$

138. Girl students constitute 10% of I year and 5% of II year at Roorkee University. During summer holidays 70% of the I year and 30% of II year students are given project. The girls take turns on duty in canteen. The chance that I year girl student is on duty in a randomly selected day is

(A) $\frac{3}{17}$ (B) $\frac{14}{17}$
(C) $\frac{3}{10}$ (D) $\frac{7}{10}$

Correct Option: B

Solution:

The desired probability

$$= \frac{\frac{10}{100} \times \frac{70}{100} \times \frac{70}{100}}{\frac{10}{100} \times \frac{70}{100} + \frac{5}{100} \times \frac{30}{100}} = \frac{14}{17}$$

139. If the harmonic mean between a and b be H , then the value of $\frac{1}{H-a} + \frac{1}{H-b}$ is

- (A) $a + b$ (B) ab
(C) $\frac{1}{a} + \frac{1}{b}$ (D) $\frac{1}{a} - \frac{1}{b}$

Correct Option: C

Solution:

Putting $H = \frac{2ab}{a+b}$, we have

$$\begin{aligned} & \frac{1}{H-a} + \frac{1}{H-b} \\ &= \frac{1}{\left(\frac{2ab}{a+b} - a\right)} + \frac{1}{\left(\frac{2ab}{a+b} - b\right)} = \frac{a+b}{ab-a^2} + \frac{a+b}{ab-b^2} \\ &= \left(\frac{a+b}{b-a}\right) \left(\frac{1}{a} - \frac{1}{b}\right) = \left(\frac{a+b}{b-a}\right) \left(\frac{b-a}{ab}\right) = \frac{a+b}{ab} = \frac{1}{a} + \frac{1}{b} \end{aligned}$$

140. $\lim_{x \rightarrow 0} \frac{2 \sin^2 3x}{x^2}$ is equal to :

- (A) 12 (B) 18 (C) 0 (D) 6

Correct Option: B

Solution:

$$\begin{aligned} & \text{Consider } \lim_{x \rightarrow 0} \frac{2 \sin^2 3x}{x^2} \\ &= 2 \cdot \lim_{x \rightarrow 0} \left[\frac{\sin 3x}{x} \right]^2 = 2 \cdot \lim_{x \rightarrow 0} \left[3 \frac{\sin 3x}{3x} \right]^2 \\ &= 2 \cdot 9 \lim_{x \rightarrow 0} \left(\frac{\sin 3x}{3x} \right)^2 = 18 \times 1 = 18 \end{aligned}$$

141. Consider an infinite geometric series with first term a and common ratio r . If its sum is 4 and the second term is $\frac{3}{4}$, then :

- (A) $a = \frac{4}{7}, r = \frac{3}{7}$ (B) $a = 2, r = \frac{3}{8}$
(C) $a = \frac{3}{2}, r = \frac{1}{2}$ (D) $a = 3, r = \frac{1}{4}$

Correct Option: D

Solution:

Since, sum = 4 and second term = $\frac{3}{4}$

$$\Rightarrow \frac{a}{1-r} = 4, \text{ and } ar = \frac{3}{4}$$

$$\Rightarrow \frac{a}{1-\frac{3}{4a}} = 4$$

$$\Rightarrow (a-1)(a-3) = 0$$

$$\Rightarrow a = 1 \text{ or } a = 3$$

142. The area bounded by curves $(x-1)^2 + y^2 = 1$ and $x^2 + y^2 = 1$ is

- (A) $\left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right)$

(B) $\frac{2\pi}{3}$

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

(D) $\frac{2\pi}{3} + \frac{\sqrt{3}}{2}$

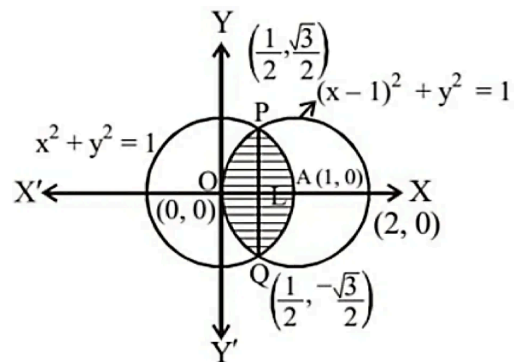
Correct Option: A

Solution:

Given circles are $x^2 + y^2 = 1 \dots (i)$

and $(x-1)^2 + y^2 = 1 \dots (ii)$

Centre of (i) is $O(0, 0)$ and radius = 1



Both these circle are symmetrical about x -axis solving (i) and (ii), we get, $-2x + 1 = 0$

$$\Rightarrow x = \frac{1}{2}$$

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

$$\Rightarrow y = \pm \frac{\sqrt{3}}{2}$$

$\therefore$ The points of intersection are

$$P\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right) \text{ and } Q\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$$

It is clear from the figure that the shaded portion in region whose area is required.

$\therefore$ Required area = area OQAPO

$$= 2 \times \text{area of the region OLAP}$$

$$= 2 \times (\text{area of the region OLPO} + \text{area of LAPL})$$

$$= 2 \left[\int_0^{\frac{1}{2}} \sqrt{1 - (x-1)^2} dx + \int_{\frac{1}{2}}^1 \sqrt{1 - x^2} dx \right]$$

$$= 2 \left[\frac{(x-1)\sqrt{1-(x-1)^2}}{2} + \frac{1}{2} \sin^{-1}(x-1) \right]_0^{\frac{1}{2}} + 2 \left[\frac{x\sqrt{1-x^2}}{2} + \frac{1}{2} \sin^{-1} x \right]_{\frac{1}{2}}^1$$

$$= -\frac{1}{2} \cdot \frac{\sqrt{3}}{2} + \sin^{-1}\left(\frac{-1}{2}\right) - \sin^{-1}(-1) + 0 + \sin^{-1}(1) - \left(-\frac{1}{2} \cdot \frac{\sqrt{3}}{2} + \sin^{-1}\left(\frac{1}{2}\right)\right)$$

$$= \left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right) \text{ sq. units.}$$

143. Evaluate: $\int_0^\pi \frac{1}{5+4\cos x} dx$

- (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{2}$
(C) $\frac{\pi}{4}$ (D) $\frac{\pi}{6}$

Correct Option: A

Solution:

We have, $\int_0^\pi \frac{1}{5+4\cos x} dx$

$$= \int_0^\pi \frac{1}{5+4\left(\frac{1-\tan^2 \frac{x}{2}}{1+\tan^2 \frac{x}{2}}\right)} dx$$

$$= \int_0^\pi \frac{1+\tan^2 \frac{x}{2}}{5(1+\tan^2 \frac{x}{2})+4(1-\tan^2 \frac{x}{2})} dx$$

$$= \int_0^\pi \frac{1+\tan^2 \frac{x}{2}}{9+\tan^2 \frac{x}{2}} dx = \int_0^\pi \frac{\sec^2 \frac{x}{2}}{9+\tan^2 \frac{x}{2}} dx$$

$$\text{Let } \tan \frac{x}{2} = t \Rightarrow \frac{1}{2} \sec^2 \frac{x}{2} dx = dt$$

$$\text{Also, } x = 0 \Rightarrow t = 0 \text{ and } x = \pi \Rightarrow t = \infty$$

$$\therefore I = \int_0^\infty \frac{dt}{9+t^2}$$

$$\therefore I = 2 \int_0^\infty \frac{dt}{9+t^2}$$

$$\therefore I = \frac{2}{3} [\tan^{-1} \frac{t}{3}]_0^\infty = \frac{2}{3} [\tan^{-1} \infty - \tan^{-1} 0]$$

$$= \frac{2}{3} \left(\frac{\pi}{2} - 0\right) = \frac{\pi}{3}$$

144. The points at which the tangent passes through the origin for the curve $y = 4x^3 - 2x^5$ are

- (A) (0, 0), (2, 1) and (-1, -2) (B) (0, 0), (2, 1) and (-2, -1)
(C) (2, 0), (2, 1) and (-3, 1) (D) (0, 0), (1, 2) and (-1, -2)

Correct Option: D

Solution:

The equation of the given curve is

$$y = 4x^3 - 2x^5$$

$$\frac{dy}{dx} = 12x^2 - 10x^4$$

Therefore, the slope of the tangent at point (x, y) is $12x^2 - 10x^4$.

The equation of the tangent at (x, y) is given by $Y - y = (12x^2 - 10x^4)(X - x) \dots (i)$

When the tangent passes through the origin $(0, 0)$, then $X = Y = 0$.

Therefore, eq. (i) reduces to

$$-y = (12x^2 - 10x^4)(-x)$$

$$\Rightarrow y = 12x^3 - 10x^5$$

$$\text{Also, we have } y = 4x^3 - 2x^5$$

$$\therefore 12x^3 - 10x^5 = 4x^3 - 2x^5$$

$$\Rightarrow 8x^5 - 8x^3 = 0$$

$$\Rightarrow x^5 - x^3 = 0$$

$$\Rightarrow x^3(x^2 - 1) = 0$$

$$\Rightarrow x = 0, \pm 1$$

When $x = 0$,

$$y = 4(0)^3 - 2(0)^5 = 0$$

When $x = 1$,

$$y = 4(1)^3 - 2(1)^5 = 2$$

When $x = -1$,

$$y = 4(-1)^3 - 2(-1)^5 = -2$$

Hence, the required points are $(0, 0)$, $(1, 2)$ and $(-1, -2)$.

145. The length of the perpendicular drawn from the point $(3, -1, 11)$ to the line $\frac{x}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ is :

- (A) $\sqrt{29}$ (B) $\sqrt{33}$ (C) $\sqrt{53}$ (D) $\sqrt{66}$

Correct Option: C

Solution:

Let feet of perpendicular is

$$(2a, 3a + 2, 4a + 3)$$

$\Rightarrow$ Direction ratio of the $\perp$ line is



$2\alpha - 3, 3\alpha + 3, 4\alpha - 8$. and

$\Rightarrow$ Direction ratio of the line are 2, 3, 4

$$\Rightarrow 2(2\alpha - 3) + 3(3\alpha + 3) + 4(4\alpha - 8) = 0$$

$$\Rightarrow \alpha = 1$$

$\Rightarrow$ Feet of $\perp$ is (2, 5, 7)

$$\Rightarrow \text{Length } \perp \text{ is } \sqrt{1^2 + 6^2 + 4^2} = \sqrt{53}$$

- 146.** Find the value of a such that the sum of the squares of the roots of the equation $x^2 - (a - 2)x - (a + 1) = 0$ is least.

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

Correct Option: C

Solution:

Let α, β be the roots of the equation.

$$\therefore \alpha + \beta = a - 2 \text{ and } \alpha\beta = -(a + 1)$$

$$\text{Now, } \alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$$

$$= (a - 2)^2 + 2(a + 1) = (a - 1)^2 + 5$$

$$\therefore \alpha^2 + \beta^2 \text{ will be minimum if } (a - 1)^2 = 0,$$

$$\text{i.e. } a = 1.$$

- 147.** How many numbers lying between 999 and 10000 can be formed with the help of the digits 0, 2, 3, 6, 7, 8, when the digits are not repeated?

(A) 100 (B) 200 (C) 300 (D) 400

Correct Option: C

Solution:

The numbers between 999 and 10000 are all 4-digit numbers. The number of 4-digit numbers formed by digits 0, 2, 3, 6, 7, 8 is ${}^6P_4 = 360$.

But here those numbers are also involved which begin from 0. So, we take those numbers as three-digit numbers. Taking initial digit 0, the number of ways to fill remaining 3 places from five digits 2, 3, 6, 7, 8 are ${}^5P_3 = 60$.

$$\text{So, the required numbers} = 360 - 60 = 300.$$

- 148.** The sum of all odd numbers between 1 and 1000 which are divisible by 3 is

(A) 83667 (B) 90000
(C) 83660 (D) None of these

Correct Option: A

Solution:

Sum of odd numbers between 1 and 1000, which is divisible by

$$3 = 3 + 9 + 15 + 21 + 27 + \dots + 999 = S \text{ (let)}$$

$\therefore$ Let n be the number of terms in series and a is first term.

$$\therefore l = a + (n - 1)d,$$

where l is last term and d is common difference.

$$999 = 3 + (n - 1) \times 6$$

$$n - 1 = \frac{999 - 3}{6} = \frac{996}{6}$$

$$\Rightarrow n - 1 = 166$$

$$\Rightarrow n = 167$$

$$\therefore S = \frac{n}{2}[2a + (n - 1)d]$$

$$= \frac{167}{2}[2 \times 3 + (167 - 1) \times 6]$$

$$= \frac{167}{2}[1002] = 167 \times 501 = 83667$$

- 149.** The eccentricity of the ellipse whose major axis is three times the minor axis is:

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

Correct Option: C

Solution:

Let a be the major axis and b , the minor axis of the ellipse, then $3 \text{ minor axis} = \text{major axis}$.

$$\Rightarrow 3b = a$$

Eccentricity is given by:

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

$$\Rightarrow b^2 = 9b^2(1 - e^2)$$

$$\Rightarrow \frac{1}{9} = (1 - e^2)$$

$$\Rightarrow e^2 = \frac{8}{9}$$

$$\Rightarrow e = \frac{2\sqrt{2}}{3}$$

150. An ellipse has OB as semi minor axis, F and F' its foci and the angle FBF' is a right angle. Then the eccentricity of the ellipse is-

- (A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$
(C) $\frac{1}{4}$ (D) $\frac{1}{\sqrt{3}}$

Correct Option: A

Solution:

$$\angle F'BF = 90^\circ, F'B \perp FB$$

$$\text{i.e., slope of } (F'B) \times \text{Slope of } (FB) = -1$$

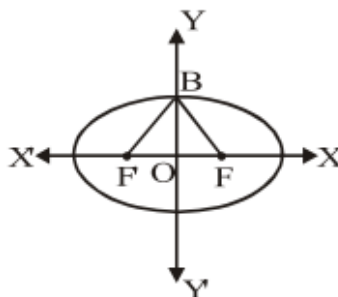
$$\Rightarrow \frac{b}{ae} \times \frac{b}{-ae} = -1,$$

$$b^2 = a^2 e^2$$

We know that

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

$$e^2 = 1 - e^2, 2e^2 = 1, e^2 = \frac{1}{2}, e = \frac{1}{\sqrt{2}}$$



BITSAT Solved Paper 2021 - ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	D	A	D	C	C	B	B	B	D	A
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	A	C	C	D	B	B	A	C	B	B
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	C	D	A	D	A	B	B	A	A	A
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	B	B	A	A	C	C	A	B	C	D
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	A	C	B	C	C	A	A	D	C	B
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	B	B	B	D	C	A	B	A	A	A
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	D	D	D	D	B	C	D	C	D	C
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	B	C	D	B	D	C	B	D	B	A
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	C	D	C	D	B	C	C	B	A	C
Que.	91	92	93	94	95	96	97	98	99	100
Ans.	A	B	D	C	D	D	A	C	A	D
Que.	101	102	103	104	105	106	107	108	109	110
Ans.	A	D	B	D	B	D	B	A	A	A
Que.	111	112	113	114	115	116	117	118	119	120
Ans.	D	B	B	A	A	A	A	D	B	C
Que.	121	122	123	124	125	126	127	128	129	130
Ans.	C	C	D	C	B	B	B	A	D	B

Que.	131	132	133	134	135	136	137	138	139	140
Ans.	A	C	C	A	B	D	C	B	C	B
Que.	141	142	143	144	145	146	147	148	149	150
Ans.	D	A	A	D	C	C	C	A	C	A