

BITSAT Solved Paper 2024 Session-II

1. If two charges q_1 and q_2 are separated with distance 'd' and placed in a medium of dielectric constant K. What will be the equivalent distance between charges in air for the same electrostatic force ?

(A) $d\sqrt{k}$ (B) $k\sqrt{d}$
(C) $1.5 d\sqrt{k}$ (D) $2 d\sqrt{k}$

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Correct Option: A**Solution:**

$$F = \frac{1}{(4\pi\epsilon_0)} \frac{q_1 q_2}{kd^2} \text{ (in medium)}$$

$$F_{Air} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{d'^2}$$

$$F = F_{Air}$$

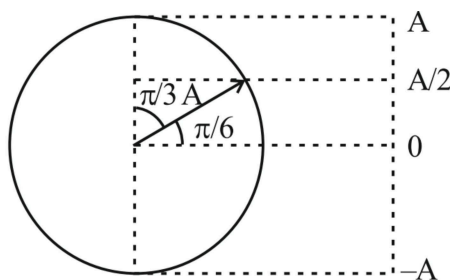
$$\frac{q_1 q_2}{4\pi\epsilon_0 kd^2} = \frac{q_1 q_2}{4\pi\epsilon_0 d'^2}$$

$$d' = d\sqrt{k}$$

2. A particle executes simple harmonic motion between $x = -A$ and $x = +A$. If time taken by particle to go from $x = 0$ to $\frac{A}{2}$ is 2 s; then time taken by particle in going from $x = \frac{A}{2}$ to A is :

(A) 3 s (B) 2 s (C) 1.5 s (D) 4 s

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Correct Option: D**Solution:**

Let time from 0 to $A/2$ is t_1 &

from $A/2$ to A is t_2 then $\omega t_1 = \pi/6$

$$\omega t_2 = \pi/3$$

$$\frac{t_1}{t_2} = \frac{1}{2}$$

$$t_2 = 2t_1 = 2 \times 2 = 4\text{sec}$$

3. A wire of resistance 160Ω is melted and drawn in wire of one-fourth of its length. The new resistance of the wire will be

(A) 10Ω (B) 640Ω (C) 40Ω (D) 16Ω

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Correct Option: A**Solution:**

Volume = Constant

$$A_1 L_1 = A_2 L_2$$

$$A_1 L = A_2 \frac{L}{4}$$

$$4A_1 = A_2$$

$$R_1 = \frac{\rho L_1}{A_1}$$

$$R_2 = \frac{\rho L_2}{A_2}$$

$$\frac{R_2}{R_1} = \frac{L_2 A_1}{A_2 L_1} = \frac{L}{4} \frac{A_1}{4A_1 L}$$

$$R_2 = \frac{1}{16} R_1 = 10\Omega$$

4. The dimensional formula of latent heat is -

(A) $[M^0 L T^{-2}]$
(B) $[ML T^{-2}]$
(C) $[M^0 L^2 T^{-2}]$
(D) $[ML^2 T^{-2}]$

Correct Option: C**Solution:**

$$Q = mL \Rightarrow [L] = \frac{[Q]}{[m]} = \frac{[ML^2 T^{-2}]}{[M]} = [M^0 L^2 T^{-2}]$$

5. Electric potential at a point 'P' due to a point charge of $5 \times 10^{-9} \text{C}$ is 50 V. The distance of 'P' from the point charge is:

(Assume, $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{Nm}^2 \text{C}^{-2}$)

(A) 3 cm (B) 9 cm (C) 90 cm (D) 0.9 cm

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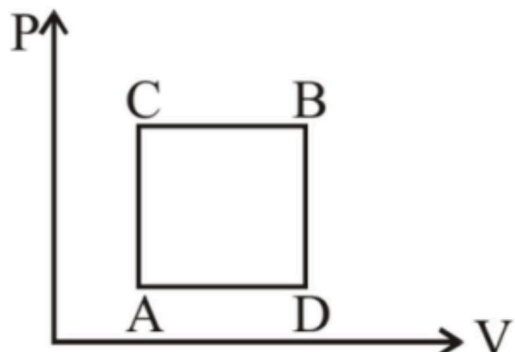
Correct Option: C**Solution:**

$$V_P = \frac{KQ}{r}$$

$$50 = \frac{9 \times 10^9 \times 5 \times 10^{-9}}{r}$$

$$r = \frac{45}{50} = \frac{9}{10} = 0.9 \text{ m} = 90 \text{ cm}$$

6. A gas can be taken from A to B via two different processes ACB and ADB.

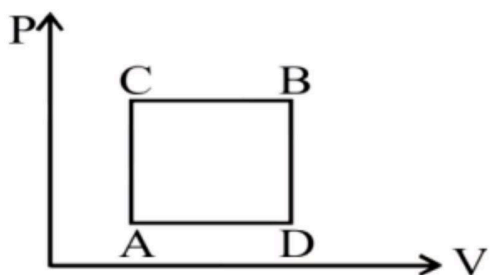


When path ACB is used 60 J of heat flows into the system and 30 J of work is done by the system. If path ADB is used work done by the system is 10 J. The heat flow into the system in path ADB is:

- (A) 80 J (B) 20 J (C) 100 J (D) 40 J

Correct Option: D

Solution:



$$\Delta Q_{ACB} = \Delta W_{ACB} + \Delta U_{ACB}$$

$$\Rightarrow 60 \text{ J} = 30 \text{ J} + \Delta U_{ACB}$$

$$\Rightarrow \Delta U_{ACB} = 30 \text{ J}$$

$$\Rightarrow \Delta U_{ADB} = \Delta U_{ACB} = 30 \text{ J}$$

$$\Delta Q_{ADB} = \Delta U_{ADB} + \Delta W_{ADB}$$

7. A long straight wire of radius a carries a steady current I . The current is uniformly distributed across its cross section. The ratio of the magnetic field at $\frac{a}{2}$ and $2a$ from the axis of the wire is :

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

Correct Option: C

Solution:

$$B_1 \cdot 2\pi \frac{a}{2} = \mu_0 \frac{I}{4}$$

$$B_1 = \frac{\mu_0 I}{4\pi a}$$

$$B_2 \cdot 2\pi 2a = \mu_0 I$$

$$B_2 = \frac{\mu_0 I}{4\pi a}$$

$$So B_1 = B_2 \Rightarrow 1 : 1$$

8. A particle is moving in a straight line. The variation of position ' x ' as a function of time ' t ' is given as $x = (t^3 - 6t^2 + 20t + 15)$ m. The velocity of the body when its acceleration becomes zero is :

- (A) 4 m/s (B) 8 m/s
(C) 10 m/s (D) 6 m/s

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Correct Option: B

Solution:

$$x = t^3 - 6t^2 + 20t + 15$$

$$\frac{dx}{dt} = v = 3t^2 - 12t + 20$$

$$\frac{dv}{dt} = a = 6t - 12$$

$$\text{When } a = 0$$

$$6t - 12 = 0; t = 2 \text{ sec}$$

$$\text{At } t = 2 \text{ sec}$$

$$v = 3(2)^2 - 12(2) + 20$$

$$v = 8 \text{ m/s}$$

9. There are two long co-axial solenoids of same length l . The inner and outer coils have radii r_1 and r_2 and number of turns per unit length n_1 and n_2 , respectively. The ratio of mutual inductance to the self-inductance of the inner-coil is:

- (A) $\frac{n_1}{n_2}$
(B) $\frac{n_2}{n_1} \cdot \frac{n_1}{r_2}$
(C) $\frac{n_2}{n_1} \cdot \frac{r_2^2}{r_1^2}$
(D) $\frac{n_2}{n_1}$

Correct Option: D

Solution:

The rate of mutual inductance is given by

$$M = \mu_0 n_1 n_2 \pi m_1^2 \quad (i)$$

The rate of self inductance is given by

$$L = \mu_0 n_1^2 \pi r_1^2 \quad (ii)$$

Dividing (i) by (ii)

$$\Rightarrow \frac{M}{L} = \frac{n_2}{n_1}$$

10. Electromagnetic waves travel in a medium with speed of $1.5 \times 10^8 \text{ ms}^{-1}$. The relative permeability of the medium is 2.0. The relative permittivity will be:

(A) 5 (B) 1 (C) 4 (D) 2

Correct Option: D

Solution:

$$\frac{\epsilon_m \times \mu_m}{\epsilon_0 \times \mu_0} = \frac{1}{v^2}$$

$$\epsilon_r \times \mu_r = \frac{c^2}{v^2}$$

$$\epsilon_r \times 2 = \frac{(3 \times 10^8)^2}{(1.5 \times 10^8)^2}$$

$$\epsilon_r \times 2 = 4$$

$$\epsilon_s = 2$$

11. The range of the projectile projected at an angle of 15° with horizontal is 50 m. If the projectile is projected with same velocity at an angle of 45° with horizontal, then its range will be :

(A) 50 m (B) $50\sqrt{2}$ m
(C) 100m (D) $100\sqrt{2}$ m

Correct Option: C

Solution:

12. In an ac circuit, an inductor, a capacitor and a resistor are connected in series with $X_L = R = X_C$. Impedance of this circuit is :

[31 August 2021 (Shift 1)]

(A) $R\sqrt{2}$ (B) R (C) Zero (D) $2R^2$

JM 2021

Correct Option: B

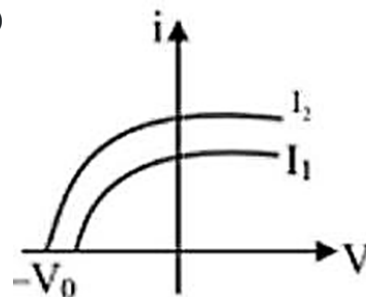
Solution:

$$Z = \sqrt{(X_L - X_C)^2 + R^2} = R \because X_L = X_C$$

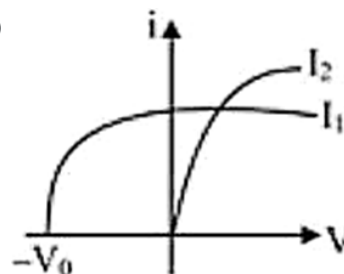
Option (3)

13. Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light ($I_1 < I_2$) of same wavelengths:

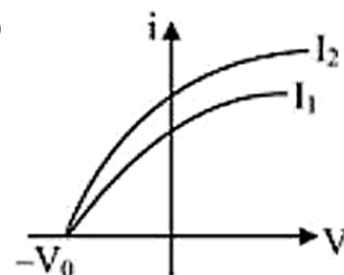
(A)



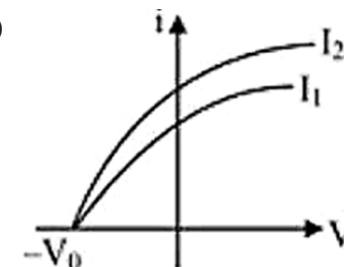
(B)



(C)



(D)



Correct Option: C

Solution:

Given lights are of same wavelength.

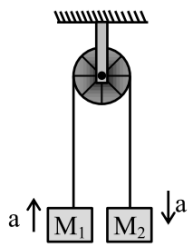
Hence stopping potential will remain same.

Since $I_2 > I_1$, hence saturation current corresponding to I_2 will be greater than that corresponding to I_1 .

14. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (where $m_2 > m_1$). If the acceleration of the system is $\frac{g}{\sqrt{2}}$, then the ratio of the masses $\frac{m_1}{m_2}$ is :

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

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Correct Option: A**Solution:**

$$a = \left(\frac{M_2 - M_1}{M_1 + M_2} \right) g$$

$$\frac{g}{\sqrt{2}} = \left(\frac{M_2 - M_1}{M_1 + M_2} \right) g$$

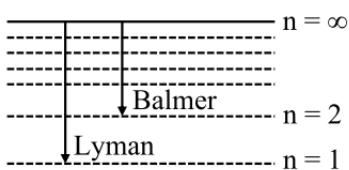
$$(M_1 + M_2) = \sqrt{2}M_2 - \sqrt{2}M_1$$

$$\frac{M_1}{M_2} = \left(\frac{\sqrt{2}-1}{\sqrt{2}+1} \right)$$

15. The ratio of the shortest wavelength of Balmer series to the shortest wavelength of Lyman series for hydrogen atom is :

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

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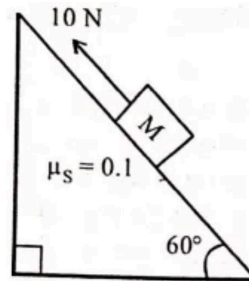
Correct Option: A**Solution:**

$$\frac{1}{\lambda} = RZ^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\frac{1}{\lambda_L} = RZ^2 \left(\frac{1}{1^2} \right)$$

$$\frac{1}{\lambda_B} = RZ^2 \left(\frac{1}{2^2} \right) \frac{\lambda_B}{\lambda_L} = 4 : 1$$

16. A block of mass 1 kg is pushed up a surface inclined to the horizontal at an angle of 60° by a force of 10 N parallel to the inclined surface as shown in the figure. When the block is pushed up by 10 m along the incline surface, what is the work done against frictional force $g = 10 \text{ m/s}^2$.



- (A) $5\sqrt{3} \text{ J}$ (B) 5 J
 (C) $5 \times 10^3 \text{ J}$ (D) 10 J

Correct Option: B**Solution:**

17. In normal adjustment, for a refracting telescope, the distance between objective and eye piece is 30 cm. The focal length of the objective, when the angular magnification of the telescope is 2, will be:

- (A) 20 cm (B) 30 cm (C) 10 cm (D) 15 cm

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Correct Option: A**Solution:**

$$f_o + f_e = 30$$

$$m = \frac{f_o}{f_e}$$

$$2 = \frac{f_o}{f_e} \Rightarrow f_o = 2f_e$$

$$\text{So } f_o + \frac{f_o}{2} = 30$$

$$f_o = 20 \text{ cm}$$

18. The atomic mass of ${}^6_6\text{C}^{12}$ is 12.000000u and that of ${}^6_6\text{C}^{13}$ is 13.003354u. The required energy to remove a neutron from ${}^6_6\text{C}^{13}$, if mass of neutron is 1.008665u, will be :

- (A) 62.5MeV (B) 6.25MeV
 (C) 4.95MeV (D) 49.5MeV

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Correct Option: C**Solution:**



$$\Delta m = (12.000000 + 1.008665) - 13.003354$$

$$= -0.00531\text{u}$$

$$\therefore \text{Energy required} = 0.00531 \times 931.5\text{MeV}$$

$$= 4.95\text{MeV}$$

19. A particle of mass m projected with a velocity u making an angle of 30° with the horizontal.

The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is :

(A) $\frac{\sqrt{3}mu^3}{16g}$

(B) $\frac{\sqrt{3}}{2} \frac{mu^2}{g}$

(C) $\frac{mu^3}{\sqrt{2}g}$

(D) zero

Correct Option: A

Solution:

$$L = mu \cos \theta \cdot H$$

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

$$= \frac{mu^3}{2g} \times \frac{\sqrt{3}}{2} \times \left(\frac{1}{2}\right)^2 = \frac{\sqrt{3}mu^3}{16g}$$

20. The acceptor level of a p-type semiconductor is 6eV. The maximum wavelength of light which can create a hole would be : Given $hc = 1242\text{eVnm}$.

(A) 407 nm

(B) 414 nm

(C) 207 nm

(D) 103.5 nm

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Correct Option: C

Solution:

$$\text{Energy} = \frac{hc}{\lambda}$$

$$E = \frac{1240}{\lambda(\text{nm})} \text{eV}$$

$$6 = \frac{1240}{\lambda(\text{nm})}$$

$$\lambda = \frac{1240}{6} = 207 \text{ nm}$$

21. The distance between Sun and Earth is R . The duration of year if the distance between Sun and Earth becomes $3R$ will be :

(A) $\sqrt{3}$ years

(B) 3 years

(C) 9 years

(D) $3\sqrt{3}$ years

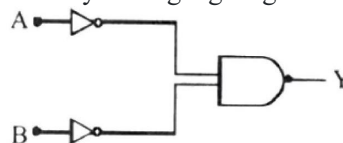
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Correct Option: D

Solution:

$$T' = T \left(\frac{3R}{R}\right)^{3/2} = 3\sqrt{3} T$$

22. Identify the logic gate given in the circuit:



(A) NAND - gate

(B) OR - gate

(C) AND gate

(D) NOR gate

Correct Option: B

Solution:

$$\text{Output } Y = \overline{\overline{A} \cdot \overline{B}} = \overline{\overline{A + B}} \text{ (By De-Morgan Law)}$$

$$\therefore Y = A + B$$

This Boolean expression represents OR gate.

23. The temperature of an ideal gas is increased from 200 K to 800 K. If r.m.s. speed of gas at 200 K is v_0 . Then, r.m.s. speed of the gas at 800 K will be:

(A) V_0

(B) $4v_0$

(C) $\frac{v_0}{4}$

(D) $2v_0$

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Correct Option: D

Solution:

$$V_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$\Rightarrow V_{\text{rms}} \propto \sqrt{T}$$

Increasing temperature 4 times, rms speed gets doubled.

24. With rise in temperature, the Young's modulus of elasticity:

(A) changes erratically

(B) decreases

(C) increases

(D) remains unchanged

Correct Option: B

Solution:

$$y = \frac{F/A}{\Delta \ell / \ell} = \frac{F/A}{\alpha \Delta T} \quad \text{as } \Delta T \uparrow, y \downarrow$$

25. One main scale division of a vernier caliper is equal to m units. If n^{th} division of main scale coincides with $(n + 1)^{\text{th}}$ division of vernier scale, the least count of the vernier caliper is:

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

Correct Option: B

Solution:

$$n\text{MSD} = (n + 1)\text{VSD}$$

$$\Rightarrow 1\text{VSD} = \frac{n}{n+1}\text{MSD}$$

$$L \cdot C = 1\text{MSD} - 1\text{VSD}$$

$$L \cdot C = m - m\left(\frac{n}{n+1}\right)$$

$$L \cdot C = m\left(\frac{n+1-n}{n+1}\right)$$

$$\Rightarrow L \cdot C = \left(\frac{m}{n+1}\right)$$

26. Pressure inside two soap bubbles are 1.01 and 1.02 atmosphere, respectively. The ratio of their volumes is:

- (A) 4 : 1 (B) 0.8 : 1 (C) 8 : 1 (D) 2 : 1

Correct Option: C

Solution:

According to question, pressure inside, 1st soap bubble,

$$\Delta P_1 = P_1 - P_0 = 0.01 = \frac{4T}{R_1}$$

$$\text{And } \Delta P_2 = P_2 - P_0 = 0.02 = \frac{4T}{R_2}$$

Dividing, equation (ii) by (i),

$$\frac{1}{2} = \frac{R_2}{R_1} \Rightarrow R_1 = 2R_2$$

$$\text{Volume } V = \frac{4}{3}\pi R^3 \Rightarrow \frac{V_1}{V_2} = \frac{R_1^3}{R_2^3} = \frac{(2R_2)^3}{R_2^3} = \frac{8R_2^3}{R_2^3} = 8$$

27. A microwave of wavelength 2.0 cm falls normally on a slit of width 4.0 cm. The angular spread of the central maxima of the diffraction pattern obtained on a screen 1.5 m away from the slit, will be:

- (A) 30° (B) 15°
(C) 60° (D) 45°

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Correct Option: C

Solution:

For first minima $a \sin \theta = \lambda$

$$\sin \theta = \frac{\lambda}{a} = \frac{1}{2}$$

$$\theta = 30^\circ$$

$$\text{Angular spread} = 60^\circ$$

28. A solid metallic cube having total surface area 24 m^2 uniformly heated. If its temperature is increased by 10°C calculate the increase in volume of the cube. (Given $\alpha = 5.0 \times 10^{-4} \text{ }^\circ\text{C}^{-1}$)

- (A) $2.4 \times 10^6 \text{ cm}^3$
(B) $1.2 \times 10^5 \text{ cm}^3$
(C) $6.0 \times 10^4 \text{ cm}^3$
(D) $4.8 \times 10^5 \text{ cm}^3$

Correct Option: B

Solution:

29. Two bodies of mass 1 kg and 3 kg have position vector $\hat{i} + 2\hat{j} + \hat{k}$ and $-3\hat{i} - 2\hat{j} + \hat{k}$ respectively. The magnitude of position vector of centre of mass of this system will be similar to the magnitude of vector:

- (A) $\hat{i} - 2\hat{j} + \hat{k}$
(B) $-3\hat{i} - 2\hat{j} + \hat{k}$
(C) $-2\hat{i} + 2\hat{k}$
(D) $-2\hat{i} - \hat{j} + 2\hat{k}$

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Correct Option: A

Solution:

$$\vec{r}_{com} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2} = \frac{1(\hat{i} + 2\hat{j} + \hat{k}) + 3(-3\hat{i} - 2\hat{j} + \hat{k})}{1 + 3}$$

$$= -2\hat{i} - \hat{j} + \hat{k}$$

$$2\hat{i} - \hat{j} + \hat{k} = \sqrt{(2)^2 + (1)^2 + (1)^2} = \sqrt{6}$$

check-

$$\hat{i} - 2\hat{j} + \hat{k} : \sqrt{1^2 + (-2)^2 + 1^2} = \sqrt{6}$$

$$-3\hat{i} - 2\hat{j} + \hat{k} : \sqrt{9 + 4 + 1} = \sqrt{14}$$



$$-2\hat{i} + 2\hat{k} : \sqrt{4+4} = \sqrt{8}$$

$$-2\hat{i} - \hat{j} + 2\hat{k} : \sqrt{4+1+4} = 3$$

correct Answer is (A)

30. The speed of sound in oxygen at S.T.P. will be approximately: (Given, $R = 8.3\text{JK}^{-1}$, $\gamma = 1.4$)

(A) 315 m/s (B) 333 m/s (C) 341 m/s (D) 325 m/s

Correct Option: A

Solution:

31. One molar concentration of a solution represents :

- (A) 1 mole of solute in 1 kg of solution.
(B) 1 mole of solute in 1 L of solution.
(C) 1 mole of solvent in 1 kg of solution.
(D) 1 mole of solvent in 1 L of solution.

Correct Option: B

Solution:

1M = 1 mole of solute in 1 L solution.

32. In the chemical reaction $A \rightarrow B$, what is the order of the reaction? Given that, the rate of reaction doubles if the concentration of A is increased four times.

(A) 2 (B) 1.5 (C) 0.5 (D) 1

Correct Option: C

Solution:

We know, $r_1 = k[A]^n \dots (i)$

If conc. of A is increased four times rate of reaction on doubles.

$$2r_1 = k[4A]^n \dots (ii)$$

Divide Eq. (ii) by (i).

$$\frac{2r_1}{r_1} = \frac{k(4A)^n}{k(A)^n}$$

$$\Rightarrow 2 = (4)^n \Rightarrow 2n = (2)^{2n} \Rightarrow n = 0.5$$

33. The correct order of melting points of the following salts is

LiCl	LiF	LiI
I	II	III

- (A) I > II > III
(B) II > I > III

(C) III > II > I

(D) II > III > I

Correct Option: B

Solution:

Smaller the size of anion, smaller is the covalent character and higher will be its melting point. Hence, the order of melting point of lithium salts is $\text{LiF} > \text{LiCl} > \text{LiBr}$.

34. Which of the following relation is not correct?

- (A) $\Delta H = \Delta U - P\Delta V$
(B) $\Delta U = q + W$
(C) $\Delta S_{\text{sys}} + \Delta S_{\text{sur}} \geq 0$
(D) $\Delta S_{\text{sys}} + \Delta S_{\text{sur}} \geq 0$

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Correct Option: A

Solution:

If $U + Pv$ (By definition)

$$\Delta H = \Delta U + \Delta(Pv) \text{ at constant pressure}$$

$$\Delta H = \Delta U + P\Delta V$$

35. Among the following the correct statements are:
I. LiH , BeH_2 and MgH_2 are saline hydrides with significant covalent character
II. Saline hydrides are volatile
III. Electron-precise hydrides are Lewis bases
IV. The formula for chromium hydride is CrH
The correct option is:

- (A) I, III only (B) II, IV only
(C) I, IV only (D) III, IV only

Correct Option: C

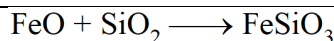
Solution:

36. The chemical composition of "slag" formed during the smelting process in the extraction of copper is:-

- (A) $\text{Cu}_2\text{O} + \text{FeS}$
(B) FeSiO_3
(C) CuFeS_2
(D) $\text{Cu}_2\text{S} + \text{FeO}$

Correct Option: B

Solution:



37. Which of the following has least tendency to liberate H_2 from mineral acids?

(A) Cu (B) Mn (C) Ni (D) Zn

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Correct Option: A

Solution:

Copper is least electropositive among the given

metals and it lies below H in reactivity series

38. In which of the following reactions does H_2O_2 act as an oxidising agent (either in acidic, alkaline or neutral medium)?

(i) $2\text{Fe}^{2+} + \text{H}_2\text{O}_2 \rightarrow$
 (ii) $2\text{MnO}_4^- + 6\text{H}^+ + 5\text{H}_2\text{O}_2 \rightarrow$
 (iii) $\text{I}_2 + \text{H}_2\text{O}_2 + 2\text{OH}^- \rightarrow$
 (iv) $\text{Mn}^{2+} + \text{H}_2\text{O}_2 \rightarrow$

(A) (ii), (iii) (B) (i), (iv)
 (C) (i), (iii) (D) (ii), (iv)

Correct Option: B

Solution:

Let us complete the reactions:

(i) $\text{Fe}^{2+} + \text{H}_2\text{O}_2 \longrightarrow \text{Fe}^{3+} + \text{H}_2\text{O} + 7$
 (ii) $\text{MnO}_4^- + \text{H}^+ + \text{H}_2\text{O}_2 \longrightarrow \text{Mn}^{2+} + \text{O}_2 + \text{H}_2\text{O}$
 (iii) $\text{I}_2 + \text{H}_2\text{O}_2 + \text{OH}^- \longrightarrow \text{I}^- + \text{O}_2 + \text{H}_2\text{O}$
 (iv) $\text{Mn}^{2+} + \text{H}_2\text{O}_2 \longrightarrow \text{Mn}^{4+} + \text{OH}^-$

In reactions, (i) and (iv) H_2O_2 ,

acts as oxidising agent and itself gets reduced to H_2O ,

39. The charge on colloidal particles is due to

(A) presence of electrolyte
 (B) very small size of particles
 (C) adsorption of ions from the solution
 (D) can't be determined

Correct Option: C

Solution:

40. Which of the following is correct order of ligand field strength?

(A) $\text{CO} < \text{en} < \text{NH}_3 < \text{C}_2\text{O}_4^{2-} < \text{S}^{2-}$
 (B) $\text{S}^{2-} < \text{C}_2\text{O}_4^{2-} < \text{NH}_3 < \text{en} < \text{CO}$
 (C) $\text{NH}_3 < \text{en} < \text{CO} < \text{S}^{2-} < \text{C}_2\text{O}_4^{2-}$
 (D) $\text{S}^{2-} < \text{NH}_3 < \text{en} < \text{CO} < \text{C}_2\text{O}_4^{2-}$

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Correct Option: B

Solution:

The increasing order of field strength of ligands (according to spectrochemical series) $\text{S}^{2-} < \text{C}_2\text{O}_4^{2-} < \text{NH}_3 < \text{en} < \text{CO}$

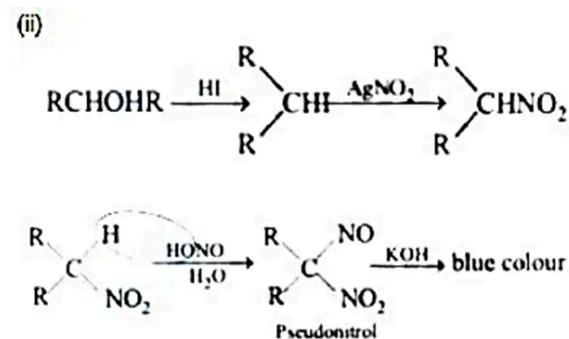
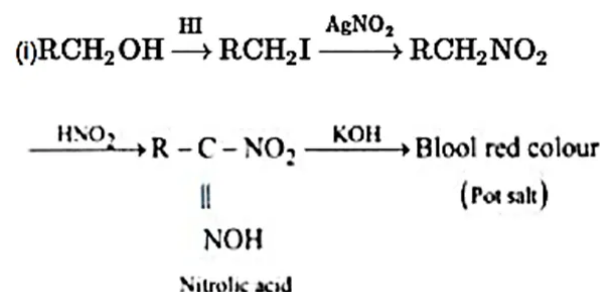
41. In the Victor-Meyer's test, the colour given by 1° , 2° and 3° alcohols are respectively:

(A) Red, colourless, blue (B) Red, blue, colourless
 (C) Colourless, red, blue (D) Red, blue, violet

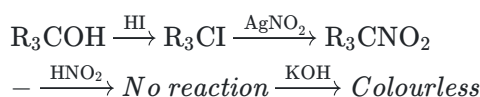
Correct Option: B

Solution:

Victor Meyer's test: The various steps involved are



(iii)



42. Which one of the following is a water soluble vitamin, that is not excreted easily?

- (A) Vitamin B₂ (B) Vitamin B₁
(C) Vitamin B₆ (D) Vitamin B₁₂

JM 2022

Correct Option: D

Solution:

Vitamins are generally classified into two categories based on their solubility: fat-soluble vitamins (A, D, E, and K) and water-soluble vitamins (B-complex group and Vitamin C).

Fat-soluble vitamins are stored in the liver and adipose tissues and are not readily excreted from the body, which can lead to toxicity if consumed in excess.

Water-soluble vitamins are usually not stored in the body to any significant extent; they dissolve in water and any excess is typically excreted through urine. Therefore, they need to be supplied regularly in the diet.

However, Vitamin B₁₂ (cobalamin) is a notable exception among water-soluble vitamins. Unlike other B-vitamins, the body can store Vitamin B₁₂ in the liver for several years. Because of this significant storage capacity, it is not excreted as easily or as quickly as other water-soluble vitamins like B₁, B₂, or B₆.

Comparing the options, Vitamin B₁, B₂, and B₆ are excreted regularly in the urine, while Vitamin B₁₂ is retained and stored in the liver.

The correct answer is **Vitamin B₁₂**.

43. Calculate the activation energy of a reaction, whose rate constant doubles on raising the temperature from 300 K to 600 K.

- (A) 3.45 kJ/mol (B) 6.90 kJ/mol
(C) 9.68 kJ/mol (D) 19.6 kJ/mol

Correct Option: A

Solution:

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\text{or, } \log\left(\frac{2k}{k}\right) = \frac{E_a}{2.303 \times 8.3} \times \frac{|600 - 300|}{300 \times 600}$$

$$E_a \approx 3.45 \text{ kJ/mol}$$

44. Which one of the following compounds is having maximum 'lone pair-lone pair' electron repulsions?

- (A) ClF₃ (B) IF₅
(C) SF₄ (D) XeF₂

Correct Option: D

Solution:

XeF₂ has three lone pairs and two bond pairs. The three lone pairs are arranged in the equatorial positions because of which they face maximum repulsion from each other.

45. The correct statement among the following is;

- (A) Ferrocene has two cyclohexadiene rings coordinated to iron atom.
(B) Ferrocene has two cyclopentadienyl anion rings bonded to iron (II) ion.
(C) Perxenate ion is [XeO₂ F₂]²⁻
(D) Perxenate ion is tetrahedral in shape.

Correct Option: B

Solution:

Ferrocene is Fe(η⁵ - C₅H₅)₂

Perxenate ion is [XeO₆]⁴⁻ which is octahedral.

46. Which among the following is used in detergent?

- (A) Sodium acetate (B) Sodium stearate
(C) Calcium stearate (D) Sodium lauryl sulphate

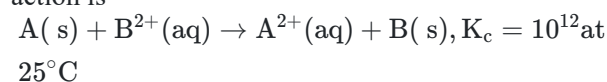
Correct Option: D

Solution:

Sodium stearate is used in soap and sodium lauryl sulphate

CH₃(CH₂)₁₀CH₂ - OSO₃⁻Na⁺ is an anionic detergent

47. The standard Gibbs energy (ΔG⁰) for the following reaction is



(K_c = equilibrium constant)

- (A) -150 kJ (B) -96.80 kJ (C) -68.47 kJ (D) -100 kJ

Correct Option: C

Solution:

48. The type of isomerism present in nitropentammine chromium (III) chloride is

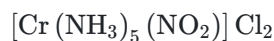
- (A) optical (B) linkage

(C) ionization

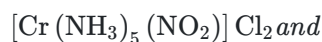
(D) polymerisation

Correct Option: B**Solution:**

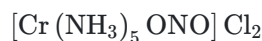
The chemical formula of nitropenta ammine chromium(III) chloride is:



It can exist in following two structures



Pentaamminenitrochromium (III) chloride



Pentaamminenitritochromium (III) chloride

Therefore, the type of isomerism found in this compound is linkage isomerism as NO_2 group is linked through N as $-\text{NO}_2$ or through O as ONO .

49. The strongest reducing agent among the following is:

- (A) SbH_3 (B) NH_3
(C) BiH_3 (D) PH_3

Correct Option: C**Solution:**

The stability of hydrides decreases from NH_3 to BiH_3 but their reducing character increases down the group.

50. Identify, from the following, the diamagnetic, tetrahedral complex

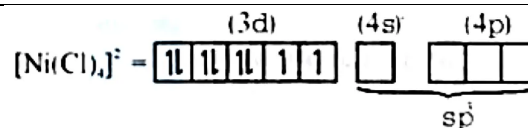
- (A) $[\text{Ni}(\text{Cl})_4]^{2-}$
(B) $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$
(C) $[\text{Ni}(\text{CN})_4]^{2-}$
(D) $[\text{Ni}(\text{CO})_4]$

Correct Option: D**Solution:**

(a) Ni in $[\text{Ni}(\text{Cl})_4]^{2-}$ exist as Ni^{2+} ion.

Cl is a weak field ligand (high spin). It will not cause pairing of electrons.

Hence, configuration of $[\text{Ni}(\text{Cl})_4]^{2-}$ is

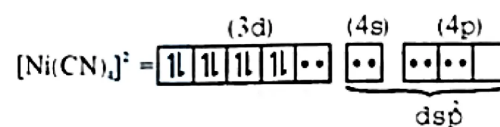


Tetrahedral with two unpaired electrons (i.e., paramagnetic) and has sp^3 hybridisation.

(b) In $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, $(\text{C}_2\text{O}_4)^{2-}$ is a bidentate ligand thus, give octahedral structure.

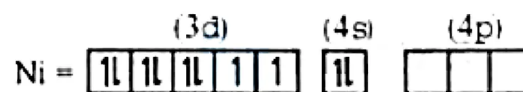
(c) In $[\text{Ni}(\text{CN})_4]^{2-}$, Ni exist as Ni^{2+} ion.

CN^- is a strong field ligand (low spin). Causes pairing of electrons of 3d orbital.

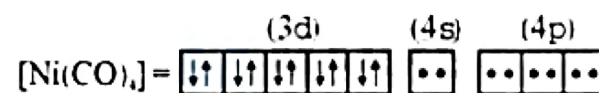


Hence, the structure of is square planar and it is diamagnetic.

(d) In $[\text{Ni}(\text{CO})_4]$, Ni has zero oxidation state. i.e.,



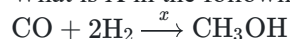
CO is a strong field ligand causes rearrangement and pairing of electrons of 3d and 4s orbital.



Structure of $\text{Ni}(\text{CO})_4$ is tetrahedral with sp^3 hybridisation and it is diamagnetic.

Hence, (4) is the correct answer.

51. What is X in the following reaction?



- (A) 623 K/300 atm
(B) KMnO_4/H^+
(C) Zn/Δ
(D) $\text{ZnO} - \text{Cr}_2\text{O}_3$, 200 – 300 atm, 573 – 673 K

Correct Option: D**Solution:**

The given reaction is for the industrial preparation of methanol from a mixture of carbon monoxide and hydrogen. In the reaction the gaseous mixture is subjected to 200 atmosphere and then passed over heated catalyst mixture of ZnO and Cr_2O_3 kept at $573 - 673 \text{ K}$. This reaction results the formation of methanol vapours which are then condensed to liquid state.

52. When the same quantity of electricity is passed through the aqueous solutions of the given electrolytes for the same amount of time, which metal will be deposited in maximum amount on the cathode?

- (A) ZnSO_4 (B) FeCl_3
(C) AgNO_3 (D) NiCl_2

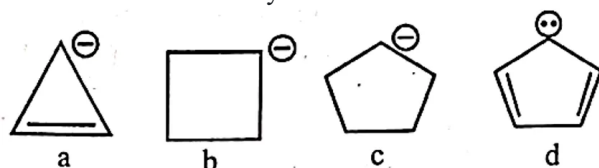
Correct Option: C

Solution:

$$\frac{\text{Mass of metal}_1 \text{ deposited}}{\text{Mass of metal}_2 \text{ deposited}} = \frac{\text{Eq. wt. of metal}_1}{\text{Eq. wt. of metal}_2}$$

The equivalent weight of silver is highest among the given options.

53. Correct order of stability of carbanion is

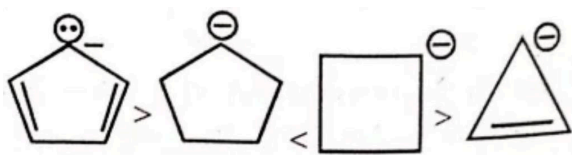


- (A) $C > B > D > A$ (B) $A > B > C > D$
(C) $D > A > C > B$ (D) $D > C > B > A$

Correct Option: D

Solution:

As we know compound (4) is aromatic and the compound (1) is anti-aromatic. Hence compound (4) is most stable and compound (1) is least stable among these in compound (2) and (3) carbon atom having charge is sp^3 hybridised. On the basis of angle strain theory compound (3) is more stable than compound (2).



54. Which of the following is not a semi-synthetic polymer?

- (A) Cis-polyisoprene (B) Cellulose nitrate
(C) Cellulose acetate (D) Vulcanised rubber

Correct Option: A

Solution:

cis-polyisoprene is natural rubber.

55. Which of the following is not correct about Grignard reagent?

- (A) It is a nucleophile
(B) Forms new carbon-carbon bond
(C) Reacts with carbonyl compounds
(D) It is an organomanganese compound

Correct Option: D

Solution:

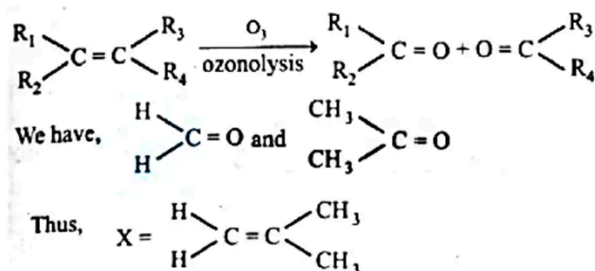
Grignard reagent = $\text{R}-\overset{\delta}{\text{Mg}}\overset{\delta}{\text{X}}$

56. An alkene X on ozonolysis gives a mixture of Propan-2-one and methanal. What is X?

- (A) Propene (B) 2-Methylpropene
(C) 2-Methylbut-1-ene (D) 2-Methylbut-2-ene

Correct Option: B

Solution:



57. Which of the following is only a redox reaction but not a disproportionation reaction?

- (A) $4\text{H}_3\text{PO}_3 \rightarrow 3\text{H}_3\text{PO}_4 + \text{PH}_3$
(B) $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
(C) $\text{P}_4 + 3\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 3\text{NaH}_2\text{PO}_2 + \text{PH}_3$
(D) $\text{P}_4 + 8\text{SOCl}_2 \rightarrow 4\text{PCl}_3 + 2\text{S}_2\text{Cl}_2 + 4\text{SO}_2$

Correct Option: D

Solution:

The reaction $\text{P}_4 + 8\text{SOCl}_2 \rightarrow 4\text{PCl}_3 + 2\text{S}_2\text{Cl}_2 + 4\text{SO}_2$ involves change of oxidation state of P from 0 to +3 and that of S from +4 to +2.

Thus, it is a redox reaction but not a disproportionation reaction.

58. Le-Chatelier principle is not applicable to :-

- (A) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$.
 (B) $\text{Fe}(\text{s}) + \text{S}(\text{s}) \rightleftharpoons \text{FeS}(\text{s})$
 (C) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
 (D) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$

Correct Option: B

Solution:

Solution Not Required

59. 1 L closed flask contains a mixture of 4 g of methane and 4.4 g of carbon dioxide. The pressure inside the flask at 27°C is [Assume ideal behaviour of gases]

- (A) 8.6 atm (B) 2.2 atm (C) 4.2 atm (D) 6.1 atm

Correct Option: A

Solution:

no. of moles of

$$\text{CH}_4 (n_1) = \frac{4}{16} = 0.25 \text{ mol}$$

no. of moles of

$$\text{CO}_2 (n_2) = \frac{4.4}{44} = 0.1 \text{ mol}$$

Total no. of moles

$$(n_T) = n_1 + n_2 = 0.35 \text{ mol}$$

$$\therefore P = \frac{0.35 \times 0.082 \times 300}{1} = 8.6 \text{ atm}$$

60. The energy of second orbit of hydrogen atom is $-5.45 \times 10^{-19} \text{ J}$. What is the energy of first orbit of Li^{2+} ion (in J) ?

- (A) -1.962×10^{-18} (B) -1.962×10^{-17}
 (C) -3.924×10^{-17} (D) -3.924×10^{-18}

Correct Option: B

Solution:

$$E_n = -13.6 \left[\frac{z^2}{n^2} \right] \text{ eV}$$

$$\Rightarrow E_1 = -13.6 \left[\frac{3^2}{1^2} \right] \text{ eV} = -122.4 \text{ eV}$$

$$= -122.4 \times 1.602 \times 10^{-19} \text{ J} = -1.962 \times 10^{-17} \text{ J}$$

61. The Prime Minister's recent trip to Nigeria, the first bilateral prime ministerial visit to Africa since Jawaharlal Nehru's 45 years ago, recalls a long neglected Indian obligation. "It is up to Asia to help Africa to the best of her ability," Nehru told the Bandung Conference in 1955: "because we are sister continents." The Prime Minister proposed strategic partnership with African nations might at last make good that 52-year old promise and also, perhaps, challenge China's expedient diplomacy.

In the intervening years, the West's sanctimonious boycott of many African regimes - after nearly a century of extreme colonial exploitation - left the continent in the grip of oppressive rulers looking for new political sponsors, arms-sellers and trading partners. Not only was it an abdication of the developed world's responsibility to the world's least developed region, sanctions actually compounded the sufferings of poorer Africans. The Darfur killings continue and there is no mellowing of Robert Mugabe's repression in Zimbabwe.

Abandoned by the West Africa looked elsewhere. Beijing filled the vacuum by eagerly embracing dangerous and unsavoury regimes in its search for oil and other minerals. China demonstrated its influence by playing host to 48 out of 53 African leaders a year ago in a jamboree that was historic as well as historical. Historic because China has succeeded in becoming the pre-eminent outside power in Africa and its second biggest trading partner. Historical because modern Chinese diplomacy draws on the Middle Kingdom's ancient formula; the tribute system. It was how the son of Heaven brought those nations whom the Celestial Empire called "barbarians" into his imperial trading and, through it, cultural and political system.

Contemporary China's economic penetration of Africa also heralds a new era of cultural and political ties though the Chinese foreign ministry repeatedly assure the world that "our cooperation is not designed to be against or preclude any third party." This is untrue in a world of finite resources. Once the Chinese are established in a country, no one else gets a foothold. Myanmar, where India failed to obtain the desired gas concessions, is a prime example. Aware that the hunt for energy is a zero-sum game, China's leadership courts African leaders with regular visits and substantial grants.

After decades of neglect - Vajpayee's Africa visit over a decade ago was to attend a Commonwealth Summit - India will have to move cautiously but quickly if it is to break China's monopoly. Along with investing in African human capital, China has outlined a strategic investment plan to build three to five trade economic cooperation zones in Africa by 2009 to boost trade, which is expected to tap \$40 billion this year. That could double to \$30 billion by 2010 on the back of an insatiable demand for natural resources to feed China's booming economy.

From the passage, it can be inferred that the author's views are:

- (A) in favour of India gaining an edge over China



- (B) against India entering into a competition with China
- (C) in favour of not making any investment in African countries
- (D) appreciation of oppressive and barbaric African rulers.

Correct Option: A

Solution:

62. The fear of an impending invasion has more to do than even the debasing of the coinage than with the financial difficulties.

- (A) The fear
- (B) impending invasion
- (C) than even the debasing of the coinage
- (D) financial

Correct Option: C

Solution:

63. These essays are intellectually ____ and represent various levels of complexity.

- (A) revealing (B) modern
- (C) superior (D) persistent

Correct Option: C

Solution:

64. He was congratulated by his teacher on his brilliant success in the recent examination.

- (A) His teacher congratulated him on his brilliant success in the recent examination.
- (B) His teacher congratulated him for his success in the examination.
- (C) His teacher congratulated him on his success.
- (D) His teacher congratulated him.

Correct Option: A

Solution:

65. They first sun-dried the garbage for one to three days to bring down the moisture level.

- (A) The moisture level was brought down by sun-drying the garbage for one to three days
- (B) One to three days of sun-drying brought down the moisture level of the garbage.
- (C) The moisture level of the garbage came down when it was sun-dried for one to three days.

- (D) The garbage was first sundried for one to three days to bring down the moisture level.

Correct Option: D

Solution:

66. Choose the correct spelling from the given words.

- (A) Elusive (B) Elusief (C) Elusivie (D) Ellusive

Correct Option: A

Solution:

67. Since July 1991, the government of India has effectively put the liberalisation policy into practice. The drastic steps even include some administrative reforms for pruning the government agencies. Last year the Japanese business circles represented by the Ishikawa Mission called attention of their Indian counterparts to what they considered to be the major impediments in India. However, thanks to the almost revolutionary reforms put into effect by the Indian government, those impediments either have been removed or now are on their way out. This development gives a new hope for the future of economic co-operation between the two countries. At the same time, it should be borne in mind that there is a stiff competition with other countries, notably China and South-East Asian countries, in this regard. The success stories of ASEAN countries welcoming Japanese investments with adequate infrastructure are already known in India but it may be useful if further studies of Japanese joint ventures in ASEAN countries be made by Indian business circles. The coastal areas of China have initiated a very active campaign to welcome foreign economic participation.

Beyond our bilateral relationship, India's more active participation in global economy is needed. India certainly deserves a far bigger share of world trade considering its vast resources. It is strongly hoped that the Indian government's recently initiated effort of enlarging its export market would bear fruit.

India has steadfastly maintained its parliamentary democracy since independence. Considering its size, its population and its internal complexity, the overall maintenance of national integrity and political stability under parliamentary democracy is remarkable and admirable indeed. Here lies the base for the status of India in the world. By effectively implementing its economic reform with the support of public opinion, this democratic polity of India has again demonstrated its viability and resilience. At the same time, it gives hope and inspiration to the whole world which faces the difficult problem of North-South confrontation.

Which of the following is TRUE about the author's view regarding India's participation in world trade?

- (A) India should actively contribute in a big way as it has tremendous resources.

- (B) India's sharing in global economy has already been very fast and beyond its resources.
- (C) India should refrain from making efforts in enlarging its export market.
- (D) India needs to first strengthen its democracy.

Correct Option: A

Solution:

68. The convention was ____ due to the pandemic as they wanted people to remain safe.

- (A) cancelled (B) called off
(C) brought up (D) broken off

Correct Option: B

Solution:

69. YOGA: EXERCISE::

- (A) Pineapple : Fruit (B) Leg : Limb
(C) Mango : Vegetable (D) Tree : Field

Correct Option: A

Solution:

70. P: And with each passing moment, he felt an urgent need to run and hide as though the bell was sounding a warning.

Q: And heavy that he could scarcely hold onto it and he wanted to know what was in the package and he stopped near an alley corner and unwrapped in.

R: It sounded suddenly directly above his head and when he looked, it was not there but went on tolling.

S: And he stood on a street corner in a red glare of light like that which came from the furnace and he had a big package in his arms so wet and slippery.

Which of the following should be the FIRST sentence after rearrangement?

- (A) RPSQ (B) RSPQ (C) RQPS (D) PSRQ

Correct Option: A

Solution:

71. If 'black' means 'white', 'white' means 'red', 'red' means 'yellow', 'yellow' means 'blue', 'blue' means 'green', 'green' means 'purple' and 'purple' means 'orange' then what is the colour of clean sky?

- (A) green (B) purple (C) blue (D) yellow

Correct Option: A

Solution:

72. Which sequence of letters when placed at the blanks one after another will complete the given letter series ?

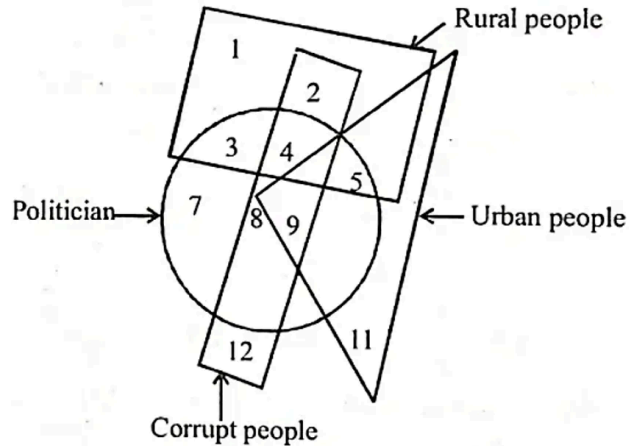
b ____ b ____ bb ____ bbb ____ bb ____ b

- (A) bbbbaa (B) bbaabb (C) ababab (D) aabaab

Correct Option: C

Solution:

73. In the following venn diagram, Identify the politician from urban areas who are corrupt.

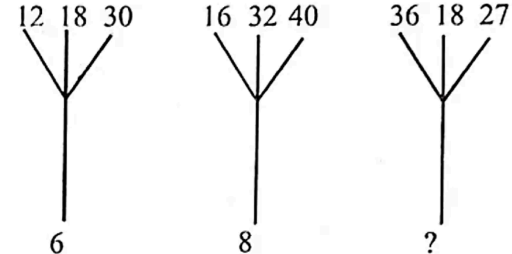


- (A) 4 (B) 8 (C) 9 (D) 10

Correct Option: C

Solution:

74. Find the correct number at the place of question mark.



- (A) 6 (B) 9 (C) 12 (D) 18

Correct Option: B

Solution:

75. If NATION is coded as 467234 and EARN be coded as 1654 then ATTENTION should be coded as :-

- (A) 43276956 (B) 956143654 (C) 766412743 (D) 6771472

Correct Option: D

Solution:

N A T I O N
 ↓ ↓ ↓ ↓ ↓ ↓
 4 6 7 2 3 4

E A R N
 ↓ ↓ ↓ ↓
 1 6 5 4

A T T E N T I O N
 ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
 6 7 7 1 4 7 2 3 4

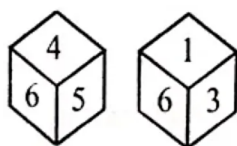
76. If all the letters in the word 'PRINCE' are rearranged in alphabetical order, then how many letter(s) will remain unchanged?

(A) None (B) One (C) Two (D) Three

Correct Option: C

Solution:

77. Two positions of a dice are shown below. Identify the number at the bottom when the top is 3.



(A) 2 (B) 4 (C) 5 (D) 6

Correct Option: B

Solution:

78. In a certain way 'Diploma' is related to 'Education'. Which of the following is related to 'Trophy' in a similar way?

(A) Sports (B) Athlete (C) Winning (D) Prize

Correct Option: A

Solution:

79. Five boys A, B, C, D and E are standing in a line. A is taller than E but shorter than D. B is shorter than E and C is the tallest. Who is in the middle?

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

Correct Option: D

Solution:

80. In the following question you have to identify the correct response from the given premises stated according to the following symbols. If '+' means '÷', '-' means '×', '÷' means '+' and '×' means '-', then $63 \times 24 + 8 \div 4 + 2 - 3 = ?$

(A) 54 (B) 66 (C) 186 (D) 48

Correct Option: B

Solution:

81. Six people are sitting on the ground in a hexagonal shape. The hexagon's vertices are marked as A, B, C, D, E and F but not in any order. However, all the sides of the hexagon are of same length. A is not adjacent to B or C. D is not adjacent to C or E; B and C are adjacent; F is in the middle of D and C.

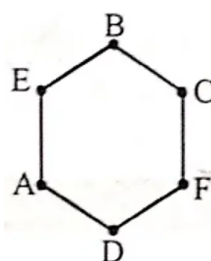
Who is at the same distance from D as E is from D ?

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

Correct Option: B

Solution:

The following hexagonal arrangement is possible.



82. Six people are sitting on the ground in a hexagonal shape. The hexagon's vertices are marked as A, B, C, D, E and F but not in any order. However, all the sides of the hexagon are of same length. A is not adjacent to B or C. D is not adjacent to C or E; B and C are adjacent; F is in the middle of D and C.

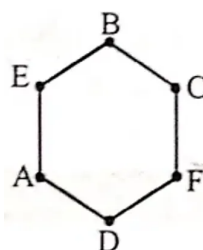
Who is placed opposite to E ?

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

Correct Option: A

Solution:

The following hexagonal arrangement is possible.



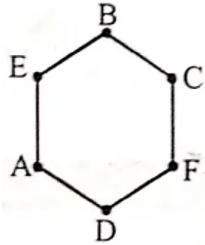
83. Six people are sitting on the ground in a hexagonal shape. The hexagon's vertices are marked as A, B, C, D, E and F but not in any order. However, all the sides of the hexagon are of same length. A is not adjacent to B or C. D is not adjacent to C or E; B and C are adjacent; F is in the middle of D and C.

If one neighbour of A is D, then who is the other one?

(A) B (B) C (C) E (D) F

Correct Option: C**Solution:**

The following hexagonal arrangement is possible.



84. Rohit walked 25 metres towards South. Then he turned to his left and walked 20 metres. He then turned to his left and walked 25 metres. He again turned to his right and walked 15 metres. At what distance is he from the starting point and in which direction?

(A) 35 metres East (B) 35 metres North
(C) 40 metres East (D) 60 metres East

Correct Option: A**Solution:**

85. **Statements:**

All biscuits are chocolates.
Some chocolates are breads.
All breads are pastries.

Conclusions

I. Some biscuits are pastries.
II. Some pastries are chocolates.

(A) Only I and II follow (B) Only I follow
(C) Only II follow (D) None follow

Correct Option: C**Solution:**

86. **Statements:**

Some pots are buckets.
Some buckets are bags.
Some bags are purses.

Conclusions:

I. Some purses are buckets.
II. Some bags are pots.

(A) All follow (B) None follows
(C) Only I follow (D) Only II follow

Correct Option: B**Solution:**

87. Find the missing number in the following series: 27, 29, 33, ?, 57

(A) 30 (B) 41 (C) 40 (D) 35

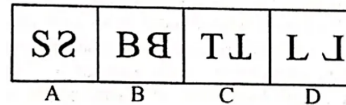
Correct Option: B**Solution:**

88. A family has a man, his wife, their four sons and their wives. The family of every son also have 3 sons and one daughter. Find out the total number of male members in the family.

(A) 4 (B) 8 (C) 12 (D) 17

Correct Option: D**Solution:**

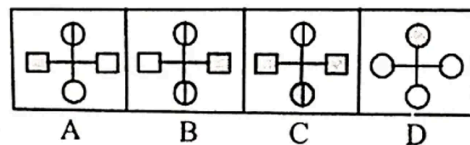
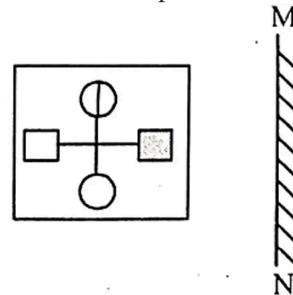
89. Find the odd one out.



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

Correct Option: C**Solution:**

90. Choose the mirror image for the following figure when the mirror is kept at the MN line.



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

Correct Option: C**Solution:**

91. If the angle made by the tangent at the point (x_0, y_0) on the curve $x = 12(t + \sin t \cos t)$, $y = 12(1 + \sin t)^2$, $0 < t < \frac{\pi}{2}$, with the positive x-axis is $\frac{\pi}{3}$, then y_0 is equal to

(A) $6(3 + 2\sqrt{2})$ (B) $3(7 + 4\sqrt{3})$
(C) 27 (D) 48

Correct Option: C**Solution:**



92. The integral $\int \frac{x^2(x \sec^2 x + \tan x)}{(x \tan x + 1)^2} dx$ is equal to

- (A) $-\frac{x^2}{x \tan x + 1} + c$
 (B) $2 \log_e |x \sin x + \cos x| + c$
 (C) $-\frac{x^2}{x \tan x + 1} + 2 \log_e |x \sin x + \cos x| + c$
 (D) $\frac{x^2}{x^2 \tan x - 1} - 2 \log_e |x \sin x + \cos x| + c$

Correct Option: C

Solution:

93. Given below is the distribution of a random variable X :

$X = x$	1	2	3	4
$P(X = x)$	λ	2λ	3λ	4λ

If $\alpha = P(X < 3)$ and $\beta = P(X > 2)$, then $\alpha : \beta =$

- (A) $2 : 5$ (B) $3 : 4$ (C) $4 : 5$ (D) $3 : 7$

Correct Option: D

Solution:

94. If $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$, then the value of $|\hat{i} \times (\vec{a} \times \hat{i})|^2 + |\hat{j} \times (\vec{a} \times \hat{j})|^2 + |\hat{k} \times (\vec{a} \times \hat{k})|^2$ is equal to

- (A) 17 (B) 18 (C) 19 (D) 20

Correct Option: B

Solution:

95. If $\frac{dy}{dx} - y \log_e 2 = 2^{\sin x} (\cos x - 1) \log_e 2$, then $y' =$

- (A) $2^{\sin x} + c2^x$ (B) $2^{\cos x} + c2^x$
 (C) $2^{\sin x} + c2^{-x}$ (D) $2^{\cos x} + c2^{-x}$

Correct Option: A

Solution:

96. $\int \frac{x^3 - 1}{x^3 + x} dx =$

- (A) $x + \log |x| + \frac{1}{2} \log (x^2 + 1) + \sin^{-1}(x) + c$
 (B) $x - \log |x| + \frac{1}{2} \log (x^2 + 1) - \sin^{-1}(x) + c$
 (C) $x + \log |x| - \frac{1}{2} \log (x^2 + 1) + \tan^{-1}(x) + c$
 (D) $x - \log |x| + \frac{1}{2} \log (x^2 + 1) - \tan^{-1}(x) + c$

Correct Option: D

Solution:

97. At $x = \frac{\pi^2}{4}$, find $\frac{d}{dx} (\tan^{-1}(\cos \sqrt{x}) + \sec^{-1}(e^x)) =$

- (A) $\frac{1}{\sqrt{e^{\frac{\pi^2}{2}} - 1}} - \frac{1}{\pi}$
 (B) $\frac{\pi}{4} + \frac{1}{\sqrt{e^{\frac{\pi^2}{2}} + e^{\frac{\pi^2}{2}}}}$
 (C) $\frac{1}{\sqrt{e^{\frac{\pi^2}{2}} + e^{\frac{\pi^2}{2}}}} + \frac{2}{\pi} \cot\left(\frac{\sqrt{\pi}}{2}\right)$

(D) $\frac{1}{\sqrt{e^{\frac{\pi^2}{2}}}} + \frac{1}{\pi}$

Correct Option: A

Solution:

98. If $\cot(\cos^{-1} x) = \sec\left\{\tan^{-1}\left(\frac{a}{\sqrt{b^2 - a^2}}\right)\right\}$ where $b > a$, then $x =$

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

Correct Option: A

Solution:

99. If $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ are defined by $f(x) = 5x - 3$ and $g(x) = x^2 + 3$, then $g \circ f^{-1}(3)$ is equal to

- (A) $\frac{25}{3}$ (B) $\frac{111}{25}$
 (C) $\frac{9}{25}$ (D) $\frac{25}{111}$

Correct Option: B

Solution:

100. If $f(x) = \begin{cases} \frac{x^2 \log(\cos x)}{\log(1+x)}, & x \neq 0 \\ 0, & x = 0 \end{cases}$, then at $x = 0$, $f(x)$ is

- (A) not continuous
 (B) continuous but not differentiable
 (C) differentiable
 (D) not continuous, but differentiable

Correct Option: C

Solution:

101. The function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = \frac{x}{\sqrt{1+x^2}}$ is

- (A) surjective but not injective
 (B) bijective
 (C) injective but not surjective
 (D) neither injective nor surjective

Correct Option: C

Solution:

Given that, $f(x) = \frac{x}{\sqrt{1+x^2}}$

For injective: Let $x_1, x_2 \in \mathbb{R}$ such that

$$f(x_1) = f(x_2)$$

$$\Rightarrow \frac{x_1}{\sqrt{1+x_1^2}} = \frac{x_2}{\sqrt{1+x_2^2}} \Rightarrow \frac{x_1^2}{1+x_1^2} = \frac{x_2^2}{1+x_2^2}$$

$$\Rightarrow x_1^2 + x_1^2 x_1^2 = x_2^2 + x_1^2 x_2^2 \Rightarrow x_1^2 = x_2^2$$

$$\Rightarrow x_1 = x_2$$

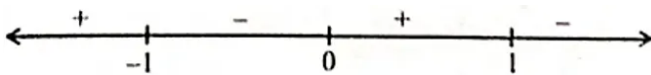
So, $f(x)$ is injective.

For surjective: Let $y = \frac{x}{\sqrt{1+x^2}}$

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

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

$$\Rightarrow \frac{y^2}{1-y^2} \geq 0$$



$$\therefore y \in (-1, 1)$$

So, $f(x)$ is not surjective.

102. Let R be the relation "is congruent to" on the set of all triangles in a plane.

- (A) Reflexive only (B) Symmetric only
(C) Symmetric and reflexive only (D) Equivalence relation

Correct Option: D

Solution:

103. At an election a voter may vote for any number of candidates not exceeding the number to be elected. If 4 candidates are to be elected out of the 12 contested in the election and voter votes for at least one candidate, then the number of ways in which a voter can vote is

- (A) 793 (B) 298 (C) 781 (D) 1585

Correct Option: A

Solution:

104. If ${}^{22}P_{r+1} : {}^{20}P_{r+2} = 11 : 52$, then r is equal to

- (A) 3 (B) 5 (C) 7 (D) 9

Correct Option: C

Solution:

105. Find the rational roots of the equation $2x^4 + x^3 - 11x^2 + x + 2 = 0$.

- (A) $\frac{1}{2}$ and 2 (B) $\frac{1}{2}, 2, \frac{1}{4}, -2$

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

$$(D) \frac{1}{2}, 2, \frac{3}{4}, -2$$

Correct Option: A

Solution:

106. If $A = 1 + r^a + r^{2a} + r^{3a} + \dots \infty$ and $B = 1 + r^b + r^{2b} + r^{3b} + \dots \infty$, then $\frac{a}{b}$ is equal to

- (A) $\log_B(A)$
(B) $\log_{1-B}(1-A)$
(C) $\log_{\frac{B-1}{B}}\left(\frac{A-1}{A}\right)$
(D) None of these

Correct Option: C

Solution:

107. The equations $x - y + 2z = 4$, $3x + y + 4z = 6$, $x + y + z = 1$ have

- (A) unique solution (B) infinitely many solutions
(C) no solution (D) two solutions

Correct Option: B

Solution:

Given equations, $x - y + 2z = 4$

$$3x + y + 4z = 6$$

$$x + y + z = 1$$

$$\text{Let } \Delta = \begin{vmatrix} 1 & -1 & 2 \\ 3 & 1 & 4 \\ 1 & 1 & 1 \end{vmatrix}$$

$$= 1(1-4) + 1(3-4) + 2(3-1)$$

$$= -3 - 1 + 4 = 0$$

$$\text{and } \Delta_1 = \begin{vmatrix} 4 & -1 & 2 \\ 6 & 1 & 4 \\ 1 & 1 & 1 \end{vmatrix}$$

$$= 4(1-4) + 1(6-4) + 2(6-1)$$

$$= -12 + 2 + 10 = 0$$

Now, $\Delta = 0$ and $\Delta_1 = 0$

$\therefore$ These equations have infinitely many solutions.

108. If x is a complex root of the equation

$$\begin{vmatrix} 1 & x & x \\ x & 1 & x \\ x & x & 1 \end{vmatrix} + \begin{vmatrix} 1-x & 1 & 1 \\ 1 & 1-x & 1 \\ 1 & 1 & 1-x \end{vmatrix} = 0,$$

then $x^{2007} + x^{-2007} =$



(A) 1 (B) -1 (C) -2 (D) 2

Correct Option: C

Solution:

Expanding the two determinants, we get

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

$$\Rightarrow x^3 + 1 = 0$$

$$\Rightarrow x = -\omega, -\omega^2, -1$$

$$x^{2007} + x^{-2007} = -1 - 1 = -2$$

109. If A and B are symmetric matrices of same order such that $AB + BA = X$ and $AB - BA = Y$, then $(XY)^T =$

(A) XY (B) $X^T Y^T$
(C) $-YX$ (D) $-Y^T X^T$

Correct Option: C

Solution:

$$\begin{aligned} \text{Since } XY &= (AB + BA)(AB - BA) \\ &= (AB)AB + (BA)(AB) - (AB)(BA) - (BA)(BA) \\ \text{Now } (XY)^T &= ((AB) \cdot (AB))^T + (BA \cdot AB)^T - (AB \cdot BA)^T \\ &= (AB)^T \cdot (AB)^T + (AB)^T \cdot (BA)^T - (BA)^T (AB)^T \\ &\quad - (BA)^T (BA)^T \\ &= (B^T \cdot A^T)(B^T \cdot A^T) + (B^T \cdot A^T) \cdot (A^T B^T) \\ &\quad - (A^T B^T)(B^T A^T) - (A^T B^T)(A^T B^T) \end{aligned}$$

Since, A & B are symmetric matrix.

$$\begin{aligned} &= (BA)(BA) + (BA)(AB) - (AB)(BA) \\ &\quad - (AB)(AB) \\ &= (BA - AB)(BA + AB) = -YX \end{aligned}$$

110. If the variance of the data 2, 3, 5, 8, 12 is σ^2 and the mean deviation from the median for this data is M , then $\sigma^2 - M =$
- (A) 10.2 (B) 5.8 (C) 10.6 (D) 8.2

Correct Option: A

Solution:

Observations : 2, 3, 5, 8, 12

$$\text{Mean} = \frac{2+3+5+8+12}{5} = 6$$

$$\therefore \sigma^2 = 13.2$$

$$\text{Median} = 5 = m$$

$$\therefore \text{Mean deviation about median}$$

$$\Rightarrow \frac{\sum |z_i - m|}{n} = \frac{3+2+0+3+7}{5} = 3$$

$$M = 3 \Rightarrow \sigma^2 - M = 13.2 - 3 = 10.2$$

111. If $p : 2$ is an even number

$q : 2$ is a prime number,

$r : 2 + 2 = 2^2$

Then the symbolic statement $p \rightarrow (q \vee r)$ means

- (A) 2 is an even number and 2 is a prime number or $2 + 2 = 2^2$
(B) 2 is an even number then 2 is a prime number or $2 + 2 = 2^2$.
(C) 2 is an even number or 2 is a prime number then $2 + 2 = 2^2$
(D) If 2 is not even number then 2 is a prime number $\alpha = 2 + 2 = 2^2$

Correct Option: B

Solution:

$P \rightarrow (q \vee r)$. If 2 is even number then 2 is a prime number or $2 + 2 = 2^2$.

112. Given a real valued function f such that $f(x) =$

$$\begin{cases} \frac{\tan^2\{x\}}{x^2 - [x]^2} & \text{for } x > 0 \\ 1 & \text{for } x = 0 \\ \sqrt{\{x\} \cot\{x\}} & \text{for } x < 0 \end{cases} \text{ Then}$$

- (A) $\text{LHL} = 1$
(B) $\text{RHL} = \sqrt{\cot 1}$
(C) $\lim_{x \rightarrow 0} f$ exists
(D) $\lim_{x \rightarrow 0} f(x)$ does not exist

Correct Option: D

Solution:

$$\begin{aligned} \lim_{x \rightarrow 0^-} f(x) &= \lim_{h \rightarrow 0} \sqrt{\{-h\} \cot\{-h\}} \\ &= \lim_{h \rightarrow 0} \sqrt{(1-h) \cot(1-h)} = \sqrt{\cot 1} \end{aligned}$$

$$\begin{aligned} \lim_{x \rightarrow 0^+} f(x) &= \lim_{h \rightarrow 0} \frac{\tan^2\{h\}}{h^2 - [h]^2} = \lim_{h \rightarrow 0} \frac{\tan^2 h}{h^2} = 1 \\ \therefore \lim_{x \rightarrow 0} f(x) \text{ does not exist.} \end{aligned}$$

Let $f(x) = \sin x$, $g(x) = \cos x$, $h(x) = x^2$ then

113. If p and q be the longest and the shortest distance respectively of the point $(-7, 2)$ from any point (α, β) on the curve whose equation is $x^2 + y^2 - 10x - 14y - 51 = 0$, then the G.M. of p is

(A) $2\sqrt{11}$ (B) $5\sqrt{5}$
(C) 13 (D) 11

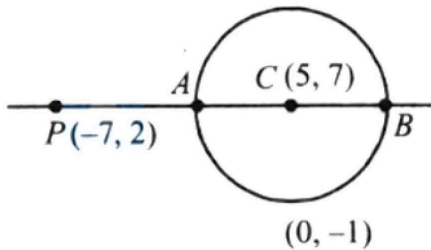
Correct Option: A

Solution:

The centre C of the circle = $(5, 7)$ and the radius

$$= \sqrt{5^2 + 7^2 + 51} = 5\sqrt{5}$$

$PC = \sqrt{12^2 + 5^2} = 13 \Rightarrow q = PA = 13 - 5\sqrt{5}$ and
 $p = PB = 13 + 5\sqrt{5}$



$$\begin{aligned} \therefore \text{G.M. of } p \text{ and } q \\ &= \sqrt{pq} = \sqrt{(13 - 5\sqrt{5})(13 + 5\sqrt{5})} \\ &= \sqrt{169 - 125} = 2\sqrt{11}. \end{aligned}$$

114. If the straight lines $2x + 3y - 1 = 0$, $x + 2y - 1 = 0$, and $ax + by - 1 = 0$ form a triangle with the origin as the orthocentre, then (a, b) is equal to
- (A) $(6, 4)$ (B) $(-3, 3)$ (C) $(-8, 8)$ (D) $(0, 7)$

Correct Option: C

Solution:

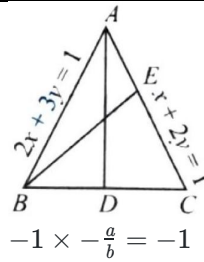
Here, point A is the intersection of line AB and AC so equation of line passing through A.

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

This line passes through the orthocentre $(0, 0)$, then $-1 - \lambda = 0$

$$\Rightarrow \lambda = -1 \text{ On substituting}$$

$\lambda = -1$ in Eq. (i), we get $x + y = 0$ as the equation of AD. Since $AD \perp BC$, therefore



$$\Rightarrow a + b = 0$$

Similarly, by applying the condition that BE is perpendicular to CA, we get

$$a + 2b = 8$$

Now, solving these equations, we get

$$a = -8, \quad b = 8$$

115. The coefficient of the highest power of x in the expansion of
- $$(x + \sqrt{x^2 - 1})^8 + (x - \sqrt{x^2 - 1})^8$$
- (A) 64 (B) 128 (C) 256 (D) 512

Correct Option: C

Solution:

$$\begin{aligned} \text{Since } (x + \sqrt{x^2 - 1})^8 + (x - \sqrt{x^2 - 1})^8 \\ &= 2 \{ {}^8C_0 x^8 + {}^8C_2 x^6 (x^2 - 1) + {}^8C_4 x^4 (x^2 - 1)^2 \\ &\quad + {}^8C_6 x^2 (x^2 - 1)^3 + {}^8C_8 x^0 (x^2 - 1)^4 \} \end{aligned}$$

So coefficient of highest power of x

$$\begin{aligned} &= 2 \{ {}^8C_0 + {}^8C_2 + {}^8C_4 + {}^8C_6 + {}^8C_8 \} \\ &= (1 + 1)^8 + (1 - 1)^8 = 2^8 = 256 \end{aligned}$$

116. If $\tan^{-1} \left[\frac{1}{1+1.2} \right] + \tan^{-1} \left[\frac{1}{1+2.3} \right] + \dots + \tan^{-1} \left[\frac{1}{1+n(n+1)} \right] = \tan^{-1}[x]$, then x is equal to
- (A) $\frac{1}{n+1}$ (B) $\frac{n}{n+1}$
(C) $\frac{1}{n+2}$ (D) $\frac{n}{n+2}$

Correct Option: D

Solution:

$$\begin{aligned}
 & \tan^{-1}\left(\frac{1}{1+1.2}\right) + \tan^{-1}\left(\frac{1}{1+2.3}\right) + \dots \\
 & + \tan^{-1}\left(\frac{1}{1+n(n+1)}\right) = \tan^{-1}(x) \\
 \Rightarrow & \tan^{-1}\left(\frac{2-1}{1+1.2}\right) + \tan^{-1}\left(\frac{3-2}{1+2.3}\right) + \dots \\
 & + \tan^{-1}\left(\frac{n+1-n}{1+n(n+1)}\right) = \tan^{-1}(x) \\
 \Rightarrow & \tan^{-1}(2) - \tan^{-1}(1) + \tan^{-1}(3) - \tan^{-1}(2) + \dots \\
 & + \tan^{-1}(n+1) - \tan^{-1}(n) = \tan^{-1}(x) \\
 \Rightarrow & \tan^{-1}(n+1) - \tan^{-1}(1) = \tan^{-1}(x) \\
 \therefore & \tan^{-1}(A) - \tan^{-1}(B) = \tan^{-1}\left(\frac{A-B}{1+A \cdot B}\right) \\
 \Rightarrow & \tan^{-1}\left(\frac{n}{n+2}\right) = \tan^{-1}(x) \Rightarrow x = \frac{n}{n+2}
 \end{aligned}$$

117. If $z_1, z_2, \dots, z_n$ are complex numbers such that $|z_1| = |z_2| = \dots = |z_n| = 1$, then $|z_1 + z_2 + \dots + z_n|$ is equal to

- (A) $|z_1 z_2 z_3 \dots z_n|$
 (B) $|z_1| + |z_2| + \dots + |z_n|$
 (C) $\left|\frac{1}{z_1} + \frac{1}{z_2} + \dots + \frac{1}{z_n}\right|$
 (D) n

Correct Option: C

Solution:

$$\begin{aligned}
 |z_1| &= |z_2| = |z_3| = \dots = |z_n| = 1 \\
 \Rightarrow z_1 \bar{z}_1 &= z_2 \bar{z}_2 = z_3 \bar{z}_3 = \dots = z_n \bar{z}_n = 1 \\
 \bar{z}_1 &= \frac{1}{z_1}, \bar{z}_2 = \frac{1}{z_2}, \bar{z}_3 = \frac{1}{z_3}, \dots, \bar{z}_n = \frac{1}{z_n} \\
 \text{Now, } |z_1 + z_2 + z_3 + \dots + z_n| &= |\bar{z}_1 + \bar{z}_2 + \dots + \bar{z}_n| \\
 |\bar{z}_1 + \bar{z}_2 + \bar{z}_3 + \dots + \bar{z}_n| &= \left| \frac{1}{z_1} + \frac{1}{z_2} + \frac{1}{z_3} + \dots + \frac{1}{z_n} \right|
 \end{aligned}$$

118. If $z, \bar{z}, -z, -\bar{z}$ form a rectangle of area $2\sqrt{3}$ square units, then one such z is

- (A) $\frac{1}{2} + \sqrt{3}i$ (B) $\frac{\sqrt{5} + \sqrt{3}i}{4}$
 (C) $\frac{3}{2} + \frac{\sqrt{3}i}{2}$ (D) $\frac{\sqrt{3} + \sqrt{11}i}{2}$

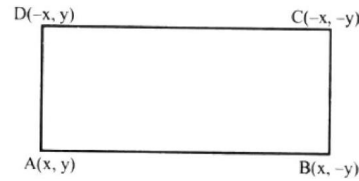
Correct Option: A

Solution:

Let a complex number, $z = x + iy$.

$$\Rightarrow \bar{z} = x - iy$$

Then, vertices of rectangle for $z, \bar{z}, -z, -\bar{z}$ are $(x, y), (x, -y), (-x, -y), (-x, y)$.



Now, Area of rectangle = $(2x)(2y) = 4xy$.

It is given that,

$$\text{Area} = 2\sqrt{3} = 4xy \Rightarrow 2xy = \sqrt{3}.$$

$$\therefore x = \frac{1}{2}, \quad y = \sqrt{3} \quad \therefore z = \frac{1}{2} + \sqrt{3}i$$

119. $f(x) = \frac{\cos x}{\left[\frac{2x}{\pi}\right] + \frac{1}{2}}$, where x is not an integral multiple of π

- and $\{[\cdot]\}$ denotes the greatest integer function, is
 (A) an odd function (B) an even function
 (C) neither odd nor even (D) None of these

Correct Option: A

Solution:

$$f(-x) = \frac{\cos(-x)}{\left[\frac{2(-x)}{\pi}\right] + \frac{1}{2}} = \frac{\cos x}{-1 - \left[\frac{2x}{\pi}\right] + \frac{1}{2}}$$

(As x is not an integral multiple of π)

$$= -\frac{\cos x}{\left[\frac{2x}{\pi}\right] + \frac{1}{2}} = -f(x)$$

Therefore, $f(x)$ is an odd function.

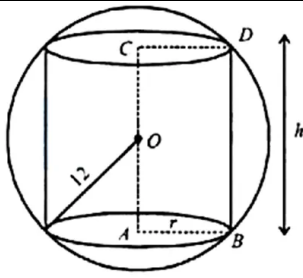
120. The maximum volume (in cu. units) of the cylinder which can be inscribed in a sphere of radius 12 units is

- (A) $384\sqrt{3}\pi$ (B) $768\sqrt{3}\pi$
 (C) $\frac{768\pi}{\sqrt{3}}$ (D) $\frac{1152\pi}{\sqrt{3}}$

Correct Option: B

Solution:

$$\begin{aligned}
 12^2 &= r^2 + \left(\frac{h}{2}\right)^2 \Rightarrow V = \pi r^2 h \\
 \Rightarrow V &= \pi \left(144 - \frac{h^2}{4}\right) h
 \end{aligned}$$



$$\Rightarrow V = 144\pi h - \frac{\pi}{4}h^3 \Rightarrow \frac{dV}{dh} = 144\pi - \frac{3\pi}{4}h^2$$

$$\Rightarrow \frac{dV}{dh} = 0 \Rightarrow 144\pi = \frac{3\pi}{4}h^2$$

$$\Rightarrow h^2 = 48 \times 4 \Rightarrow h = 8\sqrt{3}$$

$$\therefore 12^2 = r^2 + 48 \Rightarrow r^2 = 96$$

$$Volume = \pi r^2 h = \pi \times 96 \times 8\sqrt{3} = 768\sqrt{3}\pi \text{ cm}^3.$$

121. $\int_5^9 \frac{\log 3x^2}{\log 3x^2 + \log(588 - 84x + 3x^2)} dx$ is equal to

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

Correct Option: A

Solution:

$$I = \int_5^9 \frac{\log 3x^2 dx}{\log 3x^2 + \log(588 - 84x + 3x^2)} \dots (i)$$

$$= \int_5^9 \frac{\log 3x^2 dx}{\log 3(14 - x)^2}$$

$$= \int_5^9 \frac{\log 3(14 - x)^2 dx}{\log 3(14 - x)^2 + \log 3(14 - (14 - x))^2}$$

$$[\int_a^b f(x) dx = \int_a^b f(a + b - x) dx]$$

$$I = \int_5^9 \frac{\log 3(14 - x)^2 dx}{\log 3(14 - x)^2 + \log 3x^2} \quad (ii)$$

$$2I = \int_5^9 \frac{\log 3x^2 + \log 3(14 - x)^2}{\log 3(14 - x)^2 + \log 3x^2} dx$$

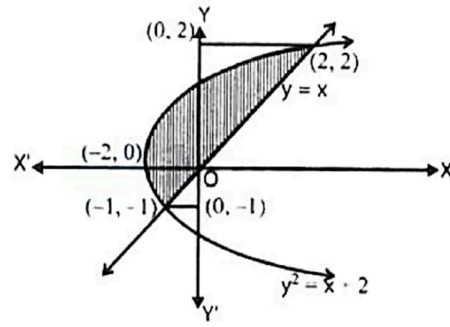
$$2I = \int_5^9 dx = 9 - 5 = 4 \Rightarrow I = 2$$

122. The area of the region bounded by the curves $x = y^2 - 2$ and $x = y$ is

- (A) 9/4 (B) 9 (C) 9/2 (D) 9/7

Correct Option: C

Solution:



On solving, $x = y^2 - 2$ and $x = y$, we get $(-1, -1)$ and $(2, 2)$.

Area of the shaded region,

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

$$= \left[\frac{y^2}{2} - \frac{y^3}{3} + 2y \right]_{-1}^2 = \left(\frac{4}{2} - \frac{8}{3} + 4 \right) - \left(\frac{1}{2} + \frac{1}{3} - 2 \right)$$

$$= \frac{10}{3} + \frac{7}{6} = \frac{27}{6} = \frac{9}{2}$$

123. Let ABC be a triangle and be $\vec{a}, \vec{b}, \vec{c}$ the position vectors of A, B, C respectively. Let D divide BC in the ratio 3 : 1 internally and E divide AD in the ratio 4 : 1 internally. Let BE meet AC in F. If E divides BF in the ratio 3 : 2 internally then the position vector of F is

- (A) $\frac{\vec{a} + \vec{b} + \vec{c}}{3}$
(B) $\frac{\vec{a} - 2\vec{b} + 3\vec{c}}{2}$
(C) $\frac{\vec{a} + 2\vec{b} + 3\vec{c}}{2}$
(D) $\frac{\vec{a} - \vec{b} + 3\vec{c}}{3}$

Correct Option: D

Solution:

$$\vec{OA} = \vec{a}, \vec{OB} = \vec{b}, \vec{OC} = \vec{c}$$

$$\text{Now P.V of Di.e } \vec{OD} = \frac{1 \times \vec{OB} + 3 \times \vec{OC}}{1+3}$$

$$\vec{OD} = \frac{\vec{b} + 3\vec{c}}{4}$$

$$\vec{OE} = \frac{4\vec{OD} + \vec{OA}}{4+1} = \frac{4\left(\frac{\vec{b} + 3\vec{c}}{4}\right) + \vec{a}}{5}$$



$$\Rightarrow \vec{OE} = \frac{\vec{a} + \vec{b} + 3\vec{c}}{5}$$

$$\text{Now, } \vec{OE} = \frac{2\vec{OB} + 3\vec{OF}}{2+3}$$

$$\Rightarrow \vec{OF} = \frac{5\vec{OE} - 2\vec{OB}}{3}$$

$$\Rightarrow \vec{OF} = \frac{\frac{5(\vec{a} + \vec{b} + 3\vec{c})}{5} - 2\vec{b}}{3}$$

$$\Rightarrow \vec{OF} = \frac{\vec{a} - \vec{b} + 3\vec{c}}{3} \Rightarrow P.V. \text{ of } F \text{ is } \frac{\vec{a} - \vec{b} + 3\vec{c}}{3}$$

124. The angle between the lines whose direction cosines are given by the equations $3l + m + 5n = 0$, $6mn - 2nl + 5lm = 0$ is

- (A) $\cos^{-1}(\frac{1}{6})$ (B) $\cos^{-1}(-\frac{1}{6})$
(C) $\cos^{-1}(\frac{2}{3})$ (D) $\cos^{-1}(-\frac{5}{6})$

Correct Option: B

Solution:

The given equations are

$$3l + m + 5n = 0 \dots\dots(i)$$

$$\text{and } 6mn - 2nl + 5lm = 0 \dots(ii)$$

From (i), we have $m = -3l - 5n$.

Putting $m = -3l - 5n$ in (ii),

$$\text{we get } 6(-3l - 5n)n - 2nl + 5l(-3l - 5n) = 0$$

$$\Rightarrow (n+1)(2n+1) = 0$$

$$\Rightarrow \text{either } l = -n \text{ or } l = -2n.$$

If $l = -n$, then putting $l = -n$ in (i), we obtain $m = -2n$.

If $l = -2n$, then putting $l = -2n$ in (i), we obtain $m = n$.

Thus, the direction ratios of two lines are $-n, -2n, n$ and $-2n, n, n$ i.e., $1, 2, -1$ and $-2, 1, 1$

Hence, the direction cosines are

$$\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{-1}{\sqrt{6}} \text{ or } \frac{-2}{\sqrt{6}}, \frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}.$$

The angle θ between the lines is given by

$$\cos \theta = \frac{1}{\sqrt{6}} \times \frac{-2}{\sqrt{6}} + \frac{2}{\sqrt{6}} \times \frac{1}{\sqrt{6}} + \frac{-1}{\sqrt{6}} \times \frac{1}{\sqrt{6}} = \frac{-1}{6}$$

$$\Rightarrow \theta = \cos^{-1}\left(\frac{-1}{6}\right)$$

125. The probability that a certain electronic component fail when first used is 0.10. If it does not fail immediately, the probability that it lasts for one year is 0.99. The probability that a new component will last for one year is

- (A) 0.99 (B) 0.871 (C) 0.891 (D) 0.762

Correct Option: C

Solution:

Probability that the electronic component fails when first used is $P(F) = 0.10$. Therefore,

$$P(F') = 1 - P(F) = 0.90.$$

Let E be the event that a new component will last for one year.

$$\text{Then, } P(E) = P(F)P\left(\frac{E}{F}\right) + P(F')P\left(\frac{E}{F'}\right)$$

(total probability theorem)

$$= 0.10 \times 0 + 0.90 \times 0.99 = 0.891.$$

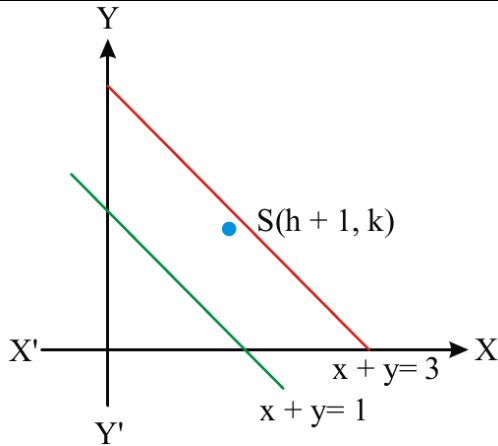
126. If the focus of parabola $(y - k)^2 = 4(x - h)$ always lie between the lines $x + y = 1$ and $x + y = 3$ then

- (A) $0 < h + k < 2$ (B) $0 < h + k < 1$
(C) $1 < h + k < 2$ (D) $1 < h + k < 3$

Correct Option: A

Solution:

Coordinate of focus will be $(h + 1, k)$ Now focus should lie to the opposite side of origin with respect to with respect to line. $x + y - 1 = 0$ and same side as origin with respect to line $x + y - 3 = 0$. Hence $h + k > 0$ and $h + k < 2$.



127. The sum of the infinite series $1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \frac{51}{6^5} + \frac{70}{6^6} + \dots$ is equal to:
- (A) $\frac{425}{216}$ (B) $\frac{429}{216}$
 (C) $\frac{288}{125}$ (D) $\frac{280}{125}$

JM 2022

Correct Option: C**Solution:**

$$S = 1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \dots$$

$$\frac{S}{6} = \frac{1}{6} + \frac{5}{6^2} + \frac{12}{6^3} + \frac{22}{6^4} + \dots$$

on subtraction

$$\frac{5}{6}S = 1 + \frac{4}{6} + \frac{7}{6^2} + \frac{10}{6^3} + \frac{13}{6^4} + \dots$$

$$\frac{5}{36}S = 1 + \frac{4}{6^2} + \frac{7}{6^3} + \frac{10}{6^4} + \frac{13}{6^5} + \dots$$

on subtraction

$$\frac{25}{36}S = 1 + \frac{3}{6} + \frac{3}{6^2} + \frac{3}{6^3} + \dots = \frac{8}{3}$$

$$S = \frac{288}{125}$$

128. Let the acute angle bisector of the two planes $x - 2y - 2z + 1 = 0$ and $2x - 3y - 6z + 1 = 0$ be the plane P. Then which of the following points lies on P?

- (A) $(3, 1, -\frac{1}{2})$ (B) $(-2, 0, -\frac{1}{2})$
 (C) $(0, 2, -4)$ (D) $(4, 0, -2)$

JM 2021

Correct Option: B**Solution:**

$$P_1 : x - 2y - 2z + 1 = 0 \quad P_2 : 2x - 3y - 6z + 1 = 0$$

$$\left| \frac{x-2y-2z+1}{\sqrt{1+4+4}} \right| = \left| \frac{2x-3y-6z+1}{\sqrt{2^2+3^2+6^2}} \right|$$

$$\frac{x-2y-2z+1}{3} = \pm \frac{2x-3y-6z+1}{7}$$

Since $a_1 a_2 + b_1 b_2 + c_1 c_2 = 20 > 0$ Therefore,

negative sign will give the acute bisector

$$7x - 14y - 14z + 7 = -[6x - 9y - 18z + 3]$$

$$\Rightarrow 13x - 23y - 32z + 10 = 0$$

$(-2, 0, -\frac{1}{2})$ satisfies it.

129. Consider the following statements :

A : Rishi is a judge.

B : Rishi is honest.

C : Rishi is not arrogant.

The negation of the statement "if Rishi is a judge and he is not arrogant, then he is honest" is

- (A) $B \rightarrow (A \vee C)$
 (B) $(\sim B) \wedge (A \wedge C)$
 (C) $B \rightarrow ((\sim A) \vee (\sim C))$
 (D) $B \rightarrow (A \wedge C)$

JM 2022

Correct Option: B**Solution:**

$$\sim ((A \wedge C) \rightarrow B)$$

$$\sim (\sim (A \wedge C) \vee B)$$

Using De-Morgan's law

$$(A \wedge C) \wedge (\sim B)$$

130. The sum of all values of x in $[0, 2\pi]$, for which $\sin x + \sin 2x + \sin 3x = 0$, is equal to :

- (A) 8π (B) 11π (C) 12π (D) 9π

JM 2021

Correct Option: D**Solution:**

$$(\sin x + \sin 4x) + (\sin 2x + \sin 3x) = 0$$

$$\Rightarrow 2 \sin \frac{5x}{2} \left\{ \cos \frac{3x}{2} + \cos \frac{x}{2} \right\} = 0$$

$$\Rightarrow 2 \sin \frac{5x}{2} \{ 2 \cos x \cos \frac{x}{2} \} = 0$$

$$2 \sin \frac{5x}{2} = 0 \Rightarrow \frac{5x}{2} = 0, \pi, 2\pi, 3\pi, 4\pi, 5\pi$$

$$\Rightarrow x = 0, \frac{2\pi}{5}, \frac{4\pi}{5}, \frac{6\pi}{5}, \frac{8\pi}{5}, 2\pi$$

$$\cos \frac{x}{2} = 0 \Rightarrow \frac{x}{2} = \frac{\pi}{2} \Rightarrow x = \pi$$



$$\cos x = 0 \Rightarrow x = \frac{\pi}{2}, \frac{3\pi}{2}$$

$$\text{So sum} = 6\pi + \pi + 2\pi = 9\pi$$

BITSAT Solved Paper 2024 Session-II - ANSWER KEY

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