

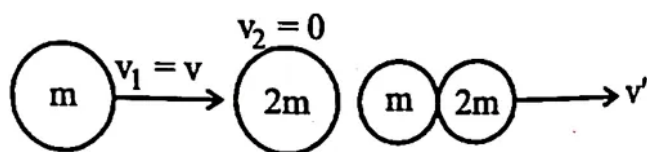
BITSAT Solved Paper 2023 Session-I

1. A particle of mass m moving with velocity v collides with a stationary particle of mass $2m$. After collision, they stick together and continue to move together with velocity

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

Correct Option: C

Solution:



Applying conservation of linear momentum

$$\begin{aligned}\Rightarrow \vec{P}_i &= \vec{P}_f (\because P = mv) \\ mv_1 + 2mv_2 &= (m + 2m)v' \\ mv + 2m \times 0 &= (3m)v' \\ \Rightarrow mv &= 3mv' \Rightarrow v' = \frac{v}{3}\end{aligned}$$

2. Electric field in a certain region is given by $\vec{E} = (\frac{A}{x^2}\hat{i} + \frac{B}{y^3}\hat{j})$. The SI unit of A and B are:

(A) Nm^3C^{-1} ; Nm^2C^{-1}
(B) Nm^2C^{-1} ; Nm^2C^{-1}
(C) Nm^3C ; Nm^2C
(D) Nm^2C ; Nm^2C

Correct Option: B

Solution:

3. The magnetic moment of an electron (e) revolving in an orbit around nucleus with an orbital angular momentum is given by:

(A) $\vec{\mu}_L = \frac{e\vec{L}}{2m}$
(B) $\vec{\mu}_L = -\frac{e\vec{L}}{2m}$
(C) $\vec{\mu}_l = -\frac{e\vec{L}}{m}$
(D) $\vec{\mu}_l = \frac{2e\vec{L}}{m}$

Correct Option: A

Solution:

4. A radioactive material is reduced to $\frac{1}{8}$ of its original amount in 3 days. If 8×10^{-3} kg of the material is left after 5 days, what is the initial amount of the material?
(A) 700 gm (B) 900 gm (C) 475 gm (D) 256

Correct Option: D

Solution:

5. In a Young's double slit experiment, the intensities at points, for the path difference $\frac{\lambda}{4}$ and $\frac{\lambda}{3}$ (λ being the wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits, then $\frac{I_1 + I_2}{I_0} = \dots$

(A) 3 (B) 5 (C) 7 (D) 10

Correct Option: A

Solution:

Resultant intensity in Young's double slit experiment

$$I = 4I_0 \cos^2\left(\frac{\Delta\phi}{2}\right)$$

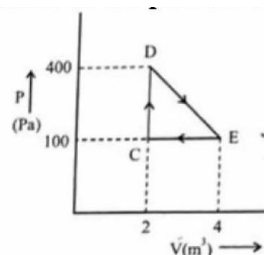
For path difference $\frac{\lambda}{4}$ phase difference,

$$\begin{aligned}\Delta\phi &= \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{4} \\ \therefore I_1 &= 4I_0 \cos^2\left(\frac{\pi}{4}\right) = 2I_0\end{aligned}$$

For path difference $\frac{\lambda}{3}$

$$\begin{aligned}I_2 &= 4I_0 \cos^2\left(\frac{2\pi}{\lambda} \times \frac{\lambda}{3}\right) = I_0 \\ \therefore \frac{I_1 + I_2}{I_0} &= 3\end{aligned}$$

6. A thermodynamic system is taken through cyclic process ABCDA. The total work done in the process is :



(A) 100 J (B) 300 J (C) Zero (D) 200

Correct Option: B

Solution:

Work done = Area under the curve



$$\Rightarrow W = \frac{1}{2} \times (4 - 2) \times (400 - 100) = \frac{1}{2}(2) \times 300$$

$$W = 300 \text{ J}$$

7. The work done in placing a charge of 8×10^{-18} coulomb on a condenser of capacity 100 microfarad is

- (A) 3.1×10^{-26} joule (B) 4×10^{-10} joule
(C) 32×10^{-32} joule (D) 16×10^{-32} joule

Correct Option: C

Solution:

$$\text{Work done} = \frac{1}{2} \frac{q^2}{C} = \frac{(8 \times 10^{-18})^2}{2 \times 100 \times 10^{-6}} = 32 \times 10^{-32} \text{ J}$$

8. The force between two small charged spheres having charges of $1 \times 10^{-7} \text{ C}$ and $2 \times 10^{-7} \text{ C}$ placed 20 cm apart in air is

- (A) $4.5 \times 10^{-2} \text{ N}$ (B) $4.5 \times 10^{-3} \text{ N}$
(C) $5.4 \times 10^{-2} \text{ N}$ (D) $5.4 \times 10^{-3} \text{ N}$

Correct Option: B

Solution:

$$\text{Here, } q_1 = 1 \times 10^{-7} \text{ C, } q_2 = 2 \times 10^{-7} \text{ C,}$$

$$r = 20 \text{ cm} = 20 \times 10^{-2} \text{ m}$$

$$F = \frac{q_1 q_2}{4\pi\epsilon_0 r^2} = \frac{9 \times 10^9 \times 1 \times 10^{-7} \times 2 \times 10^{-7}}{(20 \times 10^{-2})^2} = 4.5 \times 10^{-3} \text{ N}$$

9. A charge particle is moving in a uniform magnetic field $(2\hat{i} + 3\hat{j})\text{T}$. If it has an acceleration of $(\alpha\hat{i} - 4\hat{j})\text{m/s}^2$, then the value of α will be

- (A) 3 (B) 6 (C) 12 (D) 2

Correct Option: B

Solution:

$$\text{As } \vec{F} = q(\vec{v} \times \vec{B})$$

$$\vec{a} = \frac{q}{m}(\vec{v} \times \vec{B})$$

So, $\vec{a}$ & $\vec{B}$ are $\perp$ to each other Hence,

$$\vec{a} \cdot \vec{B} = 0$$

$$(\alpha\hat{i} - 4\hat{j}) \cdot (2\hat{i} + 3\hat{j}) = 0$$

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

$$\alpha = \frac{12}{2} \Rightarrow \alpha = 6$$

10. If 1000 droplets of water of surface tension 0.07 N/m having the same radius 1 mm each, combine to form single drop. In the process the released surface energy ($\text{Take } \pi = \frac{22}{7}$)

- (A) $7.92 \times 10^{-6} \text{ J}$ (B) $7.92 \times 10^{-4} \text{ J}$
(C) $9.68 \times 10^{-4} \text{ J}$ (D) $8.8 \times 10^{-5} \text{ J}$

Correct Option: B

Solution:

$$1000 \times \frac{4\pi}{3} (1)^3 = \frac{4\pi}{3} R^3$$

$$R = 10 \text{ mm}$$

$$T \times 1000 \times 4\pi (10^{-3})^2$$

$$- T \times 4\pi (10 \times 10^{-3})^2 = \Delta E$$

$$\Delta E = 4 \times \pi \times 7 \times 10^{-2} [1000 - 100] \times 10^{-6}$$

$$\Delta E = 7.92 \times 10^{-4} \text{ J}$$

11. The ratio of average electric energy density and total energy density of electromagnetic wave is:

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

JM 2

Correct Option: D

Solution:

$$\langle u_E \rangle = \langle u_B \rangle = \frac{1}{2} \langle u_{\text{total}} \rangle$$

$$\text{So } \frac{\langle u_E \rangle}{\langle u_{\text{total}} \rangle} = \frac{1}{2}$$

12. The effect of increase in temperature on the number of electrons in conduction band (n_e) and resistance of semiconductor will be as:

- (A) Both n_e and resistance decrease
(B) Both n_e and resistance increase
(C) n_e increases, resistance decreases
(D) n_e decreases, resistance increases

JM 2

Correct Option: C

Solution:

As temperature increases, more electron excite to conduction band and hence conductivity increases, therefore resistance decreases.

13. In an LC oscillator, if values of inductance and capacitance become twice and eight times, respectively, then the resonant frequency of oscillator becomes x times its initial resonant frequency ω_0 . The value of x is:

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

JM 2023

Correct Option: A**Solution:**

The resonance frequency of LC oscillations circuit is

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$L \rightarrow 2L$$

$$C \rightarrow 8C$$

$$\omega = \frac{1}{\sqrt{2L \times 8C}} = \frac{1}{4\sqrt{LC}}$$

$$\omega = \frac{\omega_0}{4}$$

$$\text{So } x = \frac{1}{4}$$

14. A 100 m long wire having cross-sectional area $6.25 \times 10^{-4} \text{ m}^2$ and Young's modulus is 10^{10} Nm^{-2} is subjected to a load of 250 N, then the elongation in the wire will be :

(A) $6.25 \times 10^{-3} \text{ m}$ $6.25 \times 10^{-3} \text{ m}$
(B) $4 \times 10^{-4} \text{ m}$ $4 \times 10^{-4} \text{ m}$
(C) $6.25 \times 10^{-6} \text{ m}$
(D) $4 \times 10^{-3} \text{ m}$

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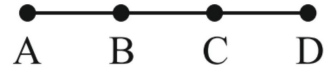
Correct Option: D**Solution:**

$$\text{Elongation in wire } \delta = \frac{F\ell}{AY}$$

$$\delta = \frac{250 \times 100}{6.25 \times 10^{-4} \times 10^{10}}$$

$$\delta = 4 \times 10^{-3} \text{ m}$$

15. An object moves with speed v_1 , v_2 , and v_3 along segment AB, BC and CD respectively as shown in : Where $AB = BC$ and $AD = 3AB$, then average speed the object will be :



(A) $\frac{v_1 + v_2 + v_3}{3}$
(B) $\frac{v_1 v_2 v_3}{3(v_1 v_2 + v_2 v_3 + v_3 v_1)}$
(C) $\frac{3v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$
(D) $\frac{v_1 + v_2 + v_3}{3v_1 v_2 v_3}$

JM 2

Correct Option: C**Solution:**

$$AB = x$$

$$BC = x$$

$$2x + CD = 3x$$

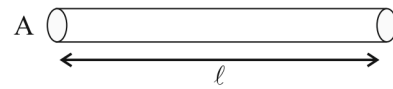
$$CD = x$$

$$\langle v \rangle = \frac{3x}{\frac{x}{v_1} + \frac{x}{v_2} + \frac{x}{v_3}} = \frac{3v_1 v_2 v_3}{v_2 v_3 + v_1 v_3 + v_1 v_2}$$

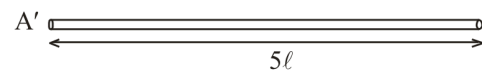
16. The resistance of a wire is 5Ω . It's new resistance in if stretched to 5 times of it's original length will be :

(A) 625 (B) 5 (C) 125 (D) 25

JM 2

Correct Option: C**Solution:**

$$R_{\text{initial}} = \frac{\rho \ell}{A} = 5\Omega$$



$$A' \xrightarrow[\ell]{0} 0$$

$$R_{\text{initial}} = \frac{\rho \ell}{A} = 5\Omega$$

$$A' \xrightarrow{5\ell}$$

$\therefore$ Volume of wire is constant in stretching $V_i = V_f$

$$A_i \ell_i = A_f \ell_f$$

$$A \ell = A' (5 \ell)$$

$$A' = \frac{A}{5}$$

$$R_f = \frac{\rho \ell_f}{A_f} = \frac{\rho (5 \ell)}{\left(\frac{A}{5}\right)}$$

$$= 25 \left(\frac{\rho \ell}{A} \right)$$

$$= 25 \times 5 = 125 \Omega$$

17. The free space inside a current carrying toroid is filled with a material of susceptibility 2×10^{-2} . The percentage increase in the value of magnetic field inside the toroid will be

(A) 2% (B) 0.2% (C) 0.1% (D) 1%

JM 2023

Correct Option: A

Solution:

$$\text{As } X_m = 2 \times 10^{-2}$$

$$\mu_r = 1 + X_m = 1.02$$

$$\Rightarrow B = \mu_r B_0 = 1.02 B_0$$

So percentage increase in magnetic field

$$= \frac{B - B_0}{B_0} \times 100\% = 2\%$$

18. A bicycle tyre is filled with air having pressure of 270 kPa at 27°C . The approximate pressure of the air in the tyre when the temperature increases to 36°C is

(A) 270 kPa (B) 262 KPa (C) 278 kPa (D) 360 kPa

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Correct Option: C

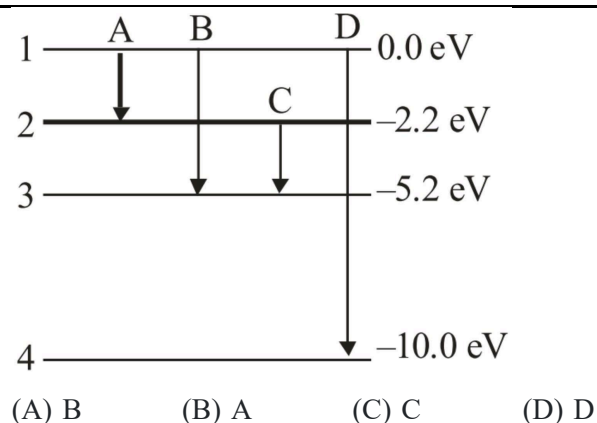
Solution:

$$\text{Taking volume constant: } \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\Rightarrow P_2 = \frac{P_1}{T_1} \times T_2 = \frac{270 \times (309)}{300}$$

$$= 278 \text{ kPa}$$

19. The energy levels of an atom is shown in figure. Which one of these transitions will result in the emission of a photon of wavelength 124.1 nm ? Given ($h = 6.62 \times 10^{-34} \text{ Js}$)



JM 2

Correct Option: D

Solution:

$$\lambda = \frac{hc}{\Delta E}$$

$$\Delta E_A = 2.2 \text{ eV}$$

$$\Delta E_B = 5.2 \text{ eV}$$

$$\Delta E_C = 3 \text{ eV}$$

$$\Delta E_D = 10 \text{ eV}$$

$$\lambda_A = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{2.2 \times 1.6 \times 10^{-19}}$$

$$= \frac{12.41 \times 10^{-7}}{2.2} \text{ m}$$

$$= \frac{1241}{2.2} \text{ nm} = 564 \text{ nm}$$

$$\lambda_B = \frac{1241}{5.2} \text{ nm} = 238.65 \text{ nm}$$

$$\lambda_C = \frac{1241}{3} \text{ nm} = 413.66 \text{ nm}$$

$$\lambda_D = \frac{1241}{10} = 124.1 \text{ nm}$$

20. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. The number of spectra emitted will be:

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

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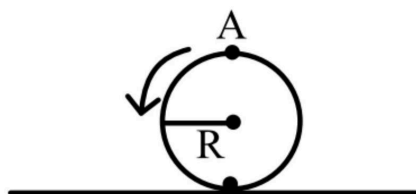
Correct Option: C

Solution:

According to Bohr's postulates, an electron makes jump higher energy orbital if it absorbs a photon of energy equal to difference between the energies of an excited state and the ground state. Assuming that collided electron takes energy equal to 10.2 eV or 12.09 eV from incoming electron beam (some part lost due to collision). The

maximum excited state is $n = 3$. So, number of spectral lines is $\frac{3(3-1)}{2} = 3$

21. A disc is rolling without slipping on a surface. The radius of the disc is R . At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is

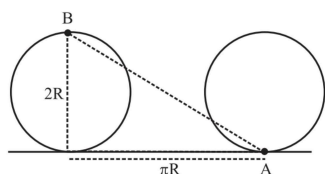


- (A) $R\sqrt{4 + \pi^2}$ (B) $R\sqrt{\pi^2 + 4}$
(C) $R\sqrt{\pi^2 + 1}$ (D) $2R$

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Correct Option: A

Solution:



$$\text{Displacement} = \sqrt{(2R)^2 + (\pi R)^2} = R\sqrt{4 + \pi^2}$$

22. The ratio of intensities at two points P and Q on the screen in a Young's double slit experiment where phase difference between two waves of same amplitude are $\pi/3$ and $\pi/2$, respectively are

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

JM 2023

Correct Option: C

Solution:

$$I_{net} = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$$

$$= I_0 + I_0 + 2I_0 \cos \frac{\pi}{3}$$

$$= 2I_0 + 2I_0 \times \frac{1}{2} = 3I_0$$

$$I_{net} = I_0 + I_0 + 2I_0 \cos 90^\circ = 2I_0$$

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

23. Two planets A and B of radii R and $1.5 R$ have densities ρ and $\rho/2$ respectively. The ratio of acceleration due to gravity at the surface of B to A is :

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

JM 2

Correct Option: C

Solution:

$$g = \frac{GM}{R^2} = \frac{4}{3}\pi G \rho R$$

$$\therefore \frac{g_2}{g_1} = \frac{\rho_2}{\rho_1} \times \frac{R_2}{R_1} = \frac{1}{2} \times 1.5 = \frac{3}{4}$$

24. A particle executes SHM of amplitude A. The distance from the mean position when its kinetic energy becomes equal to its potential energy is :

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

JM 2

Correct Option: C

Solution:

$$KE = PE$$

$$\frac{1}{2}M\omega^2 (A^2 - x^2) = \frac{1}{2}M\omega^2 x^2$$

$$A^2 - x^2 = x^2 \Rightarrow A^2 = 2x^2$$

$$\Rightarrow x = \pm \frac{A}{\sqrt{2}}$$

25. Which of the following Maxwell's equations is valid under time varying conditions but not valid for static conditions :

(A) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

(B) $\oint \vec{E} \cdot d\vec{l} = 0$

(C) $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \phi_B}{\partial t}$

(D) $\oint \vec{D} \cdot d\vec{A} = Q$

JM 2

Correct Option: C

Solution:

Based on equations of Maxwell

26. Proton (P) and electron (e) will have same deBroglie wavelength when the ratio of their momentum is (assume, $m_p = 1849 m_e$)

- (A) 1:43 (B) 43:1 (C) 1:1849 (D) 1:1

JM 2

Correct Option: D

Solution:

De Broglie wavelength is $\lambda = \frac{h}{mv}$

$$\lambda_p = \lambda_e \Rightarrow m_p v_p = m_e v_e \Rightarrow p_p = p_e$$

27. At any instant the velocity of a particle of mass 500 g is $(2t\hat{i} + 3t^2\hat{j}) \text{ ms}^{-1}$. If the force acting on the particle at $t = 1 \text{ s}$ is $(\hat{i} + x\hat{j})\text{N}$. Then the value of x will be:

(A) 3 (B) 4 (C) 6 (D) 2

JM 2023**Correct Option: A****Solution:**

$$\vec{v} = 2t\hat{i} + 3t^2\hat{j}$$

$$\vec{a} = 2\hat{i} + 6t\hat{j}$$

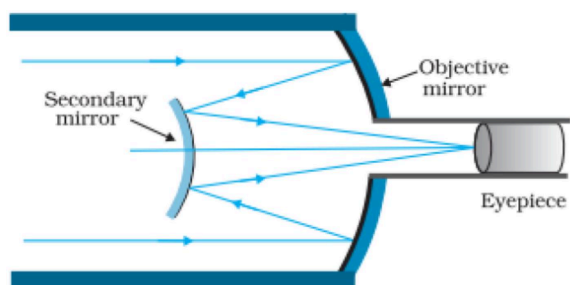
$$at t = 1, \vec{a} = 2\hat{i} + 6\hat{j}$$

$$\vec{F} = m\vec{a} = 0.5(2\hat{i} + 6\hat{j}) = \hat{i} + 3\hat{j}$$

$$\vec{F} = \hat{i} + x\hat{j} \quad \text{Hence } x = 3$$

28. In a reflecting telescope, a secondary mirror is used to:

(A) reduce the problem of mechanical support
(B) remove spherical aberration
(C) make chromatic aberration zero
(D) move the eyepiece outside the telescopic tube

JM 2023**Correct Option: D****Solution:**

It has advantage of a large focal length in a short telescope.

29. The ratio of speed of sound in hydrogen gas to the speed of sound in oxygen gas at the same temperature is:

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

JM 2**Correct Option: A****Solution:**

$$C = \sqrt{\frac{\gamma RT}{M}}$$

$$C \propto \frac{1}{\sqrt{M}}$$

$$\frac{C_{H_2}}{C_{O_2}} = \sqrt{\frac{32}{2}} = 4 : 1$$

30. A conducting loop of radius $\frac{10}{\sqrt{\pi}} \text{ cm}$ is placed perpendicular to a uniform magnetic field of 0.5 T. The magnetic field is decreased to zero in 0.5 s at a steady rate. The induced emf in the circular loop at 0.25 s is

(A) $emf = 1 \text{ mV}$ (B) $emf = 10 \text{ mV}$
(C) $emf = 100 \text{ mV}$ (D) $emf = 5 \text{ mV}$

JM 2**Correct Option: B****Solution:**

$$EMF = \frac{d\phi}{dt} = \frac{BA - 0}{t}$$

$$A = \pi r^2 = \pi \left(\frac{0.1^2}{\pi} \right) = 0.01$$

$$B = 0.5$$

$$EMF = \frac{(0.5)(0.01)}{0.5} = 0.01 \text{ V} = 10 \text{ mV}$$

BITSAT Solved Paper 2023 Session-I - ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	C	B	A	D	A	B	C	B	B	B
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	C	A	D	C	C	A	C	D	C
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	A	C	C	C	C	D	A	D	A	B