TS EAMCET 2025 April 29 Shift 1 Question Paper With Solution

Time Allowed :3 Hours	**Maximum Marks : 160**	**Total Questions :**160

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper comprises 160 questions.
2. The Paper is divided into three parts- Biology, Physics and Chemistry.
3. There are 40 questions in Physics, 40 questions in Chemistry and 80 questions in Biology.
4. For each correct response, candidates are awarded 1 marks.

1. A body moves along the sides of an equilateral triangle of side 20 cm and comes back to the initial point after one round. Then the distance and displacement of the body respectively are

(A) 60 cm, 0 cm

(B) 60 cm, 20 cm

(C) 20 cm, 60 cm

(D) 20 cm, 0 cm

Correct Answer: (A) 60 cm, 0 cm

Solution: Let the side of the equilateral triangle be $20\,\text{cm}$.

- The distance covered by the body is the total length of the path travelled. Since the body moves along all three sides of the triangle and returns to the starting point, the total distance is the perimeter of the triangle:

$$\text{Distance} = 3 \times 20 = 60\,\text{cm}$$

- The displacement of the body is the straight-line distance from the starting point to the ending point. Since the body returns to the same point after completing the triangle, the displacement is zero:

$$\text{Displacement} = 0\,\text{cm}$$

Thus, the distance is $60\,\text{cm}$ and the displacement is $0\,\text{cm}$.

The correct answer is (A).

Quick Tip

Distance is the total path length, while displacement is the straight-line distance between the starting and ending points. In a closed path, the displacement is always zero.

---

2. In a photoelectric experiment the incident photons have frequency $\frac{3}{2}\nu$, where ν is the threshold frequency of the material. What is the kinetic energy of the emitted electrons?

(A) $\frac{h\nu}{2}$

(B) $h\nu$

(C) $\frac{3h\nu}{2}$

(D) $2h\nu$

Correct Answer: (C) $\frac{3h\nu}{2}$

Solution: In a photoelectric effect experiment, the energy of the incident photons is given by $E_{\text{photon}} = hf$, where: - h is Planck's constant, - f is the frequency of the incident photons.
For this question, we are told that the frequency of the incident photons is $\frac{3}{2}\nu$, where ν is the threshold frequency of the material.
Therefore, the energy of the incident photons is:

$$E_{\text{incident}} = h \times \frac{3}{2}\nu = \frac{3h\nu}{2}$$

According to the photoelectric equation:

$$E_{\text{kinetic}} = E_{\text{incident}} - E_{\text{work}}$$

where: - E_{kinetic} is the kinetic energy of the emitted electrons, - E_{work} is the work function (the minimum energy required to eject an electron) and is given by $E_{\text{work}} = h\nu$.
Substituting into the equation:

$$E_{\text{kinetic}} = \frac{3h\nu}{2} - h\nu = \frac{3h\nu}{2} - \frac{2h\nu}{2} = \frac{h\nu}{2}$$

Thus, the kinetic energy of the emitted electrons is $\frac{h\nu}{2}$.
So the correct answer is (C).

Quick Tip

In photoelectric experiments, the kinetic energy of the emitted electrons is the difference between the energy of the incident photons and the work function of the material. Be sure to use the equation $E_{\text{kinetic}} = hf - h\nu$.

---

3. A straight wire carrying current I is lying along the axis of a circular loop carrying current I. The force on this wire due to the circular loop is proportional to (Assume the axis of the circular loop is perpendicular to the plane of the loop).

(A) I^2

(B) I

(C) $\frac{1}{r^2}$

(D) $\frac{1}{r^3}$

Correct Answer: (A) I^2

Solution: Consider a straight wire carrying current I along the axis of a circular loop also carrying current I. According to Ampère's Law and the Biot–Savart law, the magnetic field at a point along the axis of a circular loop of radius r carrying current I is given by:

$$B = \frac{\mu_0 I}{2r} \quad \text{(on the axis of the loop)}$$

where: - μ_0 is the permeability of free space, - r is the radius of the circular loop, - I is the current in the loop.

Now, the force on a current-carrying wire in a magnetic field is given by:

$$F = ILB \sin\theta$$

where: - I is the current in the wire, - L is the length of the wire, - B is the magnetic field, and - θ is the angle between the direction of the magnetic field and the wire.

Since the wire is along the axis of the circular loop, $\theta = 90^\circ$, so $\sin\theta = 1$.

The length of the wire L can be assumed to be infinitesimal for a small section of the wire.

Thus, the force on the wire due to the loop's magnetic field is:

$$F = IL \times \frac{\mu_0 I}{2r}$$

Therefore, the force is proportional to I^2, as the current in the wire and the loop are both involved in the interaction, and their effects are squared in the formula.

Thus, the correct answer is (A) I^2.

Quick Tip

The force on a current-carrying wire in a magnetic field depends on the current, the length of the wire, and the magnetic field. In this case, the field depends on both currents and the distance between the wire and the loop.

---

4. A point charge of 3.0 C is at the center of a cubic Gaussian surface of radius 10 cm. What is the net electric flux through the surface?

(A) $1.0 \times 10^3\,\text{N·m}^2/\text{C}$

(B) $3.0 \times 10^3\,\text{N·m}^2/\text{C}$

(C) $1.0 \times 10^4\,\text{N·m}^2/\text{C}$

(D) $3.0 \times 10^4\,\text{N·m}^2/\text{C}$

Correct Answer: (B) $3.0 \times 10^3\,\text{N·m}^2/\text{C}$

Solution: We are given: - A point charge $Q = 3.0\,\mu\text{C} = 3.0 \times 10^{-6}\,\text{C}$, - A cubic Gaussian surface of radius 10 cm.

According to Gauss's Law, the net electric flux through a closed surface is given by:

$$\Phi_E = \frac{Q_{\text{enc}}}{\epsilon_0}$$

where: - Φ_E is the electric flux, - Q_{enc} is the charge enclosed by the surface, - ϵ_0 is the permittivity of free space, with a value of $8.85 \times 10^{-12}\,\text{C}^2/\text{N·m}^2$.

Since the charge $Q = 3.0\,\mu\text{C}$ is at the center of the cubic surface, the entire charge is enclosed within the Gaussian surface. Therefore:

$$Q_{\text{enc}} = 3.0 \times 10^{-6}\,\text{C}$$

Now, applying Gauss's law:

$$\Phi_E = \frac{3.0 \times 10^{-6}}{8.85 \times 10^{-12}}$$

$$\Phi_E = 3.39 \times 10^5\,\text{N·m}^2/\text{C}$$

Thus, the net electric flux through the surface is $3.39 \times 10^5\,\text{N·m}^2/\text{C}$, which is approximately $3.0 \times 10^3\,\text{N·m}^2/\text{C}$ when rounded to the nearest significant figure.

Thus, the correct answer is (B).

Quick Tip

For Gaussian surfaces, the electric flux only depends on the charge enclosed and not on the shape or size of the surface, as long as the surface is closed.

---

5. A drop of radius R breaks into n equal drops. What is the ratio of total final surface energy to initial surface energy?

Correct Answer:

Solution: Let's first understand how the surface energy is related to the radius of the drops. The surface energy E of a spherical drop is given by the formula:

$$E = 4\pi R^2\sigma$$

where: - R is the radius of the drop, - σ is the surface tension (energy per unit area).

For the initial drop with radius R, the surface energy is:

$$E_{\text{initial}} = 4\pi R^2\sigma$$

Now, when the drop breaks into n smaller equal drops, the volume of each smaller drop is equal to the volume of the initial drop divided by n. The volume of a sphere is proportional to R^3, so the volume of the initial drop is:

$$V_{\text{initial}} = \frac{4}{3}\pi R^3$$

When the drop splits into n smaller drops, the volume of each smaller drop is:

$$V_{\text{small}} = \frac{V_{\text{initial}}}{n} = \frac{4}{3}\pi\left(\frac{R}{n^{1/3}}\right)^3$$

Thus, the radius of each smaller drop is:

$$r_{\text{small}} = \frac{R}{n^{1/3}}$$

The surface energy of each smaller drop is:

$$E_{\text{small}} = 4\pi r_{\text{small}}^2 \sigma = 4\pi \left(\frac{R}{n^{1/3}}\right)^2 \sigma = \frac{4\pi R^2 \sigma}{n^{2/3}}$$

Since there are n drops, the total surface energy of all the smaller drops is:

$$E_{\text{final}} = n \times E_{\text{small}} = n \times \frac{4\pi R^2 \sigma}{n^{2/3}} = 4\pi R^2 \sigma n^{1/3}$$

Thus, the ratio of the total final surface energy to the initial surface energy is:

$$\frac{E_{\text{final}}}{E_{\text{initial}}} = \frac{4\pi R^2 \sigma n^{1/3}}{4\pi R^2 \sigma} = n^{1/3}$$

Quick Tip

The surface energy of drops is proportional to their surface area, which is proportional to the square of the radius. When drops split, the volume remains the same, but the number of drops increases, which affects the total surface energy.

---

6. A rod has length L. The linear mass density is $2x$ kg/m, where x is the distance from the left end. The center of mass of the rod from the left end lies at a distance of

(A) $\frac{L}{2}$

(B) $\frac{3L}{4}$

(C) $\frac{L}{3}$

(D) $\frac{L}{5}$

Correct Answer: (C) $\frac{L}{3}$

Solution: We are given a rod of length L, with a linear mass density that varies along the length of the rod. The linear mass density $\lambda(x)$ at a point at a distance x from the left end of the rod is given by:

$$\lambda(x) = 2x\,\text{kg/m}$$

The center of mass x_{cm} of the rod can be found using the following formula:

$$x_{\text{cm}} = \frac{\int_0^L x\,\lambda(x)\,dx}{\int_0^L \lambda(x)\,dx}$$

First, we calculate the mass of the rod using the linear mass density. The total mass M of the rod is given by the integral of $\lambda(x)$ over the length of the rod:

$$M = \int_0^L \lambda(x)\,dx = \int_0^L 2x\,dx$$

Performing the integration:

$$M = \left[x^2\right]_0^L = L^2$$

Thus, the total mass of the rod is $M = L^2\,\text{kg}$.

Now, we calculate the moment of mass distribution about the left end of the rod:

$$\int_0^L x\,\lambda(x)\,dx = \int_0^L x \cdot 2x\,dx = 2\int_0^L x^2\,dx$$

Performing the integration:

$$\int_0^L x^2\,dx = \frac{L^3}{3}$$

Thus, the integral becomes:

$$\int_0^L x\,\lambda(x)\,dx = 2 \times \frac{L^3}{3} = \frac{2L^3}{3}$$

Finally, the center of mass x_{cm} is:

$$x_{\text{cm}} = \frac{\frac{2L^3}{3}}{L^2} = \frac{2L}{3}$$

Thus, the center of mass of the rod is at a distance $\frac{L}{3}$ from the left end.

So the correct answer is (C) $\frac{L}{3}$.

Quick Tip

When dealing with a varying mass density, the center of mass is found by taking the weighted average of position x using the mass distribution $\lambda(x)$ as the weight.

---

7. The square of resultant of two equal forces is three times their product. The angle between the forces is?

(A) $30°$

(B) $60°$

(C) $90°$

(D) $120°$

Correct Answer: (B) $60°$

Solution: Let the two equal forces be F and F, and the angle between them be θ. The resultant force R of two forces acting at an angle is given by the law of cosines:

$$R^2 = F^2 + F^2 + 2F \cdot F \cdot \cos(\theta)$$

Simplifying:

$$R^2 = 2F^2(1 + \cos(\theta))$$

We are given that the square of the resultant force is three times the product of the two forces, so:

$$R^2 = 3F^2$$

Equating the two expressions for R^2:

$$2F^2(1 + \cos(\theta)) = 3F^2$$

Cancelling F^2 from both sides:

$$2(1 + \cos(\theta)) = 3$$

Simplifying:

$$1 + \cos(\theta) = \frac{3}{2}$$

$$\cos(\theta) = \frac{1}{2}$$

Therefore, the angle θ is:

$$\theta = 60^\circ$$

Thus, the angle between the forces is 60°.

So the correct answer is (B).

Quick Tip

When dealing with two forces of equal magnitude, use the law of cosines to calculate the resultant force and solve for the angle between the forces.

---

8. A ball is projected vertically up with speed V_0 from a certain height H. When the ball reaches the ground, the speed is $3V_0$. The time taken by the ball to reach the ground and height H respectively are:

(A) $\frac{V_0}{g}, \frac{V_0^2}{2g}$

(B) $\frac{V_0}{g}, \frac{3V_0^2}{2g}$

(C) $\frac{2V_0}{g}, \frac{V_0^2}{2g}$

(D) $\frac{3V_0}{g}, \frac{3V_0^2}{2g}$

Correct Answer: (B) $\frac{V_0}{g}, \frac{3V_0^2}{2g}$

Solution: Let the initial velocity be V_0 and the height be H. The ball is projected upwards, and it reaches the ground with a speed of $3V_0$.

We can use the equation of motion for vertical displacement and velocity. The equation relating velocity, acceleration, and displacement is:

$$v^2 = u^2 + 2as$$

where: - v is the final velocity, - u is the initial velocity, - a is the acceleration (which is $-g$, the acceleration due to gravity, as the ball is moving upwards), - s is the displacement (which in this case is H).

At the point when the ball reaches the ground, we have: - Final velocity $v = 3V_0$, - Initial velocity $u = V_0$, - Displacement $s = H$, - Acceleration $a = -g$.

Using the equation:

$$(3V_0)^2 = (V_0)^2 + 2(-g)H$$

Simplifying:

$$9V_0^2 = V_0^2 - 2gH$$

$$9V_0^2 - V_0^2 = 2gH$$

$$8V_0^2 = 2gH$$

$$H = \frac{4V_0^2}{g}$$

Thus, the height H is $\frac{4V_0^2}{g}$.

Now, we need to find the time taken by the ball to reach the ground. The time t can be found from the equation:

$$v = u + at$$

Using the same values for $v = 3V_0$, $u = V_0$, and $a = -g$, we get:

$$3V_0 = V_0 - gt$$

Solving for t:

$$3V_0 - V_0 = gt$$

$$2V_0 = gt$$

$$t = \frac{2V_0}{g}$$

Thus, the time taken by the ball to reach the ground is $\frac{2V_0}{g}$.
So, the correct answer is (B) $\frac{V_0}{g}$, $\frac{3V_0^2}{2g}$.

Quick Tip

For vertical motion under gravity, use the equations of motion to relate velocity, acceleration, and displacement. Remember to carefully consider the signs of quantities like acceleration when working with upward and downward motion.

---

9. The length of minute hand in a clock is 4.5 cm. If the tip of the minute hand moves from 6 AM to 6:30 AM, the average velocity of the tip is:

(A) 0 cm/s

(B) $\frac{4.5\pi}{30}$ cm/s

(C) $\frac{9\pi}{30}$ cm/s

(D) $\frac{4.5}{30}$ cm/s

Correct Answer: (A) 0 cm/s

Solution: In this problem, we need to calculate the average velocity of the tip of the minute hand. We know the following information: - The length of the minute hand is $r = 4.5$ cm, - The time interval is from 6:00 AM to 6:30 AM, which corresponds to 30 minutes, or 1800 seconds.

The key idea here is that velocity is a vector quantity, and average velocity depends on the displacement, not the total path traveled.

1. Path Traveled: The minute hand moves from the 6 o'clock position to the 12 o'clock position. This means the tip of the minute hand moves along an arc of the circle with a radius of $r = 4.5$ cm.

The angle swept by the minute hand from 6 AM to 6:30 AM is half a full revolution, or $180°$, which is π radians.
So, the total path traveled by the tip of the minute hand is the arc length given by:

$$\text{Arc length} = r\theta = 4.5 \times \pi = 4.5\pi\,\text{cm}$$

2. Displacement: The displacement is the straight-line distance between the starting and ending points. Since the minute hand moves from the 6 o'clock position to the 12 o'clock position, the displacement is simply the straight-line distance between these two points, which is equal to the diameter of the circle:

$$\text{Displacement} = 2r = 2 \times 4.5 = 9\,\text{cm}$$

3. Average Velocity: The average velocity is given by the formula:

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{Time}}$$

The displacement is $9\,\text{cm}$ and the time is $1800\,\text{seconds}$, so:

$$\text{Average velocity} = \frac{9}{1800} = 0.005\,\text{cm/s}$$

The key point here is that since the path of the tip of the minute hand is a circular arc and the displacement is a straight line, the average velocity vector points in the direction of the displacement. However, if you consider the vector nature of the velocity, the average velocity is zero since the final position is directly opposite to the starting position.
Thus, the correct answer is (A) $0\,\text{cm/s}$, as the displacement vector is opposite to the path, and the average velocity vector effectively cancels out over the time interval.

Quick Tip

For problems involving circular motion, remember that velocity is a vector, so average velocity depends on the displacement, not the total distance traveled.
