Question Review

All

If a car covers $2/5^{th}$ of the total distance with v_1 speed and $3/5^{th}$ distance with v_2 then average speed is

- $\frac{1}{2}\sqrt{v_1 v_2}$
- $\frac{v_1 + v_2}{2}$
- $\frac{2v_1 v_2}{v_1 + v_2}$
- ✓ $\frac{5v_1 v_2}{3v_1 + 2v_2}$

EXPLANATIONS Report

53 % were correct!

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

$$= \frac{x}{\frac{2x/5}{v_1} + \frac{3x/5}{v_2}} = \frac{5v_1 v_2}{3v_1 + 2v_2}$$

The elastic energy stored in a wire of Young's modulus Y is

- $Y \times \frac{\text{Strain}^2}{\text{Volume}}$
- Stress × Strain × Volume
- ✓ $\frac{\text{Stress}^2 \times \text{Volume}}{2Y}$
- $\frac{1}{2} Y \times \text{Stress} \times \text{Strain} \times \text{Volume}$

EXPLANATIONS Report

41 % were correct!

Energy stored in the wire $U = \frac{1}{2} \times \text{Stress} \times \text{Strain} \times \text{Volume}$

From Hooke's law, $Strain = \dfrac{\text{Stress}}{Y}$

$\therefore U = \dfrac{1}{2} \times \dfrac{\text{Stress}^2}{Y} \times \text{Volume}$

Total internal reflection of light is possible when light enters from

- ○ Air to glass
- ○ Vacuum to air
- ○ Air to water
- ● Water to air

EXPLANATIONS Report

41 % were correct!

For total internal reflection light must travel from denser medium to rarer medium.

A ball is dropped from height 10 *m*. Ball is embedded in sand 1 *m* and stops, then

- ● Only momentum remains conserved
- ○ Only kinetic energy remains conserved
- ○ Both momentum and K.E. are conserved
- ○ Neither K.E. nor momentum is conserved

EXPLANATIONS Report

30 % were correct!

Momentum of earth-ball system remains conserved

An infinite line charge produces a field $7.182 \times 10^8 N/C$ of at a distance of 2 *cm*. The linear charge density is

- ○ $7.27 \times 10^{-4} C/m$
- ● $7.98 \times 10^{-4} C/m$
- ○ $7.11 \times 10^{-4} C/m$

○ $7.04 \times 10^{-4} C/m$

EXPLANATIONS Report

55 % were correct!

Relation for electric field is given by $E = \dfrac{\lambda}{2\pi\varepsilon_0 r}$ ...(i)

(Given: $E = 7.182 \times 10^8 N/C$)
$r = 2cm = 2 \times 10^{-2} m$

$\dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^{-9}$

From equation (i),

$$\lambda = 2\pi\varepsilon_0 rE = \frac{2 \times 2\pi\varepsilon_0 rE}{2} = \frac{1 \times 2 \times 10^{-2} \times 7.182 \times 10^8}{2 \times 9 \times 10^9} = 7.98 \times 10^{-4} C/m$$

Equation of a progressive wave is given by

$$y = 4\sin\left\{\pi\left(\frac{t}{5} - \frac{x}{9}\right) + \frac{\pi}{6}\right\}$$

Then which of the following is correct?

○ v = 5m/ sec

◉ λ = 18m

○ a = 0.04m

○ n = 50Hz

EXPLANATIONS Report

69 % were correct!

From the given equation amplitude $a = 0.04m$

$$\text{Frequency } = \frac{\text{Co-efficient of t}}{2\pi} = \frac{\pi/5}{2\pi} = \frac{1}{10} Hz$$

$$Wavelength \lambda = \frac{2\pi}{\text{Co-efficient of } x} = \frac{2\pi}{\pi/9} = 18m$$

$$\text{Wave speed } v = \frac{\text{Co-efficient of } t}{\text{Co -efficient of } x} = \frac{\pi/5}{\pi/9} = 1.8m/s$$

A body of weight 64 N is pushed with just enough force to start it moving across a horizontal floor and the same force continues to act afterwards. If the coefficients of static and dynamic friction are 0.6 and 0.4 respectively, the acceleration of the body will be (Acceleration due to gravity = g)

○ $\frac{g}{6.4}$

- 0.64 g
- $\frac{g}{32}$
- 0.2 g

EXPLANATIONS Report

47 % were correct!

Weight of the body = 64*N*

so mass of the body $m = 6.4\text{kg}, \mu_s = 0.6, \mu_k = 0.4$

Net acceleration $= \dfrac{\text{Applied force - Kinetic friction}}{\text{Mass of the body}}$

$$= \frac{\mu_s mg - \mu_k mg}{m} = (\mu_s - \mu_k)\, g = (0.6 - 0.4)g = 0.2g$$

A transparent cube of 15 cm edge contains a small air bubble. Its apparent depth when viewed through one face is 6 cm and when viewed through the opposite face is 4 cm. Then the refractive index of the material of the cube is

- 2.0
- 2.5
- 1.6
- 1.5

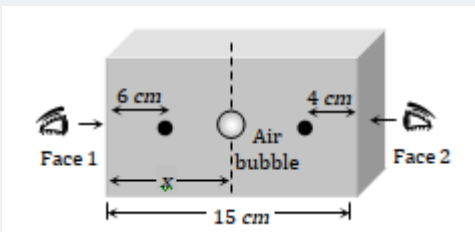
EXPLANATIONS Report

60 % were correct!

When viewed from face (1), $\mu = \dfrac{u}{v} = \dfrac{x}{v} = \dfrac{x}{6}$ .....(i)

Now when viewed from face (2), $\mu = \dfrac{15 - x}{v} = \dfrac{15 - x}{4}$ .....(ii)

From equation (i) and (ii) $\mu = \dfrac{15 - 6\mu}{4} \Rightarrow \mu = 1.5.$



The work functions of metals *A* and *B* are in the ratio 1 : 2. If light of frequencies f and $2f$ are incident on the surfaces of *A* and *B* respectively, the ratio of the maximum kinetic energies of photoelectrons emitted is (f is greater than threshold frequency of A, $2f$ is greater than threshold frequency of *B*)

- 1:1
- 1:2 ✓
- 1:3
- 1:4

EXPLANATIONS Report

49 % were correct!

$E = W_0 + K_{\max}$

$\Rightarrow hf = W_A + K_A$---------(i)

$2hf = W_B + K_B = 2W_A + K_B$---------(ii) $\left(\because \frac{W_A}{W_B} = \frac{1}{2}\right)$

Dividing equation (i) by (ii)

$\frac{1}{2} = \frac{W_A + K_A}{2W_A + K_B} \Rightarrow \frac{K_A}{K_B} = \frac{1}{2}$

Two bodies of masses 0.1 *kg* and 0.4 *kg* move towards each other with the velocities 1 *m/s* and 0.1 *m/s* respectively. After collision they stick together. In 10 *sec* the combined mass travels

- 120m
- 0.12m
- 12m
- 1.2m ✓

EXPLANATIONS Report

61 % were correct!

Velocity of combined mass, $v = \frac{m_1 v_1 - m_2 v_2}{m_1 + m_2}$

$= \frac{0.1 \times 1 - 0.4 \times 0.1}{0.5} = 0.12\text{m/s}$

∴ Distance travelled by combined mass

$= v \times t = 0.12 \times 10 = 1.2\text{m}$

A body of mass 5 gm is executing S.H.M. about a point with amplitude 10 cm . Its maximum velocity is 100 cm / sec . Its velocity will be 50 cm / sec at a distance (cm)

- 5

- ○ $5\sqrt{2}$
- ● $5\sqrt{3}$
- ○ $10\sqrt{2}$

EXPLANATIONS Report

50 % were correct!

It is given a = 10 cm and $v_{\max} = 100\,cm/sec.$

$$\Rightarrow v_{\max} = a\omega \Rightarrow \omega = \frac{100}{10} = 10\,rad/sec$$

Now, $v = \omega\sqrt{a^2 - y^2}$

$$\Rightarrow 50 = 10\sqrt{10^2 - y^2}$$

$$\Rightarrow y = 5\sqrt{3}\,cm$$

The number of photons of wavelength 540 *nm* emitted per second by an electric bulb of power 100 *W* is (taking $h = 6 \times 10^{-34} J\,\text{sec}$)

- ○ 100
- ○ 1000
- ○ 3×10^{18}
- ● 3×10^{20}

EXPLANATIONS Report

64 % were correct!

Power emitted by bulb per second in terms of energy of photon is given as

$$P = \frac{nhc}{\lambda t} \Rightarrow 100 = \frac{n \times 6 \times 10^{-34} \times 3 \times 10^{8}}{540 \times 10^{-9} \times 1} \Rightarrow n = 3 \times 10^{20}$$

If distance between the directrices be thrice the distance between the foci, then eccentricity of ellipse is :

- ○ 1/2
- ○ 2/3
- ● $1/\sqrt{3}$
- ○ 4/5

EXPLANATIONS Report

63 % were correct!

Distance between directrices is $2a/e$ and distance between foci is $2ae$. So, according to the question,

$$\frac{2a}{e} = 6ae \Rightarrow e = \frac{1}{\sqrt{3}}$$

If the position vectors of A and B are $2\hat{i} - 6\hat{j} + 4\hat{k}$ and $-3\hat{i} + 5\hat{j} - 6\hat{k}$, the position vector of the point which divides AB internally in the ratio of $3:4$ is:

- $\frac{1}{7}(-6\hat{i} + 2\hat{j} + 12\hat{k})$
- $\frac{1}{7}(18\hat{i} + -38\hat{j} + 36\hat{k})$
- $\frac{1}{7}(17\hat{i} + -39\hat{j} + 34\hat{k})$
- (selected) $\frac{1}{7}(-\hat{i} - 9\hat{j} - 2\hat{k})$

EXPLANATIONS Report

41 % were correct!

Using section formula:

If a line AB is divided internally by a point C in the ratio of $m:n$

$$\overrightarrow{OC} = \frac{n\overrightarrow{OA} + m\overrightarrow{OB}}{n+m}$$

$A = \{x : x \neq x\}$ represents

- $\{0\}$
- (selected) $\{\}$
- $\{1\}$
- $\{x\}$

EXPLANATIONS Report

76 % were correct!

This is a null set, as everything equals to itself!

Angles made by the lines represented by the equation $xy + y = 0$ with axis are

- [x] 0° and 90°
- [ ] 0° and 30°
- [ ] 30° and 60°
- [ ] 30° and 90°

EXPLANATIONS Report

78 % were correct!

Here the lines are $x = -1$ and $y = 0$ represented by $xy + y = 0$. Obviously line $y = 0$ makes an angle of 90° with y-axis and $x = -1$ make an angle of 0° with y-axis.

$$\lim_{x \to a} f(x) \cdot g(x)$$

exists if :

- [x] $\lim_{x \to a} f(x)$ and $\lim_{x \to a} g(x)$ exist
- [ ] $\lim_{x \to a} f(x)^{g(x)}$ exists
- [ ] $\lim_{x \to a} \frac{f(x)}{g(x)}$ exists
- [ ] $\lim_{x \to a} f(x) g\left(\frac{1}{x}\right)$ exists

EXPLANATIONS Report

78 % were correct!

This is fundamental concept.

If $|a| = 3,\ |b| = 4,\ |c| = 5$ and $a + b + c = 0$, then the angle between a and b is

- [ ] 0

- $\frac{\pi}{6}$
- $\frac{\pi}{3}$
- ✓ $\frac{\pi}{2}$

EXPLANATIONS Report

59 % were correct!

$a + b = -c$

$\Rightarrow \ |a|^2 + |b|^2 + 2|a||b|\cos\theta = |c|^2$

$$\Rightarrow \cos\theta = 0$$

$$\Rightarrow \theta = \frac{\pi}{2}.$$

$$\frac{d}{dx}\left[\tan^{-1}\left(\frac{a-x}{1+ax}\right)\right] =$$

- ✓ $-\frac{1}{1+x^2}$
- $\frac{1}{1+a^2} - \frac{1}{1+x^2}$
- $\frac{1}{1+\left(\frac{a-x}{1+ax}\right)^2}$
- $\frac{-1}{\sqrt{1-\left(\frac{a-x}{1+ax}\right)^2}}$

EXPLANATIONS Report

40 % were correct!

$$\frac{d}{dx}\left[\tan^{-1}\left(\frac{a-x}{1+ax}\right)\right].$$

$$= \frac{d}{dx}[\tan^{-1}a - \tan^{-1}x] = 0 - \frac{1}{1+x^2} = -\frac{1}{1+x^2}$$

The locus of a point which moves with time t in a XY-plane such that, $x = t^2 - 1$ and $y = t^2 + 1$ is:

- ○ a circle
- ○ a parabola
- ○ an ellipse
- ◉ a straight line

EXPLANATIONS

Report

63 % were correct!

Given:

$x = t^2 - 1$
$y = t^2 + 1$

Subtracting,

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

Hence, a straight line.

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