Question Review

All

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

- 25m/s
- 5m/s
- 20m/s
- 5πm/s

EXPLANATIONS Report

79 % were correct!

$$v = \frac{\text{Co-efficent of } t}{\text{Co-efficent of } x} = \frac{\omega}{k} = \frac{100}{20} = 5m/s$$

An engine develops 10 *kW* of power. How much time will it take to lift a mass of 200 *kg* to a height of 40 *m*. (g = 10 m/sec^2)

- 4 sec
- 5 sec
- 8 sec
- 10 sec

EXPLANATIONS Report

79 % were correct!

$$P = \frac{mgh}{t} = 10 \times 10^3 \Rightarrow t = \frac{200 \times 40 \times 10}{10 \times 10^3} = 8\text{sec}$$

A bullet is dropped from the same height when another bullet is fired horizontally. They will hit the ground

- One after the other
- Simultaneously

- Depends on the observer
- None of the above

EXPLANATIONS Report

Because the vertical components of velocities of both the bullets are same and equal to zero and $t = \sqrt{\frac{2h}{g}}$.

An electric lamp is connected to 220 *V*, 50 *Hz* supply. Then the peak value of voltage is

- 210 V
- 211 *V*
- 311 V
- 320 *V*

EXPLANATIONS Report

64 % were correct!

Peak voltage $= V_{rms} \times \sqrt{2} = 220 \times \sqrt{2} = 311$ *volts*

Two particles having position vectors $\overrightarrow{r_1} = (3\hat{i} + 5\hat{j})$ *metres* and $\overrightarrow{r_2} = (-5\hat{i} - 3\hat{j})$ *metres* are moving with velocities $\vec{v}_1 = (4\hat{i} + 3\hat{j}) m/s$ and $\vec{v}_2 = (\alpha\hat{i} + 7\hat{j}) \quad m/s$. If they collide after 2 seconds, the value of 'α' is

- 8
- 2
- 4
- 6

EXPLANATIONS Report

39 % were correct!

It is clear from figure that the displacement vector $\Delta\vec{r}$ between particles and is

$\Delta\vec{r} = \overrightarrow{r_2} - \overrightarrow{r_1} = -8\hat{i} - 8\hat{j}$

$|\Delta\vec{r}| = \sqrt{(-8)^2 + (-8)^2} = 8\sqrt{2}$...(i)

Now, as the particles are moving in same direction

$\left(\because \overrightarrow{v_1} \text{ and } \overrightarrow{v_2} \text{ are } +ve\right)$, the relative vellocity is given by

$\vec{v}_{rel} = \overrightarrow{v_2} - \overrightarrow{v_1} = (\alpha - 4)\hat{i} + 4\hat{j}$

$\tilde{v}_{rel} = \sqrt{(\alpha - 4)^2 + 16}$...(ii)

Now, we know $|\vec{v}_{rel}| = \dfrac{|\Delta\vec{r}|}{t}$

Substituting the values of $\vec{v}_{rel}$ and $|\Delta\vec{r}|$ from equation (i) and (ii) and t=2s, then on solving we get $\alpha = 8$

1 *g* of a steam at 100°*C* melt how much ice at 0°*C*? (Latent heat of ice = 80 *cal/gm* and latent heat of steam = 540 *cal/gm*)

- 1 *gm*
- 2 *gm*
- 4 *gm*
- 8 *gm*

EXPLANATIONS Report

49 % were correct!

Suppose *m gm* ice melted, then heat required for its melting $= mL = m \times 80\text{cal}$

Heat available with steam for being condensed and then brought to 0°*C*

$= 1 \times 540 + 1 \times 1 \times (100 - 0) = 640\text{cal}$

$\Rightarrow$ Heat lost = Heat taken

$\Rightarrow 640 = m \times 80 \Rightarrow m = 8\text{gm}$

Short trick: You can remember that amount of steam (*m'*) at 100°*C* required to melt *m gm* ice at 0°*C* is $m' = \dfrac{m}{8}$.

Here, $m = 8 \times m' = 8 \times 1 = 8gm$

An electron is accelerated through a potential difference of 200 *volts*. If *e/m* for the electron be 1.6*10[11] *coulomb/kg*, the velocity acquired by the electron will be

- 8×10^6m/s
- 8×10^5m/s
- 5.9×10^6m/s
- 5.9×10^5m/s

EXPLANATIONS Report

77 % were correct!

Kinetic Energy of the electron accelerated by a potential difference V is given as

$\dfrac{1}{2}mv^2 = QV$

$$v = \sqrt{\frac{2QV}{m}} = \sqrt{2\left(\frac{e}{m}\right)V}$$

$$\Rightarrow v = \sqrt{2 \times 1.6 \times 10^{11} \times 200} = 8 \times 10^{6}\ \mathrm{m/s}$$

A bullet of mass *m* moving with velocity *v* strikes a block of mass *M* at rest and gets embedded into it. The kinetic energy of the composite block will be

- (selected) $\frac{1}{2}mv^2 \times \frac{m}{(m+M)}$
- $\frac{1}{2}mv^2 \times \frac{M}{(m+M)}$
- $\frac{1}{2}mv^2 \times \frac{(M+m)}{M}$
- $\frac{1}{2}Mv^2 \times \frac{m}{(m+M)}$

EXPLANATIONS Report

55 % were correct!

By conservation of momentum, $mv + M \times 0 = (m+M)V$

Velocity of composite block $V = \left(\frac{m}{m+M}\right)v$

K.E. of composite block $= \frac{1}{2}(M+m)V^2$

$$= \frac{1}{2}(M+m)\left(\frac{m}{M+m}\right)^2 v^2 = \frac{1}{2}mv^2\left(\frac{m}{m+M}\right)$$

If momentum is increased by 20%, then K.E. increases by

- (selected) 44%
- 55%
- 66%
- 77%

EXPLANATIONS Report

81 % were correct!

$E = \frac{P^2}{2m}$. If m is constant then $E \propto P^2$

$$\Rightarrow \frac{E_2}{E_1} = \left(\frac{P_2}{P_1}\right)^2 = \left(\frac{1 \cdot 2P}{P}\right)^2 = 1.44$$

$$\Rightarrow E_2 = 1.44E_1 = E_1 + 0.44E_1$$

$$E_2 = E_1 + 44\% \text{ of } E_1$$

i.e. the kinetic energy will increase by 44%

The bob of a simple pendulum (mass *m* and length *l*) dropped from a horizontal position strikes a block of the same mass elastically placed on a horizontal frictionless table. The K.E. of the block will be

- 2 mgl
- mgl / 2
- **mgl** ✓
- 0

EXPLANATIONS Report

44 % were correct!

P.E. of bob at point *A* = *mgl*

This amount of energy will be converted into kinetic energy

∴ K.E. of bob at point *B* = *mgl*

and as the collision between bob and block (of same mass) is elastic so after collision bob will come to rest and total Kinetic energy will be transferred to block. So kinetic energy of block = *mgl.*

A pendulum clock keeps correct time at 0°*C*. Its mean coefficient of linear expansions is $\alpha/^\circ C$, then the loss in seconds per day by the clock if the temperature rises by *t*°*C* is

- $\frac{\frac{1}{2}\alpha t \times 864000}{1 - \frac{\alpha t}{2}}$
- **$\frac{1}{2}\alpha t \times 86400$** ✓
- $\frac{\frac{1}{2}\alpha t \times 86400}{(1 - \frac{\alpha t}{2})^2}$
- $\frac{\frac{1}{2}\alpha t \times 86400}{1 + \frac{\alpha t}{2}}$

EXPLANATIONS Report

70 % were correct!

Loss in time per second $\frac{\Delta T}{T} = \frac{1}{2}\alpha\Delta\theta = \frac{1}{2}\alpha(t-0)$

Loss in time per day,

$$\Delta t = \left(\frac{1}{2}\alpha t\right) t = \frac{1}{2}\alpha t \times (24 \times 60 \times 60) = \frac{1}{2}\alpha t \times 86400$$

A coil of resistance 400Ω is placed in a magnetic field. If the magnetic flux ø (wb) linked with the coil varies with time t (sec) as ø = $50t^2 + 4$. The current in the coil at t = 2 sec is :

- (●) 0.5 A
- ( ) 0.1 A
- ( ) 1 A
- ( ) 2 A

EXPLANATIONS Report

68 % were correct!

According to Faraday"s law of induction,

Induced e.m.f. $\varepsilon = -\frac{d\phi}{dt} = -(100t)$

Induced current i at t = 2 sec is,

$$I = \frac{E}{R} = +\frac{100 \times 2}{400} = +0.5\text{A}$$

20 teachers of a school either teach mathematics or physics. 12 of them teach mathematics while 4 teach both the subjects. Then the number of teachers teaching physics only is

- ( ) 12
- (●) 8
- ( ) 16
- ( ) None of these

EXPLANATIONS Report

70 % were correct!

Let $n(P)$= Number of teachers in Physics.

$n(M)$= Number of teachers in Maths

$n(P \cup M) = n(P) + n(M) - n(P \cap M)$

$20 = n\,(P) + 12 - 4 \Rightarrow n\,(P) = 12.$

So,

$n(P_0) = n(P) - n(P \cap M) = 8$

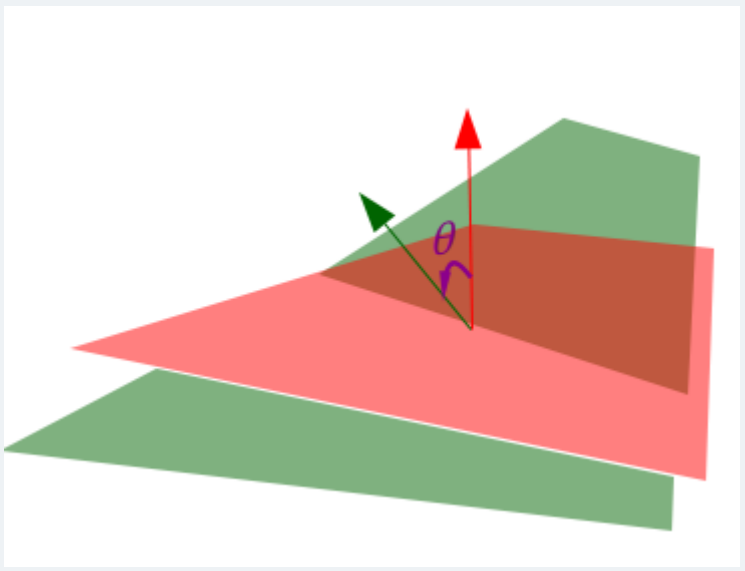
The angle between two planes is equal to

- The angle between the tangents to them from any point
- The angle between the normals to them from any point
- The angle between the lines parallel to the planes from any point
- None of these

EXPLANATIONS Report

59 % were correct!

The direction of a plane is **uniquely** determined by its normal. And, the angle betwen normals is the angle between the planes.



$$\frac{(a-1) - \frac{(a-1)^2}{2} + \frac{(a-1)^3}{3} - \ldots\ldots\infty}{(b-1) - \frac{(b-1)^2}{2} + \frac{(b-1)^3}{3} - \ldots\ldots\infty} =$$

- $\log_b a$
- $\log_a b$
- $\log_e a - \log_e b$
- $\log_e a + \log_e b$

EXPLANATIONS Report

41 % were correct!

$$\frac{(a-1)-\frac{(a-1)^2}{2}+\frac{(a-1)^3}{3}-\ldots\ldots\infty}{(b-1)-\frac{(b-1)^2}{2}+\frac{(b-1)^3}{3}-\ldots\ldots\infty}$$

$$=\frac{\log_e(1+a-1)}{\log_e(1+b-1)}=\frac{\log_e a}{\log_e b}=\log_b a.$$

If A is a $p\times q$ matrix and B is anoher matrix such that AB and BA are both defined, then B has

- ○ p rows and q columns
- ◉ q rows and p columns
- ○ p rows and p columns
- ○ q rows and q columns

EXPLANATIONS Report

67 % were correct!

Let order of B be $m\times n$ For AB to be defined, $m=q$

So, B has q rows.

Also, for BA to be defined, $p=n$

So, B has p columns.

If $Q=\left\{x:x=\frac{1}{y},\text{ where } y\in N\right\}$, then

- ○ 0 ∈ Q
- ◉ 1 ∈ Q
- ○ 2 ∈ Q
- ○ $\frac{2}{3}$ ∈ Q

EXPLANATIONS Report

75 % were correct!

The set contains all frations with numerator 1.

So, it also contains $\frac{1}{1}=1$

Hence, $1\in Q$

If $x = \dfrac{1-t^2}{1+t^2}$ and $y = \dfrac{2at}{1+t^2}$, then $\dfrac{dy}{dx} =$

- $\frac{a(1-t^2)}{2t}$
- $\frac{a(t^2-1)}{2t}$ ✓
- $\frac{a(t^2+1)}{2t}$
- $\frac{a(t^2-1)}{t}$

EXPLANATIONS Report

56 % were correct!

$x = \dfrac{1-t^2}{1+t^2}$ and $y = \dfrac{2at}{1+t^2}$

Differentiating with respect to t, we get

$$\frac{dx}{dt} = \frac{\left(1+t^2\right)(0-2t) - \left(1-t^2\right)(0+2t)}{\left(1+t^2\right)^2} = -\frac{4t}{\left(1+t^2\right)^2}$$

$$\text{and } \frac{dy}{dt} = \frac{\left(1+t^2\right)2a - 2at(2t)}{\left(1+t^2\right)^2} = \frac{2a\left(1-t^2\right)}{\left(1+t^2\right)^2}$$

$$\Rightarrow \frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{a\left(1-t^2\right)}{-2t}; \quad \therefore \frac{dy}{dx} = \frac{a\left(t^2-1\right)}{2t}$$

$-3 \le 2x + 5 \le 4$ implies

- $-4 \le x \le -1/2$ ✓
- $-4 \le x \le 1/2$
- $-1/2 \le x \le 4$
- none of these

EXPLANATIONS Report

69 % were correct!

$$-3 \le 2x + 5 \le 4$$
$$\Rightarrow -8 \le 2x \le -1$$
$$\Rightarrow -4 \le x \le -1/2$$

There are 5 roads leading to a town from a village. The number of different ways in which a villager can go to the town and return back, is :

- (●) 25
- ( ) 20
- ( ) 10
- ( ) 5

EXPLANATIONS

Report

48 % were correct!

The man can go in 5 ways and he can return in 5 ways. Hence, total number of ways are $5 \times 5 = 25$.

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