## Question Review

All

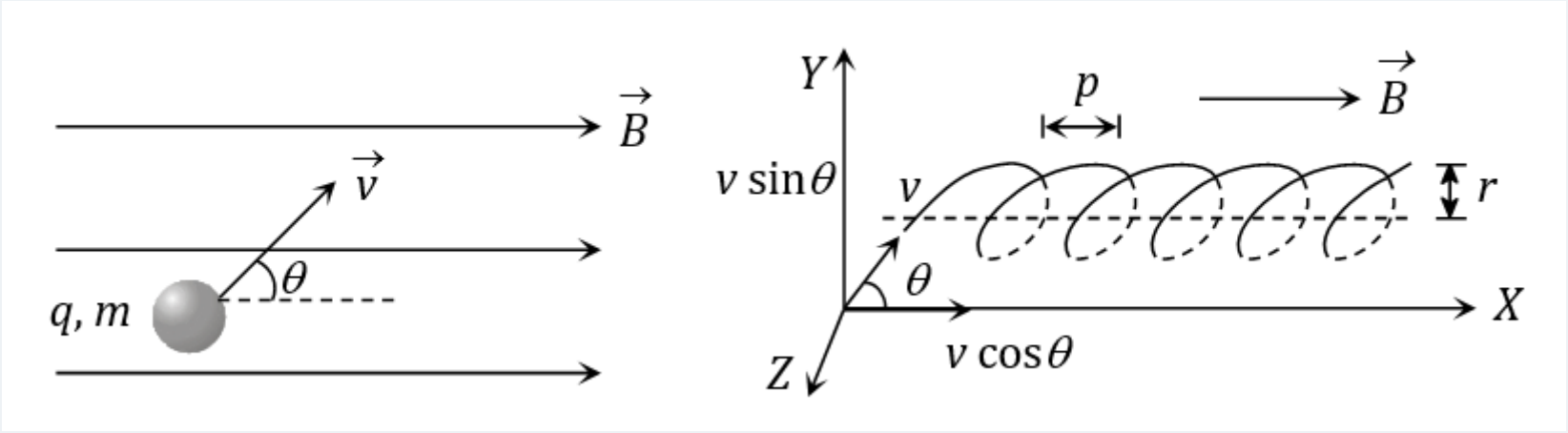
If the direction of the initial velocity of the charged particle is neither along nor perpendicular to that of the magnetic field, then the orbit will be

- A straight line
- An ellipse
- A circle
- A helix

EXPLANATIONS Report

61 % were correct!

When the charged particle is moving at an angle to the field (other than 0°, 90°, or 180°). Particle describes helical path.




Which of the following statements is wrong?

- Sound travels in straight line
- Sound is a form of energy
- Sound travels in the form of waves
- Sound travels faster in vacuum than in air

EXPLANATIONS Report

64 % were correct!

Sound needs medium to travel. In vacuum, there is no propagation of sound wave. Therefore, the statement "Sound travels faster in vacuum than in air" is wrong.

The physical quantity which has no dimensions

- ○ Angular velocity
- ○ Linear momentum
- ○ Angular momentum
- ◉ Strain

EXPLANATIONS Report

87 % were correct!

Strain $= \dfrac{\Delta L}{L}$

Both $\Delta L$ and $L$ are length.

$\therefore$ Strain has no dimensions.

When the length and area of cross-section both are doubled, then its resistance

- ○ Will become half
- ○ Will be doubled
- ◉ Will remain the same
- ○ Will become four times

EXPLANATIONS Report

63 % were correct!

$R_1 \propto \dfrac{l}{A} \Rightarrow R_2 \propto \dfrac{2l}{2A}$ i.e. $\mathrm{R}_2 \propto \dfrac{l}{A}$

$\therefore R_1 = R_2$

At what temperature is the r.m.s. velocity of a hydrogen molecule equal to that of an oxygen molecule at $47^\circ C$?

- ○ 80 K
- ○ -73 K
- ○ 3 K
- ◉ 20 K

EXPLANATIONS Report

59 % were correct!

$$v_{\text{rms}} = \sqrt{\frac{RT}{M}}$$

From the question,

$$(v_{\text{rms}})_{H_2} = (v_{\text{rms}})_{O_2}$$

$$\Rightarrow \sqrt{\frac{RT_H}{2}} = \sqrt{\frac{R(273+47)}{32}}$$

$$\Rightarrow T = 20\,\text{K}$$

In Bainbridge mass spectrograph a potential difference of 1000 *V* is applied between two plates distant 1 *cm* apart and magnetic field in *B* = 1*T*. The velocity of undeflected positive ions in *m/s* from the velocity selector is

- ○ $10^1$ m/s
- ◉ $10^5$ m/s
- ○ $10^4$ m/s
- ○ $10^2$ m/s

EXPLANATIONS Report

78 % were correct!

Condition of no deflection,

$$F_e = F_m$$

$$\Rightarrow eE = Bev$$

$$\Rightarrow v = \frac{E}{B};\ \text{where } E = \frac{V}{d} = \frac{1000}{1\times 10^{-2}} = 10^5 V/m$$

$$\Rightarrow v = \frac{10^5}{1} = 10^5 m/s$$

Consider the following two statements

1. Linear momentum of a system of particles is zero
2. Kinetic energy of a system of particles is zero

Then

- ○ 1 implies 2 and 2 implies 1
- ○ 1 does not imply 2 and 2 does not imply 1
- ○ 1 implies 2 but 2 does not imply 1
- ◉ 1 does not imply 2 but 2 implies

EXPLANATIONS

Report

27 % were correct!

Because linear momentum is vector quantity where as kinetic energy is a scalar quantity.

A ray of light is incident at 50° on the middle of one of the two mirrors arranged at an angle of 60° between them. The ray then touches the second mirror, get reflected back to the first mirror, making an angle of incidence of

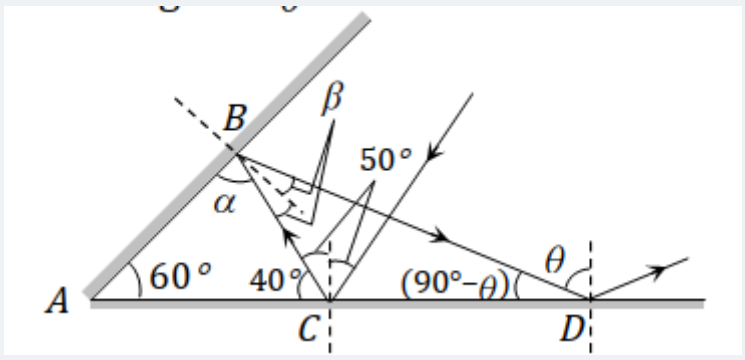
- 50°
- 60°
- 70°
- 80°

EXPLANATIONS

Report

40 % were correct!

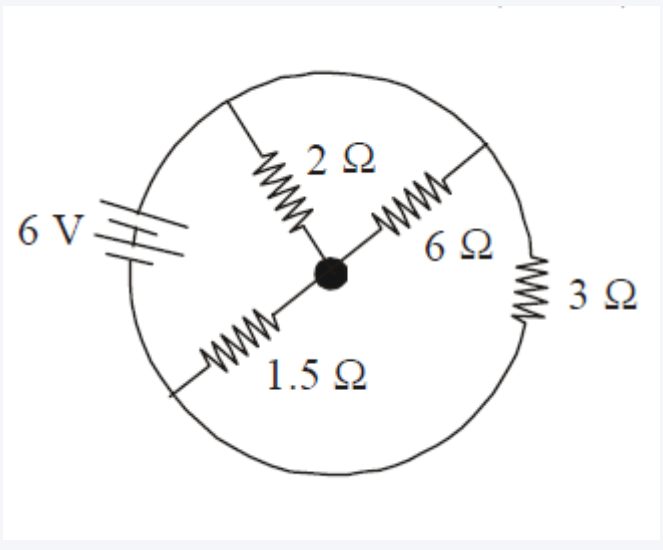
Let required angle be $\theta$




From geometry of figure

$$\text{In } \Delta ABC; \alpha = 180^\circ - (60^\circ + 40^\circ) = 80^\circ$$
$$\Rightarrow \beta = 90^\circ - 80^\circ = 10^\circ$$
$$\text{In } \Delta ABD; \angle A = 60^\circ, \angle B = (\alpha + 2\beta)$$
$$= (80 + 2 \times 10) = 100^\circ \text{ and } \angle D = (90^\circ - \theta)$$
$$\because \angle A + \angle B + \angle D = 180^\circ \Rightarrow 60^\circ + 100^\circ + (90^\circ - \theta) =$$
$$180^\circ \Rightarrow \theta = 70^\circ$$

The total current supplied to the circuit by the battery is

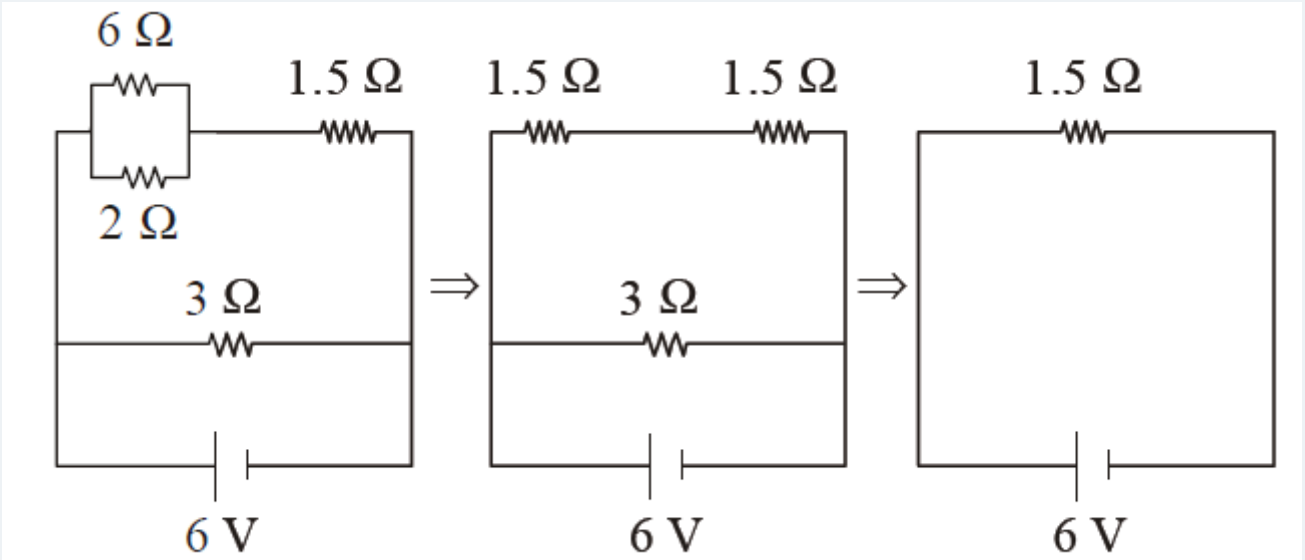


- 1 A
- 2 A
- 4 A
- 6 A

EXPLANATIONS Report

46 % were correct!

The equivalent circuits are shown below:




$$I = \frac{6}{1.5} = 4\text{A}$$

The activity of a sample of radioactive material is $A_1$ at time $t_1$ and $A_2$ at time $t_2$ $(t_2 > t_1)$.
Its mean life is T.

- $A_1 t_1 = A_2 t_2$
- $\frac{A_1 - A_2}{t_2 - t_1}$ = constant
- $A_2 = A_1 e^{(t_1 - t_2/T)}$
- $A_2 = A_1 e^{(t_1/T\, t_2)}$

EXPLANATIONS Report

62 % were correct!

Let $A_0$ = initial activity.

Then , $A_1 = A_0 e^{-\lambda t_1}$ and $A_2 = A_0 e^{-\lambda t_2}$

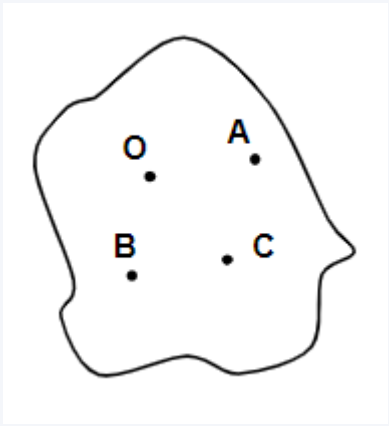
$$\therefore \frac{A_2}{A_1} = \frac{e^{-\lambda t_2}}{e^{-\lambda t_1}} = e^{(-\lambda t_2 + \lambda t_1)}$$

$$\Rightarrow A_2 = A_1 e^{\lambda(t_1 - t_2)}$$

Also. decay constant $= \frac{1}{\text{Mean life time}}$ i.e. $\lambda = \frac{1}{T}$

$\therefore A_2 = A_1 e^{(t_1 - t_2)/T}$

O is the centre of mass of a body of mass M as shown in the figure. A, B, C are three different point on the body. OB = 8 cm, OC = 10 cm, BC = 6 cm and OA = 10 cm. Which of the following can be written by using parallel axis theorem? $I_0$ is the moment of inertia about the axis passing through point O and perpendicular to plane of object.




- $I_B = I_C + M(BC)^2$
- **$I_C = I_B + M(BC)^2$**
- $I_A = I_0 + M(OB)^2$
- None of these

EXPLANATIONS Report

**42 % were correct!**

From parallel axis theorem,

$$I_C = I_0 + M(OC)^2$$

Here, OB, BC and OC i.e 8,6 and 10 is pythagoras triplet.

$$\Rightarrow I_C = I_0 + M\left(OB^2 + BC^2\right)$$

Again from parallel axis theorem, $I_B = I_0 + M(BC)^2$

$$\therefore I_C = I_B + M(BC)^2$$

A running man has half the kinetic energy of that of a boy of half of his mass. The man speeds up by $1 m/s$ so as to have same *K.E.* as that of the boy. The original speed of the man will be

- $\sqrt{2}$m/s
- $(\sqrt{2} - 1)$m/s
- **$\frac{1}{(\sqrt{2}-1)}$m/s**
- $\frac{1}{\sqrt{2}}$m/s

EXPLANATIONS Report

52 % were correct!

Let $m$ = mass of boy, $M$ = mass of man

$v$ = velocity of boy, $V$ = velocity of man

$$\frac{1}{2}MV^2 = \frac{1}{2}\left[\frac{1}{2}mv^2\right] \quad \ldots\ldots(\mathrm{i})$$

$$\frac{1}{2}M(V+1)^2 = 1\left[\frac{1}{2}mv^2\right]$$

$$m = \frac{M}{2} \text{ and solving } V = \frac{1}{\sqrt{2}-1}$$

Let the points A, B and P be (-2, 2, 4), (2, 6, 3) and (1,2,1) respectively. The magnitude of the moment of the force represented by $\overrightarrow{AB}$ and acting at A about P is

- 15
- $3\sqrt{41}$
- $3\sqrt{57}$
- None of these

EXPLANATIONS Report

49 % were correct!

$F = \overrightarrow{AB} = 4i + 4j - k$ and $\overrightarrow{AP} = 3i - 3k$ Moment of the force is $\overrightarrow{AP} \times \overrightarrow{AB}$

$$= \begin{vmatrix} i & j & k \\ 3 & 0 & -3 \\ 4 & 4 & -1 \end{vmatrix} = 12i - 9j + 12k$$

$\therefore$ Magnitude is, $\sqrt{144 + 81 + 144} = 3\sqrt{41}$.

If the volume of a spherical balloon is increasing at the rate of $900 cm^3 per\ sec$, then the rate of change of radius of balloon at instant when radius is $15cm$ [in $cm/sec$]

- $\pi$
- $9\pi$
- $\frac{1}{11}$
- Noe of these

EXPLANATIONS Report

57 % were correct!

$$V = \frac{4}{3}\pi r^3$$

Differentiate with respect to $t$

$$\frac{dV}{dt} = \frac{4}{3}\pi 3r^2 \cdot \frac{dr}{dt} \Rightarrow \frac{dr}{dt} = \frac{1}{4\pi r^2} \cdot \frac{dV}{dt}$$

$$\frac{dr}{dt} = \frac{1}{4 \times \pi \times 15 \times 15} \times 900 \Rightarrow \frac{dr}{dt} = \frac{1}{\pi}$$

Period of |sin 2*x*| + |cos 8*x*| is:

- ○ $\frac{\pi}{4}$
- ● $\frac{\pi}{2}$
- ○ $\frac{\pi}{8}$
- ○ $\frac{\pi}{16}$

EXPLANATIONS Report

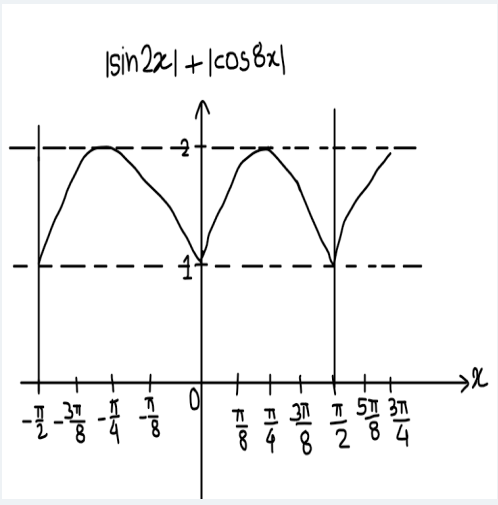
**46 % were correct!**

Clearly period of |sin 2*x*| = $\frac{\pi}{2}$ and period of |cos 8*x*| = $\frac{\pi}{8}$.

Now L.C.M. of the periods is = $\frac{\pi}{2}$

Hence (b) is correct.

It is better to sketch a rough graph of the function to predict the period.




Use of calculator is also appropriate. Use the TABLE feature (MODE >> 7) in CASIO fx-991ES calculator to see what values the function $|sin2x| + |cos8x|$ take in desired interval. See when the values start repeating and find the period.

The angle between the line $\frac{x-2}{a} = \frac{y-2}{b} = \frac{z-2}{c}$ and the plane $ax + by + cz + 6 = 0$

is

- ○ $\sin^{-1}\left(\frac{1}{\sqrt{a^2+b^2+c^2}}\right)$
- ○ $45^o$

- ○ $60^{o}$
- ● $90^{o}$

EXPLANATIONS Report

36 % were correct!

Obviously the line perpendicular to the plane because , their direction ratios are proportional.

Let $S$ be the set of all real numbers. Then the relation $R = \{(a, b) : 1 + ab > 0\}$ on $S$ is:

- ● Reflexive and symmetric but not transitive
- ○ Reflexive and transitive but not symmetric
- ○ Symmetric, transitive but not reflexive
- ○ Reflexive, transitive and symmetric

EXPLANATIONS Report

22 % were correct!

Since $1 + a.\, a = 1 + a^2 > 0\,, \forall a \in S,$

$\therefore (a,\, a) \in R$

$\therefore$ R is reflexive.

Also$(a, b) \in R \Rightarrow 1 + ab > 0$

$\Rightarrow 1 + ba > 0$

$\Rightarrow (b,\, a) \in R,$

$\therefore$ R is symmetric.

$\because (a,\, b) \in R$ and $(b,\, c) \in R$ need not imply $(a,\, c) \in R$. Hence, R is not transitive.

If \textit{A, B, C} be three sets such that $A \cup B$ = $A \cup C$ and $A \cap B$ = $A \cap C$, then

- ○ A = B
- ● B = C
- ○ A = C
- ○ A = B = C

EXPLANATIONS Report

61 % were correct!

It is obvious.

Let $A$ and $B$ be two sets. Then

- ○ A ∪ B ⊆ A ∩ B
- ● A ∩ B ⊆ A ∪ B
- ○ A ∩ B = A ∪ B
- ○ None of these

EXPLANATIONS Report

76 % were correct!

The elements of $A \cap B$ are common to both $A$ and $B$.

These elements also belong to the union as the union contains all elements of $A$ and $B$.

So, $A \cap B \subseteq A \cup B$

The range of $f(x) = |(x^2 - 2x + 1)|$ is:

- ● $[0, \infty)$
- ○ $(-\infty, 0]$
- ○ $[1, \infty)$
- ○ none of these

EXPLANATIONS Report

46 % were correct!

The funtion can be re-written as $f(x) = |(x-1)^2|$

But as $(x-1)^2$ is non-negative, $f(x) = (x-1)^2$

The range is obviously $[0, \infty)$