

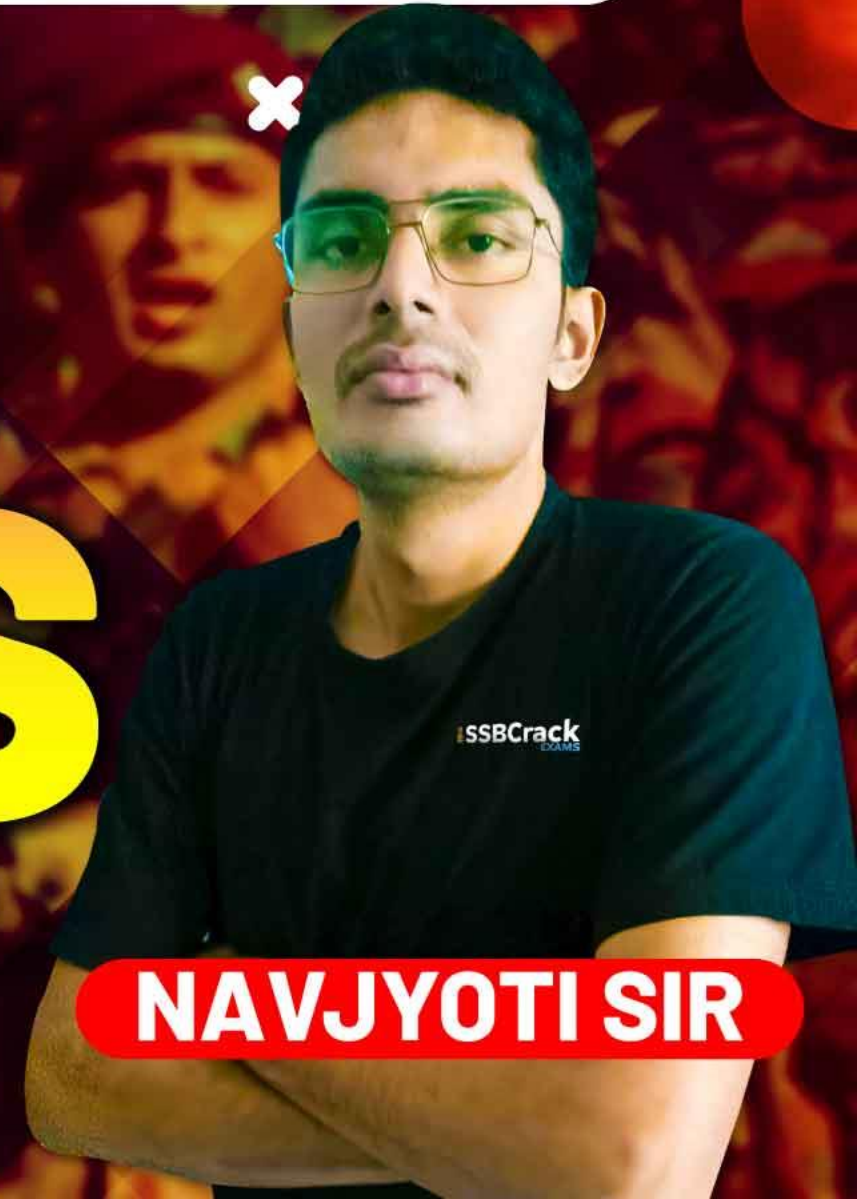
# NDA-CDS 2 2024

# GS

LIVE

# PHYSICS

CLASS 12



NAVJYOTI SIR

# **MISCELLANEOUS TOPICS**

# WHAT WILL WE STUDY ?

- Heat Transfer
- Specific and Latent Heat
- Calorimetry
- Nuclear Energy
- Rotational Motion
- Simple Harmonic Motion

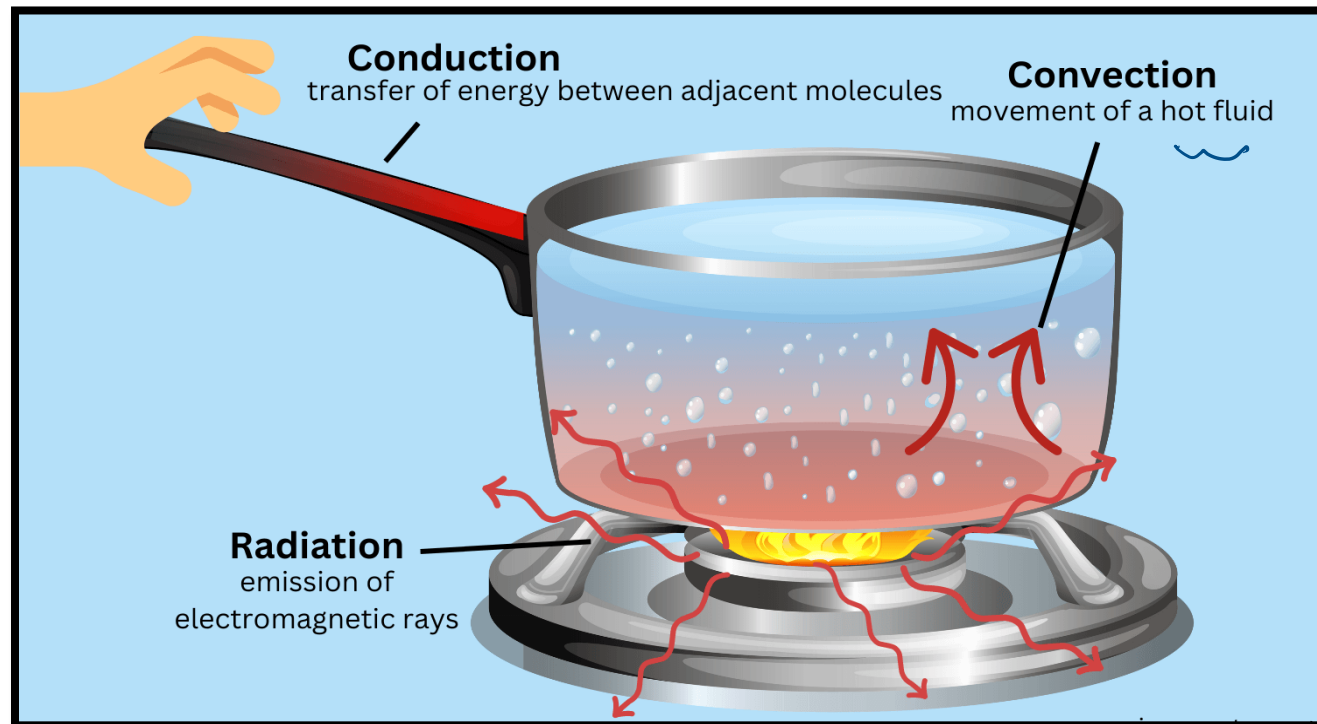


# HEAT TRANSFER

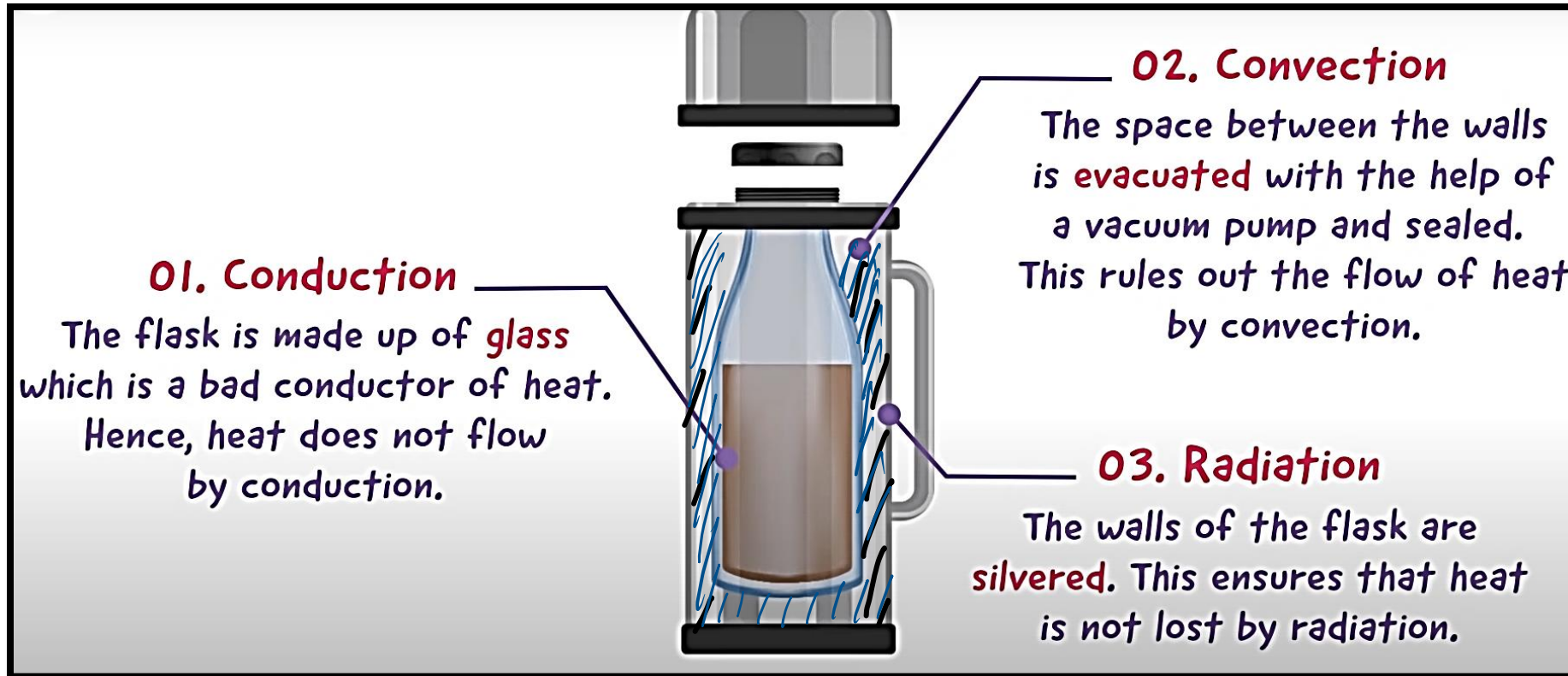
- Heat transfer is the movement of heat due to a temperature difference between a system and its surroundings. The energy transfer is always from higher temperature to lower temperature.
- The units of heat transfer are the joule (J), calorie (cal), and kilocalorie (kcal).  
$$1 \text{ cal} = 4.18 \text{ J}$$
- The unit for the rate of heat transfer is the kilowatt (KW).

# TYPES OF HEAT TRANSFER

- Conduction requires contact. (*solids*)
- Convection requires fluid flow. (*fluids - liquids, gases*)
- Radiation does not require any medium.



# THERMOS FLASK



# SPECIFIC HEAT

- The amount of heat required to raise the temperature of unit mass of the substance through  $1^{\circ}\text{C}$  is called its specific heat. It is denoted by  $c$  or  $s$ . Its SI unit is 'joule/kilogram- $^{\circ}\text{C}$ ' ( $\text{J}/\text{kg}\text{-}^{\circ}\text{C}$ ) or  $\text{Jkg}^{-1}\text{K}^{-1}$

$$Q = \underbrace{\text{mass}}_{\text{kg}} \times \underbrace{\text{specific heat}}_{c} \times \underbrace{\text{change in temperature}}_{^{\circ}\text{C}/\text{K}}$$

Heat required (J)

$c = \frac{Q}{m \cdot (\Delta T)}$

water has  
very high  
specific heat.

# LATENT HEAT

- The heat energy absorbed or released at constant temperature per unit mass for change of state is called latent heat.

- Heat energy absorbed or released during change of state is given by

$$Q = mL$$

*Latent heat of vaporisation*

where,  $m$  = mass of the substance and  $L$  = latent heat. *Latent heat of fusion*

- Its unit is cal/g or J/kg

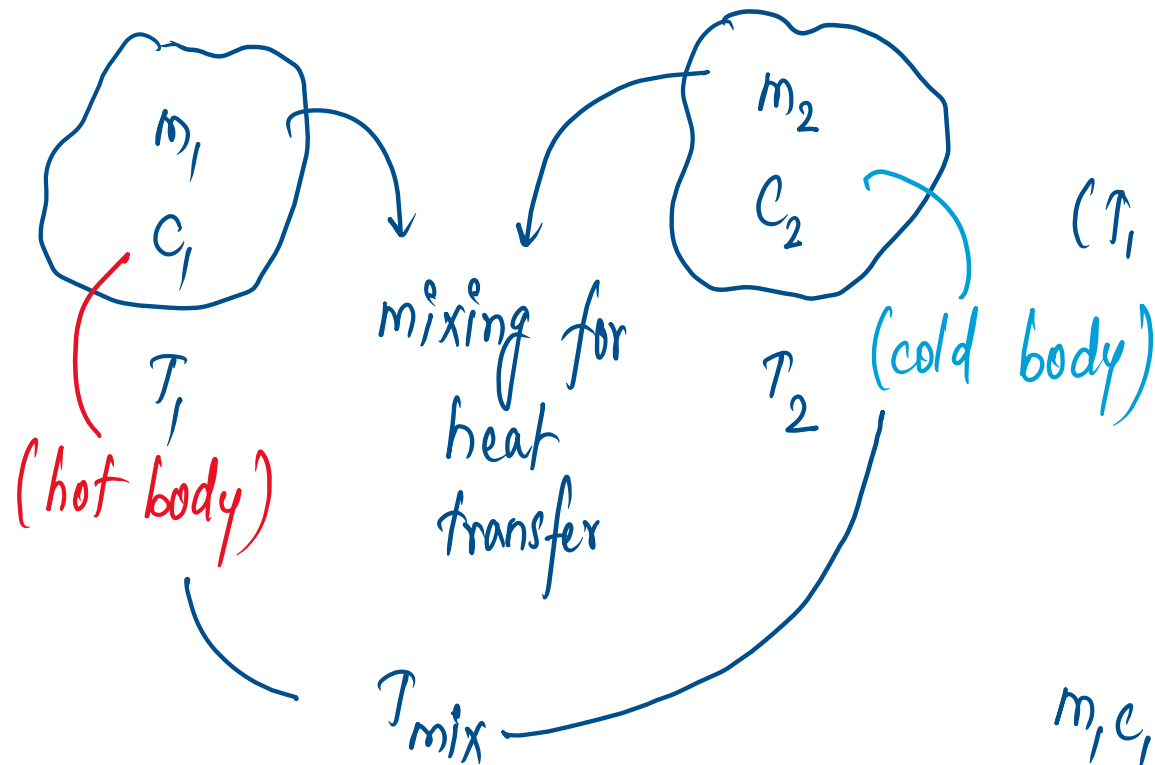


# CALORIMETRY

- Branch of heat transfer that deals with the measurement of heat. The heat is usually measured in calories or kilo calories.
- Principle of Calorimetry : When a hot body is mixed with a cold body, then heat lost by hot body is equal to the heat gained by cold body.

Heat lost = Heat gain, following the law of conservation of heat energy.

# TEMPERATURE OF MIXING



$$T_1 > T_{mix} > T_2$$

(In between  $T_1$  and  $T_2$ )

$$\text{Heat lost} = m_1 c_1 (T_1 - T_{mix})$$

$$\text{Heat gained} = m_2 c_2 (T_{mix} - T_2)$$

Heat Lost = Heat gained (principle of calorimetry)

$$m_1 c_1 (T_1 - T_{mix}) = m_2 c_2 (T_{mix} - T_2)$$

$$T_{mix} = \frac{m_1 c_1 T_1 + m_2 c_2 T_2}{m_1 c_1 + m_2 c_2}$$

# NUCLEAR ENERGY

- The process by which the identity of a nucleus is changed when it is bombarded by an energetic particle is called nuclear reaction.
- The energy released during nuclear reaction is nuclear energy.
- Two distinct ways of obtaining energy from nucleus are as

(i) Nuclear fission

breaking

Unstable → stable

(ii) Nuclear fusion

joining

# MASS – ENERGY RELATION

The diagram illustrates the mass-energy relation equation  $E = mc^2$ . The equation is written in large, colorful letters: 'E' is yellow, '=' is green, 'm' is blue, 'c' is red, and '2' is grey. Four labels with arrows point to the corresponding parts of the equation: 'Energy' (yellow) points to 'E', 'mass' (blue) points to 'm', 'speed of light (constant)' (red) points to 'c', and 'squared' (grey) points to '2'. A green label 'equals' with an upward arrow points to the '=' sign.

$$E = mc^2$$

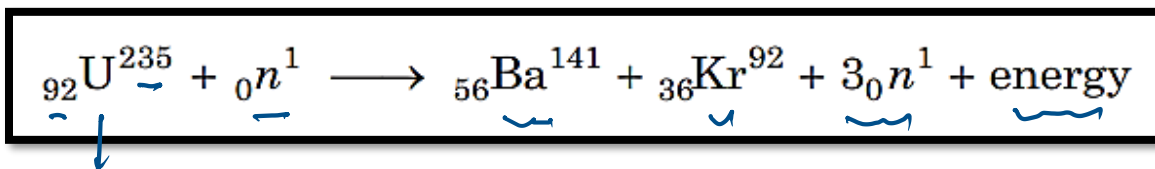
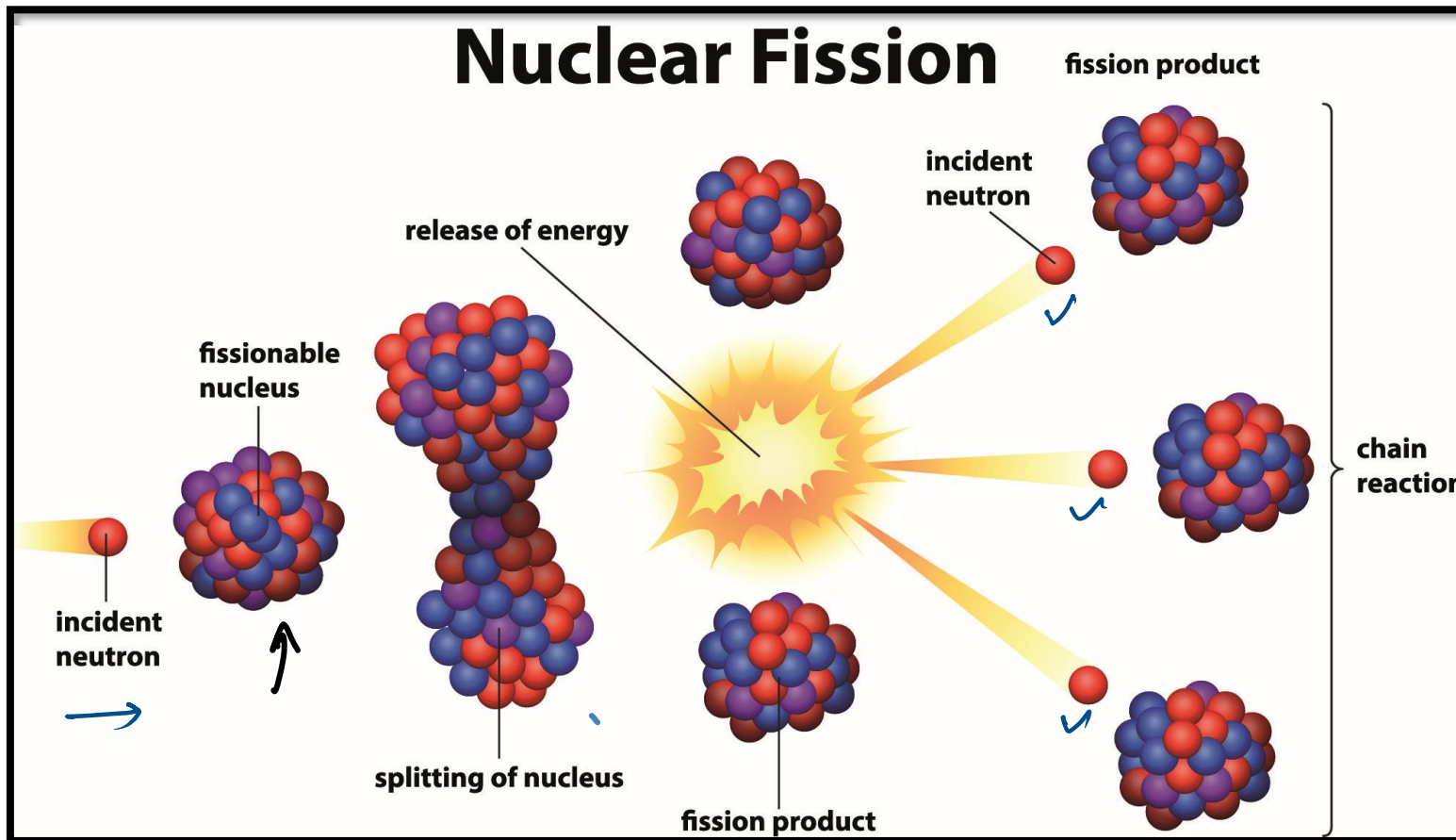
Energy

mass

squared

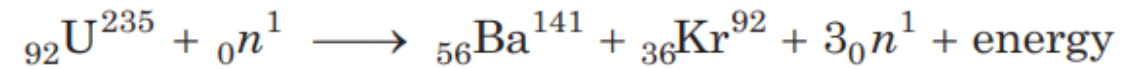
equals

speed of light  
(constant)



# CHAIN REACTIONS

- If the particle starting the nuclear fission reaction is produced as a product and further take part in the nuclear fission reaction, then a chain of fission reaction gets started.



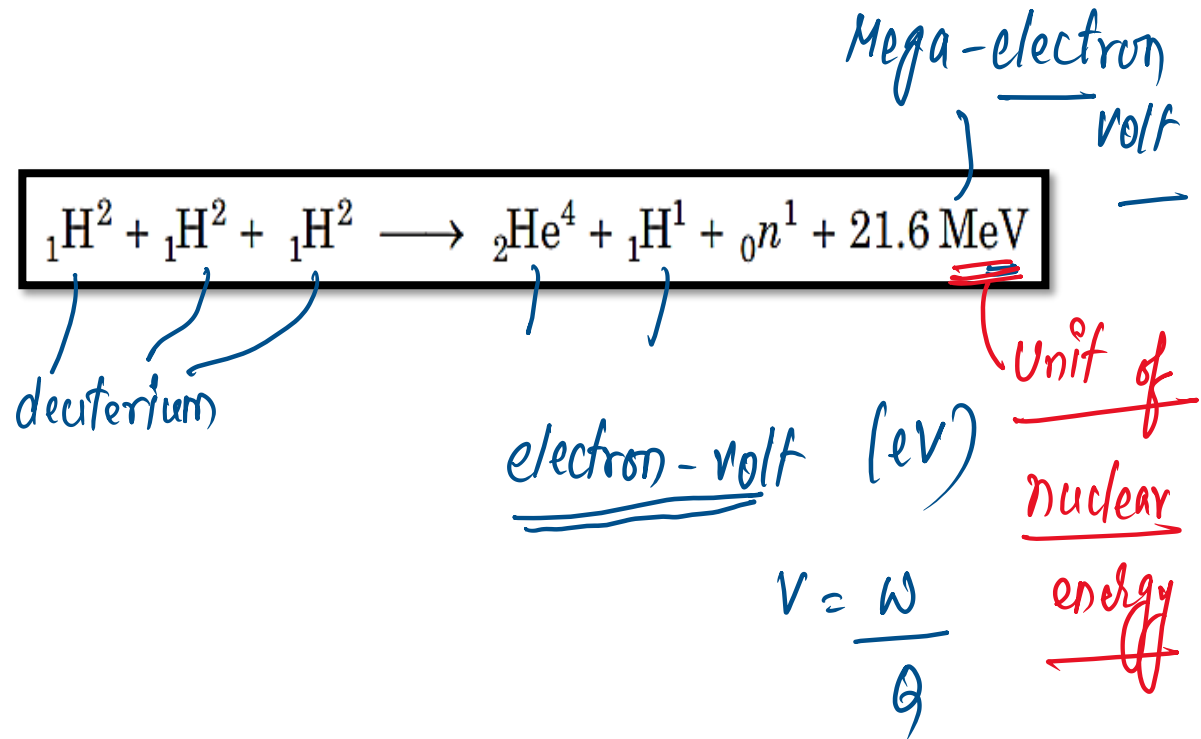
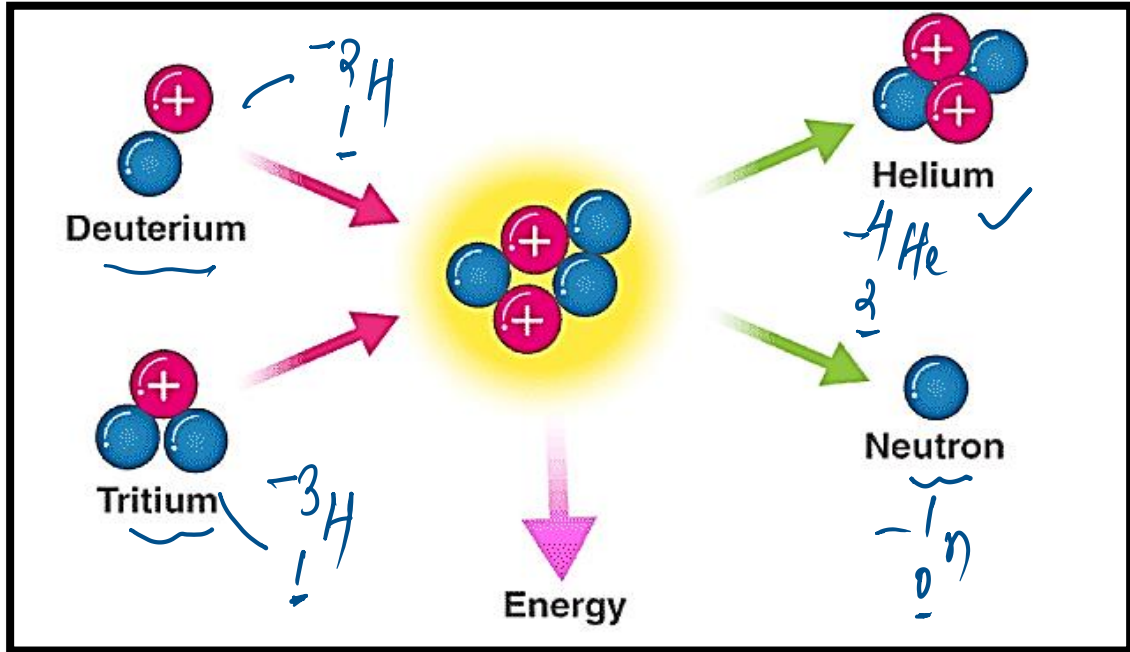
- Nuclear chain reaction are of two types

(i) Controlled chain reaction ( Nuclear Reactor ) *(Basic parts)*

(ii) Uncontrolled chain reaction ( Atom Bomb )

- A nuclear chain reaction releases several million times more energy per reaction than any chemical reaction.

# NUCLEAR FUSION



- Hydrogen bomb is based on nuclear fusion.
- The source of sun's energy is the nuclear fusion taking place in the interior of sun.

$$W = V \times Q$$

$$E \rightarrow IV \times t$$

# Centre of Mass

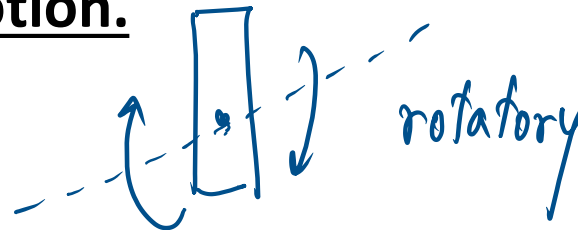
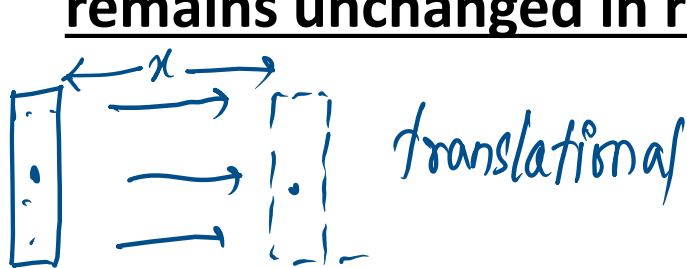
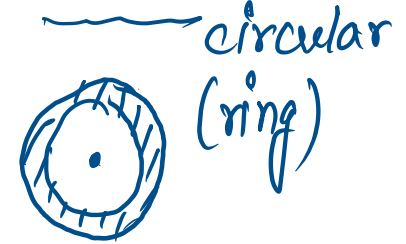
- **Centre of mass of a system is the point that behaves as whole mass of the system is concentrated on it and all external forces are acting on it.**
- **It is a hypothetical point where the entire mass of an object may be assumed to be concentrated to visualise its motion. The center of mass is the particle equivalent of a given object for application of Newton's laws of motion.**





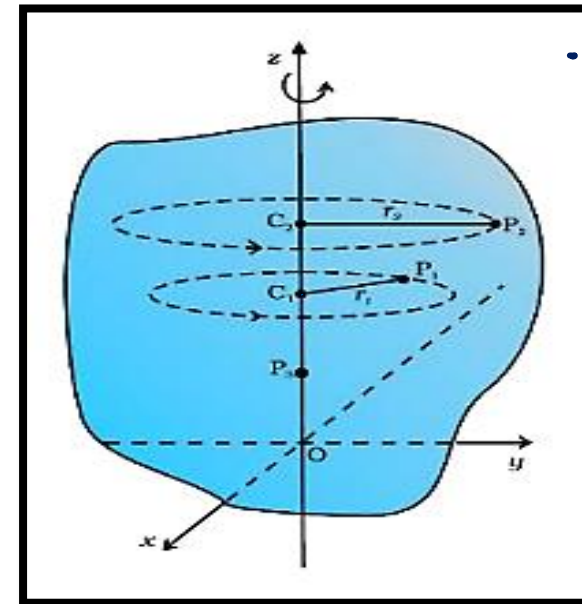
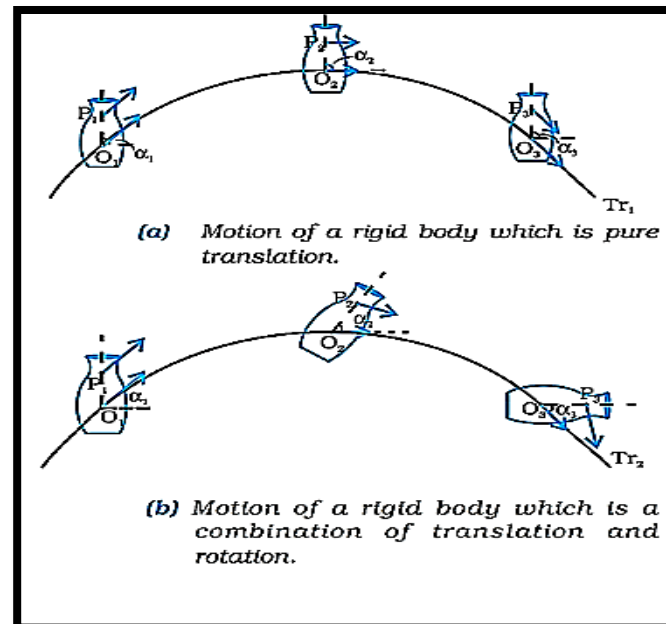
# Centre of Mass

- The position of centre of mass depends upon the shape, size and distribution of the mass of the body.
- The centre of mass of an object need not to lie with in the object.
- In symmetrical bodies having uniform homogeneous distribution of mass the centre of mass coincides with the geometrical centre of the body.
- The position of centre of mass of an object changes in translatory motion but remains unchanged in rotatory motion.



# Translational and Rotational Motion

- A rigid body performs a pure translational motion, if each particle of the body undergoes the same displacement in the same direction in a given interval of time.
- A rigid body performs a pure rotational motion, if each particle of the body moves in a circle, and the centre of all the circles lie on a straight line called the axis of rotation.



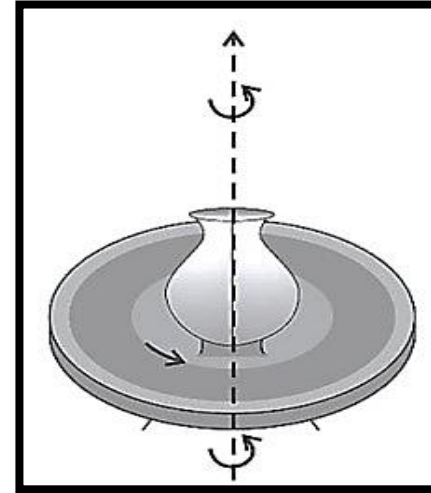
# TERMS ASSOCIATED WITH ROTATIONAL MOTION

- Angular Velocity ( $\omega$ ) :  $\omega = \frac{d\theta}{dt}$  The unit is rad/s.

(omega)

- Angular Acceleration :  $\alpha = \frac{d\omega}{dt}$  The unit is rad/s<sup>2</sup>

$\theta$  — angular displacement



# MOMENT OF INERTIA

- The tendency to resist rotational motion.
- The moment of inertia of a body about a given axis is equal to the sum of the products of the masses of its constituent particles and the square of their respective distances from the axis of rotation.

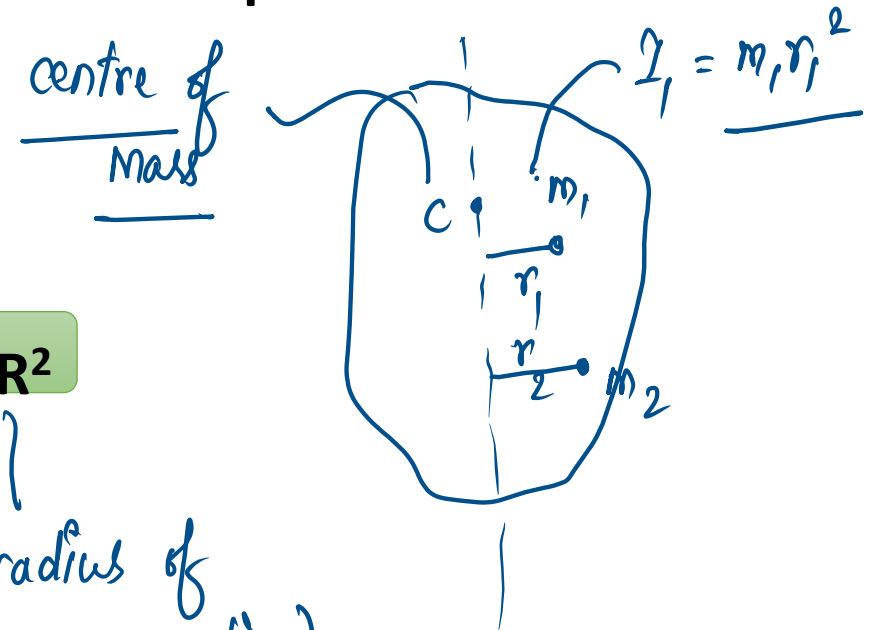
Moment of inertia of a body,

$$I = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + \dots = \sum_{i=1}^n m_i r_i^2$$

- Its unit is  $\text{kgm}^2$ .

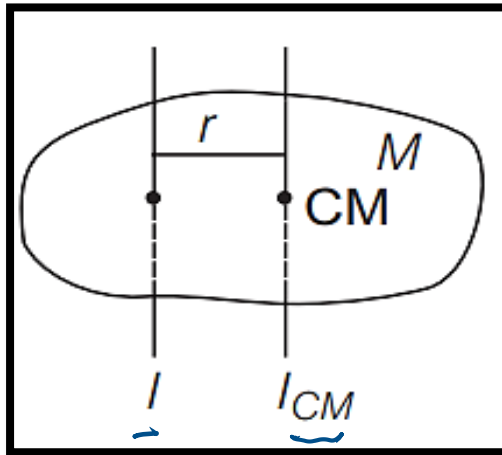
$$I = MR^2$$

(radius of gyration)



# PARALLEL AXES THEOREM

- The moment of inertia of any object about any arbitrary axis is equal to the sum of moment of inertia about a parallel axis passing through the centre of mass and the product of mass of the body and the square of the perpendicular distance between the two axes.

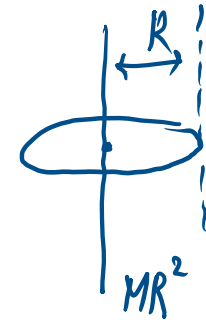


$$I = I_{CM} + Mr^2$$

Blue checkmarks are present under  $I_{CM}$  and  $Mr^2$ .

# Moment of Inertia of Some Homogeneous Rigid Bodies

Body	Axis	Figure	I
* Thin circular ring, radius $R$	Perpendicular to plane, at centre		$MR^2$ ✓
Thin circular ring, radius $R$	Diameter ✓		$MR^2/2$ ✓
Thin rod, length $L$	Perpendicular to rod, at mid point		$ML^2/12$ ✓
* Circular disc, radius $R$	Perpendicular to disc at centre		$MR^2/2$ ✓
Circular disc, radius $R$	Diameter		$MR^2/4$ ✓
Hollow cylinder, radius $R$	Axis of cylinder		$MR^2$ ✓
Solid cylinder, radius $R$	Axis of cylinder		$MR^2/2$ ✓
* Solid sphere, radius $R$	Diameter		$2MR^2/5$ ✓



$$\underline{MR^2 + MR^2 = 2MR^2}$$

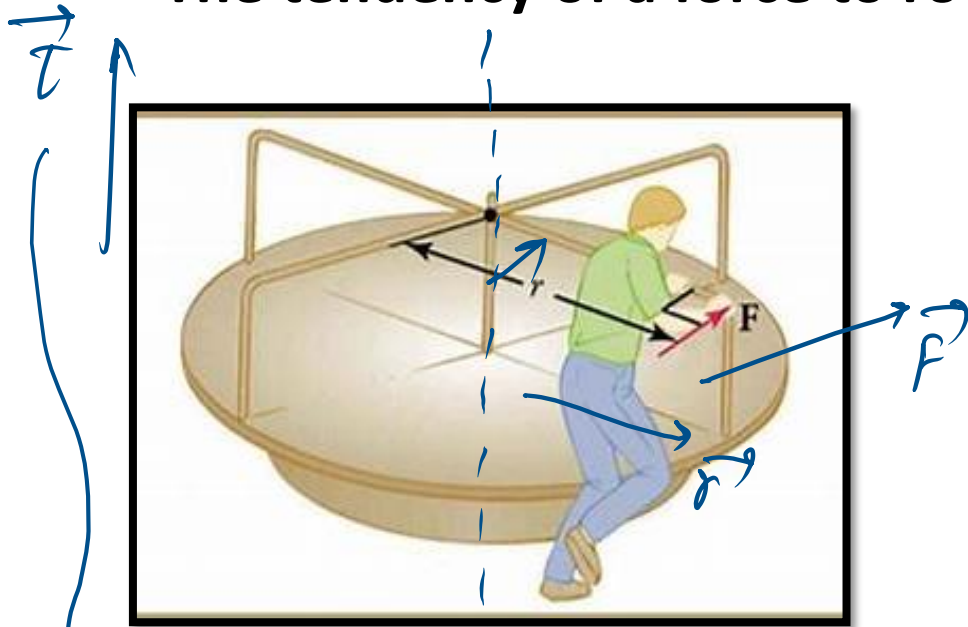
half of perpendicular axis,

# DYNAMICS OF ROTATIONAL MOTION ABOUT A FIXED AXIS

	Linear Motion	Rotational Motion about a Fixed Axis
1	Displacement $x$ ✓	Angular displacement $\theta$ ✓
2	Velocity $v = dx/dt$	Angular velocity $\omega = d\theta/dt$ ✓
3	Acceleration $a = dv/dt$	Angular acceleration $\alpha = d\omega/dt$ ✓
4	Mass $M$ ✓	Moment of inertia $I$ ✓
5	Force $F = Ma$ ✓	Torque $\tau = I\alpha$ ✓
6	Work $dW = F ds$ ✓	Work $W = \tau d\theta$ ✓
7	Kinetic energy $K = Mv^2/2$ ✓	Kinetic energy $K = I\omega^2/2$ ✓
8	Power $P = Fv$ ✓	Power $P = \tau\omega$ ✓
9	Linear momentum $p = Mv$	Angular momentum $L = I\omega$ ✓

# TORQUE

- The tendency of a force to rotate the body.



$$\vec{\tau} = \vec{r} \times \vec{F}$$

$r \sin \theta \hat{n}$

(max. at  $\theta = 90^\circ$ )

$r = \text{max. (at ends)}$

} for same  $F$

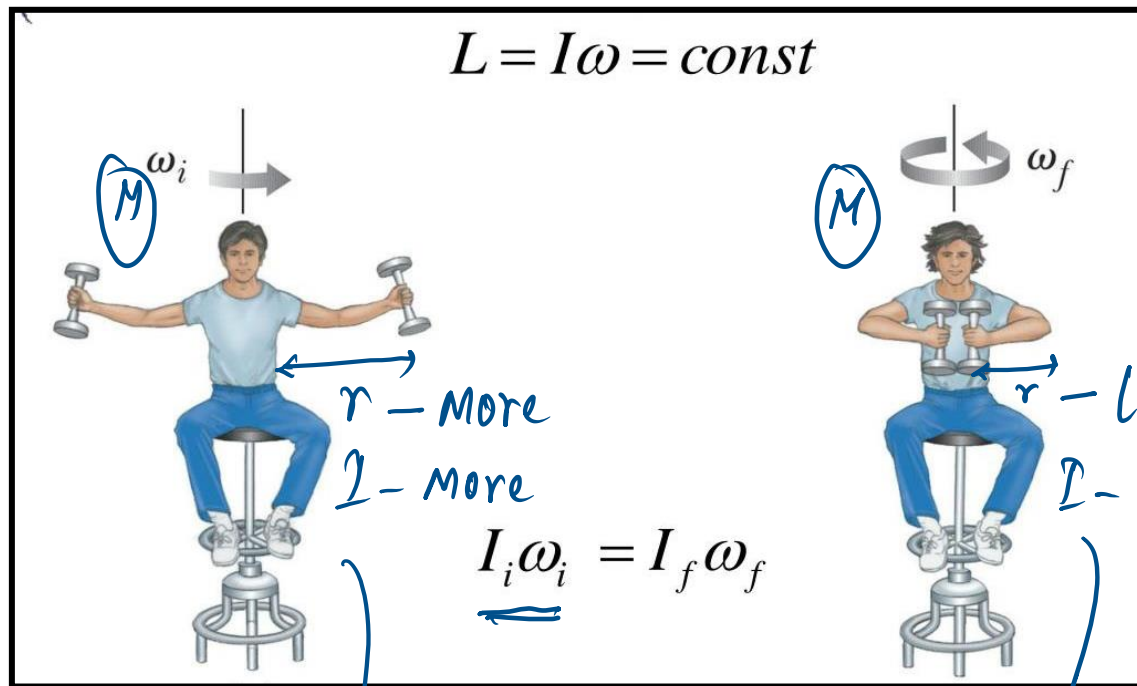
(direction

of torque perpendicular to plane containing  $\vec{r}$  and  $\vec{F}$ )



# CONSERVATION OF ANGULAR MOMENTUM

- If the external torque acting on a system is zero, then its angular momentum remains conserved.



Linear,  $p = mv$   
 angular,  $L = I\omega$

$I = Mr^2$   
 $(I \propto r^2)$

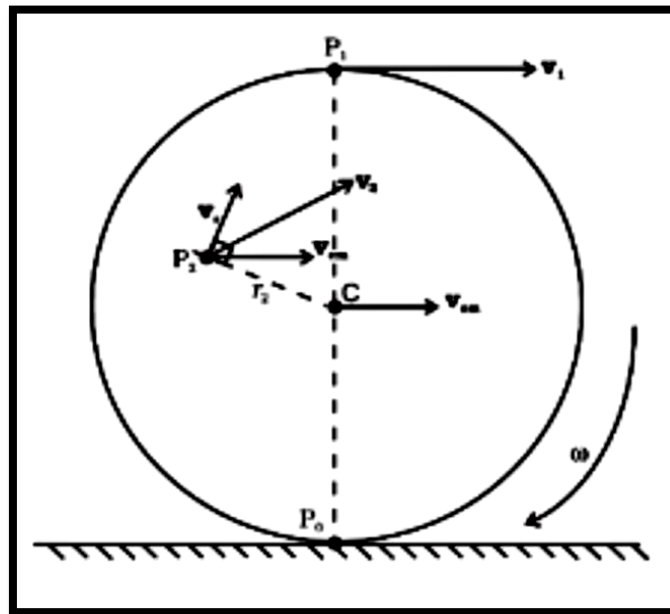
$\omega$  - less

$\omega$  - more

(so that product is constant)

# Rolling Motion — (translational + rotational)

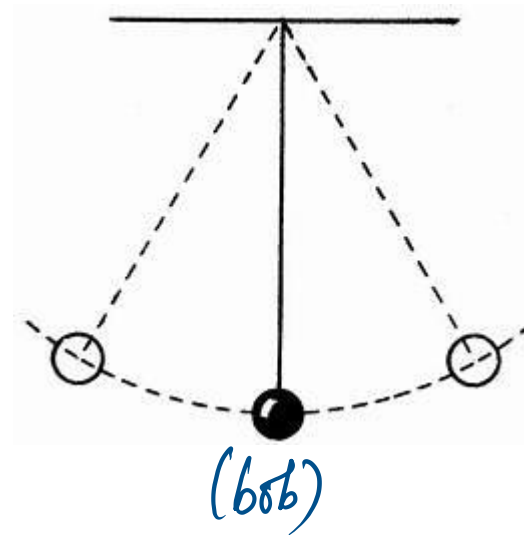
- When a body is set in rolling motion, every particle of body has two velocities - one due to its Rotational motion and the other due to its Translational motion, and the resulting effect is the vector sum of both velocities at all particles.



$$K = KE_R + KE_T$$

$$K = \frac{1}{2} I \omega^2 + \frac{1}{2} m v^2$$

# SIMPLE HARMONIC MOTION

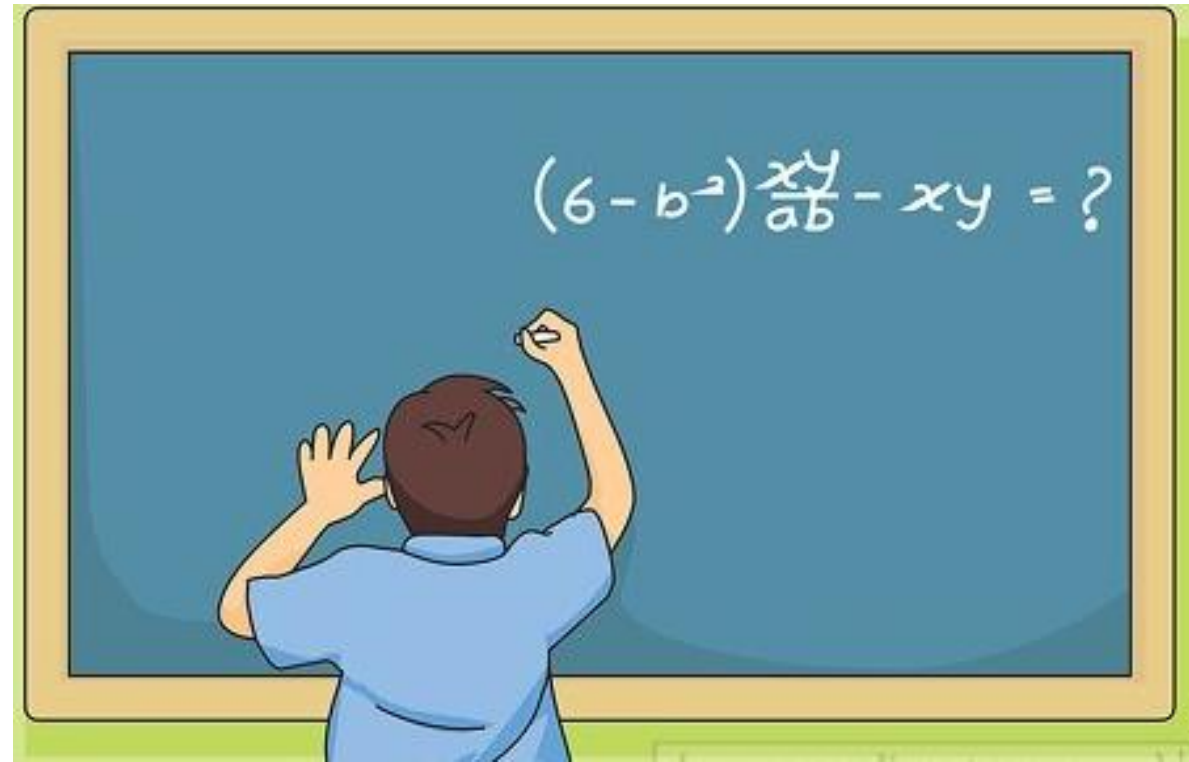


$F \propto x$  ✓ (only for small amplitudes)  
(displacement)  
(restoring force - bringing bob back to

- The force is directly proportional and opposite to the displacement and is always directed towards the mean position.

(mean position)

PRACTISE  
TIME !



1.

The hydrogen bomb and the uranium bomb are based, respectively on

- (a) nuclear fusion and fission
- (b) fission and thermonuclear fusion
- (c) geothermal fission and fusion
- (d) geothermal fusion and fission

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Answer: (A)

## NDA & CDS 2 2024 PHYSICS - CLASS 12

2.

Consider the following statements about the microphone and the speaker of a mobile phone :

1. The microphone converts sound to a mechanical signal.
2. The microphone converts sound to an electrical signal. ✓
3. The speaker converts a mechanical signal to sound.
4. The speaker converts an electrical signal to sound. ✓

Which of the statements given above are correct?

- (a) 1 and 3  
(b) 1 and 4  
(c) 2 and 3  
(d) 2 and 4 ✓

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Which of the statements given above are correct?

- (a) 1 and 3
- (b) 1 and 4
- (c) 2 and 3
- (d) 2 and 4

Answer: (D)



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**3.**

Nuclear energy is generated by

- (a) nuclear fission and its expression was proposed by Einstein.
- (b) nuclear fission and its expression was proposed by Rutherford.
- (c) nuclear fusion and its expression was proposed by Bohr.
- (d) nuclear fusion and its expression was proposed by Heisenberg.

## NDA & CDS 2 2024 PHYSICS - CLASS 12

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**Answer: (A)**

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4. In which of the following phenomena do heat waves travel along a straight line with the speed of light ?
- (a) Thermal conduction
  - (b) Thermal convection
  - (c) Thermal radiation
  - (d) Both, thermal conduction and radiation

4. In which of the following phenomena do heat waves travel along a straight line with the speed of light ?
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  - (c) Thermal radiation
  - (d) Both, thermal conduction and radiation

**Answer: (C)**

5. Which of the following represents a relation for 'heat lost = heat gained'?
- (a) Principle of thermal equilibrium
  - (b) Principle of colors
  - (c) Principle of calorimetry
  - (d) Principle of vaporization

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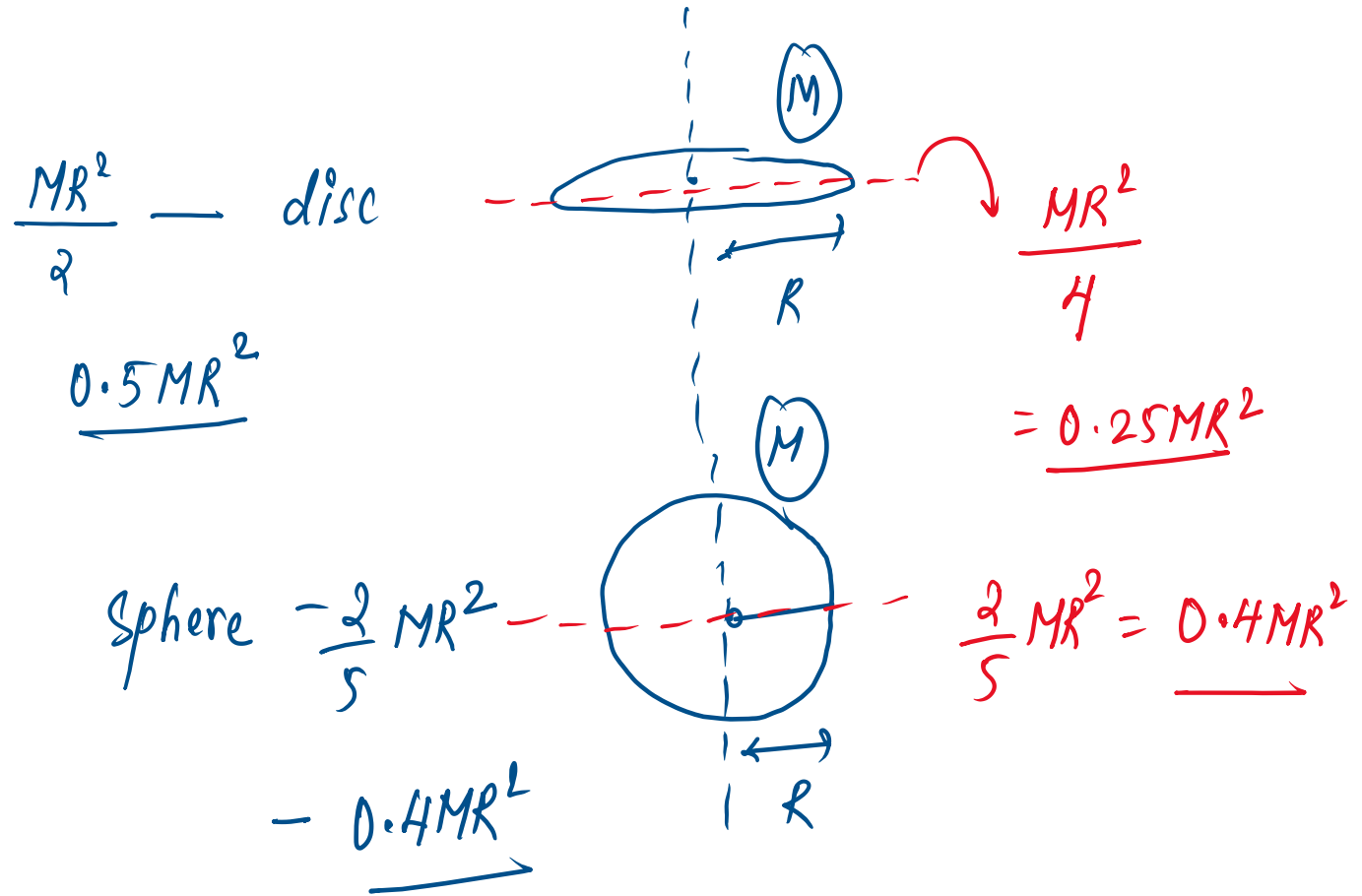
**Answer: (C)**

## NDA & CDS 2 2024 PHYSICS - CLASS 12

A solid disc and a solid sphere have the same mass and same radius. Which one has the higher moment of inertia about its centre of mass?

- (a) The disc
- (b) The sphere
- (c) Both have the same moment of inertia
- (d) The information provided is not sufficient to answer the question

(axis has to be specified)



## NDA & CDS 2 2024 PHYSICS - CLASS 12

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**Answer : D**



## NDA & CDS 2 2024 PHYSICS - CLASS 12

A thin disc and a thin ring, both have mass  $M$  and radius  $R$ . Both rotate about axes through their center of mass and are perpendicular to their surfaces at the same angular velocity. Which of the following is true ?

- (a) The ring has higher kinetic energy
- (b) The disc has higher kinetic energy
- (c) The ring and the disc have the same kinetic energy
- (d) Kinetic energies of both the bodies are zero since they are not in linear motion

## NDA & CDS 2 2024 PHYSICS - CLASS 12

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**Answer : A**

**NDA & CDS 2 2024 PHYSICS - CLASS 12**

**For which of the following does the centre of mass lie outside the body ?**

- (a) A pencil
- (b) A shotput
- (c) A dice
- (d) A bangle

**NDA & CDS 2 2024 PHYSICS - CLASS 12**

**For which of the following does the centre of mass lie outside the body ?**

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**When A Torque Acting On A System Is Zero, Then Which Of The Following Should Not Change?**

- (a) Linear velocity
- (b) Angular momentum
- (c) Angular displacement
- (d) Force acting on the body

**When A Torque Acting On A System Is Zero, Then Which Of The Following Should Not Change?**

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- (b) **Angular momentum**
- (c) Angular displacement
- (d) Force acting on the body

**Two rings have their moments of inertia in the ratio 2 : 1 and their diameters are in the ratio 2 : 1. The ratio of their masses will be**

- (a) 2 : 1
- (b) 1 : 2
- (c) 1 : 4
- (d) 1 : 1

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(a) 2 : 1

**(b) 1 : 2**

(c) 1 : 4

(d) 1 : 1



**Angular acceleration is produced in a body when a ..... acts on it.**

- A. Moment of Inertia
- B. Velocity
- C. Torque
- D. None of the Above

**Angular acceleration is produced in a body when a ..... acts on it.**

- A. Moment of Inertia
- B. Velocity
- C. Torque**
- D. None of the Above

**Which of the following statements is correct ?**

The rotational energy of a body with a given angular speed depends on its

(a) mass only

(b) material only

(c) size only

(d) mass as well as the distribution of its mass about the axis of rotation.

**Which of the following statements is correct ?**

The rotational energy of a body with a given angular speed depends on its

(a) mass only

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(c) size only

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**The combination of rotational motion and the translational motion of a rigid body is known as \_\_\_\_\_.**

- A. Frictional motion
- B. Axis motion
- C. Angular motion
- D. Rolling motion

The combination of rotational motion and the translational motion of a rigid body is known as \_\_\_\_\_.

- A. Frictional motion
- B. Axis motion
- C. Angular motion
- D. Rolling motion**

A body in rotational motion possesses rotational kinetic energy given by

-----.

a.  $KE = \frac{1}{2} I^2 \omega$

b.  $KE = \frac{1}{2} I \omega^2$

c.  $KE = 2I^2 \omega$

d.  $KE = I \omega$

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- a.  $KE = \frac{1}{2} I^2 \omega$
- b.  $KE = \frac{1}{2} I \omega^2$
- c.  $KE = 2 I^2 \omega$
- d.  $KE = I \omega$

**Answer: (B)**



**Moment of inertia, of a spinning body about an axis, doesn't depend on which of the following factors?**

- a) Distribution of mass around axis
- b) Orientation of axis
- c) Mass
- d) Angular velocity

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**REVISION !**

- 1.** Which one of the following energy is stored in the links between the atoms ?
- (a) Nuclear energy
  - (b) Chemical energy
  - (c) Potential energy
  - (d) Thermal energy

1. Which one of the following energy is stored in the links between the atoms ?
- (a) Nuclear energy
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  - (c) Potential energy
  - (d) Thermal energy

**ANSWER : C**

## NDA & CDS 2 2024 PHYSICS - CLASS 12

2.

Which of the following statements about latent heat for a given substance is/are correct ?

1. It is fixed at a given temperature.
2. It depends upon the temperature and volume.
3. It is independent of temperature and volume.
4. It depends on the temperature but independent of volume.

Select the correct answer using the code given below :

- (a) 2
- (b) 1 and 3
- (c) 4 only
- (d) 1 and 4

## NDA & CDS 2 2024 PHYSICS - CLASS 12

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- (a) 2
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- (d) 1 and 4

**ANSWER : D**

## NDA & CDS 2 2024 PHYSICS - CLASS 12

3. Thermal capacity of a body depends on the
- (a) mass of the body only
  - (b) mass and shape of the body only
  - (c) density of the body
  - (d) mass, shape and temperature of the body
- .



## NDA & CDS 2 2024 PHYSICS - CLASS 12

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  - (d) mass, shape and temperature of the body

**ANSWER : A**

4. In which of the following phenomena do heat waves travel along a straight line with the speed of light ?
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  - (c) Thermal radiation
  - (d) Both, thermal conduction and radiation

**ANSWER : C**

## NDA & CDS 2 2024 PHYSICS - CLASS 12

5. Which of the following statements about specific heat of a body is/are correct ?

1. It depends upon mass and shape of the body
2. It is independent of mass and shape of the body
3. It depends only upon the temperature of the body

Select the correct answer using the code given below :

- (a) 1 only
- (b) 2 and 3
- (c) 1 and 3
- (d) 2 only

## NDA & CDS 2 2024 PHYSICS - CLASS 12

5. Which of the following statements about specific heat of a body is/are correct ?

1. It depends upon mass and shape of the body
2. It is independent of mass and shape of the body
3. It depends only upon the temperature of the body

Select the correct answer using the code given below :

- (a) 1 only
- (b) 2 and 3
- (c) 1 and 3
- (d) 2 only

**ANSWER : D**

## NDA & CDS 2 2024 PHYSICS - CLASS 12

6. The hydrogen bomb and the uranium bomb are based, respectively on
- (a) nuclear fusion and fission
  - (b) fission and thermonuclear fusion
  - (c) geothermal fission and fusion
  - (d) geothermal fusion and fission

6. The hydrogen bomb and the uranium bomb are based, respectively on
- (a) nuclear fusion and fission
  - (b) fission and thermonuclear fusion
  - (c) geothermal fission and fusion
  - (d) geothermal fusion and fission

**ANSWER : A**

**7. The most important safety method used for protecting home appliances from short circuiting or overloading is**

- (a) Earthing
- (b) use of fuse
- (c) use of stabilizers
- (d) use of electric meter

.



**7. The most important safety method used for protecting home appliances from short circuiting or overloading is**

(a) Earthing

**(b) use of fuse**

(c) use of stabilizers

(d) use of electric meter

.

8. A positive charge is moving towards south in a space where magnetic field is pointing in the north direction. The moving charge will experience :
- (a) a deflecting force towards north direction.
  - (b) a deflecting force towards east direction.
  - (c) a deflecting force towards west direction.
  - (d) no deflecting force.

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  - (b) a deflecting force towards east direction.
  - (c) a deflecting force towards west direction.
  - (d) no deflecting force.

**ANSWER : D**

**9. To convert an AC generator into DC generator**

- (a) split-ring type commutator must be used
- (b) slip rings and brushes must be used
- (c) a stronger magnetic field has to be used
- (d) a rectangular wire loop has to be used

**9. To convert an AC generator into DC generator**

**(a) split-ring type commutator must be used**

(b) slip rings and brushes must be used

(c) a stronger magnetic field has to be used

(d) a rectangular wire loop has to be used

10.

The magnetic field strength of a current-carrying wire at a particular distance from the axis of the wire

- (a) depends upon the current in the wire
- (b) depends upon the radius of the wire
- (c) depends upon the temperature of the surroundings
- (d) None of the above

10.

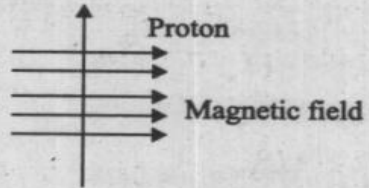
The magnetic field strength of a current-carrying wire at a particular distance from the axis of the wire

- (a) depends upon the current in the wire
- (b) depends upon the radius of the wire
- (c) depends upon the temperature of the surroundings
- (d) None of the above

ANSWER : A

11.

Consider the following image :



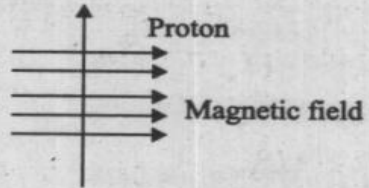
A proton enters a magnetic field at right angles to it, as shown above. The direction of force acting on the proton will be

- (a) to the right
- (b) to the left
- (c) out of the page
- (d) into the page



11.

Consider the following image :



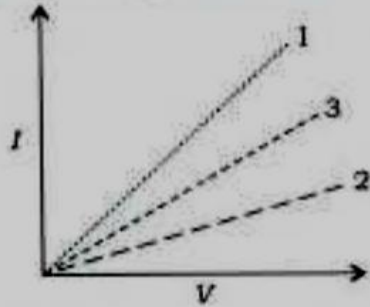
A proton enters a magnetic field at right angles to it, as shown above. The direction of force acting on the proton will be

- (a) to the right
- (b) to the left
- (c) out of the page
- (d) into the page

ANSWER : D

12.

The graphs between current ( $I$ ) and voltage ( $V$ ) for three linear resistors 1, 2 and 3 are given below :



If  $R_1$ ,  $R_2$  and  $R_3$  are the resistances of these resistors, then which one of the following is correct?

(a)  $R_1 > R_2 > R_3$

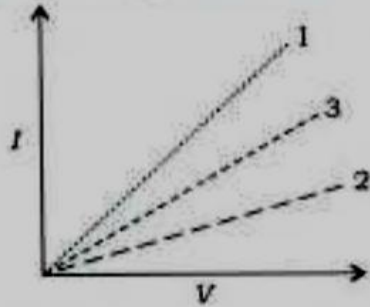
(b)  $R_1 < R_3 < R_2$

(c)  $R_3 < R_1 < R_2$

(d)  $R_3 > R_2 > R_1$

12.

The graphs between current ( $I$ ) and voltage ( $V$ ) for three linear resistors 1, 2 and 3 are given below :



If  $R_1$ ,  $R_2$  and  $R_3$  are the resistances of these resistors, then which one of the following is correct?

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(b)  $R_1 < R_3 < R_2$

(c)  $R_3 < R_1 < R_2$

(d)  $R_3 > R_2 > R_1$

ANSWER : B

**13.** Which one of the following is the value of 1 kWh of energy converted into joules ?

(a)  $1.8 \times 10^6 \text{ J}$

(b)  $3.6 \times 10^6 \text{ J}$

(c)  $6.0 \times 10^6 \text{ J}$

(d)  $7.2 \times 10^6 \text{ J}$

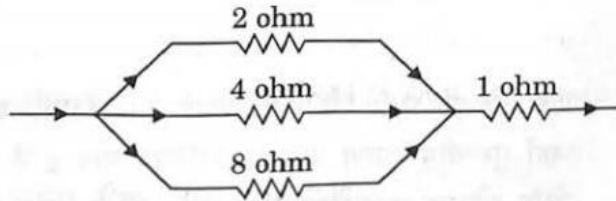
**13.** Which one of the following is the value of 1 kWh of energy converted into joules ?

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- (d)  $7.2 \times 10^6 \text{ J}$

**ANSWER : B**

14.

Consider the following part of an electric circuit :

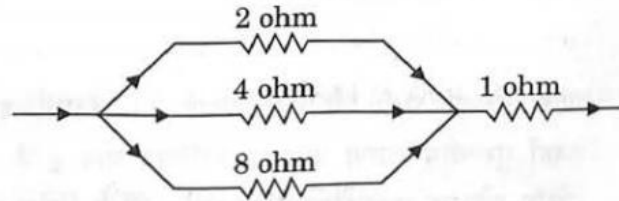


The total electrical resistance in the given part of the electric circuit is

- (a)  $\frac{15}{8}$  ohm
- (b)  $\frac{15}{7}$  ohm
- (c) 15 ohm
- (d)  $\frac{17}{3}$  ohm

14.

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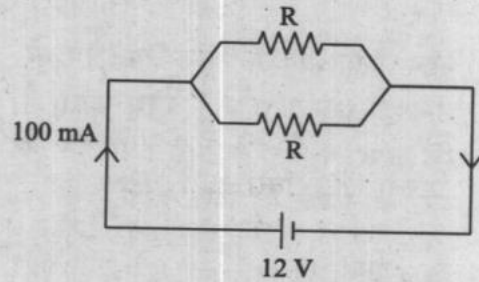
- (a)  $\frac{15}{8}$  ohm
- (b)  $\frac{15}{7}$  ohm
- (c) 15 ohm
- (d)  $\frac{17}{3}$  ohm

ANSWER : B

## NDA & CDS 2 2024 PHYSICS - CLASS 12

15.

Two equal resistors  $R$  are connected in parallel, and a battery of  $12\text{ V}$  is connected across this combination. A dc current of  $100\text{ mA}$  flows through the circuit as shown below :



The value of  $R$  is

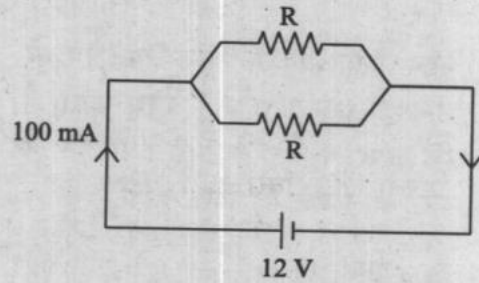
- (a)  $120\ \Omega$
- (b)  $240\ \Omega$
- (c)  $60\ \Omega$
- (d)  $100\ \Omega$



## NDA & CDS 2 2024 PHYSICS - CLASS 12

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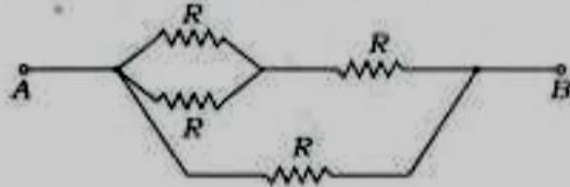
The value of  $R$  is

- (a)  $120\ \Omega$
- (b)  $240\ \Omega$
- (c)  $60\ \Omega$
- (d)  $100\ \Omega$

ANSWER : B

16.

Consider the following circuit :



Which one of the following is the value of the resistance between points A and B in the circuit given above?

(a)  $\frac{2}{5}R$

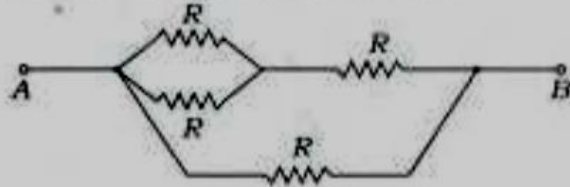
(b)  $\frac{3}{5}R$

(c)  $\frac{3}{2}R$

(d)  $4R$

16.

Consider the following circuit :



Which one of the following is the value of the resistance between points A and B in the circuit given above?

(a)  $\frac{2}{5}R$

(b)  $\frac{3}{5}R$

(c)  $\frac{3}{2}R$

(d)  $4R$

ANSWER : B

**17.**

A fuse wire must be

- (a) conducting and of low melting point
- (b) conducting and of high melting point
- (c) insulator and of high melting point
- (d) insulator and of low melting point

17. A fuse wire must be
- (a) conducting and of low melting point
  - (b) conducting and of high melting point
  - (c) insulator and of high melting point
  - (d) insulator and of low melting point

**ANSWER : A**

- 18.** Let us consider a copper wire having radius  $r$  and length  $l$ . Let its resistance be  $R$ . If the radius of another copper wire is  $2r$  and the length is  $l/2$  then the resistance of this wire will be
- (a)  $R$
  - (b)  $2R$
  - (c)  $R/4$
  - (d)  $R/8$

18. Let us consider a copper wire having radius  $r$  and length  $l$ . Let its resistance be  $R$ . If the radius of another copper wire is  $2r$  and the length is  $l/2$  then the resistance of this wire will be
- (a)  $R$
  - (b)  $2R$
  - (c)  $R/4$
  - (d)  $R/8$

ANSWER : D

19.

In an electric circuit, a wire of resistance  $10\ \Omega$  is used. If this wire is stretched to a length double of its original value, the current in the circuit would become :

- (a) half of its original value.
- (b) double of its original value.
- (c) one-fourth of its original value.
- (d) four times of its original value.



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- (c) one-fourth of its original value.
- (d) four times of its original value.

ANSWER : A

20.

When the short circuit condition occurs, the current in the circuit

- (a) becomes zero
- (b) remains constant
- (c) increases substantially
- (d) keeps on changing randomly

20.

When the short circuit condition occurs, the current in the circuit

- (a) becomes zero
- (b) remains constant
- (c) increases substantially
- (d) keeps on changing randomly

**ANSWER : C**

## NDA & CDS 2 2024 PHYSICS - CLASS 12

**21.**

A metallic wire having resistance of  $20\ \Omega$  is cut into two equal parts in length. These parts are then connected in parallel. The resistance of this parallel combination is equal to

- (a)  $20\ \Omega$
- (b)  $10\ \Omega$
- (c)  $5\ \Omega$
- (d)  $15\ \Omega$

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- (a)  $20\ \Omega$
- (b)  $10\ \Omega$
- (c)  $5\ \Omega$
- (d)  $15\ \Omega$

ANSWER : C

22. Two forces of 5.0 N each are acting on a point mass. If the angle between the forces is  $60^\circ$ , then the net force acting on the point mass has magnitude close to :
- (a) 8.6 N
  - (b) 4.3 N
  - (c) 5.0 N
  - (d) 6.7 N

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- (a) 8.6 N
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  - (d) 6.7 N

**ANSWER : A**

23.

A particle is moving in a circle of radius  $R$  with a constant speed  $v$ . Its average acceleration over the time when it moves over half the circle is :

(a)  $\frac{v^2}{R}$

(b)  $\frac{\pi v^2}{2R}$

(c)  $\frac{2v^2}{\pi R}$

(d) 0



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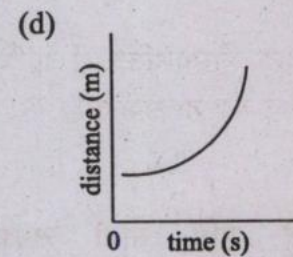
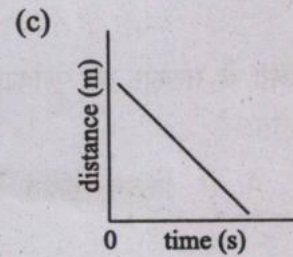
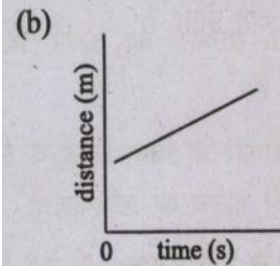
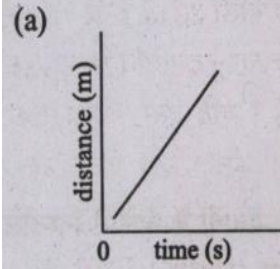
(c)  $\frac{2v^2}{\pi R}$

(d) 0

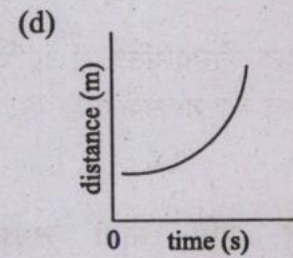
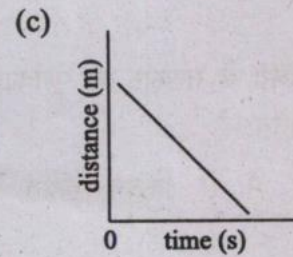
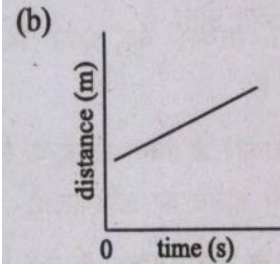
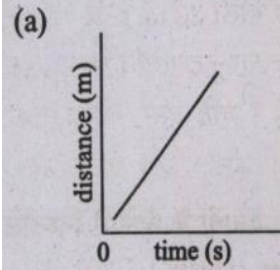
ANSWER : C

## NDA & CDS 2 2024 PHYSICS - CLASS 12

24. Which one of the following graphs represents the equation of motion  $v = u + at$ ; where all quantities are non-zero and symbols carry their usual meanings ?



24. Which one of the following graphs represents the equation of motion  $v = u + at$ ; where all quantities are non-zero and symbols carry their usual meanings ?



ANSWER : D

## NDA & CDS 2 2024 PHYSICS - CLASS 12

25.

A bullet of mass 10 g is horizontally fired with velocity  $300 \text{ m s}^{-1}$  from a pistol of mass 1 kg. What is the recoil velocity of the pistol?

(a)  $0.3 \text{ m s}^{-1}$

(b)  $3 \text{ m s}^{-1}$

(c)  $-3 \text{ m s}^{-1}$

(d)  $-0.3 \text{ m s}^{-1}$

## NDA & CDS 2 2024 PHYSICS - CLASS 12

25.

A bullet of mass 10 g is horizontally fired with velocity  $300 \text{ m s}^{-1}$  from a pistol of mass 1 kg. What is the recoil velocity of the pistol?

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(c)  $-3 \text{ m s}^{-1}$

(d)  $-0.3 \text{ m s}^{-1}$

**ANSWER : C**

26.

A boy of mass 52 kg jumps with a horizontal velocity of 2 m/s onto a stationary cart of mass 3 kg. The cart is fixed with frictionless wheels. Which one of the following would be the speed of the cart?

- (a) 2.15 m/s
- (b) 1.89 m/s
- (c) 1.51 m/s
- (d) 2.51 m/s

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(b) 1.89 m/s

(c) 1.51 m/s

(d) 2.51 m/s

**ANSWER : B**

**27.** Which one of the following forces is non-central and non-conservative ?

- (a) Frictional force
- (b) Electric force.
- (c) Gravitational force
- (d) Mechanical force



**27.** Which one of the following forces is non-central and non-conservative ?

- (a) Frictional force
- (b) Electric force.
- (c) Gravitational force
- (d) Mechanical force

**ANSWER : A**

**28.**

A negative work is done when an applied force  $\mathbf{F}$  and the corresponding displacement  $\mathbf{S}$  are

- (a) perpendicular to each other.
- (b) parallel to each other.
- (c) anti-parallel to each other.
- (d) equal in magnitude.

**28.**

A negative work is done when an applied force **F** and the corresponding displacement **S** are

- (a) perpendicular to each other.
- (b) parallel to each other.
- (c) anti-parallel to each other.
- (d) equal in magnitude.

**ANSWER : C**

**29. A mass of 10 kg is at a point A on table. It is moved to a point B horizontally , what is the work done on the object by the Gravitational force ?**

- A. 0 J
- B. 10 J
- C. 100 J
- D. 1000 J

**29. A mass of 10 kg is at a point A on table. It is moved to a point B horizontally , what is the work done on the object by the Gravitational force ?**

**A. 0 J**

B. 10 J

C. 100 J

D. 1000 J

**30.** Two bodies of mass  $M$  each are placed  $R$  distance apart. In another system, two bodies of mass  $2M$  each are placed  $\frac{R}{2}$  distance apart.

If  $F$  be the gravitational force between the bodies in the first system, then the gravitational force between the bodies in the second system will be

- (a)  $16 F$
- (b)  $1 F$
- (c)  $4 F$
- (d) None of the above

30. Two bodies of mass  $M$  each are placed  $R$  distance apart. In another system, two bodies of mass  $2M$  each are placed  $\frac{R}{2}$  distance apart.

If  $F$  be the gravitational force between the bodies in the first system, then the gravitational force between the bodies in the second system will be

- (a)  $16 F$
- (b)  $1 F$
- (c)  $4 F$
- (d) None of the above

**ANSWER : A**

31.

A liquid is kept in a glass beaker. Which one of the following statements is correct regarding the pressure exerted by the liquid column at the base of the beaker ?

- (a) The pressure depends on the area of the base of the beaker
- (b) The pressure depends on the height of liquid column
- (c) The pressure does not depend on the density of the liquid
- (d) The pressure neither depends on the area of the base of the beaker nor on the height of liquid column



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A liquid is kept in a glass beaker. Which one of the following statements is correct regarding the pressure exerted by the liquid column at the base of the beaker ?

- (a) The pressure depends on the area of the base of the beaker
- (b) The pressure depends on the height of liquid column
- (c) The pressure does not depend on the density of the liquid
- (d) The pressure neither depends on the area of the base of the beaker nor on the height of liquid column

ANSWER : B

32. Which one of the following terms **cannot** represent electrical power in a circuit?

(a)  $VI$

(b)  $I^2/R$

(c)  $I^2R$

(d)  $V^2/R$

32. Which one of the following terms *cannot* represent electrical power in a circuit?
- (a)  $VI$
  - (b)  $I^2/R$
  - (c)  $I^2R$
  - (d)  $V^2/R$

**ANSWER : B**

33.

An object is made of two equal parts by volume; one part has density  $\rho_0$  and the other part has density  $2\rho_0$ . What is the average density of the object?

(a)  $3\rho_0$

(b)  $\frac{3}{2}\rho_0$

(c)  $\rho_0$

(d)  $\frac{1}{2}\rho_0$

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(b)  $\frac{3}{2}\rho_0$

(c)  $\rho_0$

(d)  $\frac{1}{2}\rho_0$

ANSWER : B

**34.**

The time period of a 1 m long pendulum approximates to

(a) 6 s

(b) 4 s

(c) 2 s

(d) 1 s

**34.**

The time period of a 1 m long pendulum approximates to

(a) 6 s

(b) 4 s

(c) 2 s

(d) 1 s

**ANSWER : C**

- 35.** All objects experience a buoyancy when they are immersed in a fluid. Buoyancy is
- (a) a downward force
  - (b) a downward pressure
  - (c) an upward force
  - (d) an upward pressure



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- (a) a downward force
  - (b) a downward pressure
  - (c) an upward force
  - (d) an upward pressure

**ANSWER : C**

36.

Two planets orbit the Sun in circular orbits, with their radius of orbit as  $R_1 = R$  and  $R_2 = 4R$ . Ratio of their periods ( $T_1/T_2$ ) around the Sun will be

- (a)  $1/16$
- (b)  $1/8$
- (c)  $1/4$
- (d)  $1/2$

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- (b)  $1/8$
- (c)  $1/4$
- (d)  $1/2$

**ANSWER : B**

37. A pendulum clock is lifted to a height where the gravitational acceleration has a certain value  $g$ . Another pendulum clock of same length but of double the mass of the bob is lifted to another height where the gravitational acceleration is  $g/2$ . The time period of the second pendulum would be :

(in terms of period  $T$  of the first pendulum)

(a)  $\sqrt{2} T$

(b)  $\frac{1}{\sqrt{2}} T$

(c)  $2\sqrt{2} T$

(d)  $T$

37. A pendulum clock is lifted to a height where the gravitational acceleration has a certain value  $g$ . Another pendulum clock of same length but of double the mass of the bob is lifted to another height where the gravitational acceleration is  $g/2$ . The time period of the second pendulum would be :

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- (a)  $\sqrt{2} T$
- (b)  $\frac{1}{\sqrt{2}} T$
- (c)  $2\sqrt{2} T$
- (d)  $T$

**ANSWER : A**

**38.** Which one of the following statements is correct for a plane mirror?

- (a) Its focal length is zero.
- (b) The size of the image of an object placed in front of the mirror is slightly less than that of the object.
- (c) The image is virtual, erect and laterally inverted.
- (d) Its focal length is 200 cm.

**38.** Which one of the following statements is correct for a plane mirror?

- (a) Its focal length is zero.
- (b) The size of the image of an object placed in front of the mirror is slightly less than that of the object.
- (c) The image is virtual, erect and laterally inverted.
- (d) Its focal length is 200 cm.

**ANSWER : C**

**39.** In case of a concave mirror, if an object is kept between principal focus  $F$  and pole  $P$  of the mirror, then which one of the following statements about the image is NOT correct ?

- (a) The image will be virtual
- (b) The image will be enlarged or magnified
- (c) The image will be formed at infinity
- (d) The image will be erect



39. In case of a concave mirror, if an object is kept between principal focus  $F$  and pole  $P$  of the mirror, then which one of the following statements about the image is NOT correct?

- (a) The image will be virtual
- (b) The image will be enlarged or magnified
- (c) The image will be formed at infinity
- (d) The image will be erect

ANSWER : C

- 40.** An object is placed in front of a convex mirror. Which one of the following statements is correct?
- (a)* It will never form an inverted image.
  - (b)* The image moves towards the focus when the object moves towards the mirror.
  - (c)* Depending on the position of the object with respect to the mirror, the image can be inverted and real.
  - (d)* The size of the image becomes larger than that of the object when the object is placed at a distance equal to half the focal length.

**40.** An object is placed in front of a convex mirror. Which one of the following statements is correct?

- (a)* It will never form an inverted image.
- (b)* The image moves towards the focus when the object moves towards the mirror.
- (c)* Depending on the position of the object with respect to the mirror, the image can be inverted and real.
- (d)* The size of the image becomes larger than that of the object when the object is placed at a distance equal to half the focal length.

**ANSWER : A**

41. Sita, 1.5 m high, stands before a plane mirror fixed on a wall to view her full image. What should be the minimum height of the plane mirror so that Sita can view her image fully ?
- (a) 0.50 m
  - (b) 0.35 m
  - (c) 0.75 m
  - (d) 0.25 m

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**ANSWER : C**

42. Which one of the following statements about the refractive index of a material medium with respect to air is correct ?

- (a) It can be either positive or negative
- (b) It can have zero value
- (c) It is unity for all materials
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**ANSWER : D**

**43.** If the focal length of a convex lens is 50 cm, which one of the following is its power?

(a) +2 dioptr

(b) +0.02 dioptr

(c) -0.5 dioptr

(d) +0.5 dioptr

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ANSWER : A

44.

Mirage is an illustration of

- (a) only dispersion of light.
- (b) only reflection of light.
- (c) only total internal reflection of light.
- (d) both refraction and total internal reflection of light.

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**ANSWER : D**

45. Twinkling of stars is due to
- (a) particular frequencies of the starlight.
  - (b) reflection of starlight from the oceanic surface.
  - (c) atmospheric refraction of starlight.
  - (d) magnetic field of Earth.

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**ANSWER : C**

46.

The refractive index of fused quartz is 1.46 and that of sapphire is 1.77. If  $v_q$  is the speed of light in quartz and  $v_s$  is the speed of light in sapphire, then which one of the following relations is correct ?

(a)  $v_q > v_s$

(b)  $v_s > v_q$

(c)  $v_s = v_q$

(d)  $v_s = \frac{v_q}{2}$

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ANSWER : A

47. The part of the human eye on which the image is formed is

(a) pupil

(b) cornea

(c) retina

(d) iris



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**ANSWER : C**

48.

A glass prism splits white light into different colours. This phenomenon is called dispersion of light by prism. Which one of the following statements is correct ?

- (a) Red light will deviate the most and it is because of the reflection of light.
- (b) Violet light will deviate the most and it is because of the refraction of light.
- (c) Red light will deviate the most and it is because of the refraction of light.
- (d) Violet light will deviate the most and it is because of the reflection of light.

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**ANSWER : B**

49.

Human eye can see objects at different distances with contrasting illuminations. This is due to

- (a) far-sightedness
- (b) near-sightedness
- (c) far-sightedness and near-sightedness
- (d) accommodation of eye

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ANSWER : D

50.

Tyndall effect is a phenomenon of

- (a) scattering of light by the colloidal particles.
- (b) refraction of light by the colloidal particles.
- (c) dispersion of light by dust particles.
- (d) refraction of light by dust particles.

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**ANSWER : A**