



**10**

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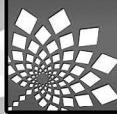


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## Preface

Greetings to beloved Teachers and Students,

“Science is a beautiful gift to humanity, we should not distort it.”

- Dr. APJ Abdul Kalam

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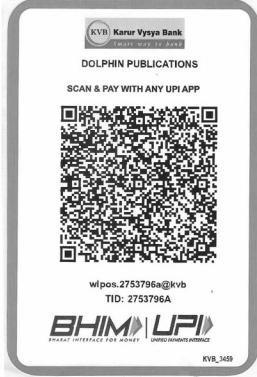
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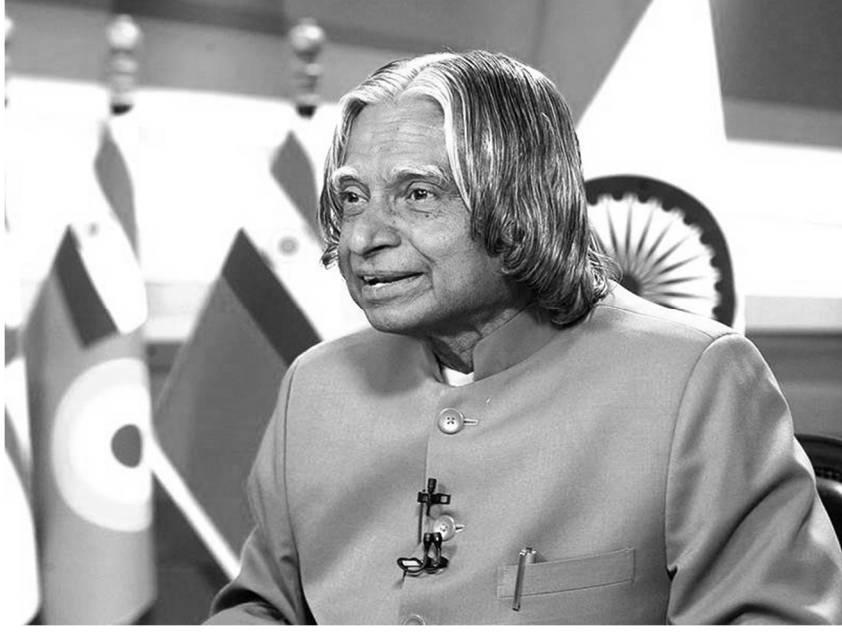
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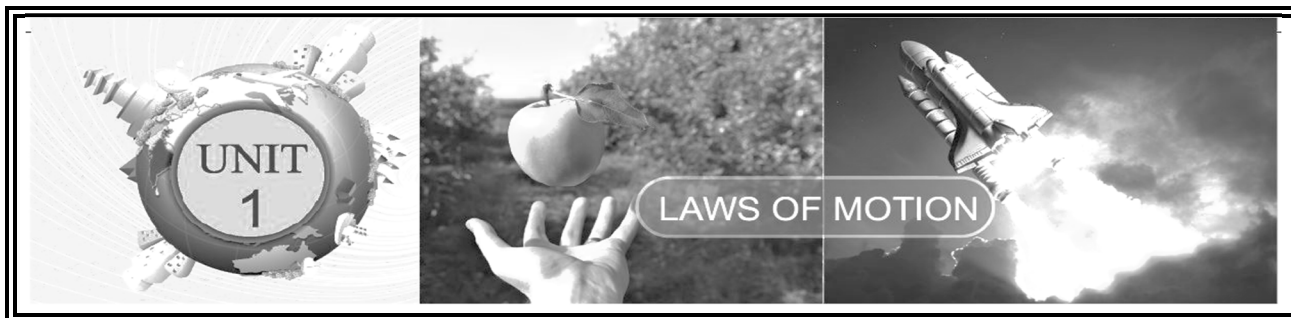
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- Dr. A.P.J. அப்துல்கலாம்



S. No.	Formula	Unit	
1.	Linear Momentum	$P = m \times v$	$\text{Kg ms}^{-1}$
2.	Torque	$\tau = F \times d$	Nm
3.	Moment of Couple	$M = F \times S$	Nm
4.	Resultant force parallel forces acting in the same direction	$F_{\text{net}} = F_1 + F_2$	N
5.	Resultant force parallel unequal forces acting in the same direction	$F_{\text{net}} = F_2 - F_1$	N
6.	Force	$F = m \times a$	N
7.	Impulse	$J = F \times t$	Ns
8.	Acceleration due to gravity	$g = \frac{GM}{R^2}$	$\text{ms}^{-2}$
9.	Change in momentum	$\Delta p = P_f - P_i$	$\text{Kg ms}^{-1}$
10.	Mass of the Earth	$M = \frac{gR^2}{G}$	kg



## Textbook Evaluation

PAGE-13

## I. CHOOSE THE CORRECT ANSWER

1. Inertia of a body depends on (APR-24)

- a) weight of the object  
 b) acceleration due to gravity of the planet  
 c) mass of the object    d) Both a & b

Ans: c) mass of the object

2. Impulse is equal to (PTA-1)

- a) rate of change of momentum  
 b) rate of force and time  
 c) change of momentum

d) rate of change of mass

Ans: c) change of momentum

3. Newton's III law is applicable

- a) for a body is at rest  
 b) for a body in motion  
 c) both a and b  
 d) only for bodies with equal masses

Ans: c) both (a) & (b)

4. Plotting a graph for momentum on the Y-axis and time on X-axis. Slope of momentum-time graph gives

- a) Impulsive force      b) Acceleration  
c) Force                      d) Rate of force

Ans: c) Force

5. In which of the following sports the turning of effect of force used

- a) swimming                  b) tennis  
c) cycling                      d) hockey

Ans: c) cycling

6. The unit of 'g' is  $\text{ms}^{-2}$ . It can be also expressed as

- a)  $\text{cms}^{-1}$                       b)  $\text{Nkg}^{-1}$   
c)  $\text{Nm}^2\text{kg}^{-1}$                   d)  $\text{cm}^2\text{s}^{-2}$

Ans: b)  $\text{Nkg}^{-1}$

7. One kilogram force equals to (APR-25)

- a) 9.8 dyne                      b)  $9.8 \times 10^4 \text{ N}$   
c)  $98 \times 10^4 \text{ dyne}$               d) 980 dyne

Ans: c)  $98 \times 10^4 \text{ dyne}$

8. The mass of a body is measured on planet Earth as M kg. When it is taken to a planet of radius half that of the Earth then its value will be \_\_\_\_\_ kg

- a) 4 M                              b) 2M  
c) M/4                              d) M

Ans: d) M

9. If the Earth shrinks to 50% of its real radius its mass remaining the same, the weight of a body on the Earth will (MAR-26)

- a) decrease by 50%      b) increase by 50%  
c) decrease by 25%      d) increase by 300%

Ans: d) increase by 300%

10. To project the rockets which of the following principle(s) is /are required?

(G.MQ.SEP-21.AUG-22, JULY-24, 25)

- a) Newton's third law of motion  
b) Newton's law of gravitation  
c) law of conservation of linear momentum  
d) both a and c

Ans: d) both a and c

### ADDITIONAL QUESTIONS

11. F be the force between the two bodies placed at a certain distance. If the distance between them is doubled then the gravitational force

F will be \_\_\_\_\_

(PTA-5)

- a) 2F                                  b) F/2  
c) F/4                                  d) 4F

Ans: c) F/4

12. The force required to produce an acceleration of  $1\text{cm s}^{-2}$  on a body of mass 1 g is (PTA-6)

- a) 1 N                                  b) 10 N  
c)  $10^2 \text{ N}$                               d) 1 dyne

Ans: d) 1 dyne

### II. FILL IN THE BLANKS

- To produce a displacement \_\_\_\_\_ is required. Ans: Force
- Passengers lean forward when sudden brake is applied in a moving vehicle. This can be explained by \_\_\_\_\_. Ans: Inertia of motion
- By convention, the clockwise moments are taken as \_\_\_\_\_ and the anticlockwise moments are taken as \_\_\_\_\_. Ans: Negative, Positive
- \_\_\_\_\_ is used to change the speed of car. Ans: Gear
- A man of mass 100 kg has a weight of \_\_\_\_\_ at the surface of the Earth. Ans: 980 N

**III. STATE WHETHER THE FOLLOWING STATEMENTS ARE TRUE OR FALSE.  
CORRECT THE STATEMENT IF IT IS FALSE**

1. The linear momentum of a system of particles is always conserved.

Ans : False.

**Correct Statement** : The linear momentum of a system of particles is always conserved when **no external force is applied.**

2. Apparent weight of a person is always equal to his actual weight.

Ans : False.

**Correct Statement** : Apparent weight and actual weight is **not equal** during upward or downward motion.

3. Weight of a body is greater at the equator and less at the polar region.

Ans : False.

**Correct Statement** : Weight of a body is **less at the equator and greater** at the polar region.

4. Turning a nut with a spanner having a short handle is so easy than one with a long handle.

Ans : False.

**Correct Statement** : Turning a nut with a spanner having a **long handle** is so easy than one with a **short handle.**

5. There is no gravity in the orbiting space station around the Earth. So the astronauts feel weightlessness.

Ans : False.

**Correct Statement** : The space station and astronauts have equal acceleration, they are under free fall condition, So the astronaut and space station are in the state of weightlessness.

**IV. MATCH THE FOLLOWING (PTA – 1)**

S. No.	Column I	Column II	Answer
a.	Newton's I law	(a) propulsion of a rocket	<b>b) Stable equilibrium of a body</b> <b>c) Law of force</b> <b>d) Flying nature of bird</b> <b>a) propulsion of a rocket</b>
b.	Newton's II law	(b) Stable equilibrium of a body	
c.	Newton's III law	(c) Law of force	
d.	Law of conservation of linear momentum	(d) Flying nature of bird	

### V. ASSERTION & REASONING

Mark the correct choice as

- a) If both the assertion and the reason are true and the reason is the correct explanation of assertion.  
 b) If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.  
 c) Assertion is true, but the reason is false.  
 d) Assertion is false, but the reason is true.

1. **Assertion** : The sum of the clockwise moments is equal to the sum of the anticlockwise moments.

**Reason** : The principle of conservation of momentum is valid if the external force on the system is zero.

**Ans** : **b) If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion**

2. **Assertion** : The value of 'g' decreases as height and depth increases from the surface of the Earth.

**Reason** : 'g' depends on the mass of the object and the Earth

**Ans** : **c) Assertion is true, but the reason is false**

### ADDITIONAL QUESTIONS

3. Understand the assertion and the reason given and choose the correct choice. (PTA-6)

**Assertion** : When a person swims he pushes the water using the hands backward and the water pushes the person in the forward direction

**Reason** : For every action there is an equal and opposite reaction

- a) Both the assertion and the reason are true and the reason is the correct explanation of assertion.  
 b) Both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.  
 c) Assertion is true, but the reason is false.  
 d) Both the assertion and the reason are false.

**Ans : a) Both the assertion and the reason are true and the reason is the correct explanation of assertion.**

### VI. ANSWER BRIEFLY

1. Define inertia. Give its classification.

(AUG -22, APR -23)

The inherent property of a body to resist any change in its state of rest (or) the state of uniform motion, unless it is influenced upon by an external unbalanced force is known as Inertia.

**Types of Inertia:**

- ii) Inertia of rest.
- iii) Inertia of motion.
- iv) Inertia of direction.

2. Classify the types of force based on their application. (AUG-22)

- Like parallel forces.
- Unlike parallel forces.

3. If a 5 N and a 15 N forces are acting opposite to one another. Find the resultant force and the direction of action of the resultant force.

$$F_1 = 5 \text{ N} \quad F_2 = 15 \text{ N}$$

Resultant Force	=	$F_2 - F_1$
	=	$15\text{N} - 5\text{N}$
	=	10N.

The direction of action of the resultant force will be in the direction of 15 N.

4. Differentiate mass and weight. (MAY-22)

Sl. No.	Mass	Weight
1.	Quantity of matter contained in the body.	Gravitational force exerted on a body due to the gravity.
2.	SI unit is kilogram.	SI unit is newton.
3.	It is a scalar quantity	It is a vector quantity

5. Define moment of a couple. (JULY-24)

Two equal and unlike parallel forces applied simultaneously at two distinct points constitute a couple. The rotating effect of a couple is known as 'moment of a couple'.

Moment of a couple = Force x perpendicular distance between the line of action of force

$$M = F \times S, \quad \text{Unit : Nm}$$

6. State the principle of moments. (APR-25)

At equilibrium, the algebraic sum of the moments of all the individual forces about any point is equal to zero.

Moment in clockwise direction = Moment in anticlockwise direction

$$F_1 \times d_1 = F_2 \times d_2$$

7. State Newton's second law. (G.MQ, MAY-22)

The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force.

$$F = m \times a$$

8. Why a spanner with a long handle is preferred to tighten screws in heavy vehicles?

Moment of a couple is measured by the product of any one of the forces and the perpendicular distance between the line of action of two forces. When the perpendicular distance is more, the turning effect is also more. So, spanner with a long handle will require lesser force to tighten screws in heavy vehicles.

9. While catching a cricket ball the fielder lowers his hands backwards. Why? (MAR-26)

In Cricket, the fielder pulls back his hands while catching the ball. By doing this he experiences a smaller force for a longer interval of time, resulting in a lesser impulse on his hands.

10. How does an astronaut float in a space shuttle? (JULY-24)

Astronauts are not floating but falling freely around the earth due to their huge orbital velocity. Since space shuttle and astronauts have equal acceleration, they are under free fall condition.

### ADDITIONAL QUESTIONS

11. Use the analogy to the fill the blank (PTA-4)

a) opening a door : Moment of force

Opening a water tap : \_\_\_\_\_

Answer: moment of couple

b) pushing a bus by a group of people :

Like parallel forces

Tug of war : \_\_\_\_\_

Answer : unlike parallel forces

**12. Why the apples weigh more at poles than at equator? (PTA - 3)**

Weight of a body varies from one place to another place on the earth since it depends on the acceleration due to gravity of the earth (g), which is not the same at all places on the earth. Since, weight  $W = mg$ , as varies, the weight of a body is more at the poles than at the equatorial

region. So weight of apples will be more at poles than at equator.

**13. Write short notes on gears. (SEP-20)**

A gear is a circular wheel with teeth around its rim. It helps to change the speed of rotation of a wheel by changing the torque and helps to transmit power.

**VII. SOLVE THE GIVEN PROBLEMS**

1. Two bodies have a mass ratio of 3:4 the force applied on the bigger mass produces an acceleration of  $12 \text{ ms}^{-2}$ . What could be the acceleration of the other body, if the same force acts on it.

$$m_1 : m_2 = 3 : 4$$

$$a_2 = 12 \text{ ms}^{-2}$$

$$a_1 = ?$$

According to Newton's third law of motion.

$$F_1 = -F_2$$

$$m_1 \times a_1 = -(m_2 \times a_2)$$

$$3 \times a_1 = -(4 \times 12)$$

$$a_1 = \frac{48}{3}$$

$$a_1 = 16 \text{ ms}^{-2}$$

So acceleration due to the same force on the smaller body  $a_1 = 16 \text{ ms}^{-2}$

2. A ball of mass 1 kg moving with a speed of  $10 \text{ ms}^{-1}$  rebounds after a perfect elastic collision with the floor. Calculate the change in linear momentum of the ball.

$$\text{Mass of the ball (m)} = 1 \text{ kg}$$

$$\text{Initial speed (u)} = 10 \text{ ms}^{-1}$$

$$\text{Final speed (v)} = 10 \text{ ms}^{-1}$$

Change in momentum

$$\Delta p = mv - mu$$

$$\Delta p = 1(-10) - 1(10)$$

$$= -10 - 10$$

$$\Delta p = -20 \text{ kg m s}^{-1}$$

3. A mechanic unscrew a nut by applying a force of 140 N with a spanner of length 40 cm. What should be the length of the spanner if a force of 40 N is applied to unscrew the same nut?

$$\text{Force } F_1 = 140 \text{ N}$$

$$\text{Length } (l_1) = 40 \text{ cm} = 0.4 \text{ m}$$

$$\text{Force, } F_2 = 40 \text{ N}$$

$$\text{Length, } (l_2) = ?$$

Length of the spanner,

$$F_1 l_1 = F_2 l_2$$

$$140 \times 0.4 = 40 \times l_2$$

$$l_2 = \frac{140 \times 0.4}{40}$$

$$\text{Length of the spanner } (l_2) = 1.4 \text{ m}$$

4. The ratio of masses of two planets is 2:3 and the ratio of their radii is 4:7. Find the ratio of their accelerations due to gravity.

Accelerations due to gravity (g)	=	$\frac{GM}{R^2}$
$g_1 : g_2$	=	?
$M_1 : M_2$	=	2 : 3
$R_1 : R_2$	=	4 : 7

$\frac{g_1}{g_2} = \frac{M_1}{M_2} \times \frac{R_2^2}{R_1^2}$
$\frac{g_1}{g_2} = \frac{2}{3} \times \frac{7^2}{4^2}$
$= \frac{98}{48} = \frac{49}{24}$

**Ratio of their Acceleration due to gravity**

$$g_1 : g_2 = 49 : 24$$

### ADDITIONAL QUESTIONS

5. A lift is moving downwards with an acceleration of  $1.8 \text{ ms}^{-2}$ . Then what is the apparent weight realised by a man of mass 50 kg (PTA-1)

Acceleration due to gravity for Earth (at sea level) is	$= 9.8 \text{ ms}^{-2}$ .
Acceleration (a)	$= 1.8 \text{ ms}^{-2}$
mass (m)	$= 50 \text{ kg}$
Apparent weight R	$= m (g-a)$
R	$= 50 (9.8 - 1.8)$
	$= 50 \times 8$

$$= 400 \text{ N}$$

6. A force of 5 N applied on a body produces and acceleration  $5 \text{ cm s}^{-2}$ . Calculate the mass of the body. (PTA-5)

F	$= 5 \text{ N}$
a	$= 5 \text{ cm s}^{-2} (0.05 \text{ m s}^{-2})$
F	$= ma$
m	$= \frac{F}{a}$
m	$= \frac{5}{0.05}$

$$m = 100 \text{ kg}$$

7. Calculate the velocity of a moving body of mass 5kg whose linear momentum is  $2 \text{ kgms}^{-1}$  (GMQ)

$$\text{Linear momentum} = 2 \text{ kg ms}^{-1}$$

$$\text{Mass} = 5 \text{ Kg}$$

$$\text{Linear momentum} = \text{Mass} \times \text{Velocity}$$

$$\text{Velocity} = \frac{\text{Linear momentum}}{\text{Mass}}$$

$$V = \frac{2}{5}$$

$$= 0.4 \text{ ms}^{-1}$$

### VIII. ANSWER IN DETAIL

1. What are the types of inertia? Give an example for each type.

(PTA-3, AUG-22, APR-24, MAR-26)

There are 3 types of Inertia. They are

I) Inertia of rest

II) Inertia of motion

III) Inertia of direction

- I) Inertia of rest:

The resistance of a body to change its state of rest is called inertia of rest.

Ex: When you vigorously shake the branches of a tree, some of the leaves and fruits are detached and they fall down.

II) Inertia of motion:

The resistance of a body to change its state of motion is called inertia of motion.

Ex: An athlete runs some distance before jumping because this will help him jump longer and higher.

**III) Inertia of direction:**

The resistance of a body to change its direction of motion is called inertia of direction.

Ex: When you make a sharp turn while driving a car, you tend to lean sideways,

**2. State Newton's laws of motion?****(SEP-21, AUG-22)****Newton's First Law:**

This law states that every body continues to be in its state of rest or the state of uniform motion along a straight line unless it is acted upon by some external force.

**Newton's Second Law:**

According to this law, "the force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force".

$$F = m \times a$$

**Newton's Third Law:**

Newton's third law states that 'for every action, there is an equal and opposite reaction. They always act on two different bodies'.

$$F_A = -F_B$$

**3. Deduce the equation of a force using Newton's second law of motion. (APR - 23)**

This law helps us to measure the amount of force. So it is also called as law of force.

Let 'm' be the mass of a moving body, moving along a straight line with an initial speed 'u' after a time interval of 't', the velocity of the body changes to 'v' due to the impact of an unbalanced external force 'F'.

$$\begin{aligned} \text{Initial momentum of the body } P_i &= mu \\ \text{Final momentum of the body } P_f &= mv \\ \text{Change in momentum } \Delta p &= P_f - P_i \\ &= mv - mu \end{aligned}$$

By Newton's second law of motion,  
Force,  $F \propto$  rate of change of momentum.

$F \propto$  change in momentum / time.

$$F \propto (mv - mu) / t$$

$$F = Km (v-u) / t$$

Here K is the proportionality constant.  $K=1$  in all systems of units. Hence,

$$F = \frac{m(v-u)}{t}$$

Since, acceleration = change in velocity/time,  
 $a = (v-u)/t$ . Hence, we have

$$\boxed{F = m \times a}$$

$$\boxed{\text{Force} = \text{mass} \times \text{acceleration}}$$

**4. State and prove the law of conservation of linear momentum. (G.M.Q, APR-25)**

There is no change in the linear momentum of a system of bodies as long as no net external force acts on them.

Let two bodies A and B having masses  $m_1$  and  $m_2$  move with initial velocity  $u_1$  and  $u_2$  in a straight line. Let the velocity of the first body be higher than that of the second body. i.e,  $u_1 > u_2$ . During an interval of time  $t$  second, they tend to have a collision. After the impact, both of them move along the same straight line with a velocity  $v_1$  and  $v_2$  respectively.

Force on body B due to A,

$$F_A = m_2 (v_2 - u_2) / t$$

Force on body A due to B,

$$F_B = m_1 (v_1 - u_1) / t$$

By Newton's III law of motion,

$$\text{Action force} = \text{Reaction force}$$

$$F_B = -F_A$$

$$m_1 (v_1 - u_1) / t = -m_2 (v_2 - u_2) / t$$

$$m_1 v_1 + m_2 v_2 = m_1 u_1 + m_2 u_2$$

The above equation confirms **in the absence of an external force, the algebraic sum of the momentum after collision is numerically equal to sum of the momentum before collision.**

**5. Describe rocket propulsion.**

(PTA – 4, SEP-20, AUG-22)

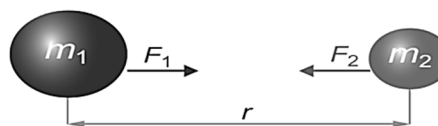
- i) Propulsion of rockets is based on the law of conservation of linear momentum as well as Newton's third law of motion.
- ii) Rockets are filled with a fuel in the propellant tank.
- iii) When the rocket is fired, this fuel is burnt and hot gas is ejected with a high speed from the nozzle of the rocket, producing a huge momentum.
- iv) To balance this momentum, an equal and opposite reaction force is produced in the combustion chamber, which makes the rocket project forward.
- v) While in motion, the mass of the rocket gradually decreases, until the fuel is completely burnt out.
- vi) Since, there is no net external force acting on it, the linear momentum of the system is conserved.
- vii) The mass of the rocket decreases with altitude, which results in the gradual increase in velocity of the rocket.
- viii) At one stage, it reaches a velocity, which is sufficient to just escape from the gravitational pull of the Earth. This velocity is called escape velocity.

**6. State the universal law of gravitation and derive its mathematical expression**

(JUNE-23, 25)

This law states that every particle of matter in this universe attracts every other particle with a force. This force is directly proportional to the product of their masses and inversely proportional to the square of the distance between the centers of these masses. The direction of the force acts along the line joining the masses.

Force between the masses is always attractive and it does not depend on the medium where they are placed



Let,  $m_1$  and  $m_2$  be the masses of two bodies

A and B placed  $r$  metre apart in space

$$\text{Force } F \propto m_1 \times m_2 \quad \rightarrow 1$$

$$\text{Also } F \propto \frac{1}{r^2} \quad \rightarrow 2$$

On combining the above two expressions 1 and 2

$$F \propto \frac{m_1 \times m_2}{r^2}$$

$$F = \frac{Gm_1 m_2}{r^2}$$

Where  $G$  is the universal gravitational constant.

Its value in SI unit is  $6.674 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ .

**7. Give the applications of universal law of gravitation.** (JULY-24, 25)

- i) Dimensions of the heavenly bodies can be measured using the gravitation law.
- ii) Mass of the Earth, radius of the Earth, acceleration due to gravity, etc. can be calculated with a higher accuracy.
- iii) Helps in discovering new stars and planets.
- iv) One of the irregularities in the motion of stars is called 'Wobble' lead to the disturbance in the motion of a planet nearby. In this condition the mass of the star can be calculated using the law of gravitation.
- v) Helps to explain germination of roots is due to the property of geotropism which is the property of a root responding to the gravity.
- vi) Helps to predict the path of the astronomical bodies.

**ADDITIONAL QUESTIONS****8. i) Shock absorbers are used in luxury buses.why?** (PTA -2)

Shock absorbers are used in luxury buses to reduce jerks while moving on uneven roads.

- ii) A weight of a man 686N on the surface of the earth. Calculate the weight of the same person on moon ('g' value of a moon is 1.625 ms<sup>-2</sup>)

$w = 686 \text{ N}$
$w = mg$
$m = \frac{w}{g}$
$= \frac{686}{9.8}$
$= 70 \text{ kg}$

Weight on moon,

$w = mg$
$= 70 \times 1.625$
$113.75 \text{ N}$

- iii) Name the law of motion used in flying of birds. Give another example for the same law Newton's third law of motion.

(E.g) Man swimming and Rocket propulsion.

When a person swims he pushes the water using the hands backwards (Action), and the water pushes the swimmer in the forward direction (Reaction)

9. A body of mass  $m$  is initially moving with a velocity  $u$ . When a force  $F$  acts on the body it picks up velocity  $v$  in  $t$  second so that the acceleration ( $a$ ) is produced. Using this data derive the relation between the force, mass and acceleration. (PTA-5)

Let 'm' be the mass of a moving body, moving along a straight line with an initial speed 'u' after a time interval of 't', the velocity of the body changes to 'v' due to the impact of an unbalanced external force 'F'.

Initial momentum of the body  $P_i = mu$

Final momentum of the body  $P_f = mv$

Change in momentum  $\Delta p = P_f - P_i$

$$= mv - mu$$

By Newton's second law of motion,

Force,  $F \propto$  rate of change of momentum.

$F \propto$  change in momentum / time.

$F \propto (mv - mu) / t$

$F = Km (v-u) / t$

Here K is the proportionality constant.  $K=1$  in all systems of units. Hence,

$$F = \frac{m(v-u)}{t}$$

Since, acceleration = change in velocity/time,

$a = (v-u)/t$ . Hence,

$$F = m \times a$$

**Force = mass  $\times$  acceleration**

10. At what height from the centre of the earth surface, the acceleration due to gravity will be 1/4 the of its value on the surface of the earth. (PTA-6)

The acceleration due to gravity =  $g$

Height from the centre of the Earth,  $R' = R + h$

The acceleration due to gravity at that height,

$$g' = \frac{g}{4}$$

$g' = \frac{GMm}{(R')^2}$
$g = \frac{GMm}{(R)^2}$
$\frac{g}{g'} = \left(\frac{R'}{R}\right)^2$
$= \left(\frac{R+h}{R}\right)^2$
$= \left(1 + \frac{h}{R}\right)^2$
$4 = \left(1 + \frac{h}{R}\right)^2$
$2 = 1 + \frac{h}{R}$
$h = R$
Since $R' = R + h$
$h = R'$
<b>So <math>R' = 2R</math></b>

**From the centre of the Earth, the object is placed at twice the radius of the earth.**

## IX. HOT QUESTIONS

1. Two blocks of masses 8 kg and 2 kg respectively lie on a smooth horizontal surface in contact with one other. They are pushed by a horizontally applied force of 15 N. Calculate the force exerted on the 2 kg mass.

Mass of block 1, $m_1$	= 8kg
Mass of block 2, $m_2$	= 2kg
Force, $F_1$	= 15N
Force exerted on 2 kg, $F_2$	= mass X acceleration
	= $\frac{m_2}{m_1 + m_2} \times F_1$
	= $\frac{2}{8+2} \times 15$
	= 3 N
Force exerted on 2 kg, $F_2$	= 3N

2. A heavy truck and bike are moving with the same kinetic energy. If the mass of the truck is four times that of the bike, then calculate the ratio of their momenta. (Ratio of momenta = 2:1)

Kinetic energy of the heavy truck

$K.E_t = \frac{1}{2} m_t v_t^2$
Kinetic energy of the bike
$K.E_b = \frac{1}{2} m_b v_b^2$
$\frac{1}{2} m_t v_t^2 = \frac{1}{2} m_b v_b^2$
$\frac{v_t^2}{v_b^2} = \frac{m_b}{m_t}$
$[\therefore m_t = 4m_b]$
$= \frac{m_b}{4m_b} = \frac{1}{4}$

$$\frac{v_t}{v_b} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

Ratio of momenta

$$P_t = m_t v_t$$

$$P_b = m_b v_b$$

$$\frac{P_t}{P_b} = \frac{4m_b v_t}{m_b v_b}$$

$$= 4 \times \frac{1}{2}$$

$$\frac{P_t}{P_b} = \frac{2}{1}$$

$$P_t : P_b = 2 : 1$$

The ratio of their momentum of the truck to the momentum of the bike = 2:1

3. “Wearing helmet and fastening the seat belt is highly recommended for safe journey” Justify your answer using Newton’s laws of motion.

- Newton’s first law states that every object continues to be in its state of rest or the state of uniform motion unless it is acted upon by some external force.
- While we travel in a bus or in a bike, when a sudden brake is applied, the upper part of our body leans in the forward direction. This is due to the body likes to continue to be in its state of motion.
- So, if we wear seat belt, it would stop us from being in motion and wearing helmet will save our life by protecting our skull.

## SLOW LEARNERS MATERIAL

### Answer Briefly:

**1. Define inertia. Give its classification.**

- The inherent property of a body to resist any change in its state of rest.

Types : a) Inertia of rest  
 b) Inertia of motion  
 c) Inertia of direction

**2. Classify the types of force based on their application.**

- Like parallel force
- unlike parallel force

**3. If a 5 N and a 15 N forces are acting opposite to one another. Find the resultant force and the direction of action of the resultant force**

$F_1 = 5 \text{ N}$   
 $F_2 = 15 \text{ N}$   
 $F_{\text{net}} = F_2 - F_1$   
 $F_{\text{net}} = 15 - 5 = 10 \text{ N}$   
 Resultant Force = 10 N  
 The direction of  $F_{\text{net}}$  is 15 N

**4. Differentiate mass and weight.**

Mass	Weight
Scalar quantity	Vector quantity
Quantity of matter	Gravitational force
SI unit kg	SI unit newton
Does not varies place to place	Varies place to place

**5. Define moment of a couple.**

- The rotation effect of a couple is known as 'moment of couple'.
- Moment of a couple (M) = Force (F) x Perpendicular distance (S) Unit Nm.

**6. State the principle of moments.**

- At equilibrium, the algebraic sum of the moments of all the individual forces about any point is equal to zero.
- Moment in clockwise direction ( $F_1 \times d_1$ ) = Moment in anticlockwise direction ( $F_2 \times d_2$ )

**7. State Newton's second law.**

- The force acting on a body is directly proportional to the rate of change of linear momentum of the body.  $F = m \times a$

**8. Why a spanner with a long handle is preferred to tighten screws in heavy vehicles?**

High torque with less force  
 Moment of force =  $F \times d$

**9. While catching a cricket ball the fielder lowers his hands backwards. Why?**

- Increase the time interval
- To lesser impulse on his hands

**10. How does an astronaut float in a space shuttle?**

- Space station and astronauts have equal acceleration, they are under free fall condition.
- Hence, both the astronauts and the space station are in the state of weightlessness.

### Answer in Detail:

**1. What are the types of inertia? Give an example for each type.**

**a) Inertia of rest:**

To resist a body to change its state of rest.  
**Ex:** After Shaking leaves fall down.

**b) Inertia of motion:**

To resist a body to change its state of Motion.

**Ex:** An athlete runs some distance before jumping.

**c) Inertia of direction:**

To resist a body to change its direction.

**Ex:** a sharp turn while driving a car, you tend to lean sideways.

**2. State Newton's laws of motion?**

**a) Newton's First law**

Everybody continues to be in its state of rest or the state of uniform motion along a straight line unless it is acted upon by some external force.

**b) Newton's second law**

The force acting on a body is directly proportional to the rate of change of linear momentum of the body.  $F = ma$

**c) Newton's third law**

For every action, there is an equal and opposite reaction.

$$F_A = - F_B$$

**3. Deduce the equation of a force using Newton's second law of motion.**

The force acting on a body is directly proportional to the rate of change of linear momentum of the body.

Initial momentum of the body  $P_i = mu$

Final momentum of the body  $P_f = mv$

Change in momentum =  $P_f - P_i$

$$= mv - mu$$

By Newton's second law of motion,

$$F \propto \frac{\text{Change in momentum}}{\text{Time}}$$

$$F \propto \frac{mv - mu}{t}$$

$$F = \frac{km(v-u)}{t}$$

k is constant,  $k = 1$

$$F = \frac{m(v-u)}{t}$$

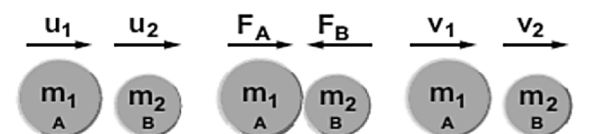
$$a = \frac{(v-u)}{t}$$

Therefore,

$$F = ma$$

**4. State and prove the law of conservation of linear momentum.**

"There is no change in the linear momentum of a system of a body as long as no net external force acts of them"



Let two bodies A and B having masses  $m_1$  and  $m_2$  move with a initial velocity  $u_1$  and  $u_2$  in a straight line.

During an interval of time  $t$  second, they tend to have a collision

After the impact, both of the body's velocity  $v_1$  and  $v_2$  respectively

Force on a body B due to A,

$$F_B = \frac{m_2(v_2 - u_2)}{t}$$

Force on a body A due to B,

$$F_A = \frac{m_1(v_1 - u_1)}{t}$$

By Newton's III law,

$$F_A = - F_B$$

$$\frac{m_1(v_1 - u_1)}{t} = - \frac{m_2(v_2 - u_2)}{t}$$

$$m_1v_1 - m_1u_1 = - m_2v_2 + m_2u_2$$

$$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$$

Momentum after collision = Momentum before collision

**5. Describe rocket propulsion.**

- Laws : Newton's third law and law of conservation of linear momentum.
- Filled with fuel in the propellant tank.
- Fuel is burnt, hot gas is ejected.
- Project forward due to momentum.
- Fuel get decreases.
- Mass decreases, Velocity increases
- Reaches escape velocity

**6. State the universal law of gravitation and derive its mathematical expression**

- Every particle of matter in this universe attracts every other particle with a force.
- This force is directly proportional to the product of their masses and inversely proportional to the square of distance between the center of these masses.

$$F \propto m_1 \times m_2 \quad \text{----- (1)}$$

$$F \propto \frac{1}{r^2} \quad \text{----- (2)}$$

(1) & (2)

$$F \propto m_1 \times m_2 / r^2 ;$$

$$F = \frac{Gm_1m_2}{r^2}$$

**7. Give the applications of universal law gravitation.**

- To discover new stars and planets.
- To calculate the mass of a star.
- To accurately calculate Earth's mass, radius and g.
- To predict the path of the space objects (or) astronomical bodies.
- To measure the dimensions of space objects (or) astronomical bodies.

## PRACTICALS

S. NO.		NAME OF THE EXPERIMENT	TIME
1.	PHYSICS	Determination of weight of an object using the principle of moments	40 minutes
2.		Determination of focal length of a convex lens	40 minutes
3.		Determination of resistivity	40 minutes
4.	CHEMISTRY	Identification of the dissolution of the given salt whether it is exothermic or endothermic	40 minutes
5.		Testing the solubility of the salt	40 minutes
6.		Testing the water of hydration of salt	40 minutes
7.		Test the given sample for the presence of acid or base	40 minutes
8.	BIO - BOTANY	Photosynthesis - Test tube and Funnel Experiment (Demonstration)	40 minutes
9.		Parts of a Flower	40 minutes
10.		Mendel's Monohybridcross	40 minutes
11.		Observation of Transverse Section of Dicot stem and Dicot Root	40 minutes
12.	BIO - ZOOLOGY	Observation of Models - Human Heart and Human Brain	40 minutes
13.		Identification of Blood Cells	40 minutes
14.		Identification of Endocrine Glands	40 minutes

# PHYSICS

## 1. DETERMINATION OF WEIGHT OF AN OBJECT USING THE PRINCIPLE OF MOMENTS

**Aim:**

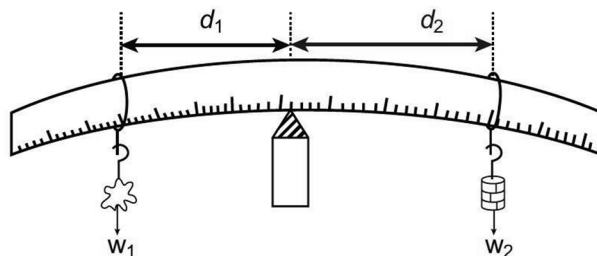
To determine the weight of an object using the principle of moments

**Apparatus required:**

A metre scale, a knife edge, slotted weights, thread

**Procedure:**

- A metre scale is supported at its centre of gravity by a knife edge or suspended by using a thread tied to its centre so that the scale is in the horizontal position. Ensure that the scale is in equilibrium position.
- A known weight  $W_2$  and an unknown weight  $W_1$  are suspended from to either side of the scale using the weight hangers.
- Fix the position of one weight hanger and adjust the position of the second weight hanger such that the scale is in equilibrium.
- Measure the distance  $d_1$  and  $d_2$  of the two weight hangers from the centre of the scale accurately.
- The experiment is repeated for different positions of the unknown weight. Measure the distances. The reading are tabulated as follows:

**Observation:**

S. No.	Weight in the weight hanger ( $W_2$ ) kg	Distance of known weight $d_1$ (m)	Distance of unknown weight $d_2$ (m)	$W_2 \times d_2$ (kg x m)	Unknown weight $W_1 = \frac{W_2 \times d_2}{d_1}$ (kg)
1	0.050	0.2	0.13	0.01	0.077
2	0.100	0.2	0.255	0.02	0.078
3	0.150	0.2	0.375	0.03	0.080
<b>Mean</b>					<b>0.078</b>

**Calculations:**

Moment of a force can be calculated using the formula

Moment of the force = Force x distance

$$\text{Clock wise moment by unknown weight} = W_1 \times d_1$$

$$\text{Clockwise moment by known weight} = W_2 \times d_2$$

$$W_1 \times d_1 = W_2 \times d_2 \quad \text{Unknown weight } W_1 = \frac{W_2 \times d_2}{d_1}$$

**Result:**

Using the principle of moments, the weight of the unknown body  $W_1 = 0.078$  Kg.

## GOVT. EXAM - MARCH 2026

## PART - I

Note : (i) Answer all the questions.

12x1=12

(ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer.

- If the earth shrinks to 50% of its real radius its mass remaining the same, the weight of a body on the Earth will:
  - decrease by 50%
  - increase by 50%
  - decrease by 25%
  - increase by 300%
- Magnification of a convex lens is:
  - Positive
  - Negative
  - Either positive or negative
  - Zero
- In a simple circuit, why does the bulb glow when you close the switch?
  - The switch produces electricity
  - Closing the switch completes the circuit
  - Closing the switch breaks the circuit
  - The bulb is getting charged
- In the nuclear reaction  ${}_6X^{12} \xrightarrow{\alpha\text{decay}} {}_Z Y^A$ , the value of A and Z is:
  - 8, 6
  - 8, 4
  - 4, 8
  - Cannot be determined with given data
- The basis of modern periodic law is \_\_\_\_\_.
  - Atomic number
  - Atomic mass
  - Isotopic mass
  - Number of neutrons
- Solubility of NaCl in 100 ml water is 36 g. If 25 g of salt is dissolved in 100 ml of water how much more salt is required for Saturation?
  - 12 g
  - 11 g
  - 16 g
  - 20 g
- Powdered CaCO<sub>3</sub> reacts more rapidly than flaky CaCO<sub>3</sub> because of \_\_\_\_\_.
  - large surface area
  - high pressure
  - high concentration
  - high temperature
- Which of the following pairs can be the successive members of a homologous series?
  - C<sub>3</sub>H<sub>8</sub> and C<sub>4</sub>H<sub>10</sub>
  - C<sub>2</sub>H<sub>2</sub> and C<sub>2</sub>H<sub>4</sub>
  - CH<sub>4</sub> and C<sub>3</sub>H<sub>6</sub>
  - C<sub>2</sub>H<sub>5</sub>OH and C<sub>4</sub>H<sub>8</sub>OH
- The endarch condition is the characteristic feature of:
  - root
  - stem
  - leaves
  - flowers
- The loss of one or more Chromosome in a ploidy is called \_\_\_\_\_.
  - Tetraploidy
  - Aneuploidy
  - Euploidy
  - Polyploidy
- Excessive consumption of alcohol leads to:
  - Loss of memory
  - Cirrhosis of liver
  - State of hallucination
  - Suppression of brain function
- Which is used to edit programs?
  - Inkscape
  - script editor
  - stage
  - sprite

## PART - II

Note : Answer any seven questions. Question No.22 is compulsory.

7x2=14

- State Boyle's law.
- Define: Relative atomic mass.
- What is rust? Give the equation for formation of rust.
- Name the simplest Ketone and give its structural formula.
- Why is the circulation in man referred to as double circulation?
- Write the differences between endocrine and exocrine gland.
- How can menstrual hygiene be maintained during menstrual days?
- Why is Archaeopteryx considered to be a connecting link?
- Match the following:
  - Bio gas - energy saving
  - Natural gas - CO<sub>2</sub>
  - Green House gas - Renewable energy
  - CFL Bulbs - Non-renewable energy

22. A source producing a sound of frequency 500 Hz is moving towards a listener with a velocity of  $30 \text{ ms}^{-1}$ . The speed of the sound is  $330 \text{ ms}^{-1}$  in air. What will be the frequency heard by the listener?

**PART - III**

**Note : Answer any seven questions. Question No.32 is Compulsory.**

**7x4=28**

23. a) List any two properties of light.  
b) Draw a ray diagram to show the image formed by a convex lens when the object is placed between F and 2F.
24. a) Distinguish between Linear and Areal expansion.  
b) What is co-efficient of Real expansion?
25. What are the factors that affect the velocity of sound in gases?
26. i) In Japan, after the Second World War some of the new born children are having congenital diseases. Why?  
ii) Give any two uses of radio isotopes in the field of agriculture.
27. a) Identify the bond between H and F in HF molecule.  
b) What property forms the basis of identification?  
c) How does the property vary in Periods and in Groups?
28. How is ethanoic acid prepared from ethanol? Give the chemical equation.
29. i) Why are the rings of cartilages found in trachea of Rabbit?  
ii) List out any two parasitic adaptations in Leech.
30. Classify Neurons based on its structure.
31. Enumerate the importance of Forest.
32. A container whose capacity is 70 ml is filled with a liquid up to 50 ml. Then, the liquid in the container is heated. Initially, the level of the liquid falls from 50 ml to 48.5 ml. Then we heat more, the level of the liquid rises to 51.2 ml. Calculate the apparent and real expansion.

**PART - IV**

**Note : Answer all the questions. Draw diagrams wherever necessary.**

**3x7=21**

33. a) i) What are the types of inertia? Give an example for each type.  
ii) While catching a cricket ball, the fielder lowers his hands backwards. Why?

**OR**

- b) i) Three resistors of  $1\Omega$ ,  $2\Omega$  and  $4\Omega$  are connected in parallel in a circuit. If a  $1\Omega$  resistor draws a current of 1A, find the current through the other two resistors.  
ii) State Ohm's Law.
34. a) i) What is meant by binary solution?  
ii) Give an example each for.  
1) Gas in liquid      2) Solid in liquid  
3) Solid in solid      4) Gas in gas  
iii) What is aqueous and non-aqueous solution? Give an example.

**OR**

- b) i) Explain the types of double displacement reactions with examples.  
ii) Calculate the pH of  $1.0 \times 10^{-4}$  molar solution of  $\text{HNO}_3$
35. a) i) Name the three basic tissues system in flowering plants.  
ii) What is Photosynthesis and where in a cell does it occur?  
iii) What is Respiratory Quotient?

**OR**

- b) i) Why did Mendel select pea plant for his experiments?  
ii) What are Okazaki fragments?  
iii) DNA consists of two \_\_\_\_\_ chains.

விடுதலைக் கிணடருக்கும் நேரமல்லாம்  
படித்தல் கிணடருப்பீரம்

எமது வெளியீடுகள் (STATE BOARD)

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