

PHYSICS

Unit 1

Laws of Motion

FORMULAE

1.	Linear Momentum	$p = mv$
2.	Parallel forces are acting in the same direction	$F_{\text{net}} = F_1 + F_2$
3.	Parallel unequal forces are acting in the opposite direction	$F_{\text{net}} = F_1 - F_2$ (if $F_1 > F_2$) $F_{\text{net}} = F_2 - F_1$ (if $F_2 > F_1$)
4.	Torque	$\tau = F \times d$
5.	Principle of moments	$F_1 \times d_1 = F_2 \times d_2$
6.	Moment of Couple	$M = F \times S$
7.	Force	$F = m \times a$
8.	Impulse	$J = \Delta P$
9.	Law of conservation of linear momentum	$m_1 v_1 + m_2 v_2 = m_1 u_1 + m_2 u_2$
10.	Newton's Universal law of gravitation	$F = \frac{GMm}{R^2}$ [$G = 6.674 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-2}$]
11.	Acceleration due to gravity	$g = \frac{GM}{R^2}$
12.	Weight	$W = mg$
13.	Mass of the Earth	$M = \frac{gR^2}{G}$
14.	Acceleration	$a = \frac{v - u}{t}$


PUBLIC EXAM FREQUENTLY ASKED QUESTIONS
1 MARK**CHOOSE THE CORRECT ANSWER :**

- Inertia of a body depends on** \otimes
 (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]
- Impulse is equals 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]
- In which of the following sport the turning of effect of force used?** \otimes [Qy-2019]
 (a) swimming (b) tennis
 (c) cycling (d) hockey
 [Ans. (c) cycling]
- One kilogram force equals to** \otimes
 (a) 9.8 dyne (b) 9.8×10^4 N
 (c) 98×10^4 dyne (d) 980 dyne
 [Ans. (c) 98×10^4 dyne]
- To project the rockets which of the following principle(s) is/(are) required?**
 [GMQP-2019; Sep-2021; FRT & Aug.-'22]
 (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]
- 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) 4 F [Ans. (c) F/4]

- The force required to produce an acceleration of 1 cm s^{-2} on a body of mass 1 g is _____** [PTA-6]
 (a) 1 N (b) 10
 (c) 10^2 dyne (d) 1 dyne [Ans. (d) 1 dyne]
- Force has :** [FRT-'22]
 (a) Magnitude only
 (b) Direction only
 (c) Both direction and magnitude
 (d) None of the above
 [Ans. (c) Both direction and magnitude]

FILL IN THE BLANKS :

- To produce a displacement _____ is required. [FRT-'22]
 [Ans. force/unbalanced force]
- A man of mass 100 kg has a weight of _____ at the surface of the Earth. \otimes
 [Ans. 980 N]
- Unit of force in SI system is _____. [FRT-'22]
 [Ans. Newton]
- Opening a door: Moment of force, Opening a water tap: _____ [PTA-4]
 [Ans. Moment of a couple]
- pushing a bus by a group of people: Like parallel forces, Tug of war _____ [PTA-4]
 [Ans. Unlike parallel force.]

STATE WHETHER THE FOLLOWING STATEMENTS ARE TRUE OR FALSE CORRECT THE STATEMENT IF IT IS FALSE :

- Weight of a body is greater at the equator and less at the polar region.** \otimes

Ans. False.

Correct Statement : Weight of the body is less at equator, more at polar region.

MATCH THE FOLLOWING :

[PTA-1]

1.

	Column I		Column II
(a)	Newton's I law	-	propulsion of a rocket
(b)	Newton's II law	-	Stable equilibrium of a body
(c)	Newton's III law	-	Law of force
(d)	Law of conservation of linear momentum	-	Flying nature of bird

Ans.

	Column I		Column II
(a)	Newton's law	-	stable equilibrium of a body
(b)	Newton's II law	-	Law of force
(c)	Newton's III law	-	Flying nature of bird
(d)	Law of conservation of linear momentum	-	propulsion of a rocket

2.

[FRT-'22]

	List - I		List - II
(1)	Newton's I law	-	Passengers leaning sideways
(2)	Newton's II law	-	Stable equilibrium of a body
(3)	Newton's III law	-	Law of force
(4)	Inertia of direction	-	Flying nature of a bird
		-	Falling of an object from upward to Earth

Ans.

	List - I		List - II
(1)	Newton's I law	-	Stable equilibrium of a body
(2)	Newton's II law	-	Law of force
(3)	Newton's III law	-	Flying nature of bird
(4)	Inertia of direction	-	Passengers learning sideways

ASSERTION AND 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 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]

[Hint:] 'g' depends on the geometric radius of the Earth.

2. **Understand the assertion statement and the reason given and choose the correct choice.** [PTA-2]

Assertion : When a person swims he pushes the water using the hands backwards 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 the 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 the assertion.]

2 MARKS**ANSWER BRIEFLY :**

1. Define inertia. Give its classification. [Aug-'22]

Ans. 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'.

Classification:

- (i) Inertia of rest (ii) Inertia of motion
(iii) Inertia of direction

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

⊗ [FRT & Aug-'22]

Ans. Based on the direction and application forces can be classified into,

- (i) Like parallel forces (ii) Unlike parallel forces

3. Differentiate mass and weight. ⊗ [May-'22]

Ans.

S. No.	Mass	Weight
(i)	It is the quantity of matter contained in the body	It is the gravitational force exerted on a body.
(ii)	It is a scalar quantity	It is a vector quantity
(iii)	SI unit is kilogram	SI unit is Newton

4. State the principle of moments. [Qy-2019]

Ans. (i) When a number of like or unlike parallel forces act on a rigid body and the body is in equilibrium, then the algebraic sum of the moments in the clockwise direction is equal to the algebraic sum of the moments in the anticlockwise direction.

- (ii) Moment in clockwise direction
= Moment in anticlockwise direction,
 $F_1 \times d_1 = F_2 \times d_2$

5. State Newton's second law. ⊗

[GMQP-2019; May-'22]

Ans. (i) According to Newton's second 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".

- (ii) $F = m \times a$ (Force = mass \times acceleration)

6. Calculate the velocity of a moving body of mass 5 kg whose linear momentum is 2 kg ms⁻¹.

[GMQP-2019]

Linear momentum = mass \times velocity

$$\text{Velocity} = \frac{\text{linear momentum}}{\text{mass}} = \frac{2}{5} = 0.4 \text{ ms}^{-1}.$$

7. Write short notes on gears. [Sep-2020]

Ans. Gears : 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.

4 MARKS**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 ms⁻². What could be the acceleration of the other body, if the same force acts on it. ⊗

Given

$$m_1 \text{ (Smaller body)} = 3 \text{ kg;}$$

$$m_2 \text{ (bigger body)} = 4 \text{ kg}$$

$$a_2 \text{ (bigger body)} = 12 \text{ ms}^{-2}$$

$$\text{To find : } a_1 \text{ (smaller body)} = ?$$

Solution

According to Newton's third law of motion,

$$F_1 = -F_2$$

$$m_1 a_1 = -m_2 a_2$$

$$3a_1 = \frac{-4 \times 12}{3}$$

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

2. 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. ⊗

Given

$$m_1 : m_2 = 2 : 3;$$

$$R_1 : R_2 = 4 : 7$$

$$\text{To find : Ratio of } g = ?$$