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Preface

Education is not the learning of facts.
It is rather training of the mind to think.

- **Albert Einstein**

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With due respect to Teachers, I would like to mention that this guide will serve as a teaching companion to qualified teachers. Also, this guide will be an excellent learning companion to students with exhaustive exercises and in-text questions in addition to precise answers for textual questions.

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I once again sincerely thank the Teachers, Parents and Students for supporting and valuing our efforts.

God Bless all.

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CONTENTS

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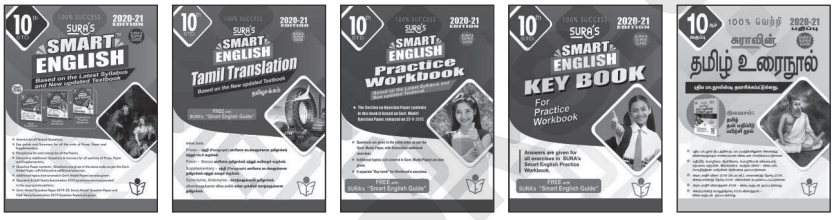

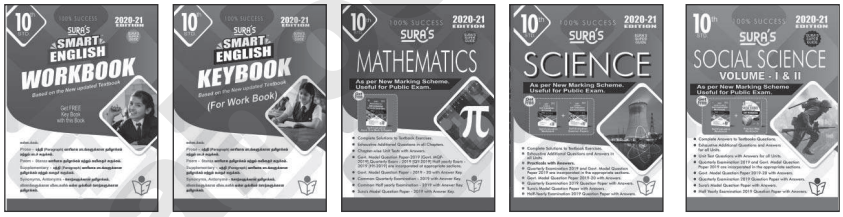

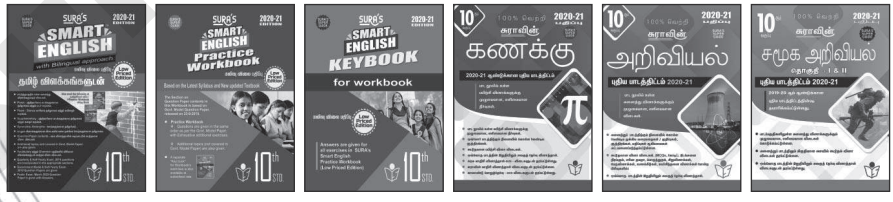

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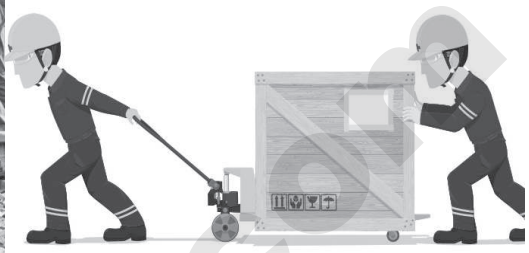
PHYSICS

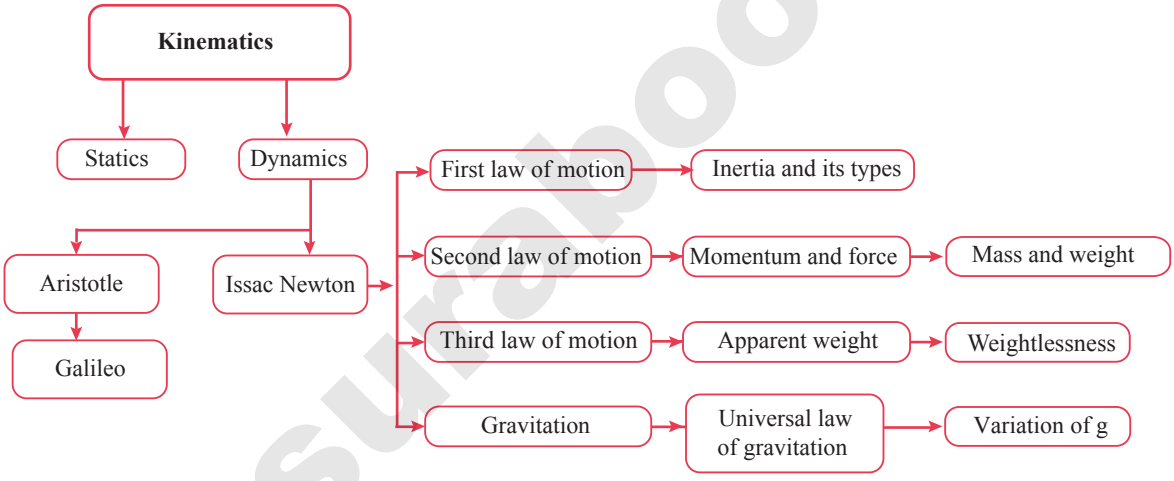
UNIT 1





LAWS OF MOTION

CONCEPT MAP



MUST KNOW DEFINITIONS

Linear momentum	:	The product of mass and velocity of a moving body gives the magnitude of its linear momentum. It acts in the direction of the velocity of the body.
Like parallel forces	:	Two or more forces of equal or unequal magnitude acting along the same direction parallel to each other.
Unlike parallel forces	:	Two or more equal forces or unequal forces act along opposite directions parallel to each other.
Resultant Force	:	When several forces act simultaneously on the same body, then the combined effect of multiple forces can be represented by a single force, as resultant.
Moment of the couple	:	It is measured by the product of any one of the forces and the perpendicular distance between the line of action of two forces.

Impulse	:	When a force F acts on a body for a period of time t, then the product of force and time.
Weight	:	Weight is equal to gravitational force. Also weight (W) = mass × acceleration due to gravity. i.e W = *mg*
Mass	:	The quantity of matter contained in the body. Its SI unit is kilogram (*kg*).
Inertial mass	:	If mass is defined in association with force and inertia, it is termed as "inertial mass".
Gravitational mass	:	When the mass of a body is defined in association with the gravitational field, it is termed as "gravitational mass".
Apparent weight	:	Apparent weight is the weight of the body acquired due to the action of gravity and other external forces on the body.
Weightlessness	:	Whenever a body or a person falls freely under the action of Earth's gravitational force alone, it appears to have zero weight.

FORMULAE

1.	Linear Momentum	$P = mv$
2.	Parallel forces are acting in the same direction	$F_{net} = F_1 + F_2$
3.	Parallel unequal forces are acting in the opposite direction	$F_{net} = F_1 - F_2$ (if $F_1 > F_2$) $F_{net} = F_2 - F_1$ (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	$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$
10.	Newton's Universal law of gravitation	$F = \frac{GMm}{R^2}$ $[G = 6.674 \times 10^{-11}\ Nm^2\ kg^{-2}]$
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	$a = \frac{v - u}{t}$

TEXTBOOK EVALUATION

I. CHOOSE THE CORRECT ANSWER :

1. Inertia of a body depends on
(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 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

3. Newton's III law is applicable
(a) for a body is at rest
(b) for a body in motion
(c) both a & 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 sport the turning effect of force used? *[Qy-2019]*
(a) swimming (b) tennis
(c) cycling (d) hockey **Ans. (c) cycling**

6. The unit of 'g' is ms^{-2}. It can be also expressed as
(a) $cm\ s^{-1}$ (b) $N\ kg^{-1}$
(c) $N\ m^2\ kg^{-1}$ (d) $cm^2\ s^{-2}$ **Ans. (b) $N\ kg^{-1}$**

7. One kilogram force equals to
(a) 9.8 dyne (b) 9.8×10^4 N
(c) 98×10^4 dyne (d) 980 dyne
Ans. (c) 98×10^4dyne

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) 2 M
(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
(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? *[GMQP-2019]*
(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**

II. FILL IN THE BLANKS :

1. To produce a displacement _____ is required. **Ans. force**
2. Passengers lean forward when sudden brake is applied in a moving vehicle. This can be explained by _____ **Ans. inertia of motion**
3. By convention, the clockwise moments are taken as _____ and the anticlockwise moments are taken as _____ **Ans. negative, positive**
4. _____ is used to change the speed of car. **Ans. Gear or Torque**
5. 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 : In the absence of external force, the linear momentum of a system of particle is always conserved.

2. Apparent weight of a person is always equal to his actual weight
Ans. False.
Correct Statement : Apparent weight of a person is not equal to his actual weight.

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

Ans. False.

Correct Statement : Weight of the body is less at equator, more at 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 : When space station and astronauts have equal acceleration, they are under free fall condition, so both astronaut and space station are in the state of weightlessness.

IV. Match the following : *(PTA-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

V. Assertion and Reason :

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) 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**

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

VI. Answer briefly :

1. Define inertia. Give its classification.

Ans. The inherent property of the 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) Inertial of direction

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

Ans. (i) **Like parallel forces:** Two or more forces of equal or unequal magnitude acting along the same direction, parallel to each other are called like parallel forces.

(ii) **Unlike parallel forces:** If two or more equal forces or unequal forces act along opposite directions parallel to each other, then they are called 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

Ans.

$F_1 = 5$ N;

$F_2 = 15$ N

$R = F_2 - F_1$ (if $F_2 > F_1$)

$= 15 - 5 = 10$

Resultant force = 10 N

Resultant force of 10 N is acting in the direction of F_2. (i.e.) greater force.

4. Differentiate mass and weight.

	Mass	Weight
(i)	It is the quantity of matter contained in the body	It is the gravitational force exerted on a body due to the gravity.
(ii)	It is a scalar quantity	It is a vector quantity
(iii)	SI unit is kg (kilogram)	SI unit is N (newton)
(iv)	Mass of a body remains the same at any point on the Earth	Weight of a body varies from one place to another place on the Earth
(v)	Measured using a physical balance	Measured using a spring balance

5. Define moment of a couple.

Ans. (i) Rotating effect of a couple is known as **moment of a couple.**

(ii) Moment of a couple = Force × perpendicular distance between the line of action of forces, M = F × S

6. 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 moments in clockwise direction is equals to the algebraic sum of moments in anticlockwise direction.

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

7. State Newton's second law. *[GMQP-2019]*

Ans. (i) 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 force.

(ii) F = m × a
Force = mass × acceleration

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

Ans. (i) The turning effect of a body depends upon the distance of the line of action of the applied force from the axis of rotation.

(ii) Larger the perpendicular distance, lesser is the force required to turn the body. So spanner with long handle is preferred.

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

Ans. When the fielder pulls back his hands he experiences a smaller force for a longer interval of time leading to less damage to his hands.

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

Ans. Astronauts are not floating but falling freely around the Earth due to their huge oribital velocity. Since spacestation and astronauts have equal acceleration, they are under free fall condition. (R = 0 refer case 4 in Table 1.2). Hence, both the astronauts and the spacestation are in the state of weightlessness.

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 ms^{-2}. What could be the acceleration of the other body, if the same force acts on it.

Given

Mass ratio of two bodies is 3 : 4
So let's assume
Mass of smaller body = $m_1 = 3$ kg
Mass of bigger body = $m_2 = 4$ kg
Acceleration due to force applied by bigger body = $a_2 = 12\ ms^{-2}$

To find : Acceleration due to the same force on the smaller body = a_1 = ?

Solution

According to Newton's second law of motion.

$F = m \times a$

$F_1 = m_1 a_1$ $\qquad F_2 = m_2 a_2$

$F_1 = 3a_1$ $\qquad F_2 = 4 \times 12 = 48$ N

As the force is the equal

$F_1 = -F_2$

$3a_1 = -48$

$\therefore\ a_1 = -\frac{48}{3} = -16\ ms^{-2}$

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

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

Given

Mass, m = 1 kg
Initial velocity, u = 10 ms^{-1}
Final velocity, v = $-10 ms^{-1}$

To find : Change in linear momentum
$= m(v - u) = mv - mu$

Solution

Momentum before collision = $mu = (1 \times 10)$
= 10 kg ms^{-1}
Momentum after collision = mv
= $-(1 \times 10)$
= -10 kg ms^{-1}
Change in momentum(Δp) = $mv - mu$
Δp = $-10 - 10$
= **-20 kg ms^{-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?

Given

Force F_1 = 140 N
Length L_1 = 40 cm = 40×10^{-2} m
Force, F_2 = 40 N
Length, L_2 = ?

To find : $F_1 \times L_1 = F_2 \times L_2$

Length of the spanner,

$$L_2 = \frac{F_1 \times L_1}{F_2}$$

Solution

$$L_2 = \frac{140 \times \cancel{40} \times 10^{-2}}{\cancel{40}}$$

$$= 140 \times 10^{-2} \text{ m}$$

Length, L_2 = 1.4 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.

Given

The ratio of masses of two bodies is $m_1 : m_2$
i.e 2 : 3

Mass of the smaller body, m_1 = 2 kg
Mass of the bigger body m_2 = 3 kg
Radius of the smaller body, R_1 = 4 km
Radius of the bigger body, R_2 = 7 km
i.e $r_1 : r_2$ = 4 : 7

To find : $g_1 : g_2 = ?$

Solution

We know that

$$g = \frac{GM}{R^2}$$

$$g_1 = \frac{GM_1}{R_1^2} \; ; \; g_2 = \frac{GM_2}{R_2^2}$$

$$\frac{g_1}{g_2} = \frac{\frac{\cancel{G}M_1}{R_1^2}}{\frac{\cancel{G}M_2}{R_2^2}} = \frac{M_1}{R_1^2} \times \frac{R_2^2}{M_2}$$

$$\frac{g_1}{g_2} = \left(\frac{M_1}{M_2}\right)\left(\frac{R_2}{R_1}\right)^2 = \left(\frac{2}{3}\right)\left(\frac{7}{4}\right)^2$$

$$\frac{g_1}{g_2} = \frac{\overset{1}{\cancel{2}}}{3} \times \frac{7 \times 7}{\underset{2}{\cancel{4}} \times 4} = \frac{49}{24}$$

The ratio is, $g_1 : g_2 = 49 : 24$

VIII. Answer in detail.

1. What are the types of inertia? Give an example for each type. *(PTA-3)*

Ans. (i) Inertia of rest : The resistance of a body to change its state of rest is called **inertia of rest.**

Eg: When you vigorously shake the branches of a tree some of the leaves and fruit 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.**

Eg : 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.**

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

2. State Newton's laws of motion.

Hint: **3 Physical law describes the relationship between a body and the forces.**

Ans. (i) **Newton's First law:** 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.

(ii) **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 and the change in momentum takes place in the direction of force.
- This law helps us to measure the amount of force. So it is called as "law of force".

(iii) **Newton's third law of motion:** For every action there is an equal and opposite reaction. They always act on two different bodies.

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

Ans. (i) Let "*m*" be the mass of a moving body, moving along a straight line with an initial speed '*u*'.

(ii) After a time interval of '*t*' second, the velocity of the body changes to '*v*' due to the impact of an unbalanced external force F.

(iii) Initial momentum of the body → $P_i = mu$

(iv) Final momentum of the body → $P_f = mv$

(v) Change in momentum → $\Delta p = P_f - P_i$

$= mv - mu$

By Newton's second law of motion,

Force, F ∝ rate of change of momentum

F ∝ change in momentum / time

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

$F = k\, m\, (v - u)\, t$

Here, *k* is the proportionality constant.

k = 1 in all system of units. Hence,

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

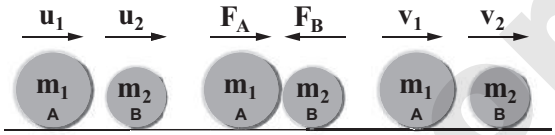
Since, acceleration = change in velocity / time, $a = (v-u) / t$.

(vi) Hence, we have $F = m \times a$

Force = mass × acceleration

4. State and prove the law of conservation of linear momentum. *[GMQP-2019]*

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



Conservation of linear momentum

Proof:

- 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,

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

Force on body A due to B,

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

By Newton's III law of motion,

Action force = Reaction force

$$F_B = -F_A$$

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

$$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2 \text{ ------ (A)}$$

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

Hence the law of conservation of linear momentum is proved.

5. Describe rocket propulsion. *(PTA-4; Sep-2020)*

Hint: **Rocket propulsion is the process that uses force to move a rocket off the ground into the atmosphere.**

Ans. (i) Propulsion of rockets is based on law of conservation of linear momentum as well as Newton's III law of motion.

(ii) Rockets are filled with a fuel (either liquid or solid) in the propellant tank.

(iii) When the rocket is fired, this fuel is burnt and a 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. Since, there is no net external force acting on it, the linear momentum of the system is conserved.

(vi) The mass of the rocket decreases with altitude, results in the gradual increase in velocity of the rocket.

(vii) 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. *[Qy-2019]*

Ans.

- 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 centers of these masses.
- The direction of the force acts along the line joining the masses

Let m_1 and m_2 be the masses of two bodies A and B placed at r metre apart in space

Force $F \propto m_1 \times m_2$

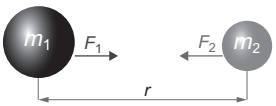
$F \propto 1/r^2$

On combining the above two expressions,

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

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

Where G is universal gravitational constant. Its value in SI unit is 6.674×10^{-11} N m^2 kg^{-2}.



Gravitational force between two masses

7. Give the applications of universal law gravitation.

Hint: Newton's law of gravitation is applicable universally. So it is also called as universal law of gravitation.

(i) Dimensions of the heavenly bodies can be measured using gravitation law.

(ii) **Eg.** 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 planet nearby.

(v) Here mass of the star can be calculated using law of gravitation.

(vi) Helps to explain germination of roots due to the property of geotropism.

(vii) Helps to predict the path of the astronomical bodies.

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.

Given

Mass of block 1, m_1 = 8 kg

Mass of block 2, m_2 = 2 kg

Total mass, $m = m_1 + m_2$

$m = 8 + 2$

m = 10 kg

Force, F_1 = 15 N

To find : Force exerted on 2 kg, F_2 = ?

Solution

Force, F_1 = mass × acceleration

$F_1 = ma$

$F_1 = 10 \times a$

$$a = \frac{F_1}{10} = \frac{15}{10} = 1.5 \text{ ms}^{-2}$$

Force exerted on m_2 (2 kg) is,

$F_2 = m_2 a = 2 \times 1.5$

$F_2 = 3$ N

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)

Given

Kinetic energy of the truck = Kinetic energy of the bike

$$\frac{1}{2}m_t v_t^2 = \frac{1}{2}m_b v_b^2 \quad \text{.....①}$$

Also, $m_t = 4m_b$ .....②

Substituting ② in ①

$$\frac{1}{2}(4)m_b v_t^2 = \frac{1}{2}m_b v_b^2$$

$$4v_t^2 = v_b^2$$

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

$$v_t = \frac{1}{2}v_b \quad \text{.....③}$$

To find : Ratio of the momenta, i.e $m_t v_t : m_b v_b$

$$\frac{p_{truck}}{p_{bike}} = \frac{m_t v_t}{m_b v_b} = 4 \times \frac{1}{2} = \frac{2}{1} = 2:1$$

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

Ans. (i) While you are travelling in a bike or in a car, when a sudden brake is applied, the upper part of your body leans in the forward direction.

(ii) Similarly, when the vehicle is suddenly move forward from rest, you lean backward. This is due to, any body would like to continue to be in its state of rest or the state of motion.

(iii) Newtons law of inertia takes place. So wearing helmet and seat belts while driving a car are highly recommended for a safe journey.

PTA Questions & Answers

1 MARK

1. 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

2. 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

2 MARKS

1. Use the analogy to fill the blank *[PTA-4]*

a) Opening a door: Moment of force, Opening a water tap: _____

Ans. Moment of a couple.

b) pushing a bus by a group of people: Like parallel forces, Tug of war _____

Ans. Unlike parallel force.

2. A lift is moving downwards with an acceleration of 1.8 ms^{-2}. What is apparent weight realised by a man of mass 50kg? *[PTA-1]*

Given

acceleration = 1.8 ms^{-2}
mass = 50 kg
g = 9.8 ms^{-2}

To find : Apparent weight, R = ?

Solution

Formula: $R = m(g - a)$

$R = 50(9.8 - 1.8) = 50 \times 8 = 400$

$R = 400$ N

3. 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.

4 MARKS

1. Why the apples weight more at poles than at equator? *[PTA-3]*

Ans. (i) Acceleration due to gravity (g) is more at poles (g = 9.8 ms^{-2}) than at equator (g = 9.78 ms^{-2}). Further the weight of an object depends on 'g'.

(ii) So, the weight of the apple is more at the pole than at the equatorial region.

2. A force of 5 N applied on a body produces an acceleration 5 cm s^{-2}. Calculate the mass of the body. *[PTA-5]*

Given

Force = 5 N
Acceleration = 5 cm s^{-2} = 0.05 ms^{-2}

To find : Mass of the body = ?

Solution

$$F = ma$$
$$5 = m(0.05)$$
$$m = \frac{5}{0.05} = 100 \text{ kg}$$

3. At what height from the centre of the earth surface, the acceleration due to gravity will be 1/4th of its value on the surface of the earth. *[PTA-6]*

Data

Height from the centre of the Earth,

$$R' = R + h$$

The acceleration due to gravity at that height,

$$g' = g/4$$

Solution

$$g = GMm / R^2$$
$$g' = GMm / R'^2$$
$$\frac{g}{g'} = \left(\frac{R'}{R}\right)^2 = \left(\frac{R+h}{R}\right)^2$$
$$= \left(1+\frac{h}{R}\right)^2$$
$$4 = \left(1+\frac{h}{R}\right)^2$$
$$2 = 1+\frac{h}{R}$$

(or)

$$h = R$$
$$R' = 2R$$

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

7 MARKS

1. (i) Shock absorbers are used in luxury buses. why? *[PTA-2]*

Ans. (i) Luxury buses are fitted with springs and shock absorbers to reduce jerks while moving on uneven roads.

(ii) A large acting for a short period of time.

(iii) Vehicle receives the sudden movement when it moves on the surfaces and receives impulsive force.

(iv) To minimize this impact, shock absorbers are used in the luxury buses.

ii) A weight of a man is 686 N on the surface of the earth. Calculate the weight of the same person on moon. ('g' value of a moon is 1.625 ms^{-2}) *[PTA-2]*

Given

Weight of a mass on earth = 686 N

9.8 N = 1 kg in mass

$$\therefore 686 \text{ N} = \frac{686}{9.8} = 70 \text{ kg}$$

'g' value of a moon is 1.625 ms^{-2}

Solution

Weight = mass (m) × acceleration due to gravity (g)
m = 70 kg
g = 1.625 ms^{-2}
W = mg
W = 70 × 1.625 = 113.75 N

iii) Name the law of motion used in flying of birds. Give another example for the same law. (7 Marks) *[PTA-2]*

Ans. Newton's third law of motion.

Another Example: When a person swims, he pushes the water using his hands backwards (action), and the water pushes the swimmer in the forward direction (reaction).

3. 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]*

Ans. Initial momentum of the object = mu

Final momentum of the object = mv

The change in momentum

$= mv - mu$

$= m(v - u)$ ... (1)

Rate of change of momentum

$= \frac{\text{Change of momentum}}{\text{time}}$

$= \frac{m(v-u)}{t}$ ... (2)

According to Newton's second law of the motion, this is nothing but applied force.

$\therefore$ The applied force,

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

Acceleration, $a = \frac{v-u}{t}$

The applied force, $F \ \alpha \ ma$

$F \ \alpha \ k\,ma \ (k = 1)$

$\therefore F = ma$

Force acting on an object is a product of its mass and acceleration.

GOVERNMENT EXAM QUESTIONS & ANSWERS

2 MARKS

1. Calculate the velocity of a moving body of mass 5 kg whose linear momentum is 2 kg ms^{-1}. *[GMQP-2019]*

Linear momentum = mass × velocity

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

2. 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.

ADDITIONAL QUESTIONS & ANSWERS

CHOOSE THE CORRECT ANSWER — 1 MARK

1. Physics that deals with the effect of force on bodies is _____.

(a) Kinematics (b) Dynamics
(c) Statics (d) Mechanics

Ans. (d) Mechanics

2. _____ deals with the bodies which are at rest under the action of forces.

(a) Statics (b) Kinematics
(c) Dynamics (d) Mechanics

Ans. (a) Statics

3. Study of moving bodies under the action of forces _____.

(a) Statics (b) Kinematics
(c) Dynamics (d) Mechanics

Ans. (c) Dynamics

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

(a) inertia of rest
(b) inertia of motion
(c) momentum
(d) inertia of direction

Ans. (a) inertia of rest

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

(a) force
(b) momentum
(c) inertia of motion
(d) inertia of direction

Ans. (c) inertia of motion

6. The resistance of a body to change its direction of motion is _____.

(a) force (b) momentum
(c) inertia of motion (d) inertia of direction

Ans. (d) inertia of direction

7. In a sports fields, an athlete runs before taking a long jump is due to _____ .

(a) force (b) momentum
(c) inertia of motion (d) inertia of direction

Ans. (c) inertia of motion

8. The act of cleaning a carpet by heating it with a stick is an example for inertia of _____.

(a) motion (b) direction
(c) rest (d) momentum

Ans. (c) rest

9. **A luggage is usually tied with a rope on the roof of the buses due to _____.**
(a) inertia of motion
(b) inertia of direction
(c) inertia of rest
(d) momentum
Ans. (a) inertia of motion

10. **The momentum of a heavy object at rest will be _____.**
(a) large (b) infinity
(c) zero (d) small
Ans. (c) zero

11. **Inertia is a _____**
(a) property of matter
(b) type of force
(c) the speed of an object
(d) none of the above
Ans. (a) property of matter

12. **A & B are two objects with masses 100 kg & 75 kg respectively, then _____**
(a) both will have same inertia
(b) B will have more inertia
(c) A will have more inertia
(d) both will have less inertia
Ans. (c) A will have more inertia

13. **The physical quantity which is the measure of inertia is _____.**
(a) density (b) weight
(c) force (d) mass
Ans. (d) mass

14. **The sparks produced during sharpening a knife against a grinding wheel leaves the rim of the wheel tangentially. This is due to ____.**
(a) inertia of rest
(b) inertia of motion
(c) inertia of direction
(d) force applied
Ans. (c) inertia of direction

15. **The law that gives a qualitative definition of force is _____**
(a) Newton's I law
(b) Newton's II law
(c) Newton's III law
(d) Law of gravitation
Ans. (a) Newton's I law

16. **The SI unit of force is _____.**
(a) energy (b) joule
(c) newton (d) dyne
Ans. (c) newton

17. **A body is said to be under balanced force when the resultant force applied on that body is ___.**
(a) zero (b) infinite
(c) one (d) none
Ans. (a) zero

18. **If equal or unequal forces act along opposite directions parallel to each other, then they are called _____ parallel forces.**
(a) resultant (b) equilibriant
(c) like (d) unlike
Ans. (d) unlike

19. **The rotating or turning effect of a force is _____.**
(a) momentum (b) torque
(c) couple (d) none
Ans. (b) torque

20. **Acceleration of an object will increase as the net forces increases depending on its _____.**
(a) volume (b) mass
(c) shape (d) density
Ans. (b) mass

21. **The formula used for Newton's II law of motion is _____.**
(a) Force = mass × acceleration
(b) Velocity = acceleration × time
(c) Momentum = mass × velocity
(d) Speed = distance | time
Ans. (a) Force = mass × acceleration

22. **An ice skater pushes harder with his leg muscles, he begins to move faster. This is an example of _____.**
(a) Newton's I law (b) Newton's II law
(c) Newton's III law
(d) Law of conservation
Ans. (b)Newton's II law

23. **You're riding a bike when suddenly you hit a large rock. The bike stops moving but you fly over the handle - bars. This is an example of __**
(a) Newton's I law (b) Newton's II law
(c) Newton's III law (d) Law of conservation
Ans. (a) Newton's I law

24. **When you paddle a canoe, the canoe goes forward. This is an example of _____.**
(a) Newton's I law (b) Newton's II law
(c) Newton's III law (d) Law of conservation
Ans. (c) Newton's III law

25. **The acceleration in a body is due to _____.**
(a) balanced force (b) unbalanced force
(c) equilibriant (d) couple
Ans. (b) unbalanced force

26. When an object undergoes acceleration, ___.
(a) its speed always increase
(b) a force always acts on it
(c) its velocity always increases
(d) velocity always decreases
Ans. (b) a force always acts on it

27. A force of 20 N is acting on an object of mass 10 kg. The acceleration produced is _____.
(a) 1 ms^{-2} (b) 2 ms^{-2}
(c) 20 ms^{-2} (d) 10 ms^{-2} Ans. (b) 2 ms^{-2}

28. The physical quantity which is equal to rate of change of momentum is _____.
(a) displacement (b) acceleration
(c) force (d) impulse Ans. (c) force

29. The physical quantity which is equal to change in momentum is _____.
(a) velocity (b) acceleration
(c) force (d) impulse
Ans. (d) impulse

30. An example for a vector quantity is _____.
(a) speed (b) distance
(c) momentum (d) length
Ans. (c) momentum

31. Impulse is equal to _____.
(a) ma (b) Ft
(c) mv (d) $\frac{v-u}{t}$ Ans. (b) Ft

32. SI unit of impulse is _____.
(a) Ns (b) Ns^2
(c) kg ms^{-2} (d) kg m^2s^{-2} Ans. (a) Ns

33. The gravitational force of Earth acting on a body of mass 1 kg is _____
(a) 8.9 N (b) 9.8 N
(c) 980 N (d) 1 N Ans. (b) 9.8 N

34. The resultant of action & reaction forces is _____
(a) greater than zero (b) less than zero
(c) zero (d) one Ans. (c) zero

35. Rocket works on the principle of conservation of _____.
(a) mass (b) energy
(c) momentum (d) velocity
Ans. (c) momentum

36. Which of the following statement is not correct for an object moving along a straight path in an accelerated motion?
(a) its speed keeps changing
(b) its velocity always changes
(c) it always goes away from the Earth
(d) A force is always acting on it
Ans. (c) it always goes away from the Earth

37. A body of mass 1 kg is attracted by the Earth with a force which is equal to _____.
(a) 9.8 N (b) 6.67×10^{11}
(c) 1 N (d) 9.8 ms^{-1} Ans. (a) 9.8 N

38. According to the Newton's III law of motion, action & reaction _____.
(a) always act on the same body
(b) have same magnitude & direction
(c) always act in opposite directions
(d) act on either body at normal to each other
Ans. (c) always act in opposite directions

39. A water tanker filled up to $\frac{2}{3}$ of its height is moving with a uniform speed, on sudden application of the brake, the water in the tank would _____.
(a) move backward (b) be unaffected
(c) rise upwards (d) move forward
Ans. (d) move forward

40. The value of g _____.
(a) increases as we go above the Earth's surface
(b) decreases as we go to the centre of the Earth
(c) remains constant
(d) is more at equator and less at poles
Ans. (d)decreases as we go to the centre of the Earth

41. The ball is thrown up, the value of g will be _____.
(a) zero (b) +ve
(c) –ve (d) negligible Ans. (c) –ve

42. The distance between two bodies becomes 6 times more than the usual distance, then force becomes _____.
(a) 36 times (b) 6 times
(c) 12 times (d) $\frac{1}{36}$ times
Ans. (d) $\frac{1}{36}$ times