BODHI
SCIENCE MANUAL

10

New Edition 2024-2025

A PRODUCT FROM

Bodhi Team

Author

G. Geetha. Msc.,B.Ed.,
V.Thilagavathi Bsc.,B.Ed.,

For orders: 8675744747; Email: bodhi22@gmail.com
6374113093

PREFACE

This science manual is developed by experienced teachers who prioritize students' understanding, success in exams, and attainment of higher grades. The material is designed to facilitate easy comprehension and retention of concepts and answers. All questions are derived from the textbook and crafted to reflect those asked in both general examination papers and Parent-Teacher Association (PTA) assessments. Students who focus on mastering key concepts will excel in their exams. This manual is tailored to students' mental states, aiming to enhance their learning experience and performance. With the guidance of Mr. S. Mohan, our organization has been actively involved in producing quality educational resources since 2022. We congratulate all students who utilize the BODHI manual for achieving higher grades in all subjects.

All the best to the all

BODHI TEAM.

Unit-1
Laws of Motion

Formulae:

- Linear momentum : P= mxv
- Torque : τ = F xd
- Momentum of a couple : M =F xS
- Force : F= mxa
- Impulse : J = F xt =ΔP
- R=m(g+a) → R > W
- R = m(g-a) → R<W
- Gravitational force (g) = GM /R^2
- Weight w=mxg
- Change in momentum: $\Delta p=P_f-P_i$
- Kinetic energy $E_k=1/2\ mV^2$
- R = mg →R=W
- R= m(g-g) →R=0

TEXT BOOK QUESTIONS

1. Choose the correct answer:

1. Inertia of a body depends on **mass of the object**.
2. Impulse is equals to **change of momentum**. **(PTA – 1)**
3. Newton's III law is applicable **for a body is at rest & for a body in motion**. **(OR) both a & b**
4. Plotting a graph for momentum on the X-axis and time on Y-axis .Slope of momen- tum-time graph gives **force**.
5. In which of the following sport the turning of effect of force used **cycling**. **(QY- 2019)**
6. The e unit of 'g' is ms^{-2}. It can be also expressed as **N kg^{-1}**.
7. One kilogram force equals to **$98x10^4$ 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 **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 **increase by 300%**
10. To project the rockets which of the follow-ing principle(s) is /(are) required?
    Newton's third law of motion and law of conservation of linear momentum. (Sep- 2021, FRT- 2)

ll. Fill in the blanks

1. To produce a displacement **force** is required. **(FRT- 2022)**
2. Passengers lean forward when sudden brake is applied in a moving vehicle. This can be explained by **Inertia.**
3. By convention, the clockwise moments are taken as **negative** and the anticlockwise moments are taken as **positive**.
4. **Gear** is used to change the speed of car.
5. A man of mass 100kg has a weight of **980N** at the surface of the earth.

lll. Match the following: (PTA-1)

Column-I	Column-II
1. Newton's I law	-a) Propulsion of a rocket
2. Newton's II law	-b) Stable equilibrium of a body
3. Newton's III law	-c) Law of force
4. Law of conservation of linear momentum	-d) Flying nature of bird

Answer: 1-b, 2-c, 3-d, 4-a.

lV. State the whether the following statements are true or false.

1. The linear momentum of a system of particles is always conserved. (**False**)
   (Correct statement: The linear momentum of a system of particles is conserved when no external force is applied)
2. Apparent weight of a person is always equal to his actual weight. (**False**)
   (Correct statement: Apparent weight of a person is always equal to his actual weight the person is at rest.)
3. Weight of a body is greater at the equator and less at the polar region.(**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.(**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.(**False**)
   (Correct statement: Astronauts and orbiting space station are under free fall with same acceleration so the astronauts feel weight lessness.)

V. Assertion and Reasoning:

Mark the correct choice as

a) If both the assertion and the reason are true and 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 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.

Answer: 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.

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

Vl. Answer briefly:

1. Define inertia. Give its classification. (Aug- 22)

Ability of a body to maintain its state of rest or motion is called inertia.

Their types

- ✓ Interia of rest
- ✓ Interia of motion
- ✓ Interia of direction.

2. Classify the types of force based on their application? (FRT& Aug- 2022)

Types of forces

- ❖ Like parallel force
- ❖ Unlike parallel force.

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

Given: $F_1 = 5N$ $F_2=15N$

Resultant force $=F_2-F_1$

$= 15-5 =10$

Resultant force =10N. The direction of F net is F_2.

4. Differentiate mass and weight. (May - 2022)

	Mass	Weight
1.	**Quantity of matter** Contained in the body.	**Gravitational force exerted** On it due to the earth's gravity.
2.	SI unit is kg	SI unit is Newton
3.	It is a **scalar quantity.**	It is a **vector quantity**
4.	It remains the same at	**It varies from one place to**

	any point on the earth.	**another place** on the earth.
5.	Fundamental quantity.	Derived quantity.

5. Define moment of a couple?

- The line of action of two forces does not coincide.
- It does not produce any translatory motion since the resultant is zero.
- But it causes the rotation of the body.
- **Rotating effect of a couple is known as moment of a couple.**

6. State the principle of moments? (QY- 2019)

- When a number of like or unlike parallel forces act on a rigid body and body is in equilibrium moment in clockwise direction =moment in anticlockwise direction.

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

7. State Newton's second law? (May – 2022)

- **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.

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

- If the handle is **long**, then the moment of force will be high, then less force is only needed.

Moment of force = F x d.

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

- A fielder experiences a **smaller force** for a **longer interval** of time to catch the ball , resulting in a **lesser impulse** on his hands.
- Thus he pulls back his hand while catching the ball.

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

- Astronuts are not floating but falling freely around the earth due to their huge orbital velocity.
- Since space station and astronunts have equal acceleration, they are under free fall condition.
- Hence both the astronunts and the space station are in the state of weightlessness.

Vll. Solve the given problems:

1. Two bodies have a mass ratio of 3:4 . The force applied on the bigger mass produces an accderation of 12 ms^{-2}.what could be the acceleration of the other body, it the same force acts on it?

Given:

- ✓ Mass of a smaller body =m_1=3kg
- ✓ Mass of a bigger body =m_2=4kg

bigger mass produces an acceleration =a_2=12ms^{-2} a_1=?

Solution:

We know F= ma → F_1= m_1a_1 →F_2=m_2a_2.

$\frac{F1}{F2} = \frac{m1}{m2} \times \frac{a1}{a2}$ → $1 = \frac{3}{4} \times \frac{a1}{12}$ (∴F1/F_2 =1) (same force)

$\frac{a1}{12} \times \frac{3}{4}$ =1= a_1 =16ms^{-1}.

∴ Acceleration of the other body is 16 ms^{-2}.

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

Given:

Mass of a ball (m) = 1kg

Initial velocity u= 10 ms^{-1}

Final velocity v= -10ms^{-1}

Solution: change in linear momentum = m(v-u)

= mv-mu

= 1x (-10-10)

= 1x-20

= -20 kg ms^{-1}

(∴ -ve sign indicates the direction of momentum.)

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

Given:

Force F_1=140N; F_2=40N

Length L_1= 40cm; Length L_2=?

$F_1 \times L_1 = F_2 \times L_2$

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

Solution:

L_2= 140x40 /40 =140 cm

∴If a force 40N is applied, the length of the spanner should be 140 cm.

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:

Ratio of mass m_1= 2, m_2=3 →2:3

Ratio of radii R1= 4, R_2=7 →4:7

Ratio of acceleration due to gravity = g_1: g_2=?

Solution:

We know $g=GM/R^2$ $g_1=GM_1/R_1^2$ $g_2=GM_2/R_2^2$

$$\frac{g_1}{g_2} = \frac{GM_1 / R_1 2}{g_2 / R_2 2} = \frac{M_1}{R_+ 2} \times \frac{R_2 2}{M_2}$$

$$= \frac{M_1}{M_2} \times \frac{R_2 2}{R_1 2}$$

$$= \frac{M_1}{M_2} \times \left(\frac{R_2}{R_1}\right)^2 \Rightarrow \frac{2}{3} \times \left(\frac{7}{4}\right)^2 \Rightarrow \frac{2}{3} \times \frac{49}{16}$$

$$= \frac{g_1}{g_2} \Rightarrow \frac{49}{24}$$ The ratio is $g_1 : g_2$ = 49 :24.

Vlll. Answer in detail:

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

(PTA- 3, Aug-22, Apr- 2024)

(or)

Explain the different types of inertia with an example for each type.

(FRT- 2022)

Types of inertia

- ✓ Intertia of rest
- ✓ Intertia of motion
- ✓ Intertia of direction

Intertia of rest:

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

(Ex): Shake the branches of a tree, some of the leaves and fruits detach and fall down.

Intertia of motion:

The resistance of a body to change its state of motion.

(Ex): An athlete runs some distance before jumping.

Intertia of direction:

The resistance of a body to change its direction of motion.

(Ex): a sharp turn while driving a car, tend to lean sideways.

2. State Newton's laws of motion? (Sep-2012, Aug-2022)

a) Newton's first law:

Everybody continues to be in its state of rest or the 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 and the change in momentum takes place in the direction of the force.

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

c) Newton's third law:

- For every action, there is an equal and opposite reaction.
- They always act on two different bodies

($F_B = -F_A$)

3. Deduce the equation of a force using Newton's second law of motion? (TRT- 2024)

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 change in momentum takes place in the direction of the force".

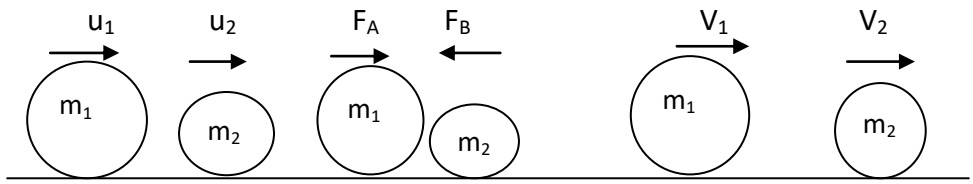
Initial momentum of the body $P_i = mu$
Final momentum of the body $P_f = mu$
Change in momentum $\Delta p = P_f - P_i = mv - mu$
F α change in momentum / time
F α (mv-mu)/t
F = Km (v-u) t Here K is proportionality constant

K =1 in all systems of units.
F= mv-mu /t ; m[v-u/t]
Acceleration a = v-u/ t
F= ma
Force = mass x acceleration.

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

Law of conservation of momentum:

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



Before collision on collision after collision

- Let two bodies A and B having masses m_1 and m_2 movie in a straight line.
- Let initial velocities of A and B be u_1 and u_2 respectively such that $u_1 > u_2$.
- 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,

$F_B = m_2(v_2-u_2)/t \rightarrow (1)$

Force on body A due to B

$$F_A = \frac{m_1(v_1 - u_1)}{t} \longrightarrow (2)$$

By Newton's third law, action force = reaction force

$F_A = -F_B$

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

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

$m_1v_1-m_1u_1= - m_2v_2+ m_2 u_2$

$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$

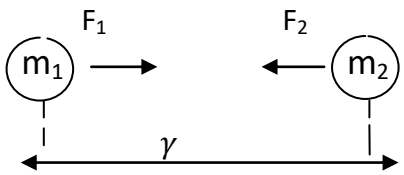
In the absence of an external force, the algebraic sum of the momentum after collision is numerically equal to the algebraic sum of the momentum before collision.

5. Describe rocket propulsion? (Sep -2022, Aug-22, PTA- 4)

- **Law of conservation of linear momentum and Newton's III law of motion.**
- **Rockets are filled with a fuel** (either liquid or solid) in the propellant tank.
- **When the rocket is fired**, this fuel is burnt and a hot gas is ejected with a speed from the nozzle of the rocket, producing a huge momentum.
- To balance this momentum, **an equal and opposite reaction force is produced** in the combustion chamber, which makes the rocket project forward.
- **In motion, the mass of the rocket gradually decreases**, until the fuel is completely burnt out.
- **There is no net external force acting on it**, and so the linear momentum of the system is conserved.
- **The mass of the rocket decreases with altitude which results in gradual increase** in velocity of the rocket.
- At one stage **it reaches escape velocity**, which is sufficient to just escape from the gravitational pull of the earth.

6. State the universal law of gravitation and derive its mathematical expression. (QY- 2019)

- The gravitational force is directly proportional to the product of their masses and inversely proportional to the square of the distance between the centers of the masses.



$F \alpha m_1m_2$

$F\alpha 1/r^2$

$F \alpha m_1m_2/r^2$

$F= Gm_1m_2/r^2$

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

7. Give the applications of universal law of gravitation?

- Heavenly bodies like stars and planets can be discovered and their dimensions and path can also be measured using the gravitation law.
- Mass of the earth, radius of the earth acceleration due to gravity, can be calculated with a higher accuracy.
- It maintains the motion of all the planets around the sun and moon around the earth.
- It pulls the entire object towards the earth so that we are not flying in atmosphere.
- It helps to maintain the water flow in the rivers and seas.

lX. 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 15N. Calculate the force exerted on the 2 kg mass.

Given: m_1 = 8kg; m_2 =2 kg
Horizontally applied force F_1=15 N

$m = m_1+m_2$

$m = 8+2 = 10$ kg

Force exerted on 2 kg, F_2=?

Solution:

F=ma → F_1=ma → a= F_1/m

$a = 15/10 = 1.5$ ms^{-2}

Force exerted on m_2 (2 kg) is

$F_2= m_2a$

=2x 1.5

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 moment?

Solution:

Mass of the bike = m_1

Mass of the truck = $m_2 = 4m_1$

Kinetic energy = ½ mV^2

= $P^2/2m$.

Kinetic energy of truck and bike are same $K_1=K_2$

$$k_1 = \frac{p_1 2}{2m_1} \; k_2 = \frac{p_2 2}{2m_2}$$

$$\frac{p1^2}{2m1} = \frac{p2^2}{2m2} \quad \Rightarrow \frac{p_1^{\;2}}{2m_1} = \frac{p_2^{\;2}}{2m_2}$$

$$\left[\frac{P_1}{P_2}\right]^2 = \left[\frac{2m_1}{2m_2}\right] = \frac{m_1}{4m_1} = \frac{1}{4}\left[\because m_2 = 4m_1\right]$$

$$\frac{P_1}{P_2} = \frac{1}{2}$$

The ratio of moment is 1:2

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

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

Book inside Questions

l. Fill in the blanks.

1. The SI unit of force is **Newton**.
2. When a lift is moving upward, apparent weight is **greater than actual weight**.
3. l Newton = **10^5 dyne**
4. The SI unit of gravitational unit of force **kgf**.
5. SI unit of impulse is **Ns**
6. A sharp turn while driving a car, tend to lean sideways is due to **Intertia of direction**.
7. The mass of earth is **5.972x 10^{24}kg**.
8. The radius of earth is **6378 Km**.
9. **Force** is a vector quantity.
10. Rotating effect of a couple is known as **moment of a couple**.

ll. Short answer questions:

1. Define Torque?

- The rotating or turning effect of a force about a fixed point or fixed axis is called moment of the force about that point or torque (τ).

2. Define Impulse.

- A large force acting for a very short interval of time is called as impulse.

$$J = F \times t$$

- Impulse is also known as magnitude of change of momentum $J=\Delta p$.
- Its SI unit $Kgms^{-1}$ or Nm.

3. What is meant by apparent weight?

- The weight that you feel to posses which is not the same as you weigh actually is called apparent weight.

lll. Long answer:

1. Derive the relation between g and G?

- Let M be the mass of the earth and m be the mass of the body.
- The entire mass of the earth is assumed to be concentrated as its centre.
- By newtons law of gravitation

$F = GMm/R^2 \rightarrow (1)$

From Newtons second law $F = m_a = m_g \rightarrow (2)$

$(1) = (2)$

$$m_g = \frac{GMm}{R^2}$$

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

Acceleration due to gravity $g = \frac{GM}{R^2}$.

2. Write the application of Torque?

Gears:

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

Steering wheel:

- A small steering wheel enables you to manoeuore a car easily by transferring a torque to the wheels with less effort.

Sea saw:

- Since there is a difference in the weight of the persons sitting on it , the heavies persons lift the lighter person.
- When the heavier person comes closer to the pivot point the distance of the line of action of the force decreases.
- It causes less amount of torque to act on it. This enables the lighter person to lift the heavier person.

இது போன்ற அனைத்து வினாக்களும் மாணவர்களுக்கு எளிதில் புரியும் வகையில் மிகவும் எளிமையாகவும், தெளிவாகவும், விளக்கி வெளியிடப்பட்டுள்ளது.

ஆசிரியர்கள் மாணவர்களுக்கு இதனை வாங்கி கொடுத்து பயன்படுத்தி கொள்ளுமாறு அன்புடன் கேட்டுக்கொள்கிறோம்.

விலை மாணவர்களுக்கு ஏற்றார் போல வழங்கி வருகிறோம்.

எங்களின் science படைப்புகளின் வெளியீடு

SCIENCE MANUAL
SCIENCE QUESTION BANK

மேலும் தொடர்புக்கு: 8675744747:6374113093