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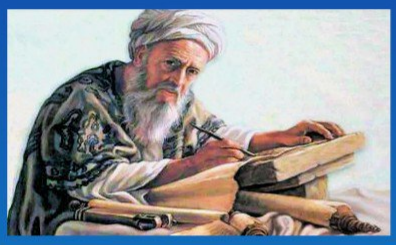
SEVEN MUSLIMS NOTES

PHYSICS 11

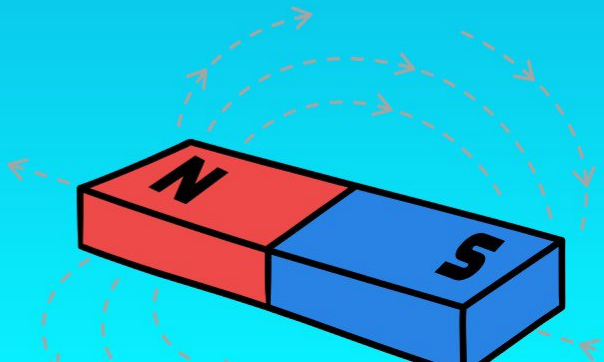


Al-Biruni (973–1048) calculated the Earth's radius and worked on the physics of planetary motion.

Best Regards to

Sir Muhammad Ali

(Physics Lecturer KIPS College)



MOTION AND FORCE

EXERCISE SHORT QUESTIONS

3.1. What is the difference between uniform velocity and variable velocity? From the explanation of variable velocity, define acceleration. Give SI units of velocity and acceleration.

	Uniform velocity	Variable velocity
1.	If a body covers equal displacement in equal intervals of time then its velocity is called uniform velocity.	If a body does not cover equal displacement in equal intervals of time then its velocity is called variable velocity.
2.	If a body moves with uniform velocity then $v_{ins} = v_{avg}$	If a body moves with variable velocity then $v_{ins} \neq v_{avg}$

When a body moves with variable velocity, it is said to be possess acceleration which is defined as " Time rate of change of velocity is called acceleration"

Unit of velocity is ms^{-1} and unit of acceleration is ms^{-2}.

3.2. An object is thrown vertically upward. Discuss the sign of acceleration due to gravity, relative to velocity, while the object is in air.

When an object is thrown vertically upward, its velocity decreases and acceleration becomes negative. At maximum height, its velocity becomes zero. When an object starts moving downward its velocity increases and acceleration becomes positive.

3.3. Can the velocity of an object reverse the direction when acceleration is constant? If so, give an example.

Yes, velocity of an object can reverse the direction when acceleration is constant. When an object is thrown vertically upward, its velocity is in upward direction. At maximum height, it becomes zero. When object starts moving downward, direction of its velocity is downward. In both cases the value of acceleration is $9.8ms^{-1}$ which remains constant throughout the motion.

3.4. Specify the correct statement

a. An object can have a constant velocity even its speed is changing.
b. An object can have a constant speed even its velocity is changing.
c. An object can have a zero velocity even its acceleration is not zero.
d. An object subjected to a constant acceleration can reverse its velocity.

Statements b, c and d are correct.

3.5. A man standing on the top of a tower throws a ball straight up with initial velocity v_i and at the same time throws a second ball straight downward with the same speed. Which ball will have larger speed when. it strikes the ground? Ignore air friction.

Both the balls will have same speed on striking the ground. The ball thrown straight up will pass through the same point with same speed while moving down and gain the same velocity as that of the ball thrown straight down, until it reaches the surface of earth.

3.6. Explain the circumstances in which the velocity "v" and acceleration "a" of a car are

i) Parallel **ii) Antiparallel**
iii) Perpendicular to one another **iv) "v" is zero but "a" is not zero**
v) "a" is zero but "v" is not zero

i. In a straight line, when the velocity of the car is increasing, both "v" and "a" are parallel.

ii. In a straight line, when the velocity of the car is decreasing, both "v" and "a" are antiparallel.
iii. Velocity "v" and acceleration "a" of the car are perpendicular when the car is moving in a circular path.
iv. When brakes are applied and car comes to rest due to acceleration then "v" is zero but "a" is not zero.
v. In a straight line, when car is moving with uniform velocity then "a" is zero but "v" is not zero.

3.7. Motion with constant velocity is a special case of motion with constant acceleration. Is this statement true? Discuss.

Yes, motion with constant velocity is a special case of motion with constant acceleration.
Constant velocity means, there is no change in velocity i.e. $\Delta v = 0$ thus

$$a = \frac{\Delta v}{\Delta t} = \frac{0}{\Delta t} = 0 \text{ (constant)}$$

3.8. Find the change in momentum for an object subjected to a given force for a given time and state law of motion in terms of momentum.

Let "F" be the force applied on an object of mass "m" which produces acceleration "a" in time Δt then

$$a = \frac{v_f - v_i}{\Delta t}$$

As newton second law is

$$F = ma$$

$$F = m\left(\frac{v_f - v_i}{\Delta t}\right)$$

$$= \frac{mv_f - mv_i}{\Delta t}$$

$$F = \frac{\text{change in momentum}}{\text{time taken}}$$

So,
Time rate of change of momentum is equal to applied force . This is the statement of newton second law of motion in terms of momentum.

3.9. Define impulse and show that it is related to linear momentum.

"When a large force act on a body for very short interval of time then the product of force and time is called impulse."

$$I = F \times \Delta t$$

$$= ma \times t$$

$$= m\left(\frac{v_f - v_i}{t}\right) t$$

$$= mv_f - mv_i$$

$$I = \Delta p$$

Thus impulse is equal to the rate of change of momentum.

3.10. State law of conservation of liner momentum, pointing out the importance of isolated system. Explain, why under certain conditions the law is useful even the system is not completely isolated.

Law of conservation of momentum

"The total linear momentum of an isolated system remains constant."

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$$

Isolated system

"A system in which no external force acts on the bodies is called isolated system."

Law of conservation of momentum holds good only for isolated system. But under certain conditions when external forces are very small as compare to internal forces, the law can be applied to a good approximation.

3.11. Explain the difference between elastic and inelastic collisions. Explain how would a bounding ball behave in each case? Give plausible reasons for the fact that K.E is not conserved in most cases?

	Elastic collisions	Inelastic collisions
1.	The type of collision in which kinetic energy remains conserved is called elastic collision.	The type of collision in which kinetic energy does not remains conserved is called inelastic collision.
2.	**Example:** When a ball is dropped from a certain height and it bounces back to the same height.	**Example:** When a ball is dropped from a certain height and it does not bounces back to the same height.

In most of the cases, some of the kinetic energy is lost in the form of heat energy and sound energy etc. kinetic energy does not remain conserved.Thus most of the collisions are not perfectly elastic.

3.12. Explain what is meant by projectile motion. Derive expressions for the

a. time of projectile

b. the range of projectile

Show that the range of projectile is maximum when projectile is thrown at the angle of 45° with the horizontal.

Ans.

a. Time of flight

"Time taken by a projectile to cover distance between point of projection and the point where it hits the ground is called time of flight."

Derivation:

$$\because \quad S = 0$$
$$\because \quad v_{iy} = v_i \sin\theta$$
$$\because \quad a_y = -g$$

Using 2nd equation of motion

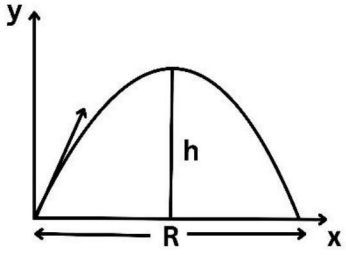
$$S = v_{iy}\, t + \frac{1}{2} a_y\, t^2$$
$$\therefore \quad 0 = v_i \sin\theta t - \frac{1}{2} g t^2$$

$$\frac{1}{2}gt^2 = v_i \sin\theta t$$

$$T = \frac{2v_i \sin\theta}{g}$$

b. Range of projectile:

"The maximum horizontal distance covered by a projectile is called range of projectile."



Derivation:

$$\because \quad a_x = 0$$
$$\because \quad v_{ix} = v_i \cos\theta$$
$$\because \quad S = R$$

Using second equation of motion

$$S = v_{ix}t + \frac{1}{2}a_x t^2$$

$$\therefore \quad R = v_i \cos\theta t + \frac{1}{2}(0)t^2$$

$$R = v_i \cos\theta t$$

$$= v_i \cos\theta \left(\frac{2v_i \sin\theta}{g}\right)$$

$$R = \frac{v_i^2 (2\sin\theta\cos\theta)}{g}$$

As $\sin 2\theta = 2\sin\theta\cos\theta$

By putting in the above equation

$$R = \frac{v_i^2 \sin 2\theta}{g}$$

3.13. At what point or points in its path does a projectile have it's maximum speed, it's minimum speed ?

- A projectile has its maximum speed at the point of projection and at the point where it hits the ground.
- A projectile has its minimum speed at the highest point of its path where vertical components of velocity becomes zero.

3.14. Each of the following questions is followed by four ……. (Skip this Question)