SCIENCE (PHYSICS)
WORKSHEET-110525
CHAPTER 09 GRAVITATION (ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : IX **DURATION : 1½ hrs**

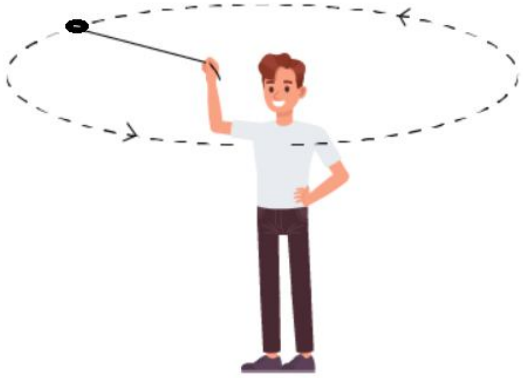
General Instructions:

(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. As indicated in the figure given below, a boy is whirling a stone tied with a thread in a horizontal circular path:



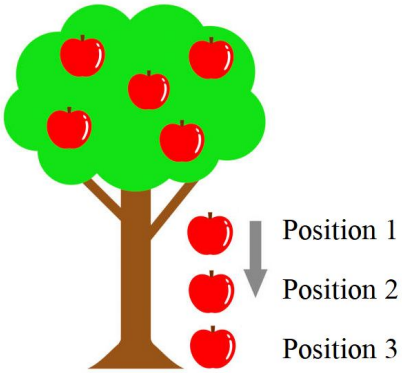
If the stone is broken from the string, it:
(a) will proceed in a straight line towards the circular path's centre.
(b) will move in a tangential to the circular path straight line.
(c) will move away from the boy in a straight line perpendicular to the circular path.
(d) will keep moving in a circular pattern.
Ans. (c) will move away from the boy in a straight line perpendicular to the circular path.
The centripetal force works towards the centre of the circular path when the boy whirls a stone linked with a thread in a circular path. When the string snaps, however, the centripetal force ceases to exist and there is no force acting. As a result, the stone will continue in a straight line and fly off along the tangent to the circular route, as predicted by Newton's first law.

2. A paper and a stone are dropped from the top of a building. Which one will reach the ground first and why?
(a) The stone, because it is heavier (air resistance plays no part.)
(b) The stone, only because it faces much less air resistance.
(c) The paper, because it is lighter (air resistance plays no part.)
(d) The paper, only because it faces much less air resistance.
Ans. (b) The stone, only because it faces much less air resistance.
Due to more surface area and air resistance, the piece of paper experiences an upward force. Stone has an irregular shape and less air resistance, hence it does not experience any upward force.

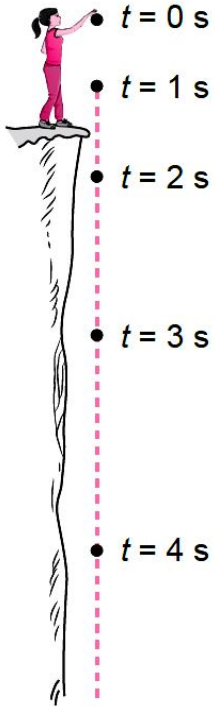
3. When a ship floats in seawater:
(a) the weight of water displaced is larger than the ship's weight

(b) the weight of water displaced is less than the ship's weight
(c) the weight of water displaced is equal to the ship's weight
(d) it displaces no water
Ans. (c) the weight of water displaced is equal to the ship's weight
According to Archimedes' principle, when a body is submerged totally or partially in a liquid, it receives an upward force equal to the weight of the fluid displaced by it, hence the mass of water displaced is equal to the mass of the ship.

4. The drawing shows an apple falling to the ground. In which of the three positions does gravity act on the apple?



(a) Position 1 only (b) Positions 1 and 2
(c) Positions 1, 2 and 3 (d) Position 3 only
Ans. (c) Positions 1, 2 and 3
The falling of an apple is an example of free fall. Everything on the earth is attracted towards the earth. When an apple is falling freely, there is absolutely no change in the direction of motion of object. But due to constant gravitational pull of the earth, the magnitude of velocity of body in free fall goes on increasing. So, the earth's gravity i.e., the attraction between the earth and an apple is there at all three positions i.e., 1, 2 and 3.



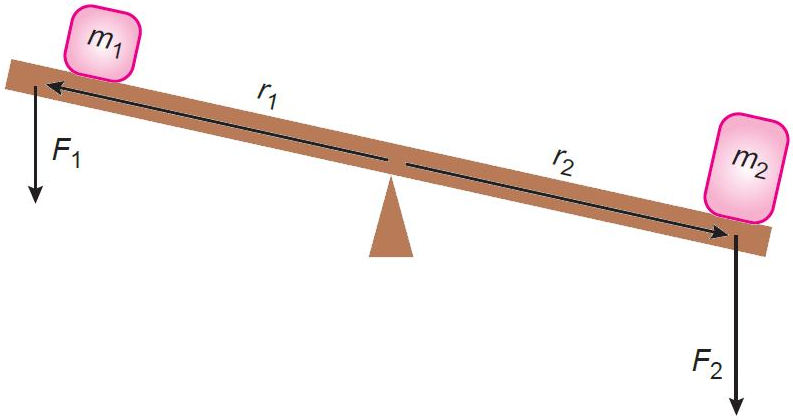
5. A ball is dropped from a height and the distance covered by the ball each second is recorded. The image shows the distance the ball covers each second.
What can be understood about the effect of gravitational force of Earth on the ball?
(a) It causes the ball to decrease its speed of fall.
(b) It causes the ball to fall with a constant speed.
(c) It increases the distance covered by the ball with every passing second.
(d) It decreases the distance covered by the ball with every passing second.
Ans. (c) It increases the distance covered by the ball with every passing second.

6. A body has a mass of 2 kg. When will the mass of the body change?
(a) When the body is taken to the moon.
(b) When the body is dropped from a height.
(c) When the body is being pulled along a smooth surface.
(d) The mass of the body will not change unless it is cut or broken.
Ans. (d) The mass of the body will not change unless it is cut or broken.
Mass of the body does not change at any time.

7. Mass of a man is 75 kg and he has reached the centre of the Earth. The mass and weight of man at the Earth's centre, with radius R, respectively, will be:
(a) 75 kg, 75 N (b) 75 kg, 0 N (c) 0 kg, 0 N (d) 75 kg, 735 N
Ans. (b) 75 kg, 0 N

At the centre of the Earth, the weight of the body is zero. The acceleration due to gravity is greatest on the Earth's surface, and it becomes zero as we approach towards the equator.
W = mg = 0 N
Mass of an object can never be zero as it is same at any other part of the Earth.

8. The image shows a two blocks of mass m_1 and m_2 on wooden plank, which is pivoted at its center.



The weights are r_1 and r_2 distances apart from the point of pivot. Under what condition do the weights get balanced on the wooden plank?
(a) When $m_1 < m_2$ and $r_1 = r_2$.
(b) When $m_1 < m_2$ and $r_1 < r_2$.
(c) When $m_1 > m_2$ and $r_1 > r_2$.
(d) When $m_1 = m_2$ and $r_1 = r_2$.
Ans. (d) When $m_1 = m_2$ and $r_1 = r_2$.

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. Assertion (A): At the centre of the Earth, a body has no centre of gravity.
Reason (R): g = 0 at the centre of Earth.
Ans. (a) Both A and R are true and R is the correct explanation of A.
At the centre of the Earth, g = 0 i.e., a body has no weight and hence there will be no centre of gravity.

10. Assertion (A): An object thrown vertically upward with certain velocity v, reaches maximum height and fall back with same velocity.
Reason (R): Whenever an object falls towards the Earth, gravitational force of the Earth causes acceleration.
Ans. (d) A is false but R is true.
When an object is thrown vertically upward with certain velocity, it will fall back freely. There will be a change in the magnitude of velocity due gravitational force of the Earth.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. If the moon attracts the earth, why does the earth not move towards the moon?
Ans. The Earth and the moon experience equal gravitational forces from each other. However, the mass of the Earth is much larger than the mass of the moon. Hence, it accelerates at a rate

lesser than the acceleration rate of the moon towards the Earth. For this reason, the Earth does not move towards the moon.

12. Why does a body reach the ground quicker at poles than at the equator when dropped from the same height?
Ans. The acceleration due to gravity is more at the poles than at the equator. The time taken for a body is less if the acceleration due to gravity is more when the initial velocities and the distance travelled are the same. So, when dropped from the same height a body reaches the ground quicker at the poles than at the equator.

13. If the volume of 50 g of a substance is 20 cm^3 and the density of water is 1 g/cm^3, will the substance float or sink? Why?
Ans. Mass = 50 g, Volume = 20 cm^3,
Density = Mass/Volume = 50/20 = 2.5 g/cm^3
If g/cm^3 Density of water = 1 g/cm^3
The substance's density is higher than that of water. As a result, the substance sinks.

14. (i) What is the source of centripetal force that a planet requires to revolve around the Sun? On what factors does that force depend?
(ii) Suppose gravity of Earth suddenly becomes zero, then which direction will the Moon begin to move if no other celestial body affects it?
Ans. (i) Gravitational force. This force depends on the product of the masses of the planet and Sun and the distance between them.
(ii) The Moon will begin to move in a straight line in the direction in which it was moving at that instant because the circular motion of Moon is due to centripetal force provided by the gravitational force of the Earth.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (Mass of the earth is 6×10^{24} kg and radius of the earth is 6.4×10^6 m).
Ans. According to the universal law of gravitation, gravitational force exerted on an object of mass m is given by:

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

Where,
Mass of Earth, $M = 6 \times 10^{24}$ kg
Mass of object, $m = 1$ kg
Universal gravitational constant, $G = 6.7 \times 10^{-11}$ Nm^2 kg^{-2}
Since the object is on the surface of the Earth, r = radius of the Earth (R)
$r = R = 6.4 \times 10^6$ m

Gravitational force, $F = \frac{GMm}{R^2} = \frac{6.7 \times 10^{-11} \times 6 \times 10^{24} \times 1}{(6.4 \times 10^6)^2} = 9.8N$

16. What happens to the force between two objects, if
(i) the mass of one object is doubled?
(ii) the distance between the objects is doubled and tripled?
(iii) the masses of both objects are doubled?
Ans. According to the universal law of gravitation, the force of gravitation between two objects is given by: $F = \frac{Gm_1m_2}{r^2}$

(i) F is directly proportional to the masses of the objects. If the mass of one object is doubled, then the gravitational force will also get doubled.

(ii) F is inversely proportional to the square of the distances between the objects. If the distance is doubled, then the gravitational force becomes one-fourth of its original value.
Similarly, if the distance is tripled, then the gravitational force becomes one-ninth of its original value.
(iii) F is directly proportional to the product of masses of the objects. If the masses of both the objects are doubled, then the gravitational force becomes four times the original value.

17. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground.
Ans. According to the equation of motion under gravity:
$v^2 - u^2 = 2gs$
Where,
u = Initial velocity of the stone = 0
v = Final velocity of the stone
s = Height of the stone = 19.6 m
g = Acceleration due to gravity = 9.8 m s^{-2}
$\therefore v^2 - 0^2 = 2 \times 9.8 \times 19.6$
$v^2 = 2 \times 9.8 \times 19.6 = (19.6)^2$
$v = 19.6$ m s^{-1}
Hence, the velocity of the stone just before touching the ground is 19.6 m s^{-1}.

SECTION – D

Questions 18 carry 5 marks each.

18. A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.
Ans. Let the two stones meet after a time t.
(i) For the stone dropped from the tower:
Initial velocity, $u = 0$
Let the displacement of the stone in time t from the top of the tower be s.
Acceleration due to gravity, g = 9.8 m s^{-2}
From the equation of motion,

$$s = ut + \frac{1}{2}gt^2 = 0 \times t + \frac{1}{2} \times 9.8 \times t$$

$$\Rightarrow s = 7.9t^2 \text{ ------(1)}$$

(ii) For the stone thrown upwards:
Initial velocity, $u = 25$ m s^{-1}
Let the displacement of the stone from the ground in time t be s'.
Acceleration due to gravity, g = −9.8 m s^{-2}
Equation of motion,

$$s' = ut + \frac{1}{2}gt^2 = 25t - \frac{1}{2} \times 9.8 \times t^2$$

$$\Rightarrow s' = 25t - 4.9t^2 \text{ ------(2)}$$

The combined displacement of both the stones at the meeting point is equal to the height of the tower 100 m.

$$\therefore s + s' = 100$$

$$\Rightarrow \frac{1}{2}gt^2 + 25t - \frac{1}{2}gt^2 = 100$$

$$\Rightarrow t = \frac{100}{25} = 4s$$

In 4 s, the falling stone has covered a distance given by equation (1) as

$s = \frac{1}{2} \times 10 \times 4^2 = 80m$

Therefore, the stones will meet after 4 s at a height (100 − 80) = 20 m from the ground

OR

A ball thrown up vertically returns to the thrower after 6 s. Find
(a) the velocity with which it was thrown up,
(b) the maximum height it reaches, and
(c) its position after 4 s.

Ans. (a) Time of ascent is equal to the time of descent. The ball takes a total of 6 s for its upward and downward journey.
Hence, it has taken 3 s to attain the maximum height.
Final velocity of the ball at the maximum height, $v = 0$
Acceleration due to gravity, g = −9.8 m s^{-2}
Equation of motion, $v = u + gt$ will give,
$0 = u + (-9.8 \times 3)$
$u = 9.8 \times 3 = 29.4$ ms^{-1}
Hence, the ball was thrown upwards with a velocity of 29.4 m s^{-1}.
(b) Let the maximum height attained by the ball be *h*.
Initial velocity during the upward journey, u = 29.4 m s^{-1}
Final velocity, $v = 0$
Acceleration due to gravity, g = −9.8 m s^{-2}
From the equation of motion, $s = ut + \frac{1}{2}at^2$

$\Rightarrow h = 29.4 \times 3 + \frac{1}{2} \times (-9.8) \times 3^2 = 44.1m$

(c) Ball attains the maximum height after 3 s. After attaining this height, it will start falling downwards.
In this case,
Initial velocity, $u = 0$
Position of the ball after 4 s of the throw is given by the distance travelled by it during its downward journey in 4 s − 3 s = 1 s.
Equation of motion, $s = ut + \frac{1}{2}gt^2$ will give

$\Rightarrow s = 0 \times t + \frac{1}{2} \times (9.8) \times 1^2 = 4.9m$

Total height = 44.1 m
This means that the ball is 39.2 m (44.1 m − 4.9 m) above the ground after 4 seconds.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Read the following information and answer the questions based on information and related studied concepts.

Sahil was driving the car at a very high speed to reach the hospital and he tried to drift the car. But the car slides from a ledge and falls to the ground in 2 seconds due to brake failure. Take acceleration due to gravity, g = 10 m/s^2.

(a) What is the speed at which the car hits the ground?
(b) What is the height of the ledge above the ground?
(c) What is more fundamental: mass or weight?
Ans. Given, Time taken = 2 sec
Acceleration due to gravity, g = 10 m/s^2
Initial velocity, u = 0 m/s (Since the car is under free fall)
(a) When car hits the ground i.e., under free fall condition,
Using the formula, v = u + gt
$\Rightarrow$ v = 0 +10 x 2
$\Rightarrow$ v = 20 m/s
(b) Height of the ledge above the ground,
Using the equation, $h = ut + \frac{1}{2}gt^2$
Where, *h* is the height,
t is the free fall period, and
g is the gravitational acceleration,
$h = 0 \times 2 + \frac{1}{2} \times 10 \times (2)^2 = 20m$
(c) Mass is more fundamental than weight because mass of body remains constant, but weight of body changes due to changes in g.

20. Read the given passage and answer the questions that follow based on the passage and related studied concepts.
A school picnic was organised at Fateh Sagar Lake, Udaipur. Children were allowed to take boat rides. All types of boats can be seen at the lake like small boats, cruise ships and many more. Shilpa found that boats are floating on water where she can also see instructions on board that "Only 8 people are allowed to go on boat ride". She got confused. She asked following questions to her teacher.

(a) How do boats float on water?
(b) Will there be any change in the water level near the boat as people start sitting?
(c) What happens to the boat's buoyant force? Compare the buoyant force acting on boat and water.
Ans. (a) According to Archimedes' principle, the force exerted on an object in a fluid equals the weight of fluid displaced (moved out of the way) by the object. Since this force called buoyant force, acting on the boat is more than its weight, the boat will float.
(b) The weight of water displaced (by the boat's submerged portion) rises.
(c) As the buoyant force acting on the boat increases, so does the buoyant force acting on the boat. Buoyant force acting on boat is more than the force acting on water, thus the boat floats.