	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: SCIENCE 2025 – 26** **SUBJECT: PHYSICS**	**Date: 28/10/2025**
Worksheet No: 07 **WITH ANSWERS**	**CHAPTER / UNIT: GRAVITATION**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.:**

OBJECTIVE TYPE OF QUESTIONS (1 MARK):

1) The weight of a body at the centre of the Earth is
   a) Zero
   b) Infinite
   c) Same as on the surface of Earth
   d) None of the above

2) If the distance between two masses is doubled, the gravitational attraction between them
   a) Is doubled
   b) Becomes four times
   c) Is reduced to half
   d) Is reduced to a quarter.

3) Which of the following statements about the gravitational constant is true?
   a) It is a force
   b) It does not have a unit
   c) It depends on the value of the masses
   d) It does not depend on the nature of the medium in which the bodies are kept.

4) As we go from the equator to the poles, the value of g.
   a) Remains the same
   b) Decreases
   c) Increases
   d) Decreases upto a latitude of 45°

5) The weight of an object in the coal mine, sea level, at the top of the mountain are W_1, W_2 and W_3 respectively, then
   a) $W_1<W_2>W_3$
   b) $W_1=W_2=W_3$
   c) $W_1<W_2<W_3$
   d) $W_1>W_2>W_3$

6) If radius of the earth is R then the height ‘h’ at which value of ‘g’ becomes one-fourth is

a) R/4
b) 3R/4
c) R
d) R/8

7) In a gravitational field, at a point where the gravitational potential is zero
   a) The gravitational field is necessarily zero
   b) The gravitational field is not necessarily zero
   c) Nothing can be said definitely about the gravitational field
   d) None of these

8) Escape velocity on a planet is v_e. If radius of the planet remains same and mass becomes 4 times, the escape velocity becomes
   a) $4v_e$
   b) $2v_e$
   c) v_e
   d) $1/2v_e$

9) The escape velocity on Earth is 11.2 km/s. On another planet having twice radius and 8 times mass of the Earth, the escape velocity will be
   a) 3.7 km/s
   b) 22.4 km/s
   c) 11.2 km/s
   d) 43.2 km/s

10) Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will
   a) keep floating at the same distance between them
   b) move towards each other
   c) move away from each other
   d) will become stationary

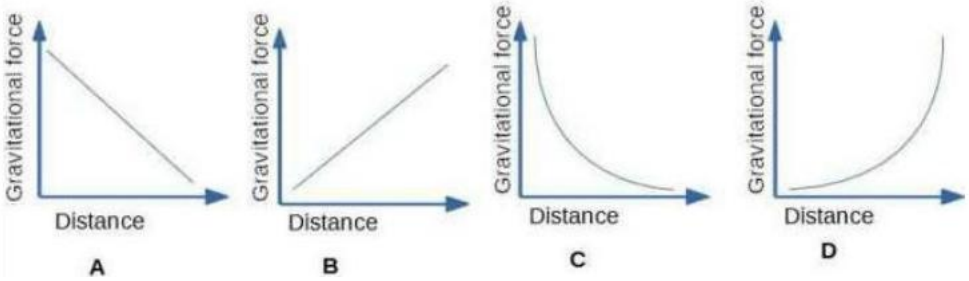
11) The acceleration due to gravity at a height 1 km above the Earth is the same as at a depth d below the surface of earth. Then
   a) d = 1/2 km
   b) d =1km
   c) d = 3/2 km
   d) d =2 km

12) The period of revolution of the planet A round the sun is 8 times that of B. The distance of A from the sun is how many times greater than that of B from the sun?
   a) 5
   b) 4
   c) 3
   d) 2

13) The radii of circular orbits of two satellites A and B of the Earth are 4R and R, respectively. If the speed of satellite A is 3v, then the speed of satellite B will be
   a) 3v/4

b) 6v
c) 12v
d) 3v/2

14) Observe the following figures and answer the question:



Which is the correct graph of gravitational force vs distance?
a) Option A
b) Option B
c) Option C
d) Option D

15) Satellite A is orbiting at height h, satellite B at 2h. Ratio of their orbital speed is:
a) 1:2
b) 2:1
c) √2:1
d) 1:√2

ASSERTION AND REASONING TYPE OF QUESTIONS (1 MARK):

DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) If Assertion is true but Reason is false.
d) If both Assertion and Reason are false.

16) **Assertion:** A body becomes weightless at the centre of Earth.
Reason: As the distance from centre of the Earth decreases, acceleration due to gravity increases.

17) **Assertion**: A planet moves faster, when it is closer to the sun in its orbit and vice versa
Reason: Orbital velocity for an orbiting planet is constant.

18) **Assertion: The** Gravitational potential of the Earth at every place on it is negative
Reason: Every body on Earth is bound by the attraction of Earth.

VERY SHORT ANSWER TYPE OF QUESTIONS: (2 MARK)

19) If a satellite orbits at a height equal to the Earth's radius, calculate its orbital velocity.

20) Show graphically how ‘g’ varies as you move from the centre of the earth to great heights above the surface.
21) A body weighs 63 N on the surface of the Earth. What is the gravitational force on it due to the Earth at a height equal to half the radius of the Earth?
22) Calculate the force of gravity on a 2 kg object on planet X that has twice Earth's mass and the same radius.
23) If the radius of the Earth shrinks by 1.5% (mass remains the same) then how would the value of acceleration due to gravity change?

SHORT ANSWER TYPE OF QUESTIONS (3 MARK):

24) A man weighs 700 N on Earth, find his weight on a planet where radius is twice Earth’s and mass four times Earth’s.
25) Two satellites orbit Earth at radii $3R$ and $6R$. Find the ratio of their orbital periods.
26) If Earth has a mass 9 times and radius 4 times than that of a planet "P". Calculate the escape velocity at the planet "P" if its value on Earth is 11.2 kms^{-1}.

LONG ANSWER TYPE OF QUESTIONS (5 MARK):

27) A man can jump 2.0 m high on the Earth. Calculate the approximate height he might be able to jump on a planet whose density is one-third that of the Earth. And whose radius is one-fourth of that of the Earth’s radius.
28) At what height from the surface of the Earth will the value of "g" be reduced by 36% of its value at the surface of the Earth?

CASE STUDY TYPE OF QUESTIONS (4 MARK):

29) Gravitational acceleration, commonly denoted as gg, varies slightly depending on where you are on Earth and your altitude. The Earth is shaped like an oblate spheroid, meaning it is slightly flattened at the poles and bulged at the equator. This causes the radius at the equator to be larger than at the poles. Since gravitational force depends inversely on the square of the distance from the Earth's center, gravity is stronger at the poles and weaker at the equator.
Additionally, the rotation of Earth causes centripetal acceleration that effectively reduces the measured gravity at the equator but has minimal effect near the poles. Local factors such as variations in rock density beneath the Earth's surface or nearby large mountains can also cause small changes in the value of g.
The acceleration due to gravity decreases with altitude since you move farther from the Earth's center. This decrease follows the inverse-square law: when the distance from the center doubles, gravity reduces to one-fourth, and when tripled, gravity reduces to one-ninth of its original value at the surface. Similarly, gravity decreases as you go below the Earth's surface due to the smaller mass attracting the object.
Therefore, the greatest gravitational acceleration is at the Earth's surface, with slight variations caused by latitude, altitude, and local geology.

i)Why is the acceleration due to gravity slightly stronger at the poles than at the equator?
a) Because the Earth is closer to the Sun at the poles.
b) Because the radius of Earth is smaller at the poles, making the distance to the center less.
c) Because centripetal force increases gravity at the poles.

d) Because there are more mountains at the poles increasing gravity.

ii)How does the rotation of Earth affect gravitational acceleration at the equator?

a) It increases gravitational acceleration due to centrifugal force.
b) It decreases gravitational acceleration due to centripetal acceleration opposing gravity.
c) It has no effect on gravitational acceleration.
d) It reverses the direction of gravitational acceleration.

iii)If the distance from the centre of the Earth doubles, what happens to the acceleration due to gravity according to the inverse-square law?

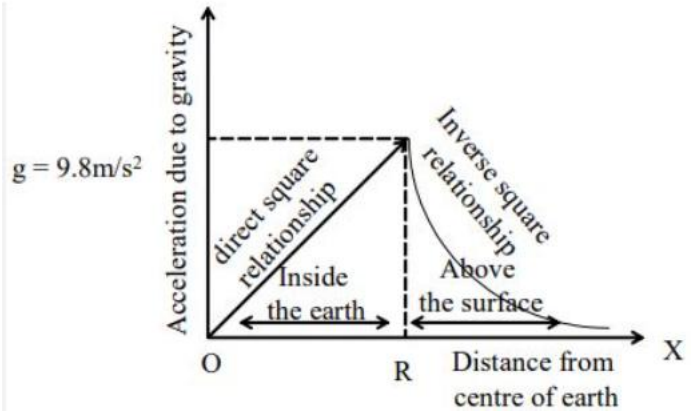
a) It doubles.
b) It reduces by a factor of 2.
c) It reduces by a factor of 4.
d) It stays the same.

iv)The weight of an object on the Moon would be:
a) The same as on Earth
b) Greater than on Earth
c) Less than on Earth due to the Moon's lower mass and radius
d) Zero because Moon has no gravity

30) Gravity is a fundamental force that attracts two bodies towards each other. According to Newton's Law of Universal Gravitation, every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.
This law explains phenomena such as the motion of planets, tides, and the behaviour of objects near Earth's surface. The acceleration due to gravity on Earth arises from this gravitational force acting on a mass.
Understanding gravitation also requires knowing about concepts like gravitational field and potential, escape velocity, and orbital motion, which are essential for grasping celestial mechanics and satellite technology.

i)State Newton's Law of Universal Gravitation and explain each term in the formula.
ii)Describe the factors affecting the value of g at different locations on the Earth's surface.
iii)Derive the expression for acceleration due to gravity on the surface of Earth starting from Newton's law.

ANSWER KEY	
1	a)Zero
2	d) Is reduced to a quarter.
3	d)It does not depend on the nature of the medium in which the bodies are kept.
4	c)Increases
5	d)$W_1 > W_2 > W_3$
6	c)R
7	b)The gravitational field is not necessarily zero
8	b)$2v_e$

9	b)22.4 km/s
10	b)move towards each other
11	d)d =2 km
12	b)4
13	b)6v
14	c)Option C
15	c)$\sqrt{2}$:1
16	c) Assertion true, Reason false.
17	c)If Assertion is true but Reason is false.
18	a)If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
19	Orbital velocity at height $h = R$: $$v = \sqrt{\frac{GM}{R+h}} = \sqrt{\frac{GM}{2R}} = \frac{v_{\text{surface}}}{\sqrt{2}}$$
20	
21	Weight at height $h = \frac{R}{2}$ where surface weight is 63 N: $$F = 63 \times \left(\frac{R}{R+\frac{R}{2}}\right)^2 = 63 \times \left(\frac{2}{3}\right)^2 = 28\,\text{N}$$
22	Gravity force on 2 kg on planet X (mass $2M_E$, radius R_E) : $$F = mg = m \times 2g = 2 \times 2 \times 9.8 = 39.2\text{N}$$
23	g = $\frac{GM}{R^2}$ decreasing radius by 1.5% will increase gravity on surface $\frac{g'}{g} = \frac{R_2^2}{R_1^2} = \frac{1}{(0.985)^2} = 1.03$ Change in acceleration = $(\frac{g1}{g-1}) \times 100\% = (1.03 - 1) \times 100\% = 3\%$
24	$W = mg = m\frac{GM}{R^2}$ $\frac{W_P}{W_E} = \frac{(GM_P/R_P^2)}{(GM_E/R_E^2)}$

	$\frac{W_P}{W_E} = \frac{(4M_E/(2R_E)^2)}{(M_E/R_E^2)} = \frac{4M_E/4R_E^2}{M_E/R_E^2}$ $\frac{W_P}{W_E} = 1$ $W_P = W_E \times 1 = 700\,\text{N}$
25	Two satellites orbit at $3R$ and $6R$. Ratio of orbital periods: $T \propto r^{3/2}$ $\frac{T_1}{T_2} = \left(\frac{3R}{6R}\right)^{3/2} = \left(\frac{1}{2}\right)^{3/2} = \frac{1}{2\sqrt{2}}$
26	Given Earth has $M_E = 9M_P$, $R_E = 4R_P$ and $v_{e,E} = 11.2$ km/s, $v_{e,P} = v_{e,E} \times \sqrt{\frac{M_P/R_P}{M_E/R_E}} = 11.2 \times \sqrt{\frac{1/1}{9/4}} = 11.2 \times \sqrt{\frac{4}{9}} = 7.4$
27	Man jumps 2 m on Earth. On planet of density $\frac{1}{3}\rho_E$ and radius $\frac{1}{4}R_E$: $g \propto \rho R$ $g_P = g_E \times \frac{1}{3} \times \frac{1}{4} = \frac{g_E}{12}$ Jump height: $h_P = h_E \times \frac{g_E}{g_P} = 2 \times 12 = 24\,m$
28	Height where g reduces by 36% (i.e., $g_h = 0.64g$): $0.64 = \left(\frac{R}{R+h}\right)^2 \rightarrow \sqrt{0.64} = \frac{R}{R+h} = 0.8$ $R + h = \frac{R}{0.8} = 1.25R \Rightarrow h = 0.25R$
29	i) b)Because the radius of Earth is smaller at the poles, making the distance to the center less. ii) b) It decreases gravitational acceleration due to centripetal acceleration opposing gravity. iii) c)It reduces by a factor of 4. iv) c) Less than on Earth due to Moon's lower mass and radius

30	i)	Every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.
	ii)	g varies with latitude, altitude; affected by Earth's shape, rotation, and local geology.
	iii)	Refer notes

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