INDIAN SCHOOL AL WADI AL KABIR		
Class: XI	DEPARTMENT OF SCIENCE -2023-24 SUBJECT: PHYSICS	DATE : 05/11/2023
WORKSHEET NO:7 WITH ANSWERS	TOPIC: GRAVITATION	A4 FILE FORMAT (PORTFOLIO)
CLASS & SEC:	NAME OF THE STUDENT:	ROLL NO.

OBJECTIVE TYPE QUESTIONS

1. What will be the acceleration due to gravity at height of 1000m from earth's surface? (Radius of the earth= 6.4×10^6m)
   A.1 m/s^2 B. 12 m/s^2 C. 9.8 m/s^2 D. 0.98 m/s^2
2. What is the unit of Universal Gravitational Constant in SI unit?
   A: N-m-Kg
   B: N/m-Kg
   C: N-m^2/Kg^2
   D: N/m^2-Kg
3. What will be the acceleration due to gravity at a height equal to half the radius of earth?
   A.4/9g B. 9/4 g C. 6/4 g D.4/6g
4. At what height above surface of earth the weight of an object will become 1\4 times of the weight at earth surface? (Radius of earth=6400km)
   A. h=R/2 B. h=R C. h=2R D. h=√R
5. Does escape velocity of a body depend on its mass?
   A: Yes B: No
6. If a stone bring back to earth from moon then its
   A: mass will be changed
   B: mass and weight will be changed
   C: Weight never be changed
   D: mass remain constant but weight will be changed
7. Gravitational potential is –
   A: proportional to distance
   B: inversely proportional to distance
   C: proportional to the square of the distance
   D: inversely proportional to the square of the distance
8. If we double the distance between two objects, gravitational force will be
   A: double B: half C: one fourth D: 4 times greater

9. A man weighs 60kg at earth surface. At what height above the earth's weight become 30kg? Given radius of earth is 6400km
   A. 2624km B. 3000km C. 2020km D. None of these
10. What is the depth from the surface of the earth at which is acceleration due to gravity is 25% of acceleration due to gravity at the surface? Given radius of earth is 6400km
    A. 1200 km B. 4000 km C. 3600 km D. 4800 km

ASSERTION AND REASONING

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

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

(c) Assertion (A) is true but reason (R) is false.

(d) Assertion (A) is false but reason (R) is true.

(e) Both Assertion and Reason are false.

11. Assertion : Smaller the orbit of the planet around the sun, shorter is the time it takes to complete one revolution.
    Reason : According to Kepler's third law of planetary motion, square of time period is proportional to cube of mean distance from sun.
12. Assertion : The universal gravitational constant is same as acceleration due to gravity.
    Reason: Gravitational constant and acceleration due to gravity have same dimensional formula.
13. Assertion: The value of acceleration due to gravity does not depend upon mass of the body on which force is applied.
    Reason : Acceleration due to gravity is a constant quantity.
14. Assertion : A planet moves faster, when it is closer to the sun in its orbit and vice versa.
    Reason : Orbital velocity in orbital of planet is constant

CASE STUDY BASED QUESTION

15. We know that the earth attracts every object with a certain force and this force depends on the mass (m) of the object and the acceleration due to the gravity (g). The weight of an object is the force with which it is attracted towards the earth.
    Mathematically
    W=mg
    Where, W = weight of object
    m = mass of object
    g = acceleration due to the gravitational force

As the weight of an object is the force with which it is attracted towards the earth, the SI unit of weight is the same as that of force, that is, Newton (N). The weight is a force acting vertically downwards; it has both magnitude and direction. We have learnt that the value of g is constant at a given place. Therefore, at a given place, the weight of an object is directly proportional to the mass, say m, of the object, that is, W α m. It is due to this reason that at a given place, we can use the weight of an object as a measure of its mass. Answer the following questions.

i) Dimensions of acceleration due to the gravity (g) is
   a) $[M^0L^1T^{-2}]$ b) $[ML^{-1}T^{-2}]$ c) $[ML^1T^{-3}]$ d) None of these

ii) SI unit of weight is same as

a) Force b) Mass c) Acceleration due to gravity d) None of these

iii) Which of the following has same unit?

a) Mass and weight b) Weight and force

c) Pressure and stress d) Both b and c

iv) Whether weight is scalar quantity or vector quantity? Justify your answer

16. Earth satellites are objects which revolve around the earth. Their motion is very similar to the motion of planets around the Sun. In particular, their orbits around the earth are circular or elliptic. Moon is the only natural satellite of the earth with a near circular orbit with a time period of approximately 27.3 days which is also roughly equal to the rotational period of the moon about its own axis. Also, the speed that a satellite needs to be travelling to break free of a planet or moon's gravity well and leave it without further propulsion is known as escape velocity. For example, a spacecraft leaving the surface of earth needs to be going 7 miles per second or nearly 25000 miles per hour to leave without falling back to the surface or falling into orbit.

(i) The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p), whose radius and mean density are twice as that of earth is
(a) $1:2\sqrt{2}$
(b) 1: 4
(c) $1: \sqrt{2}$
(d) 1: 2

(ii) Gas escapes from the surface of a planet because it acquires an escape velocity. The escape velocity will depend on which of the following factors?
(a) Mass of the planet
(b) Mass of the particle escaping
(c) Temperature of the planet
(d) None of the above

(iii) The escape velocity of a satellite from the earth is v_e. If the radius of earth contracts to $(1/4)^{th}$ of its value, keeping the mass of the earth constant, escape velocity will be
(a) doubled
(b) halved
(c) tripled
(d) unaltered

(iv) A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small as compared to the mass of the earth, then
(a) the angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant
(b) the total mechanical energy of S varies periodically with time.
(c) the linear momentum of S remains constant in magnitude
(d) the acceleration of S is always directed towards the centre of the earth

VERY SHORT ANSWER QUESTIONS (BASIC LEVEL)

17. Can gravitational potential have positive value?
18. An elephant and an ant are to be projected out of the gravitational pull of the earth. Do we need different velocities to achieve so?
19. Why G is called universal gravitation constant?
20. What is the weight of the body at the centre of the earth?

SHORT ANSWER QUESTIONS - (INTERMEDIATE LEVEL):

21. Define escape velocity. Derive an expression for the escape velocity of a body from the surface of Earth.
22. Define acceleration due to gravity and show that gravity decreases with depth
23. Gravitational force between two bodies is 1 N. If the distance between them is made twice, what will be the force?
24. (i) Define gravitational potential at a point. Is it scalar or vector quantity?
(ii) Obtain an expression for gravitational potential at a point due to earth.

ADVANCED LEVEL QUESTIONS

25. i. State Kepler's laws of planetary motion.
ii. The time period of a satellite of earth is 7 hours. If the separation between the earth and the satellite is increased to two times the previous value, what will be its new time period?
26. i. State Newton's law of gravitation.
ii. The radius of moon is 1.7×10^{6}m and its mass is 7.35×10^{22}kg. What is the acceleration due to gravity on the surface of the moon? ($G=6.67\times10\text{-}^{11}Nm^2kg^{-2}$) (Ans:1.696m/$s^2$)
27. On a planet, whose size is the same and mass three times as that of the earth, find the amount of work done to lift 5kg mass vertically upwards through 5m on the planet. (The value of g on the surface of the earth is 9.8m/s^2)
28. (a) Derive an expression for the acceleration due to gravity at a height.
(b) At what height above the earth's surface, the value of 'g' is the same as in a mine 80km deep?
29. What is orbital velocity of a satellite? Derive an expression to find the orbital velocity of a satellite, when it is at a height of 'h' from the surface of Earth. Also derive the expression to find the total energy possessed by this satellite.
30. A body weighs 90kg on the surface of the earth. How much will it weigh on the surface of the mars, whose mass is 1/9 and radius is ½ of that of the earth?
(Ans:40N) (CBSE 2003).

ANSWERS

NO	ANSWER	Marks
1.	c. 9.8 m/s^2	1
2.	C: N-m2/Kg	1
3.	a. 4/9g	1

4.	b. h=R We have the formula, g' = g/(1+h/R)^2 Here g' = acceleration due to gravity at the height g = 9.8m/s^2 R = radius of earth h = height g/g' = (1+h/R)^2 4 = (1+h/R)^2 1+h/R = 2 h/R = 1 h = R	1
5.	B: No	1
6.	D: mass remain constant but weight will be change	1
7.	B: inversely proportional to distance	1
8.	C: one fourth	1
9.	a.2624km Let acceleration due to gravity at a height h above the surface of earth be g′ So, $mg' = mgR^2/(R+h)^2$ or, $30 = 60 \times (6400)^2/(6400+h)2$ So, $h = 6400\sqrt{2} - 6400 = 2624$km	1
10.	d. 4800 km $g_d/g_s = R - d/R$ Thus for the depth where acceleration is 25% of the surface gravity we get gd as g/4 $g/4 = g(1 - d/R) \Rightarrow d = 3/4 \times R = 4800$km	1
11.	both assertion and reason are true and the reason is the correct explanation of the assertion	1
12	the assertion and reason both are false.	1
13.	Both assertion and reason are true and the reason is the correct explanation of the assertion	1
14.	both assertion and reason are true but reason is not the correct explanation of the assertion	1
15.	i. a) $[M^0L^1T^{-2}]$ ii. a) Force iii. d) Both b and c iv. Weight is vector quantity as it has magnitude as well as direction which is always towards centre of the earth.	4
16.	i. (a) $1:2\sqrt{2}$ ii.(a) Mass of the planet iii. (a) doubled iv. (d) the acceleration of S is always directed towards the centre of the earth	4
17.	The gravitational potential is always a negative value. This is because: It is defined as zero at infinity.	1
18	Both should be projected with the same velocity	1
19	Its value is constant anywhere in the Universe, and hence it's called 'Universal'.	1

20.	zero	1
21	Refer notes	2
22	Refer notes	2
23	$F = \frac{GMm}{R^2} = 1$ Now the distance between both the bodies is made twice R'=2R The new gravitational force will be $F' = \frac{GMm}{R'^2}$ $F' = \frac{GMm}{(2R)^2}$ $F' = \frac{1}{4}\frac{GMm}{R^2}$ $F' = \frac{1}{4}F$ $F' = \frac{1}{4} \times 1$ $F' = 0.25\ N$	2
24	Refer notes	3
25.	i. refer notes ii. $T^2 \propto R^3$ $\Rightarrow \left(\frac{T_1}{T_2}\right)^2 = \left(\frac{R_1}{R_2}\right)^3$ $\Rightarrow \left(\frac{T_1}{T_2}\right) = \left(\frac{R_1}{R_2}\right)^{3/2} = \left(\frac{1}{4}\right)^{3/2}$ $\Rightarrow \frac{T_2}{T_1} = (4)^{3/2} = 8$ $\Rightarrow T_2 = 8 \times T_1 = 8 \times 5 = 40$ hours	3
26	i. Refer notes ii. g = GM/R^2 g = 6.67×10^-11 × 7.35×10^22 / (1.7×10^6)^2 g = 1.7 m/s^2	5
27	On the earth, acceleration due to gravity is $g = \frac{GM}{R^2}$ On the other planet whose mass $M. = 3M$, acceleration due to gravity is $g. = \frac{GM.}{R^2} = \frac{3GM}{R^2} = 3g$ Energy required to raise the mass m = 5g by height h = 5m is equal to work done W = mg. h $= 5 \times 3g \times 5$ $= 5 \times 3 \times 10 \times 5 = 750J$	5
28	a. Refer notes	

	b. $g(1- 2h/R) = g(1- d/R)$ $\Rightarrow 1- 2h/R = 1- d/R$ $\Rightarrow 2h/R = d/R$ $\Rightarrow 2h = d$ $\Rightarrow 2h = 80\ Km$ $\Rightarrow \mathbf{h = 40\ Km}$ *(Ans.)*	
29	Refer notes	
30	Therefore, $F = mg = m\frac{GM}{R_e^2}$ $\frac{F_{Mars}}{F_{Earth}} = \frac{m[GM/R_e^2]\|_{Mars}}{m[GM/R_e^2]\|_{Earth}}$ $\frac{F_{Mars}}{90kg} = \frac{(M_{earth}/9)}{(M_{earth})} \times \frac{(R_{Earth})^2}{(R_{Earth}/2)^2} = 4/9$ $F_{Mars} = 90 \times 4/9 =$ =40N	

PREPARED BY Ms VIPINA GANGADHARAN	CHECKED BY HOD SCIENCE