Unit 7 · Gravitation

WORKSHEET

Full marks 32

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 32

1 Key words [4]

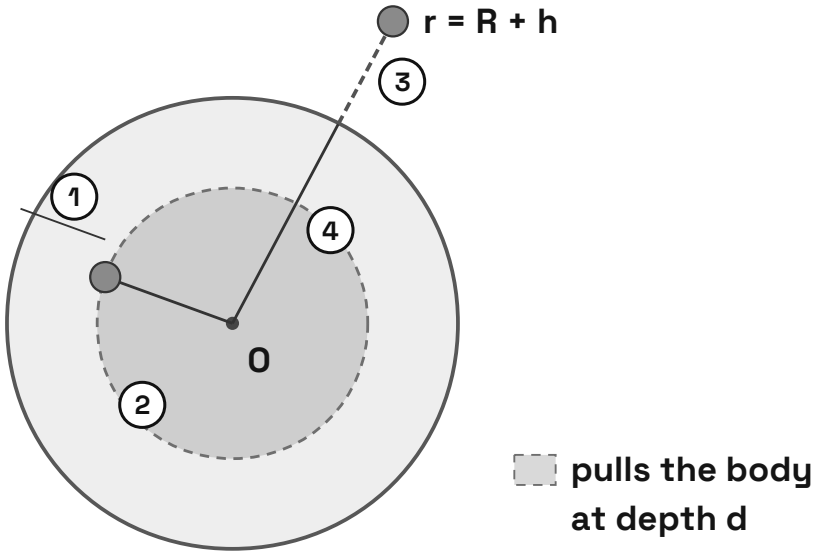
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

center of gravity	**escape velocity**	**field strength**	**G**	**geostationary**	**inertia**	**joule**
orbital velocity	**potential**	**weightlessness**				

The force of attraction between two masses of 1 kg each, 1 m apart, is the universal gravitational constant, _____. The force per unit mass at a point in a gravitational field is the _____, and the work done per unit mass in bringing a body from infinity to a point is the gravitational _____. The least speed with which a body must be thrown from a planet to get away from its gravity is the _____. The speed a satellite needs to stay in a circular orbit is its _____. A satellite that stays over the same place on the equator is _____. An astronaut in orbit feels _____ because he is in free fall. The point where the whole weight of a body acts is its _____.

2 Label the diagram [2]

The diagram shows a body above the Earth's surface and another inside the Earth. Write the length that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The SI unit of the universal gravitational constant G is: [1]

a. N kg^2/m^2 **b.** N m^2/kg^2

c. N/kg **d.** J/kg

ii. A planet has twice the Earth's mass and twice its radius. The acceleration due to gravity on its surface is: [1]

a. 2g **b.** g

c. g/2 **d.** g/4

iii. The escape velocity of a body from the Earth depends on: [1]

a. the mass of the body

b. the direction in which it is thrown

c. the mass and radius of the Earth

d. the mass of the body and the Earth's radius

iv. An astronaut on the International Space Station floats about because: [1]

a. there is no gravity in space

b. the Moon's pull balances the Earth's

c. she and the station are falling freely round the Earth together

d. the station is too far away for the Earth to pull it

v. The total energy of a satellite in a circular orbit is: [1]

a. zero **b.** positive, equal to its kinetic energy

c. negative, equal to −(its kinetic energy) **d.** negative, equal to its potential energy

4 Short answers [7]

Write short answers to the following questions.

a. Why is the value of g a little less at the equator than at the poles? Give two reasons. [2]

b. The Moon's escape velocity is about 2.4 km/s, much less than the Earth's. Why has the Moon kept no air, while the Earth has? [2]

c. Find the acceleration due to gravity at a height of 1600 km above the Earth's surface. (g at the surface 9.8 m/s^2, radius of the Earth 6400 km) **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

A satellite of mass m moves round the Earth (mass M) in a circular orbit of radius r. Find its kinetic energy, potential energy and total energy. What does the sign of the total energy tell us?

6 Numerical problems **[7]**

Solve the following problems. Show your working. Take $g = 9.8\ m/s^2$ at the Earth's surface and the Earth's radius $R = 6400$ km.

a. A satellite goes round the Earth in a circular orbit 600 km above its surface. Find its orbital speed and the time it takes for one turn, in minutes. **[4]**

Answer:

b. The Earth's mass is 81 times the Moon's, and their centers are 3.84×10^5 km apart. Find where the center of mass of the Earth and the Moon lies. Is it inside the Earth? **[3]**

Answer: _____

7 Think **[3]**

Kathmandu is about 28° north of the equator. Can a geostationary satellite be placed to stay right above Kathmandu? Explain.

8 Activity: Find the center of gravity (not marked)

Cut an irregular shape from stiff cardboard and make three small holes near its edge, A, B and C. Hang it from a pin through A, with a plumb line (a thread with a small weight) from the same pin, and draw the thread's line on the card. Repeat from B and C.

Hung from	Does the shape hang still?	Line drawn?
A		
B		
C		

Do the three lines meet at one point? Balance the card on a pencil tip there. What do you find?