Unit 11 · Force

WORKSHEET

Full marks 49

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 49

1 Key words [4]

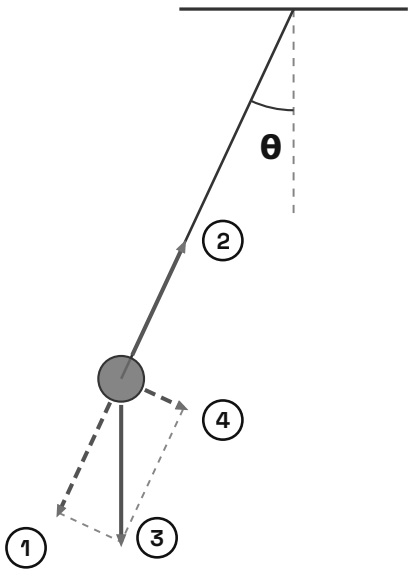
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

amplitude	**center of gravity**	**centrifugal**	**centripetal**	**effective length**	**escape velocity**
field intensity	**oscillatory**	**periodic**	**potential**		

A motion that repeats itself after equal intervals of time is called _____ motion; if it is to and fro about a mean position, it is also _____. The distance from the point of suspension to the center of a pendulum's bob is its _____. The force directed towards the center of a circle, which keeps a body moving in the circle, is the _____ force. The gravitational force on a unit mass placed at a point is the gravitational _____ there, and the work done in bringing a unit mass from infinity to that point is the gravitational _____. The smallest speed with which a body must be thrown from a planet's surface so that it never returns is its _____. The point through which the whole weight of a body acts is its _____.

2 Label the diagram [2]

The diagram shows the forces on the bob of a pendulum at an extreme position. Write the force that belongs in place of each number. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 What pulls it to the center? [3]

Match each body moving in a circle with the force that pulls it to the center. One force in the second column is not needed. Each carries 0.5 mark.

Column A		Column B
1. a stone whirled on a string	☐	**a.** the centrifugal force
2. a bus going round a bend	☐	**b.** the Sun's gravitational pull
3. a satellite round the Earth	☐	**c.** the tension of the string
4. the electron round the nucleus (Bohr's model)	☐	**d.** the push of the drum's wall
5. clothes in a spinning washing machine drum	☐	**e.** the electric attraction between them
6. the Earth round the Sun	☐	**f.** friction between the tyres and the road
		g. the Earth's gravitational pull

4 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The time period of a simple pendulum does not depend on: [1]

a. its effective length **b.** the acceleration due to gravity
c. the mass of its bob **d.** the place where it swings

ii. A body of mass m moves in a circle of radius r at speed v. If both v and r are doubled, the centripetal force becomes: [1]

a. the same **b.** twice as large
c. four times as large **d.** half as large

iii. The gravitational field intensity at the Earth's surface is numerically equal to: [1]

a. the gravitational constant G **b.** the escape velocity
c. the acceleration due to gravity g **d.** the gravitational potential

iv. A cone resting on its tip is in: [1]

a. stable equilibrium
b. unstable equilibrium
c. neutral equilibrium
d. stable or neutral equilibrium, depending on its mass

v. A planet has the same radius as the Earth but four times its mass. Its escape velocity is: [1]

a. 11.2 km/s **b.** 22.4 km/s
c. 44.8 km/s **d.** 5.6 km/s

5 Very short answers [4]

Write very short answers to the following questions.

a. What is the time period of a seconds pendulum? [1]

b. Write the SI unit of gravitational potential. [1]

c. A tuning fork has a frequency of 256 Hz. What is its time period? [1]

d. In which kind of equilibrium is a cylinder lying on its side? [1]

6 Short answers [8]

Write short answers to the following questions.

a. Give a reason: a pendulum clock loses time in summer. [2]

b. Give a reason: the roads on sharp bends of a hill highway are banked. [2]

c. Give a reason: the gravitational potential at any point near the Earth is negative. [2]

d. Write any two differences between centripetal force and centrifugal force. [2]

7 Long answers [8]

Write long answers to the following questions.

a. What is gravitational potential? What is escape velocity? Derive the relation between the escape velocity and the gravitational potential at the Earth's surface. [4]

b. How is the stability of a body related to its center of gravity and its base? Explain why racing cars are made low and wide, and why loads should not be piled high on the roof of a bus. [4]

8 Numerical problems [12]

Solve the following problems. Show your working.

a. In a school lab, Rajan finds that a pendulum of effective length 0.60 m makes 20 oscillations in 31.2 s. Find the value of g in the lab. [2]

Answer:

b. A stone of mass 0.5 kg tied to a 1.0 m string is whirled in a horizontal circle, making 2 rounds a second. Find its speed and the tension in the string. (Leave out gravity.) [3]

Answer:

c. The mass of Mars is 6.4×10^{23} kg and its radius 3,400 km. Find (i) the gravitational field intensity at its surface, (ii) the gravitational potential at its surface, and (iii) the escape velocity from Mars. ($G = 6.67 \times 10^{-11}$ N m^2/kg^2) **[4]**

Answer: _____

d. A uniform meter stick of mass 120 g carries a 30 g mass at its 90 cm mark. Find the position of the center of gravity of the stick and the mass together. **[3]**

Answer: _____

9 Think **[3]**

A pendulum clock keeps correct time in Biratnagar, on the plains. Will it run fast or slow in Kathmandu (about 1,300 m higher), and on the Moon? Explain.

10 Activity: Find g with a simple pendulum (not marked)

Pull the bob aside by no more than about 10°, time 20 complete oscillations, and fill in the table. Plot T^2 (up) against l (along), find the slope of the line, and work out $g = 4\pi^2 \div$ slope.

l (m)	Time for 20 oscillations (s)	T (s)	T^2 (s^2)
1.00			
0.80			
0.60			
0.40			