Unit 2 · Periodic Motion

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

1 Key words [4]

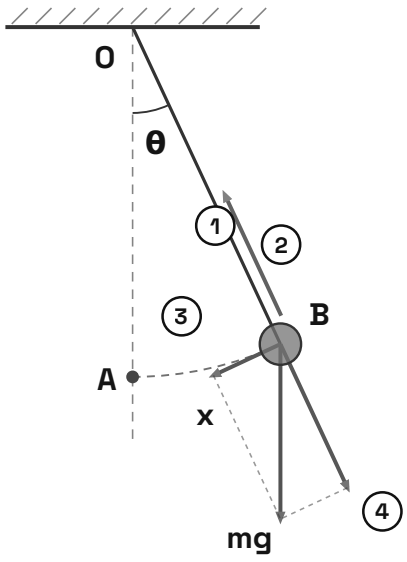
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

amplitude	damping	epoch	frequency	hertz	periodic motion	phase	resonance	simple harmonic motion	torsional constant

A motion that repeats itself at regular intervals of time is a _____. In _____ the acceleration is proportional to the displacement from the mean position and always directed towards it. The greatest displacement from the mean position is the _____, and the number of complete oscillations in one second is the _____, measured in _____. Where a particle is in its cycle, and which way it is moving, is given by its _____. The loss of energy that makes an oscillation die away is _____. When a periodic force drives a body at its own natural frequency, the body oscillates with its largest amplitude: this is _____.

2 Label the diagram [2]

The diagram shows a simple pendulum displaced through an angle θ. Write the quantity 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 graph of acceleration against displacement for a body in SHM is: [1]

a. a horizontal straight line

b. a straight line through the origin with a negative slope

c. a parabola

d. a sine curve

ii. The period of a seconds pendulum is: [1]

a. 0.5 s **b.** 1 s

c. 2 s **d.** 4 s

iii. A mass of 0.5 kg hangs from a spring of spring constant 50 N/m. The period of its vertical oscillation is about: [1]

a. 0.1 s **b.** 0.63 s

c. 1.0 s **d.** 6.3 s

iv. The amplitude of an oscillating body is doubled, its frequency staying the same. Its total energy becomes: [1]

a. the same **b.** twice as much

c. four times as much **d.** half as much

v. A car's shock absorbers are designed to be close to critical damping so that, after a bump, the car: [1]

a. keeps bouncing with a steady amplitude

b. bounces at a higher frequency

c. returns to its rest position in the shortest time without overshooting

d. creeps back very slowly

4 Short answers [7]

Write short answers to the following questions.

a. Why does the period of a simple pendulum not depend on the mass of its bob? [2]

b. Write any two differences between a damped oscillation and a forced oscillation. [2]

c. A particle moves as $y = 0.05\sin 4\pi t$, with y in meters and t in seconds. Find its amplitude, its frequency, and its greatest speed. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Show that a simple pendulum making small swings moves in simple harmonic motion, and derive an expression for its period.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take $g = 9.8\ m/s^2$.

a. A 0.2 kg mass oscillates on a spring with an amplitude of 0.08 m and a frequency of 1.5 Hz. Find i. the spring constant, ii. the total energy of the oscillation, and iii. the kinetic energy and the speed of the mass when its displacement is 0.04 m. **[4]**

Answer:

b. A pendulum of effective length 0.80 m makes 20 complete oscillations in 35.9 s. Find i. its period, ii. the value of g at that place, and iii. how much longer it must be made to become a seconds pendulum there. **[4]**

Answer: _____

7 Think **[3]**

An astronaut takes a pendulum clock and a clock run by a mass on a spring to the Moon, where g is a sixth of the Earth's. Which clock still keeps good time there? Explain.

8 Activity: How the period depends on length (not marked)

Hang a small stone or a bunch of keys on a string. For each length, time 20 complete small swings and find the period T.

Length l (m)	Time for 20 swings (s)	T^2 (s^2)	T^2/l (s^2/m)
0.30			
0.50			
0.70			
0.90			

Is T^2/l about the same each time? Use its average to find $g = 4\pi^2 \div (T^2/l)$.