

Oscillations, springs, pendulums and resonance

Physics grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and is worth 20 marks. Use $g = 9.81 \text{ m/s}^2$ where needed, show every step of your working and give answers with units and sensible significant figures.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB C.1

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Identify SHM (2 marks)

Four accelerations are given in SI units: (i) $a = -9x$, (ii) $a = -9x^2$, (iii) $a = +9x$, (iv) $a = -9$.

- State which one is SHM and give a reason. (1 mark)
- Calculate its period. (1 mark)

Question 2 Pendulum on a hook (3 marks)

A pendulum has a length of 1.50 m (pivot to centre of bob). Take $g = 9.81 \text{ m/s}^2$.

- Calculate its period for small swings. (2 marks)
- State the effect on the period of using a bob of twice the mass. (1 mark)

Question 3 Spring oscillator (3 marks)

A 0.15 kg mass oscillates on a horizontal spring of stiffness 30 N/m with amplitude 0.040 m.

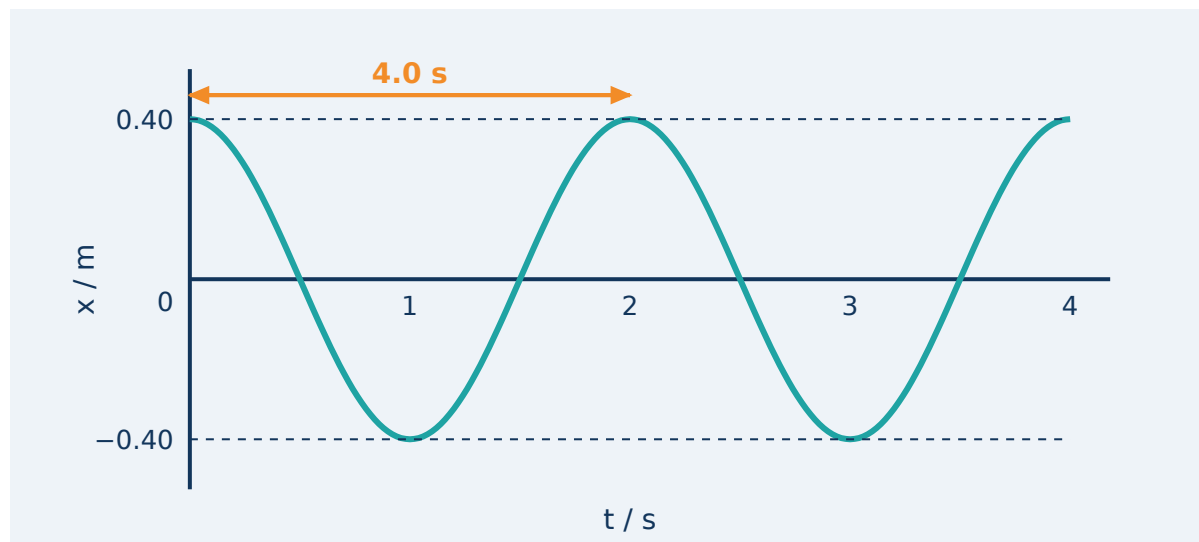
- Calculate the angular frequency. (1 mark)
- Calculate the maximum speed. (1 mark)
- Calculate the maximum acceleration. (1 mark)

Question 4 Energy graph sketch (3 marks)

- Sketch on one set of axes the variation of kinetic energy, potential energy and total energy with displacement from $-A$ to $+A$. (3 marks)

Question 5 Buoy in the swell (3 marks)

The graph shows a buoy in the sea off Mombasa.



Displacement of a buoy against time.

- Read the amplitude and period. (1 mark)
- Calculate the angular frequency. (1 mark)
- Calculate the maximum speed. (1 mark)

Question 6 Pushing a swing (2 marks)

Explain why a small push applied once every swing can build up a large amplitude, and say what the term for this effect is.

Question 7 Car suspension (2 marks)

Explain why a car suspension is designed to be close to critically damped.

Question 8 Time to move out (2 marks)

A particle in SHM has period 0.50 s and amplitude 0.080 m. It starts at the centre. Calculate the time taken to reach $x = 0.040$ m for the first time.