

SIMPLE HARMONIC MOTION

Questions:

- 1 Define simple harmonic motion.
- 2 Where is the velocity zero in an SHM oscillation?
- 3 Where is the acceleration greatest in an SHM oscillation?
- 4 What is meant by the „natural frequency“ of an oscillator?
- 5 When does resonance occur? 6 Where is the potential energy zero in an SHM oscillation?
- 7 Where is the kinetic energy greatest in an SHM oscillation? 8 Name two types of SHM oscillators.
- 9 What are meant by „free oscillation /forced oscillation/critical damping/overdamping“?

Examples:

Take $g=9.8\text{ms}^{-2}$

- 1 An object is oscillating from side, performing SHM. The time period is 2.0s, and the amplitude is 3.0cm. What are the maximum velocity and acceleration 1.0cm from the centre? (6)
- 2 A pendulum of length 2.0m is swinging between two points 40cm apart. What are the time period of oscillation and the maximum KE of the pendulum if the mass of the pendulum bob is 200g? (6)
- 3 The propeller shaft of a boat causes the engine of mass 2.0kg to vibrate with SHM. When the vibration equals the natural frequency of vibration of the engine, resonance occurs and the engine shakes itself apart. Assuming the engine behaves like a spring system with a spring constant of $4.0 \times 10^5 \text{Nm}^{-1}$ and the propeller rotates at the frequency of vibration of the engine, what is the maximum number of revolutions per second the propeller can turn at before the engine breaks up? What is the KE of the vibrating engine at resonance if the maximum amplitude of oscillation is 5.0cm? (8)
- 4 A mass of 0.15kg is placed on the end of a spring which extends 0.060m (x). The mass is then pulled downwards 0.60cm and released. Using the equation $F=kx$, determine the spring constant of the spring, k . Also calculate the time period of the resulting oscillations and their maximum velocity. What is upward tension in the spring when it is 0.20cm below the equilibrium position? (8)