

5C Simple Harmonic Motion

Simple harmonic motion (S.H.M.) is:

The equation of S.H.M.:

Speed v at displacement x , for amplitude a :

The period T :

Displacement x at time t (centre when $t = 0$ / end point when $t = 0$ / otherwise):

10. A particle is moving along a straight line with S.H.M. The amplitude of the motion is 0.8 m. It passes through the centre of the oscillation O with speed 2 m s^{-1} . Calculate:

- a) the period of the oscillation

- b) the speed of the particle when it is 0.4 m from O

- c) the time the particle takes to travel 0.4 m from O .

To show that a particle moves with S.H.M.:

11. A particle P of mass 0.5 kg is moving along a straight line. At time t seconds, the distance of P from a fixed point O on the line is x metres. The force acting on P has magnitude $10x$ and acts in the direction PO.
- a) Show that P is moving with simple harmonic motion.

b) Find the period of the motion.

Maximum speed and maximum acceleration:

12. A particle is moving in a straight line with simple harmonic motion. Its maximum acceleration is 12 m s^{-2} and its maximum speed is 4 m s^{-1} . Calculate:
- a) the period of the motion

b) the amplitude of the motion

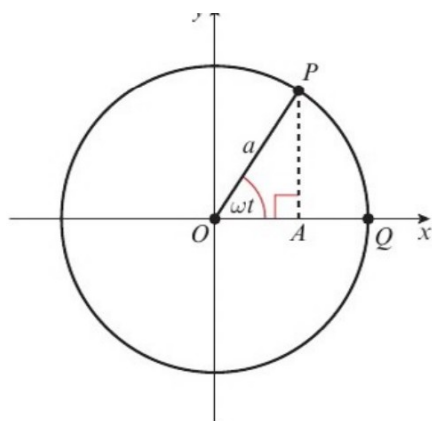
- c) the length of time, during one complete oscillation, that the particle is within $\frac{1}{3}$ m of the centre of the oscillation.

13. A small rowing boat is floating on the surface of the sea, tied to a pier. The boat moves up and down in a vertical line and it can be modelled as a particle moving with simple harmonic motion. The boat takes 2 s to travel directly from its highest point, which is 3 m below the pier, to its lowest point. The maximum speed of the boat is 3 m s^{-1} . Calculate:

- a) the amplitude of the motion

- b) the time taken by the boat to rise from its lowest point to a point 5 m below the pier.

The reference circle (geometrical method):



14. A particle P is moving with simple harmonic motion along a straight line. The centre of the oscillation is the point O , the amplitude is 0.6 m and the period is 8 s . The points A and B are points on the line of P 's motion and are on opposite sides of O . The distance OA is 0.5 m and OB is 0.1 m . Calculate the time taken by P to move directly from A to B .