3 The piston in a cylinder of a car engine is shown in Fig. 3.1.

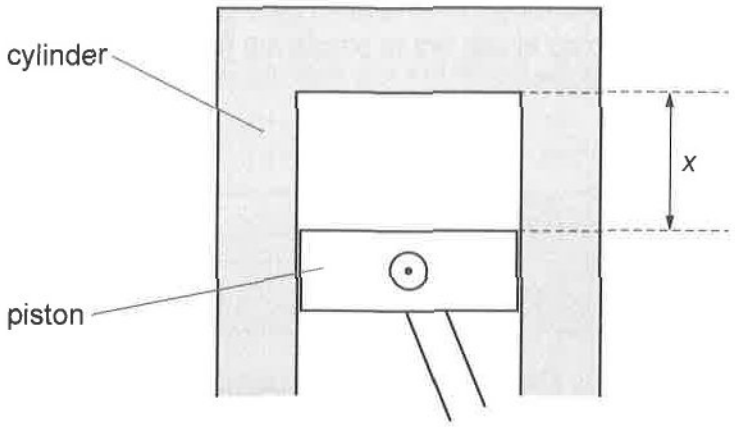

Fig. 3.1

The piston moves in the cylinder with simple harmonic motion.

The distance x between the top of the cylinder and the top of the piston varies from 1.0 cm to 6.0 cm.

At one speed of the engine, the engine completes 4200 revolutions in 1.0 minute. During one revolution of the engine, the piston moves from the position where x is minimum to where x is maximum and then back to the minimum position.

The variation with time of the distance x is shown in Fig. 3.2.

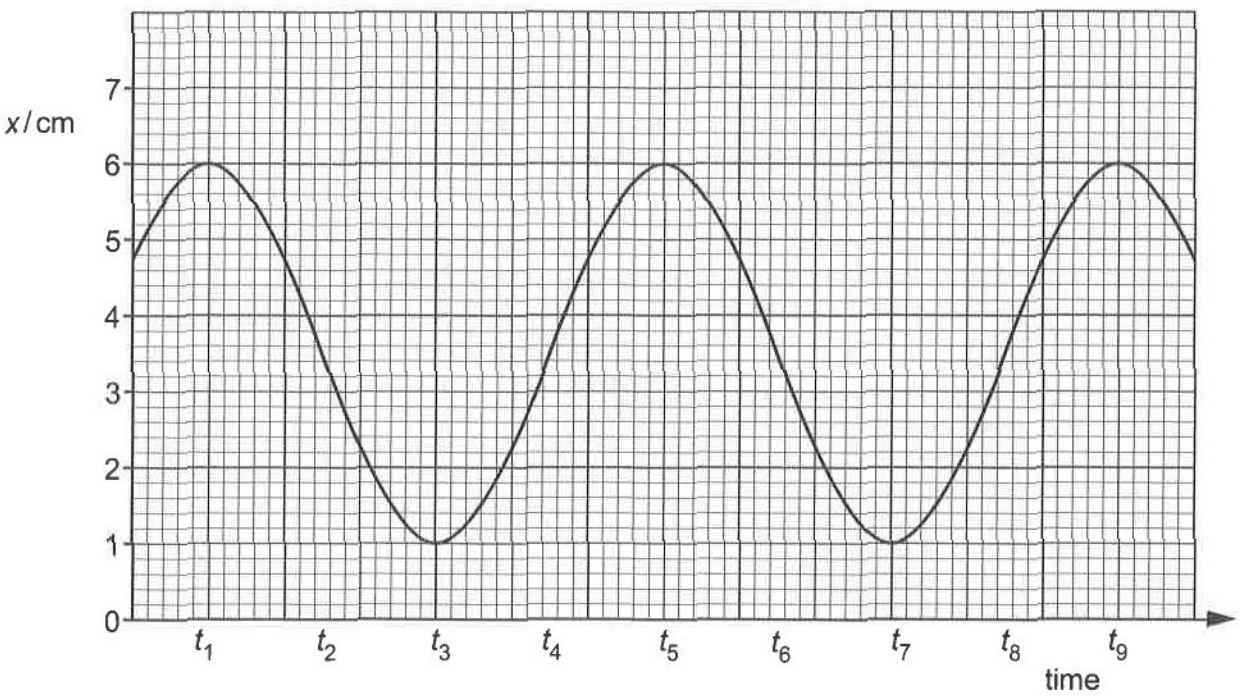

Fig. 3.2

(a) Use Fig. 3.2 to state two times at which the piston is:

(i) at its highest point near the top of the cylinder

time ..... and time ..... [1]

(ii) moving away from the top of the cylinder with maximum speed.

time ..... and time ..... [1]

(b) Determine, for the piston:

(i) the frequency of oscillation

frequency = ... Hz [1]

(ii) the maximum acceleration.

acceleration = ... $m\,s^{-2}$ [3]

(c) Use your answer to **(b)(ii)** to sketch, on the axes of Fig. 3.3, a graph to show quantitatively how the acceleration of the piston varies with the displacement from the equilibrium position.

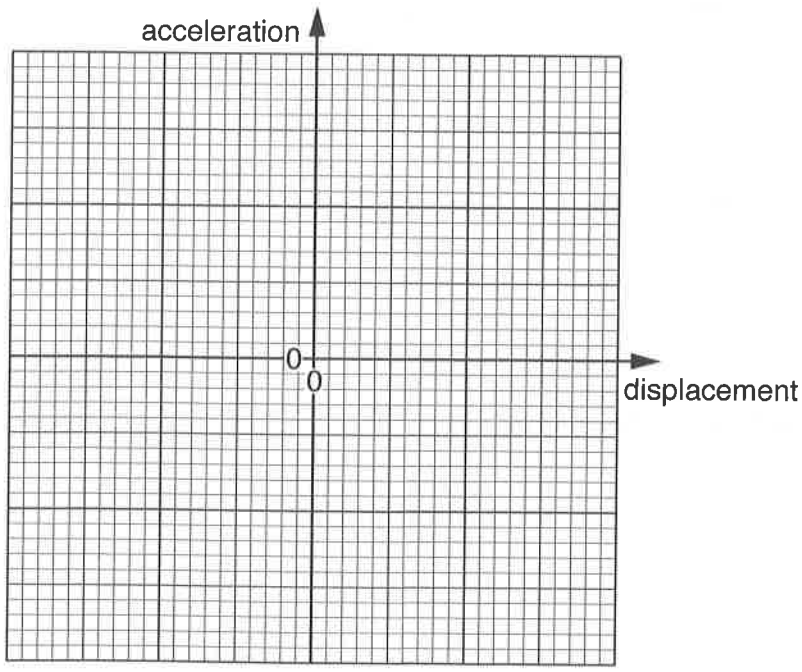

Fig. 3.3

[3]

[Total: 9]