4 A block of mass m oscillates vertically on a spring, as shown in Fig. 4.1.

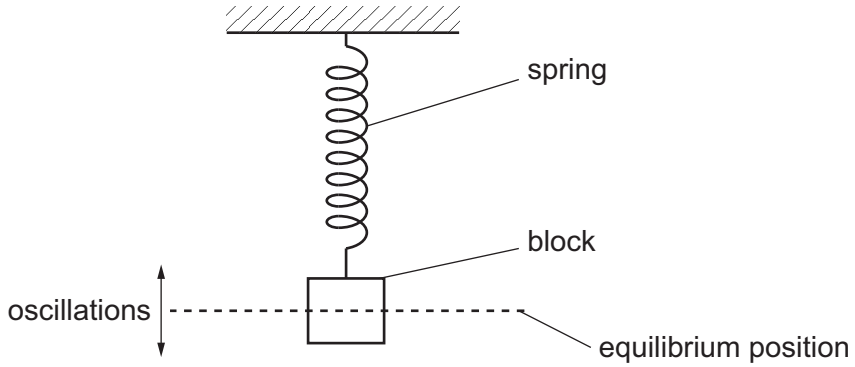

Fig. 4.1

The acceleration a of the block varies with displacement x from its equilibrium position, as shown in Fig. 4.2.

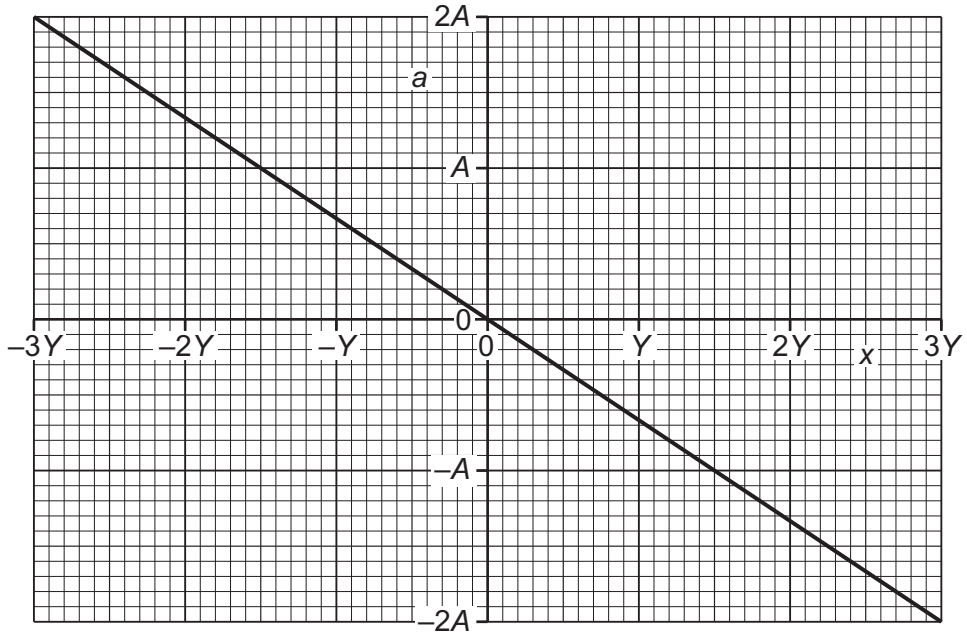

Fig. 4.2

The amplitude of the oscillations is $3Y$ and the maximum acceleration is $2A$.

(a) Explain how Fig. 4.2 shows that the oscillations of the block are simple harmonic.

.....

.....

..... [2]

(b) Deduce expressions, in terms of some or all of m, A and Y, for:

(i) the angular frequency ω of the oscillations

ω = ... [1]

(ii) the maximum speed v_0 of the oscillations

v_0 = ... [2]

(iii) the energy E of the oscillations.

E = ... [2]

(c) The period of the oscillations is 0.75 s and the value of $3Y$ is 1.8 cm.

Determine an expression for x in terms of time t, where x is in cm and t is in seconds.

x = ... [2]

[Total: 9]