4 A long strip of springy steel is clamped at one end so that the strip is vertical. A mass of 65 g is attached to the free end of the strip, as shown in Fig. 4.1.

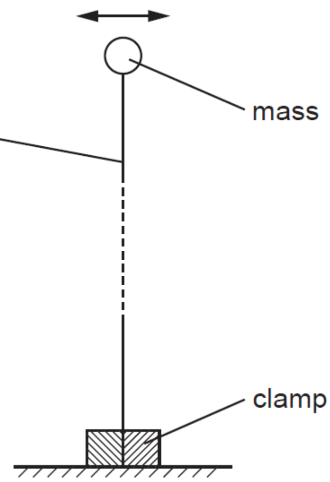

Fig. 4.1

The mass is pulled to one side and then released. The variation with time t of the horizontal displacement of the mass is shown in Fig. 4.2.

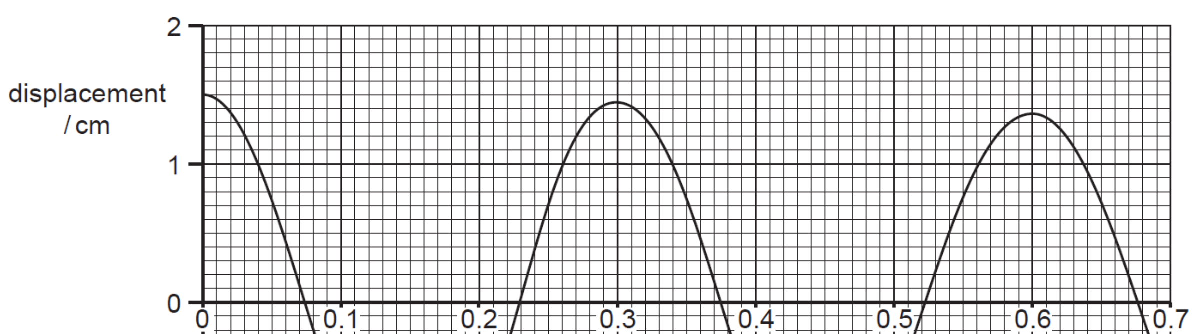

Fig. 4.2

The mass undergoes damped oscillation.

(a) (i) Suggest, with a reason, whether the damping is light, critical or heavy.

…………………………………………………………………………………………..................

…………………………………………………………………………………………..................

…………………………………………………………………………………………..... [2]

(ii) After eight complete oscillations of the mass, the amplitude of vibration is reduced from 1.5 cm to 1.1 cm.

1. Calculate the angular frequency of the oscillations.

angular frequency = …………………………….rad s^{-1} [1]

2. Calculate the loss of energy after eight complete oscillations.

loss of energy = …………………………….J [2]

3. State and explain whether, after another eight complete oscillations, the amplitude will be 0.7 cm.

…………………………………………………………………………………….............

…………………………………………………………………………………….............

……………………………………………………………………………………….[2]

(b) The variation of kinetic energy E_k of the mass with displacement x from its equilibrium position is shown in Fig. 4.3.

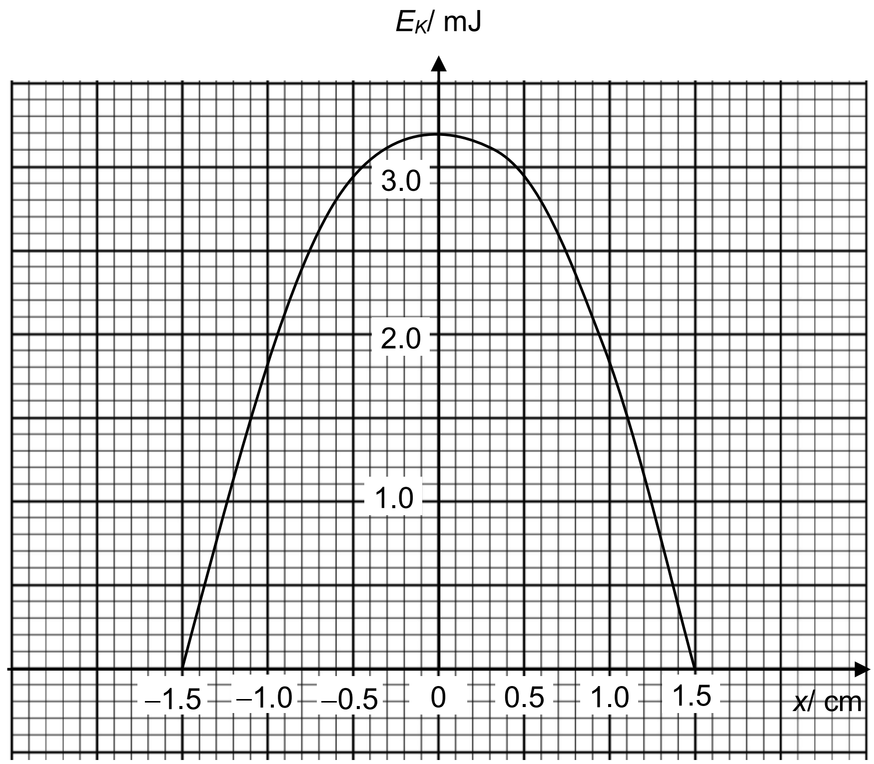

Fig. 4.3

The mass loses energy so that its maximum kinetic energy is reduced by 1.5 mJ.

Use Fig. 4.3, without further calculation, to determine the amplitude of the oscillations. Show your construction on Fig. 4.3.

amplitude = ... cm [2]

[Total: 9]