9 (a) (i) State what is meant by *simple harmonic motion*.

.....

.....

.....[2]

(ii) The variation with displacement x of the acceleration a of a mass is shown in Fig. 9.1.

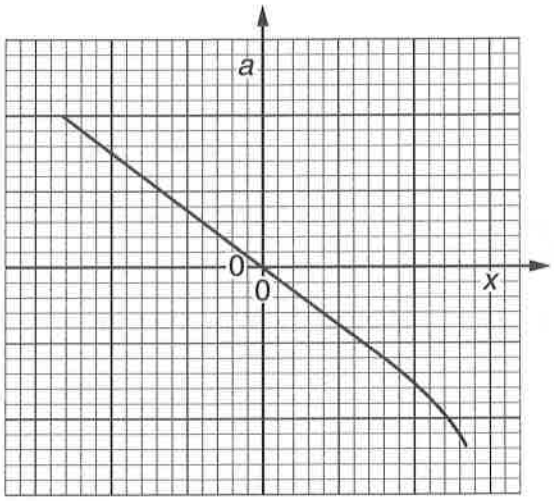

Fig. 9.1

Use Fig. 9.1 to explain how it is known that

1. the mass is oscillating

.....

.....

2. the oscillations are **not** simple harmonic.

.....

.....

[2]

(b) A flat horizontal plate is attached to an oscillator, as shown in Fig. 9.2. Sand is sprinkled on to the plate.

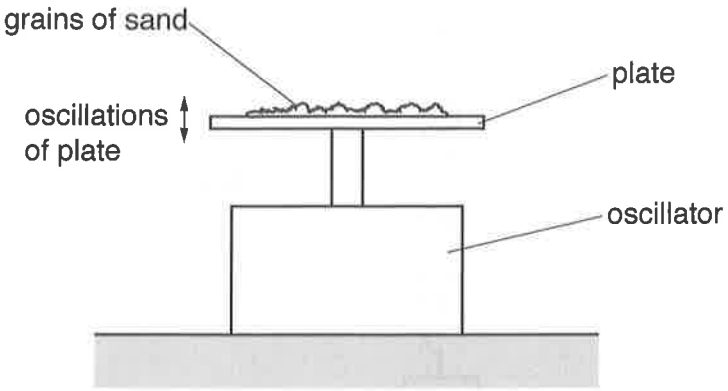

Fig. 9.2

The plate is made to oscillate vertically with small amplitude oscillations at a frequency of 13 Hz. The oscillations of the plate are simple harmonic.

The amplitude of oscillation is gradually increased until the sand first loses contact with the surface of the plate.

(i) For the plate, as the sand first loses contact with the plate,

1. state the position of the plate

.....[1]

2. calculate the amplitude of the oscillations.

amplitude = ... mm [3]

(ii) The sand consists of small grains.
The sand is replaced by larger pebbles.

Suggest and explain whether, for the pebbles to lose contact with the plate, the minimum amplitude of the oscillations would be different.

.....

.....

.....[2]

(c) A spring hangs vertically from a fixed point.
A mass of 1.2 kg is attached to the free end of the spring, as shown in Fig. 9.3.

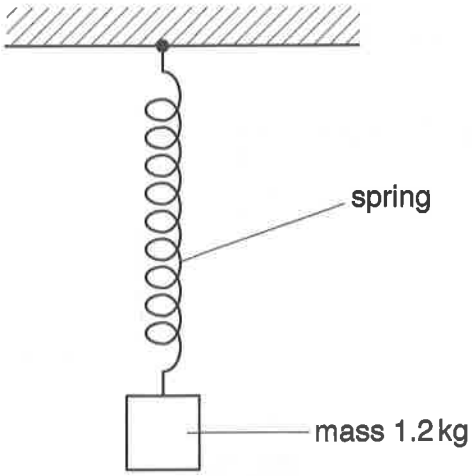

Fig. 9.3

The mass undergoes vertical oscillations with frequency 2.5 Hz and amplitude 3.4 cm.

(I) For the oscillations of the mass, determine

1. the total energy E_T

E_T = ... J [2]

2. the displacement d at which the potential energy E_P and the kinetic energy E_K of the oscillations are equal.

d = ... cm [2]

(ii) Use your answers in **(c)(i)** to sketch, on the axes of Fig. 9.4, the variation with displacement x of

1. the total energy (label this line E_T)

2. the kinetic energy (label this line E_K)

3. the potential energy (label this line E_P).

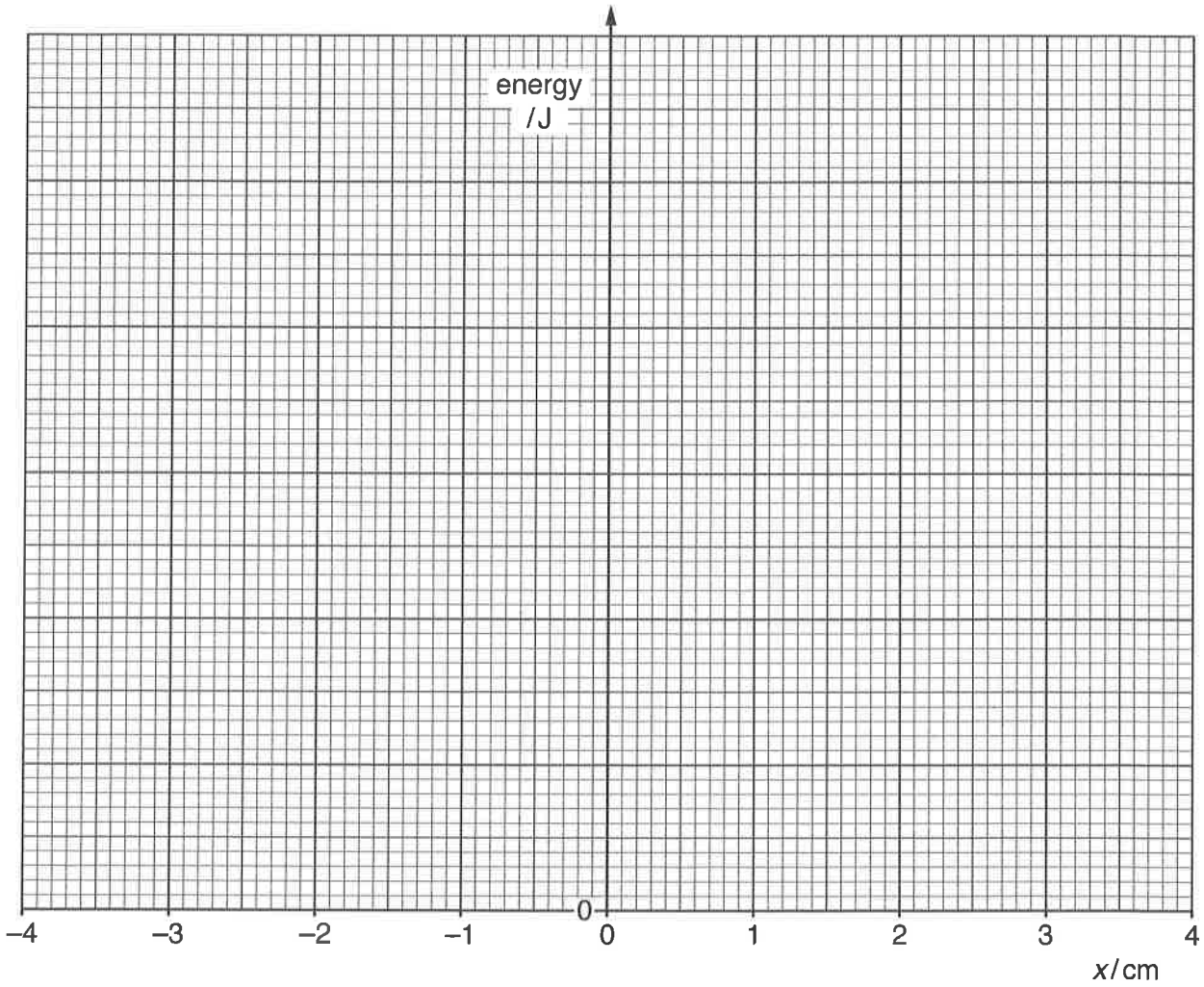

Fig. 9.4

[6]

[Total: 20]

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