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1 A spring has an unextended length of 12.0 cm. The force F required to extend the spring to a length ℓ is measured.

The variation with the length ℓ of the force F is shown in Fig. 1.1.

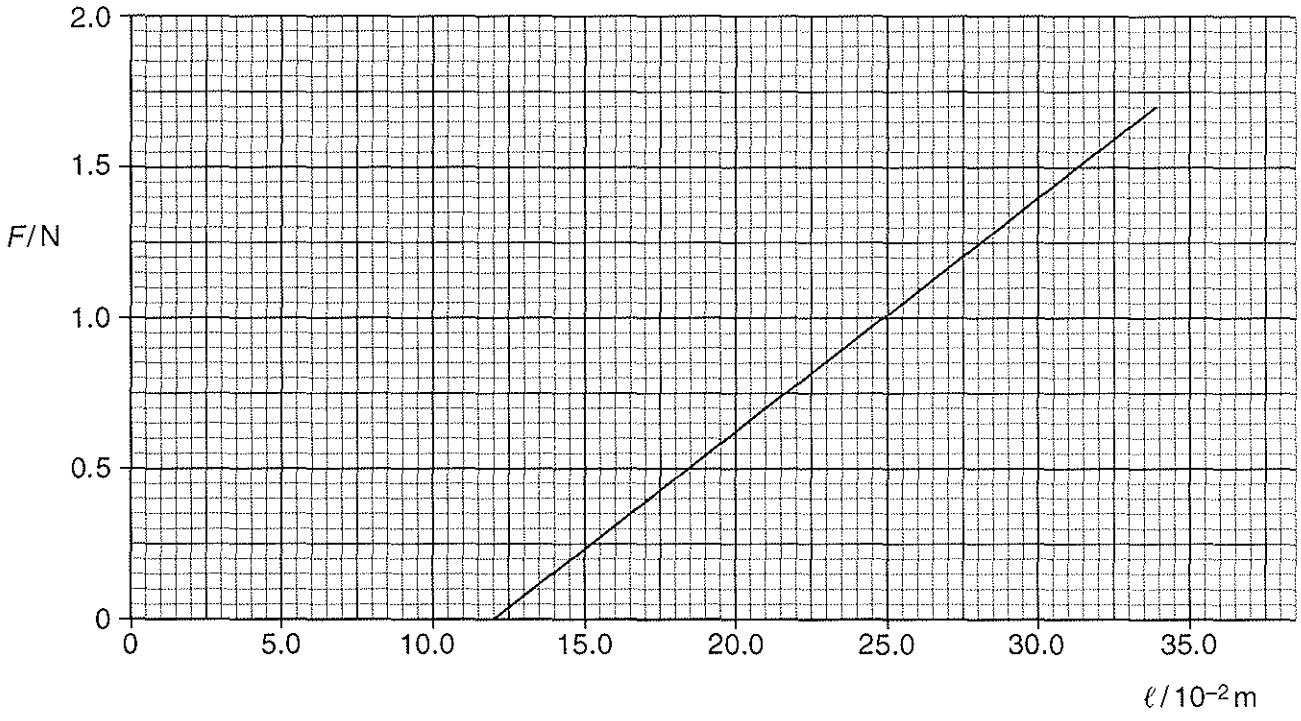

Fig. 1.1

(a) State and explain whether the spring obeys Hooke's law.

.....

.....

.....[2]

(b) Calculate the work done on the spring when it is extended from $\ell = 12.0 \times 10^{-2}$ m to $\ell = 30.0 \times 10^{-2}$ m.

work done = ... J [2]

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(c) One end of the spring is fixed and an object M of weight 1.40 N is hung vertically from the other end. The object M is pulled down and then released. The object oscillates vertically.

The variation with time t of the length ℓ of the spring is shown in Fig. 1.2.

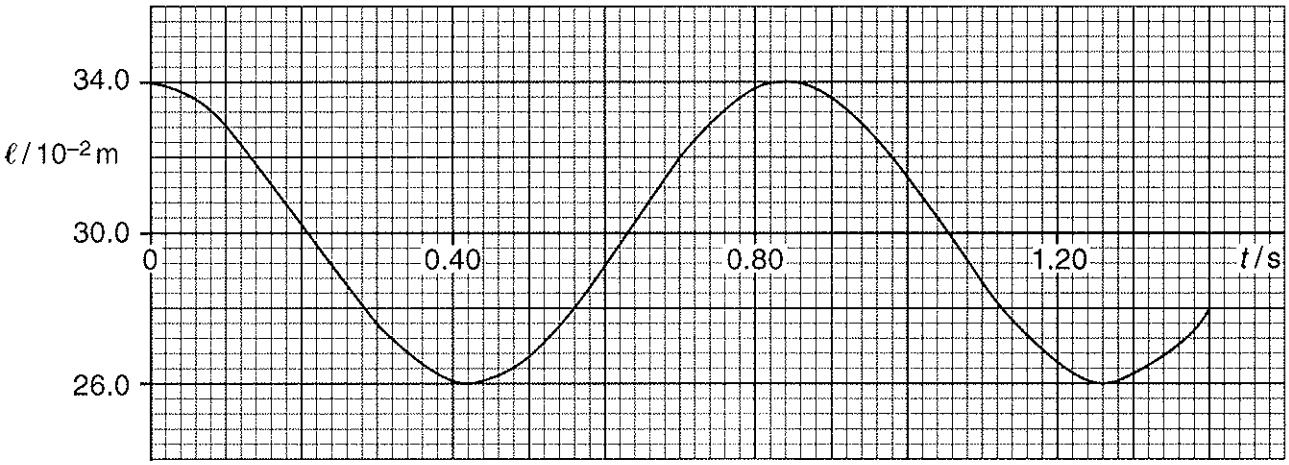

Fig. 1.2

(i) Use Fig. 1.2 to calculate the maximum speed of M.

maximum speed = ... $m\,s^{-1}$ [2]

(ii) On Fig. 1.3, show the variation with time t of the velocity v of M. Include a suitable scale on the velocity axis.

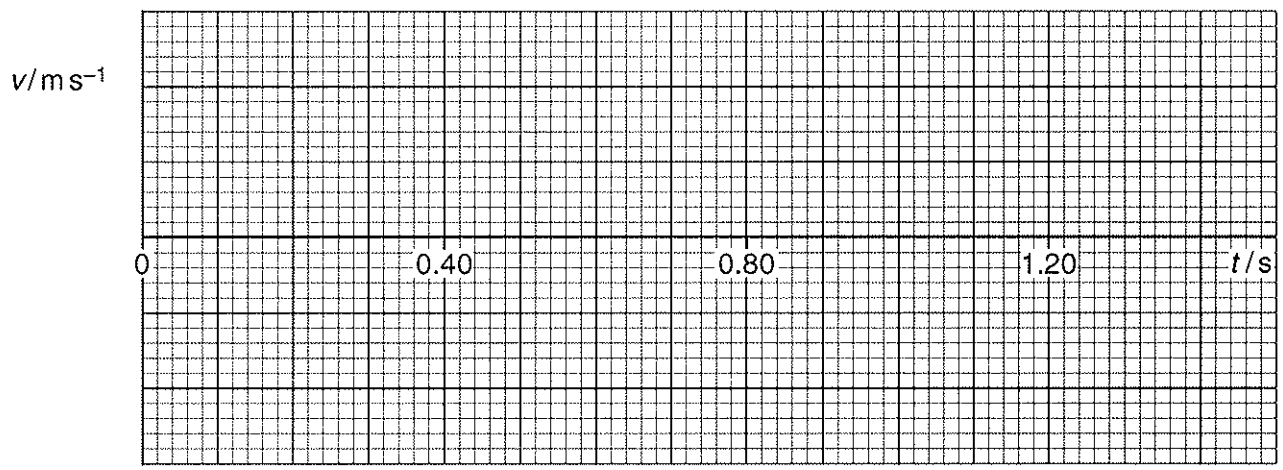

Fig. 1.3

[2]

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(d) The object M consists of two parts connected by a stiff wire of negligible mass and volume. The lower part of M is immersed in a liquid as shown in Fig. 1.4.

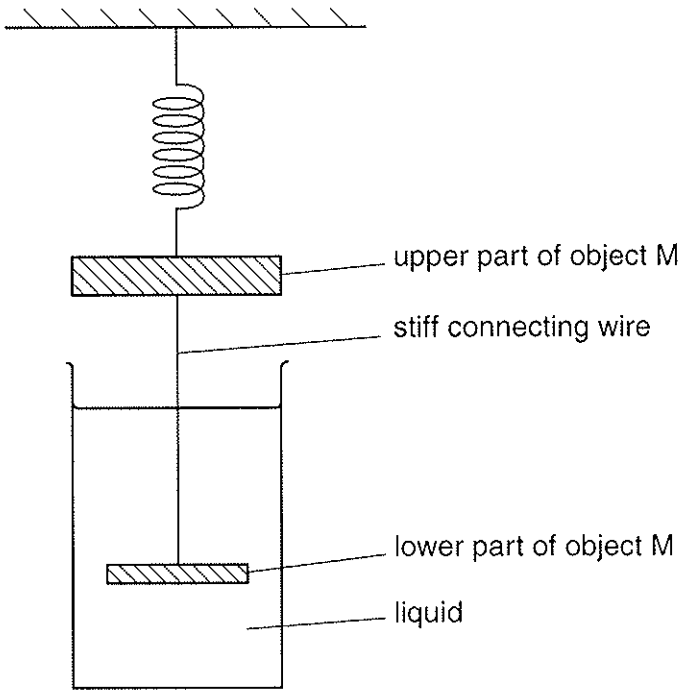

Fig. 1.4

The liquid has a density of 1000 kg m^{-3}. The volume of the part of M that is immersed in the liquid is 20 cm^3.

(i) Determine the new length of the spring.

length = ... m [3]

(ii) The object M is pulled down 4.0×10^{-2} m and is then released. The lower part of M remains immersed in the liquid at all times.
State and explain two differences that would be seen in the oscillations when compared with those shown in Fig. 1.2.

1. .....

.....

2. .....

.....

[2]