8 **(a)** Define *simple harmonic motion.*

....

....

.... [2]

(b) Fig. 8.1 shows the force–extension graph for a light spring.

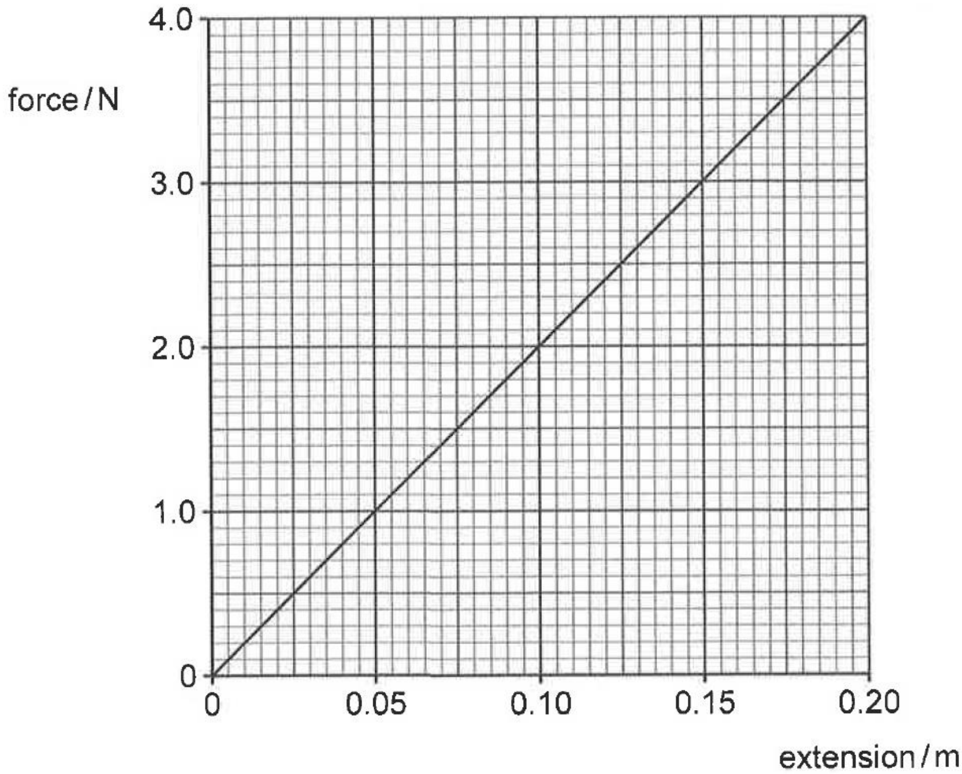

Fig 8.1

The spring described by Fig. 8.1 is attached to a fixed point on the ceiling and a mass of 2.0 N is hung on the spring.

Once the mass reaches its equilibrium position, it is displaced a further 0.15 m downward and released, such that it oscillates with simple harmonic motion.

(i) Determine the force constant k of the spring.

k = ……………………………… N m^{-1} [2]

(ii) Show that the maximum acceleration of the mass when it is oscillating in simple harmonic motion is 14.7 m s^{-2}.

[3]

(iii) Hence, determine the period of the oscillation.

period = …………………….. s [3]

(c) On Fig. 8.2, sketch the variations with time of the displacement *x*, the velocity *v* and the acceleration *a* of the object for two complete oscillations, starting at $t = 0$ when the mass is at its lowest position. Take upwards as positive.

Include an appropriate scale on the axes.

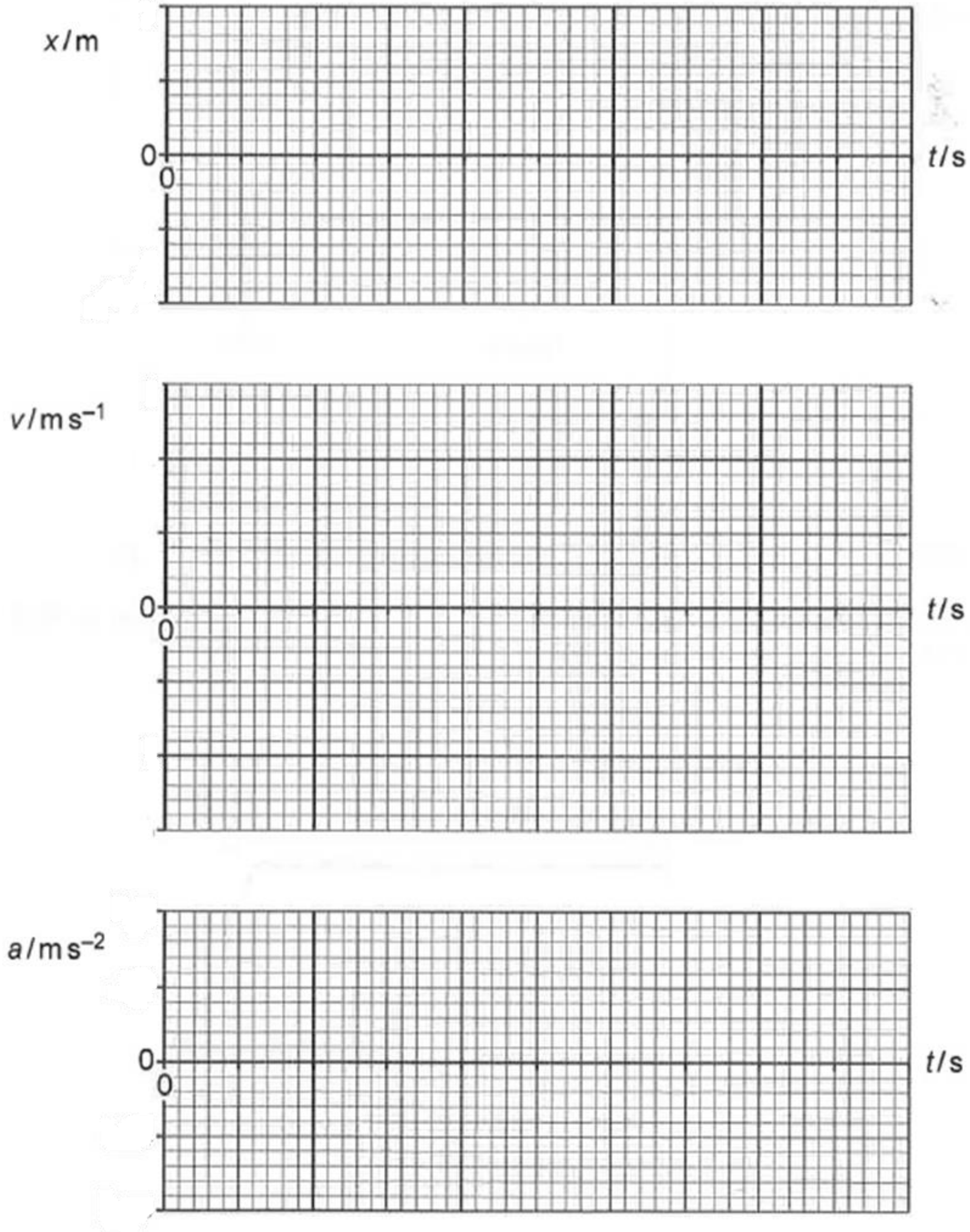

Fig. 8.2

[6]

(d) A second, identical spring is attached in parallel to the first spring as shown in Fig. 8.3.

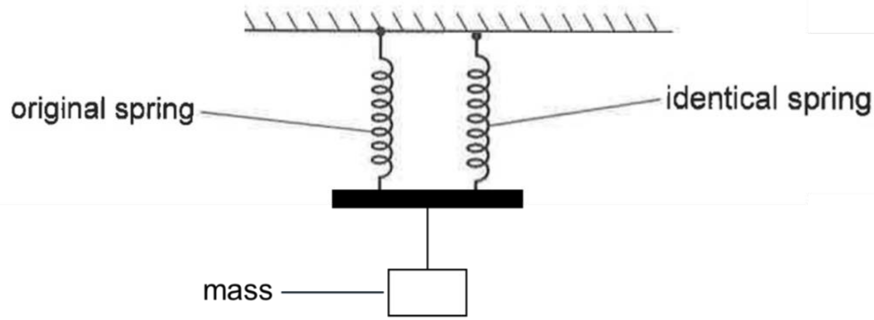

Fig. 8.3

(i) State and explain how the extension of the spring system compares with that of the original single spring when the same 2.0 N mass is suspended from it.

....

....

.... [2]

(ii) The mass is again displaced by 0.15 m and released to oscillate.

State and explain how the period of oscillation of the new system compares with the period found in **(b)(iii)**.

....

....

....

....

.... [2]

[Total: 20]