3 **(a)** Define simple harmonic motion

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…….. [1]

(b) A spring, which hangs from a fixed support, extends by 40 mm when a mass of 0.25 kg is suspended from it.

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

spring constant = …… N m^{-1} [1]

(ii) An additional mass of 0.44 kg is then placed on the spring and the system is set into vertical oscillations with an amplitude of 20 mm.

Given that $a = -\frac{kx}{m}$

where *a* is the acceleration of the mass, *x* is the displacement of the mass from equilibrium and *m* is the total mass of the oscillating system.

1. Show that the oscillation frequency is 1.5 Hz. [2]

2. Determine the displacement at which the potential energy and the kinetic energy of the oscillations are equal.

displacement = …… mm [2]

3. With both masses still in place, the spring is now suspended from a horizontal support rod that can be made to oscillate vertically at varying frequencies, as shown in Fig. 3.1.

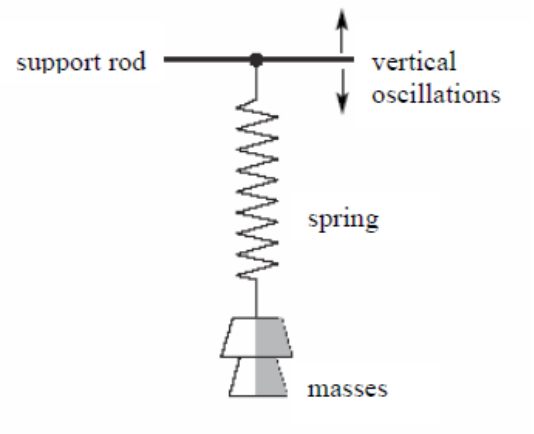

Fig. 3.1

The response of the masses suspended from the spring to the vertical oscillations of the support rod varies with frequency.

Describe and explain the motion of the masses when the support rod oscillates at a frequency from 0.2 Hz to 3.0 Hz.

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…… [4]