4 **(a)** State what is meant by resonance.

.....

.....

..... [2]

(b) Fig. 4.1 shows a heavy pendulum and a light pendulum, both suspended from the same piece of string. This string is secured at each end to fixed points.

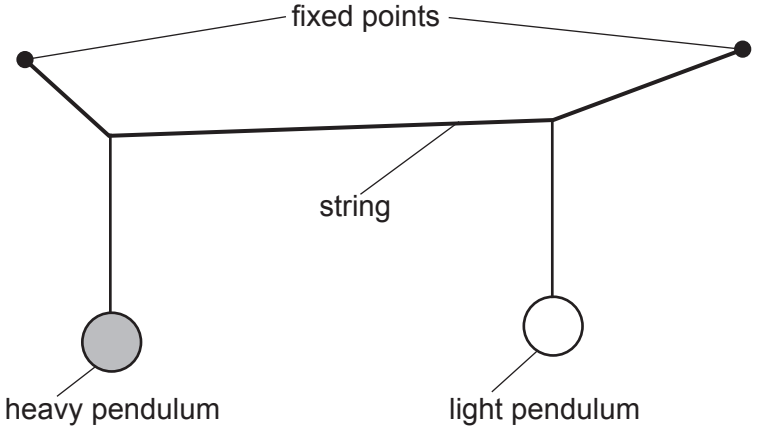

Fig. 4.1

Both pendulums have the same natural frequency.
The heavy pendulum is set oscillating perpendicular to the plane of the diagram. As it oscillates, it causes the light pendulum to oscillate.

Fig. 4.2 shows the variation with time *t* of the displacements of the two pendulums for three oscillations.

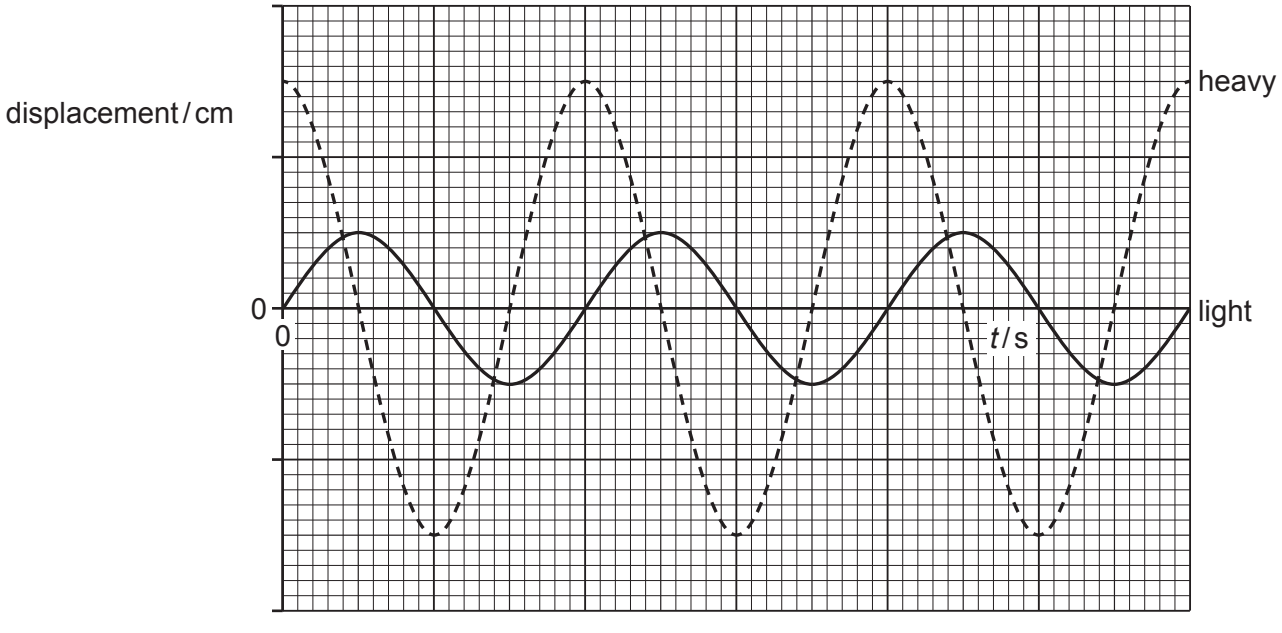

Fig. 4.2

The variation with t of the displacement x of the light pendulum is given by

$$x = 0.25 \sin 5.0\pi t$$

where x is in centimetres and t is in seconds.

(i) Calculate the period T of the oscillations.

T = ... s [2]

(ii) On Fig. 4.2, label both of the axes with the correct scales. Use the space below for any additional working that you need.

[2]

(iii) Determine the magnitude of the phase difference ϕ between the oscillations of the light and heavy pendulums. Give a unit with your answer.

ϕ = ... unit ..... [2]

[Total: 9]