4 **(a)** **(i)** By reference to the direction of propagation of energy, state what is meant by a *transverse* wave.

.....

..... [1]

(ii) State the principle of superposition.

.....

.....

..... [2]

(b) Circular water waves may be produced by vibrating dippers at points P and Q, as illustrated in Fig. 4.1.

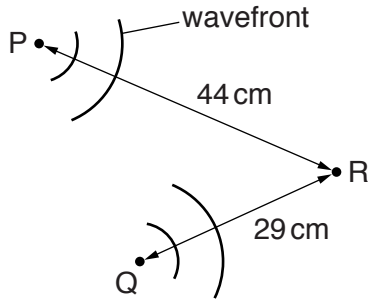

Fig. 4.1 (not to scale)

The waves from P alone have the same amplitude at point R as the waves from Q alone. Distance PR is 44 cm and distance QR is 29 cm.

The dippers vibrate in phase with a period of 1.5 s to produce waves of speed 4.0 cm s^{-1}.

(i) Determine the wavelength of the waves.

wavelength = ... cm [2]

(ii) By reference to the distances PR and QR, explain why the water particles are at rest at point R.

.....

.....

.....

.....

..... [3]

(c) A wave is produced on the surface of a different liquid. At one particular time, the variation of the vertical displacement y with distance x along the surface of the liquid is shown in Fig. 4.2.

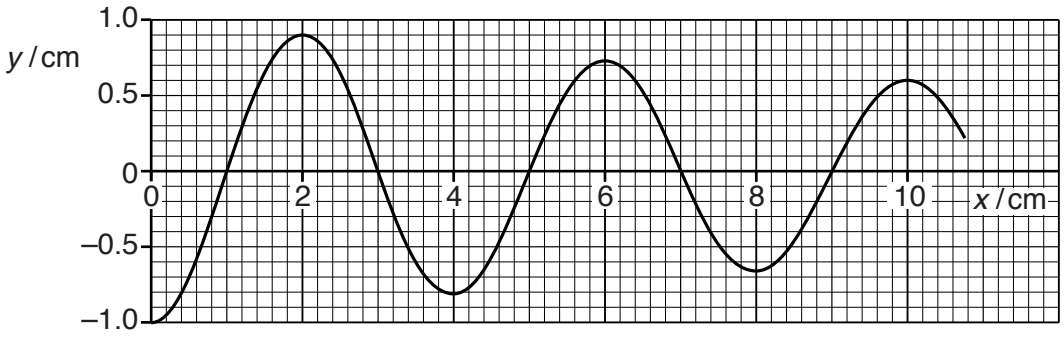

Fig. 4.2

(i) The wave has intensity I_1 at distance $x = 2.0\,\text{cm}$ and intensity I_2 at $x = 10.0$ cm.

Determine the ratio

$$\frac{\text{intensity } I_2}{\text{intensity } I_1}.$$

ratio = ... [2]

(ii) State the phase difference, with its unit, between the oscillations of the liquid particles at distances $x = 3.0\,\text{cm}$ and $x = 4.0\,\text{cm}$.

phase difference = ... [1]

[Total: 11]