

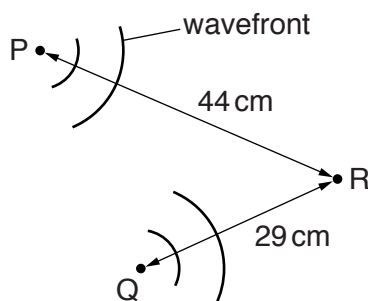
- 4 (a) (i) By reference to the direction of propagation of energy, state what is meant by a *transverse* wave.

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 ..... [1]

- (ii) State the principle of superposition.

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 .....  
 ..... [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  $4.0 \text{ cm s}^{-1}$ .

- (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.

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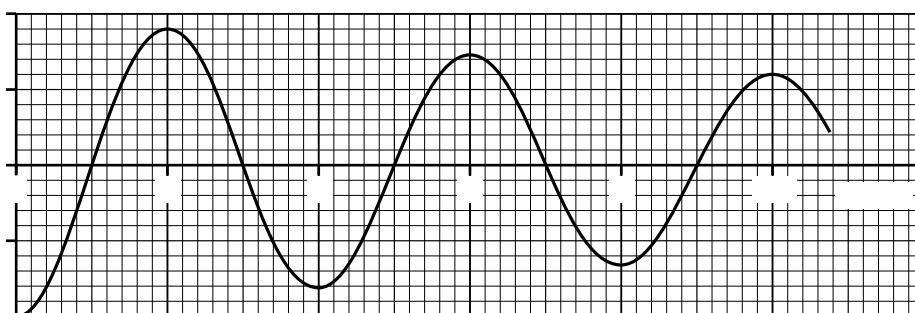
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..... [3]

- (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  $x = 2.0$  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  $x = 3.0$  cm and  $x = 4.0$  cm.

phase difference = ..... [1]

[Total: 11]