4 **(a)** **(i)** For a progressive wave, state what is meant by

1. the wavelength, and

……………………………………………………………………………………………………

……………………………………………………………………………………….………… [1]

2. the phase difference.

……………………………………………………………………………………………………

……………………………………………………………………………………….………… [1]

(ii) When two similar progressive waves of wavelength λ arrive at a common point, the interference effect is related to the path difference Δx or the phase difference $\Delta \theta$ of the two waves.

State the relationship between the path difference and the phase difference using appropriate symbols.

[1]

(b) Fig. 4.1 shows the variation with time t of the displacement of two progressive waves P and Q passing the same point.
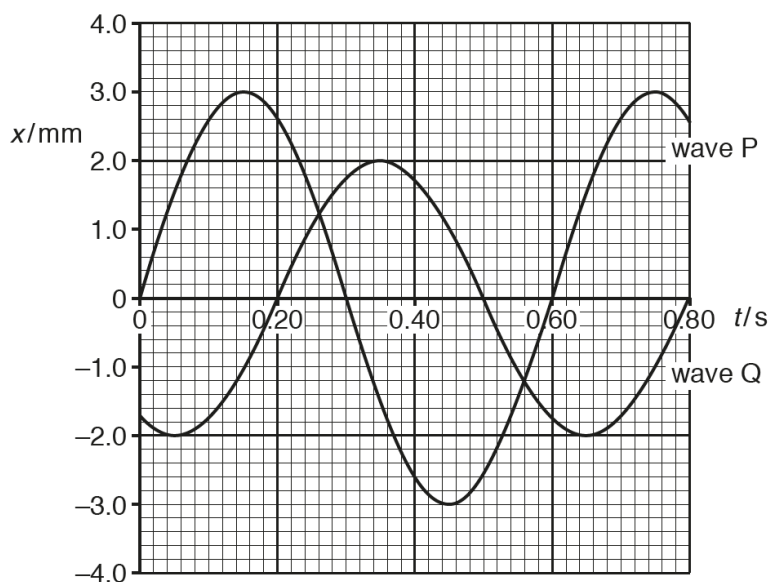

Fig. 4.1

The speed of the waves is 20 cm s^{-1}.

(i) Calculate the wavelength of the two waves.

wavelength = ………………………… cm [2]

(ii) Determine the phase difference in degrees between the two waves.

phase difference = ……..………………… ° [2]

(iii) The two waves superpose as they pass the same point.

Use Fig. 4.1 to determine the resultant displacement at time $t = 0.45$ s.

displacement = ………………………… mm [2]

(iv) Calculate the ratio

$$\frac{\text{intensity of wave Q}}{\text{intensity of wave P}}.$$

ratio = ……….………………… [2]

(v) The interference effect when the waves P and Q superpose can be observed because the two sources are coherent.

Explain what is meant by *coherent*.

……………………………………………………………………………………………………...

……………………………………………………………………………………………………….. [1]

[Total: 12]