

4 (a) A source oscillates with frequency  $f$  to produce a progressive wave of wavelength  $\lambda$ . The source takes time  $t$  to produce  $n$  complete oscillations.

(i) State what is meant by a progressive wave.

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

(ii) State expressions, in terms of some or all of  $f$ ,  $\lambda$  and  $n$ , for:

- the distance moved by a wavefront in time  $t$

distance = .....

- time  $t$ .

time  $t$  = ..... [2]

(iii) Use your answers in (ii) to determine an expression for the speed  $v$  of the wave in terms of  $f$  and  $\lambda$ .

[1]

(b) Two identical microwave sources X and Y emit waves in phase. The sources are separated by a distance of 30 cm, as shown in Fig. 4.1.

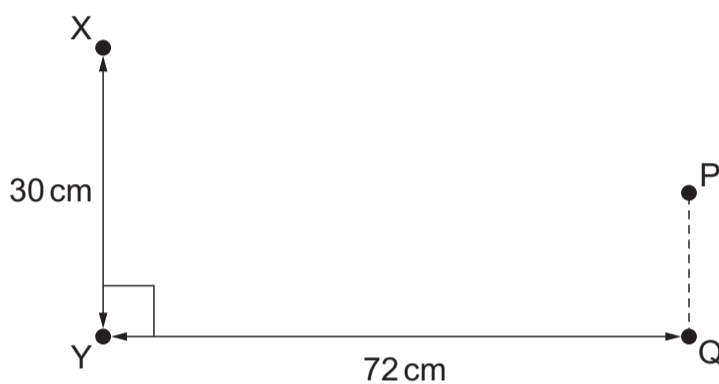


Fig. 4.1 (not to scale)

The intensity of the microwaves is to be investigated at points P and Q. Line PQ is parallel to line XY. Distance XP is equal to distance YP. Distance YQ is 72 cm and angle XYQ is  $90^\circ$ . The wavelength of the microwaves is 4.0 cm.

(i) Calculate the frequency, in GHz, of the microwaves.

frequency = ..... GHz [2]

(ii) Show that the difference between the path lengths XQ and YQ is 6 cm.

[1]

(iii) State and explain what may be deduced about the intensity of the microwaves at point Q.

.....  
 .....  
 .....  
 ..... [3]

(iv) A microwave detector is positioned at P and connected to a cathode-ray oscilloscope (CRO). The controls of the CRO are adjusted so that a waveform is shown on the screen.

Describe the changes to the amplitude of the waveform as the detector is moved from P to Q.

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 .....  
 ..... [2]