Mark scheme for Extension Worksheet – Topic 4, Worksheet 2

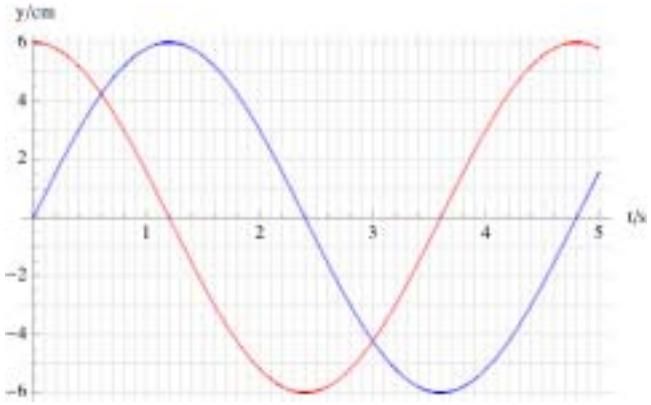
1 **a** The wavelength is 4.8 m; and so the speed is $v = f\lambda = 45 \times 4.8 = 216\ \text{m s}^{-1}$ [2]

b The displacement of the point at 4.5 m is 5.5 cm;

$$v = \pm\omega\sqrt{x_0^2 - y^2} = \pm\frac{2\pi}{T}\sqrt{x_0^2 - y^2} = \pm 2\pi f\sqrt{x_0^2 - y^2} = \pm 2\pi \times 45 \times \sqrt{0.060^2 - 0.055^2}$$

i.e. $v = \pm 6.78\ \text{m s}^{-1}$; drawing the wave a very small time later we see that the point is moving downward. [3]

c See graph in blue (sine curve) – after a quarter of a period wave will move forward a distance equal to a quarter of a wavelength.



[1]

2 V: anywhere where $y = 0$; A: anywhere where $y = \pm 6.0$ cm. [2]

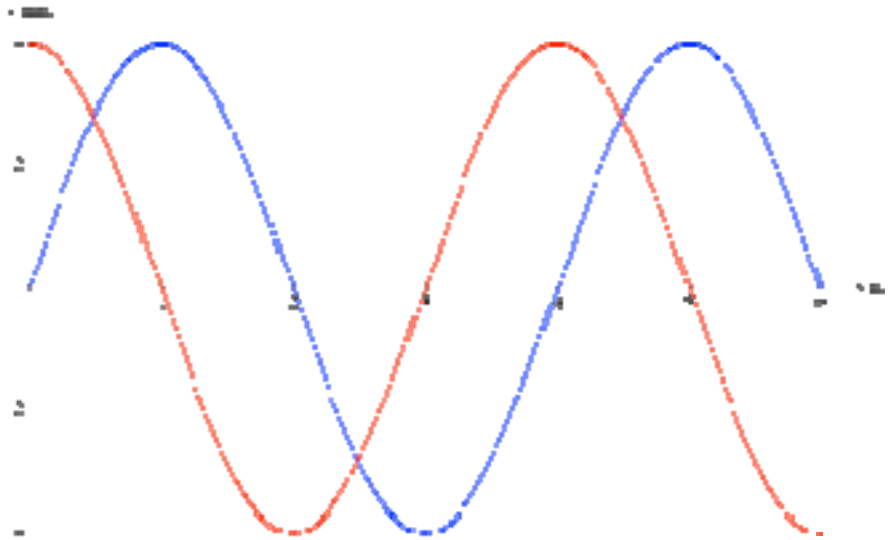
3 **a** $v = f\lambda = 25 \times 4.0 = 100\ \text{m s}^{-1}$ [1]

b The displacement of the point at 1.0 m is 0 mm;

$$v = \pm\omega\sqrt{x_0^2 - y^2} = \pm\frac{2\pi}{T}\sqrt{x_0^2 - y^2} = \pm 2\pi f\sqrt{x_0^2 - y^2} = \pm 2\pi \times 25 \times \sqrt{0.0040^2 - 0^2},$$

i.e. $v = \pm 0.628 \approx \pm 0.63\ \text{m s}^{-1}$; if we imagine drawing the wave a tiny bit of time after time zero we will see that the point at $x = 1.0$ m will now have a positive displacement i.e. it will have moved to the right. [3]

c See curve in blue below (sine curve) which is the red curve shifted forward by a quarter of a wavelength; since the time of 0.01 s corresponds to a quarter of a period.



[2]

4 R: at approximately $x = 1.2$ m ; C: at approximately $x = 3.8$ m [2]