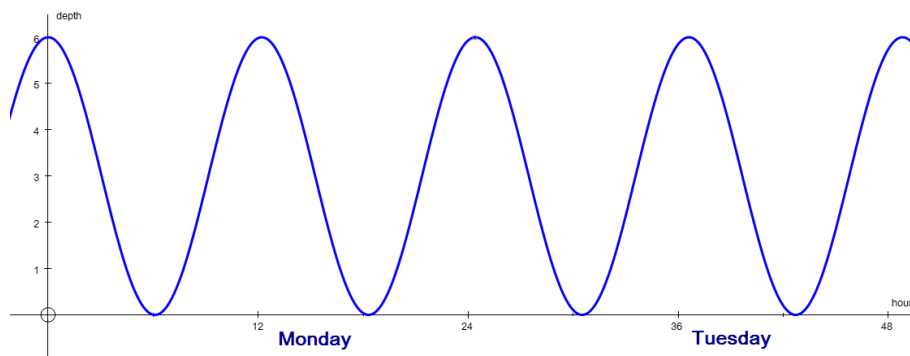


Section 2: Trigonometric equations

Solutions to Exercise level 3

1. (i)



(ii) High water occurs when the graph is a maximum

$$\cos\left(\frac{59x}{2}\right) = 1 \Rightarrow \frac{59x}{2} = 0^\circ, 360^\circ, 720^\circ, 1080^\circ, 1440^\circ$$

$$\Rightarrow x \approx 0^\circ, 12.203^\circ, 24.406^\circ, 36.610^\circ, 48.814^\circ$$

so high water on Tuesday is at approximately 0024h and 1237h.

Low water occurs when the graph is a minimum

$$\cos\left(\frac{59x}{2}\right) = -1 \Rightarrow \frac{59x}{2} = 180^\circ, 540^\circ, 900^\circ, 1260^\circ$$

$$\Rightarrow x \approx 6.102^\circ, 18.305^\circ, 30.5085^\circ, 42.712^\circ$$

so low water on Tuesday is at approximately 0631h and 1843h.

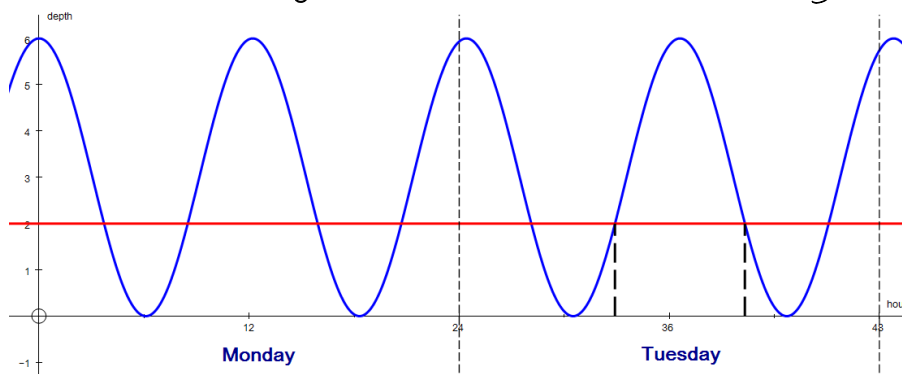
(iii)  $y = 2 \Rightarrow 3\left(\cos\left(\frac{59x}{2}\right) + 1\right) = 2$

$$\Rightarrow \cos\left(\frac{59x}{2}\right) = -\frac{1}{3} \approx \cos 109.47^\circ$$

$$\Rightarrow \frac{59x}{2} \approx 970.53^\circ, 1189.47^\circ$$

$$\Rightarrow x \approx 32.90^\circ, 40.32^\circ$$

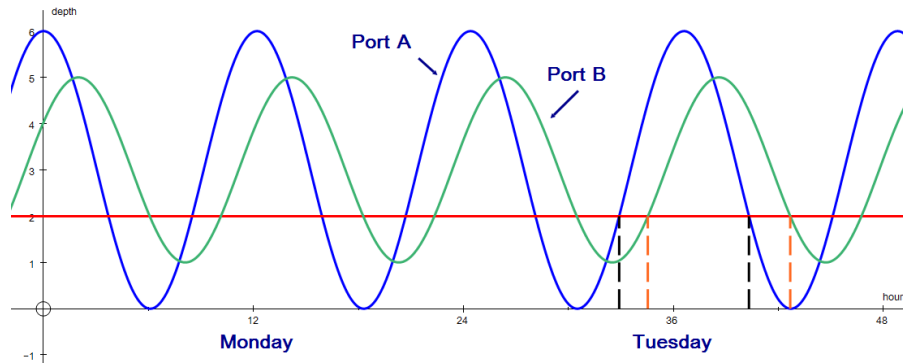
so the vessel should be brought into Port A between 0854h and 1619h.



(iv)  $y = 2\left(\cos\left(\frac{59}{2}(x-2)\right) + 1.5\right)$

# Edexcel AS Maths Trigonometry Exercise solutions

(v)



$$y = 2 \Rightarrow 2 \left( \cos\left(\frac{59}{2}(x-2)\right) \right) + 3 = 2$$

$$\Rightarrow \cos\left(\frac{59}{2}(x-2)\right) = -\frac{1}{2} \approx \cos 120^\circ$$

$$\Rightarrow \frac{59}{2}(x-2) \approx 960^\circ, 1200^\circ$$

$$\Rightarrow x-2 \approx 32.54^\circ, 40.68^\circ$$

$$\Rightarrow x \approx 34.54^\circ, 42.68^\circ$$

so the vessel could be brought into Port B between 1032h and 1841h.

(vi) Port A is accessible for  $x \approx 7.42$ , i.e. for 7 hours and 25 minutes.

Port B is accessible for  $x \approx 8.11$ , i.e. for 8 hours and 7 minutes.

So Port B is accessible for an extra 42 minutes.

2. (i)  $x = \frac{1}{2} \Rightarrow f(x) = 32\left(\frac{1}{8}\right) - 48\left(\frac{1}{4}\right) + 22\left(\frac{1}{2}\right) - 3$

$$= 4 - 12 + 11 - 3 = 0$$

so  $(2x-1)$  is a factor

$$32x^3 - 48x^2 + 22x - 3 = 0$$

$$\Rightarrow (2x-1)(16x^2 - 16x + 3) = 0$$

$$\Rightarrow (2x-1)(4x-1)(4x-3) = 0$$

(ii) Roots are  $\cos x = \frac{1}{2}$  or  $\cos x = \frac{1}{4}$  or  $\cos x = \frac{3}{4}$

$$\Rightarrow x \approx 41.4^\circ, 60^\circ, 75.5^\circ, 284.5^\circ, 300^\circ, 318.6^\circ$$

