

- 1) The height of tide, h meters, in a harbour on a certain day can be modelled by

$$h(t) = 10 + \sqrt{3} \sin(30t)^\circ + \cos(30t)^\circ, \quad 0 \leq t \leq 12,$$

where t is the time in hours since midnight.

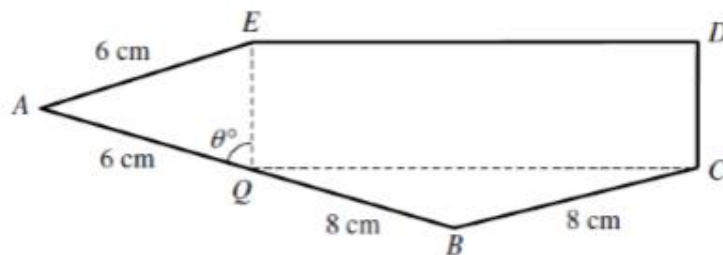
- a) Find the time when the high tide and the low tide occur during the morning hours of that day and state the corresponding depth of water in the harbour at these times.

The depth of water in this harbour needs to be at least 8.5 metres for a boat to dock

A boat arrives outside the harbour at high tide and needs five hours to unload.

- b) Show that the boat has to wait until 09:23 to enter the harbour.

2)



The figure above shows an irregular pentagon $ABCDE$. The lengths of AB , BC and AE are 14 cm, 8 cm and 6 cm respectively.

The point Q lies on AB so that AQ is 6 cm and QB is 8 cm. The point D is then constructed so that $QEDC$ is a rectangle.

Let the angle AQE be θ° and assume that θ° can vary.

- a) Given that P cm and R cm² are the perimeter and the area of the pentagon respectively, show that ...

i. ... $P = 28 + 12 \cos \theta + 16 \sin \theta$.

ii. ... $R = 146 \sin 2\theta$.

- b) Hence show that when the pentagon has a maximum area

$$P = 14(2 + \sqrt{2}) \text{ cm}^2.$$