

Question 9**(40 marks)**

The depth of water, in metres, at a certain point in a harbour varies with the tide and can be modelled by a function of the form

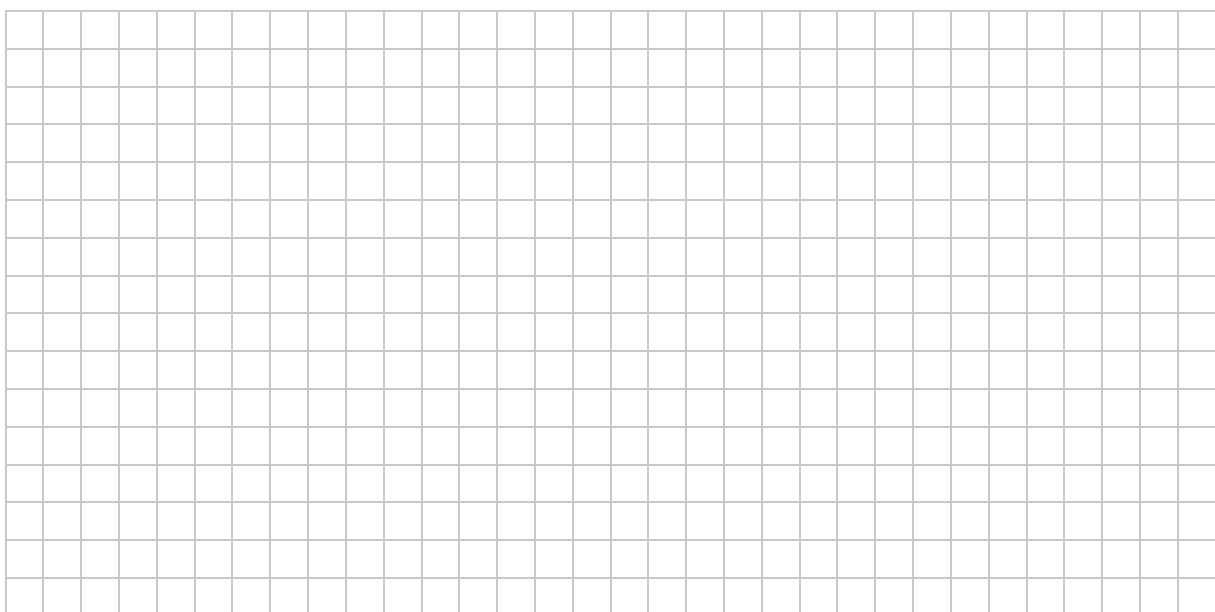
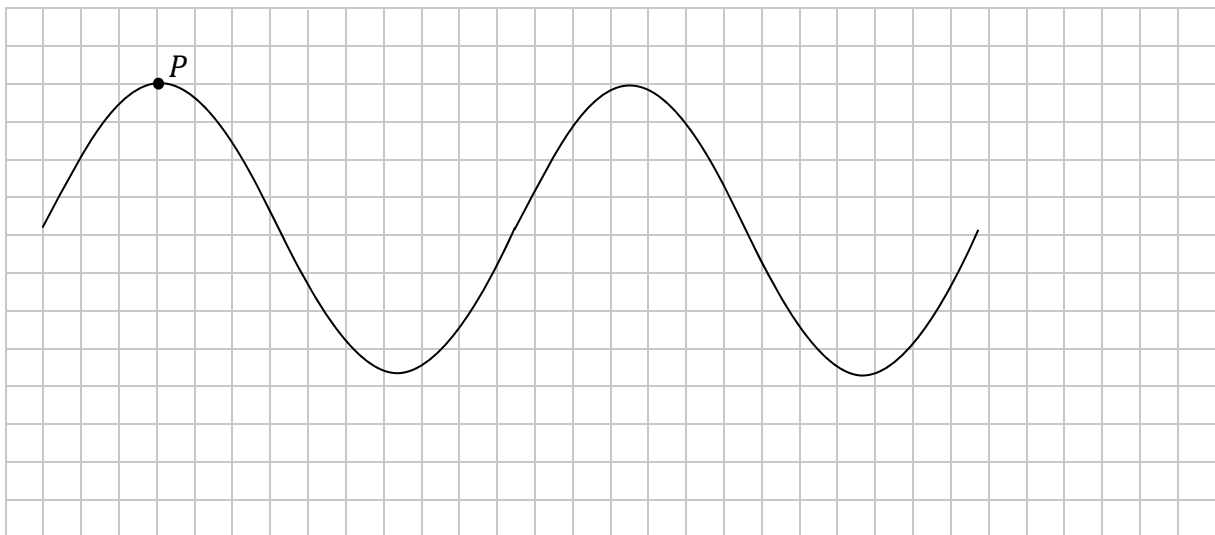
$$f(t) = a + b \cos ct$$

where t is the time in hours from the first high tide on a particular Saturday and a, b , and c are constants. (**Note:** ct is expressed in radians.)

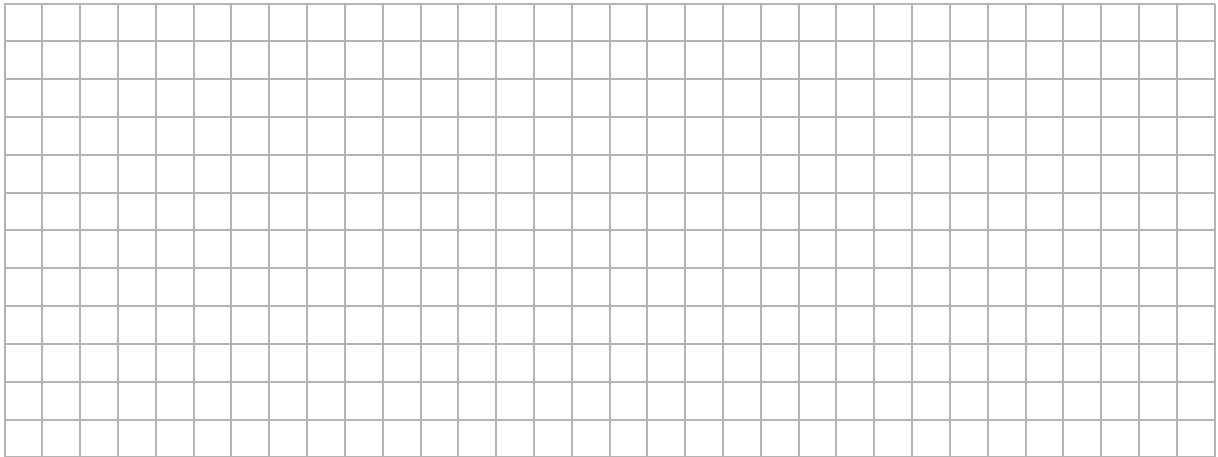
On that Saturday, the following were noted:

- The depth of the water in the harbour at high tide was 5.5 m
- The depth of the water in the harbour at low tide was 1.7 m
- High tide occurred at 02:00 and again at 14:34.

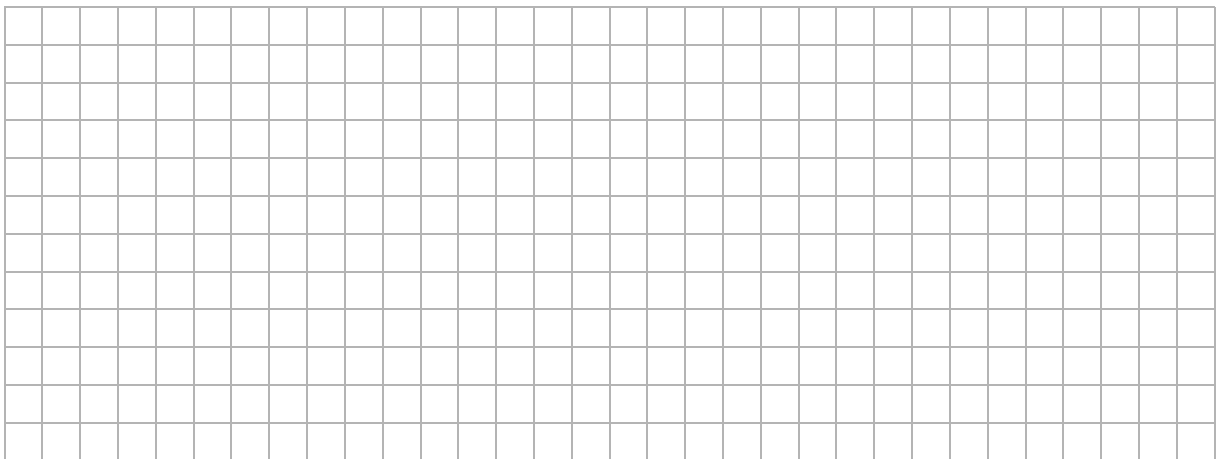
- (a) Use the information you are given to add, as accurately as you can, labelled and scaled axes to the diagram below to show the graph of f over a portion of that Saturday. The point P should represent the depth of the water in the harbour at high tide on that Saturday morning.



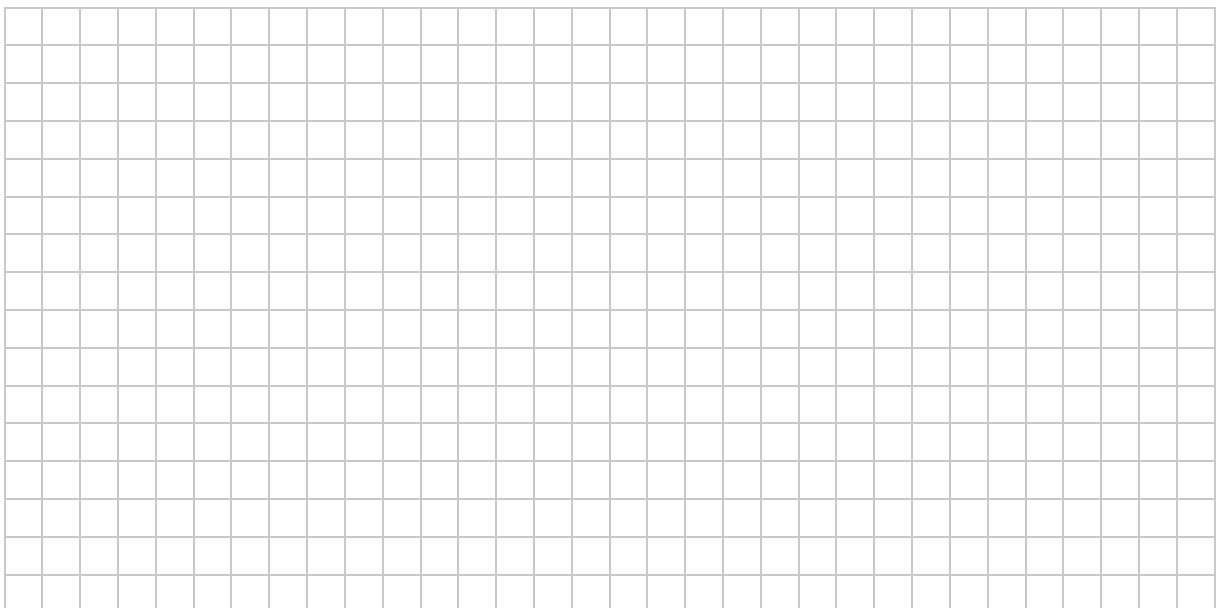
- (b) (i) Find the value of a and the value of b .



- (ii) Show that $c = 0.5$, correct to 1 decimal place.



- (c) Use the equation $f(t) = a + b \cos ct$ to find the times on that Saturday **afternoon** when the depth of the water in the harbour was exactly 5.2 m.
Give each answer correct to the nearest minute.



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