# Section Check In – Pure Mathematics: Trigonometry

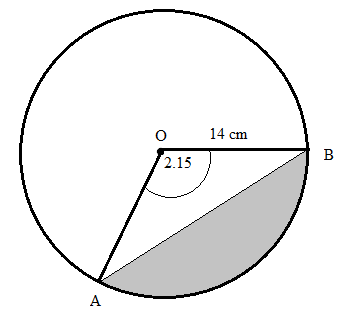
## Questions

1. In the triangle , cm and cm. Given that the area of the triangle is cm2, find the possible values of the angle .

2. Show that the exact value ofis .

3.\* Show that for a small angle , measured in radians, .

4.\* A circle has centre O and radius cm. Two points A and B lie on the circumference such that angle radians, as shown in Fig.4.



**Fig. 4**

Find the perimeter of the minor segment bounded by the arc AB and the chord AB.

5. Prove that .

6.\* Prove that .

7. Solve the equation  for .

8.\* Solve the equation  for .

9. A boat sails due north from a port. After going a distance of km, the boat changes direction and sails for a furtherkm on a bearing of .

(a) How far is the boat now from the port?

(b) On what bearing should the boat now sail to return directly to the port?

10.\* The depth of water in a harbour varies due to the tides. On a particular day, the depth of water, metres, at a time  hours after noon is given by

.

(a) Find the depth of water at high tide and determine the time when this occurs.

(b) Find the depth of water at low tide and determine the time when this occurs.

(c) When the depth of water is less than  metres, boats are unable to enter or leave the harbour. Between which two times does this occur?

**Extension**

(a) Use the identities for  and  with  to confirm the identities for  and .

(b) By taking  and , express  in terms of  and  in terms of .

(c) Use two different approaches to express  in terms of  and . Use two different approaches to express  in terms of .

(d) Consider  and  similarly.

(e) Develop further identities.

## Worked solutions

1. Using Area ,  and therefore 

Angle  or 

2.   

3. Using the small angle approximations  and ,









4. Length of arc cm

Length of chord cm

[or, using cosine rule,  and ]

Perimeter of segment cm (to 3 significant figures)

5. Left-hand side 

, using identities  and 



, cancelling 



6. Left-hand side , using  identity

, substituting  and 

, using identity 

, cancelling 

7. Equation is 

Using , 

Multiplying both sides by , 

Using identity  for the left-hand side, 

Hence  giving solutions 

8. Equation is 

Substituting  and identity for , 

Multiplying by , 

Expressing in terms of  and , 

Multiplying both sides by , 

Expressing in terms of  leads to equation 

Use of quadratic formula gives  and therefore  and 

Formula also gives  and therefore  and 

Solutions to 3 significant figures are 

9.

A

P

3 km

40°

B

5 km

(a) Using cosine rule, 



Boat is km from the port

(b) Using sine rule,  giving angle 

Bearing to sail 

10. Expressing  in form , i.e. in form 

Comparing,  and 

Squaring and adding gives  and therefore 

Dividing gives , i.e.  and therefore 

Hence depth of water is given by 

(a) High tide occurs when  and this gives 

Solving for ,  and hence 

Changing  hours to minutes,  to nearest whole number

High tide occurs  hour and  minutes after noon, i.e. at  hours

Depth of water at high tide is  metres

(b) Low tide occurs when  and this gives 

Solving for ,  and hence 

As before,  hours minutes and low tide occurs  hours and  minutes after noon

Low tide occurs at  hours and depth of water is  metres

(c) When ,  giving 

Solving  giving 

Boats cannot enter or leave harbour between  hours and  hours

**Extension**

(a) 



(b) 







(c) For , this can be written as either  or 

Using the  identity together with earlier results leads to  (or a slight variation of this if  has been used)

For , either approach will lead to 

(d) Using any of several approaches,  and 

(e) [Remember that you can check a result by substituting a particular value; this does not prove that the result is correct (because flukes can happen) but it might indicate an error. For example, if you have an expression for , choose an ordinary value such as ; does your expression with this value substituted give the same value as ?]

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