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National 5 Mathematics

Exam Questions by Topic

Circles & Pythagoras

step-by-step worked solutions included

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N5 Maths Exam Questions by Topic

Working through N5 Maths exam questions by topic is an excellent strategy to consolidate, and strengthen, your learning to fully prepare for the actual exam.

The best way to use this guide is for checking your answers after you have tried the questions yourself. Please don't just read the solutions whenever you get stuck! If you find the resources helpful to your deeper understanding of National 5 Mathematics, as well as helping you better prepare for the final exam, then please let others know about us at ***www.national5maths.co.uk*** – thank you!

The contents of these worked solutions have not been checked or approved by the Scottish Qualifications Authority. They reflect the authors' opinions of good answers to exam questions and where possible have been checked against publicly available marking instructions.

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2015 N5 Past Paper P2, Q12

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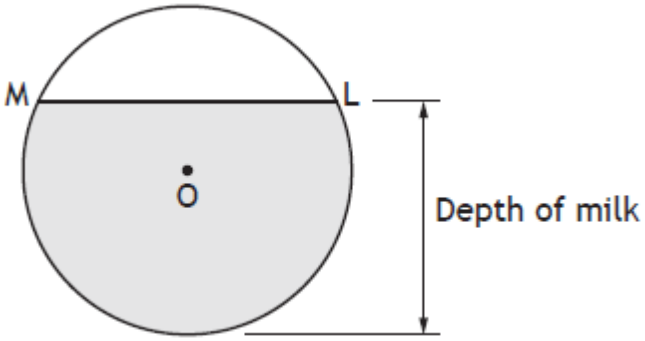
1. The diagram below shows the cross-section of a milk tank.



The radius of the circle, centre O, is 1.2 metres.

The width of the surface of the milk in the tank, represented by ML in the diagram, is 1.8 metres.

Calculate the depth of the milk. (4 marks)

2014 N5 Past Paper P1, Q12

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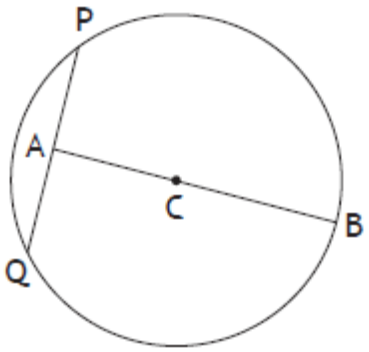
2. The diagram below shows a circle, centre C.



The radius of the circle is 15 centimetres.

A is the mid-point of chord PQ.

The length of AB is 27 centimetres.

Calculate the length of PQ. (4 marks)

2013 N5 Specimen P1, Q12

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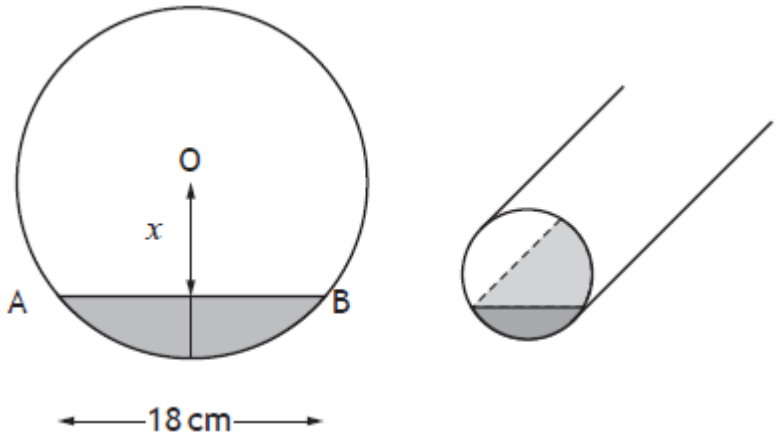
3. A cylindrical pipe has water in it as shown.



The depth of the water at the deepest point is 5 centimetres.

The width of the water surface, AB, is 18 centimeters.

The radius of the pipe is r centimetres.

The distance from the centre, O, of the pipe to the water surface is x centimetres.

(a) Write down an expression for x in terms of r. (1 mark)

(b) Calculate r, the radius of the pipe. (3 marks)

N5 Practice Paper C, P1, Q9

4. A pony shelter is part of a cylinder as shown in figure 1.

It is 6 metres wide and 2 metres high.

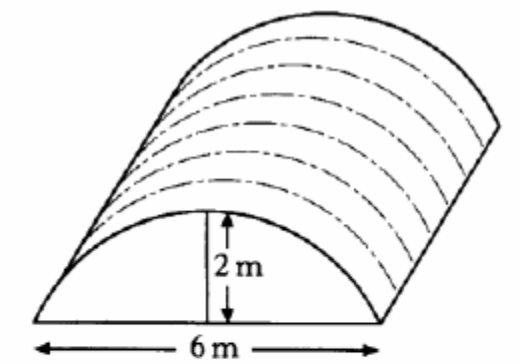


Figure 1

The cross section of the shelter is a segment of a circle with centre O, as shown in figure 2.

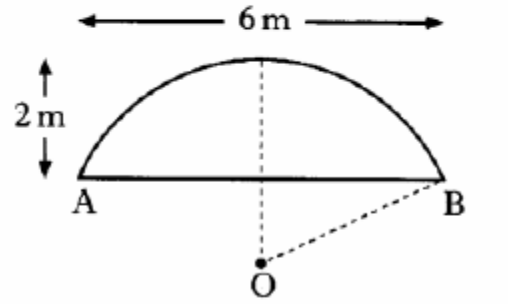


Figure 2

OB is the radius of the circle.

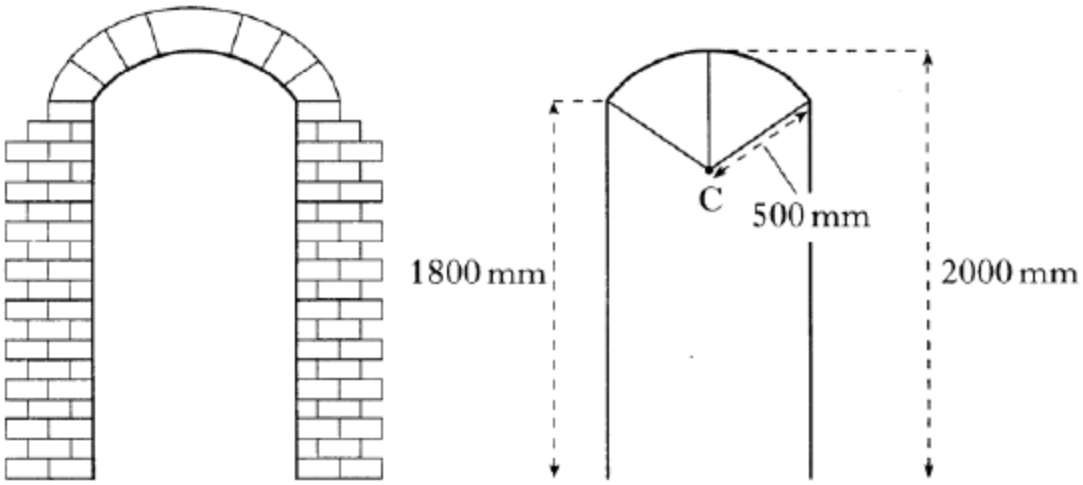
Calculate the length of OB. (4 marks)

N5 Practice Paper D, P2, Q7

5. The curved part of a doorway is an arc of a circle with radius 500 millimetres and centre C.

The height of the doorway to the top of the arc is 2000 millimetres.

The vertical edge of the doorway is 1800 millimetres.



Calculate the width of the doorway. (5 marks)

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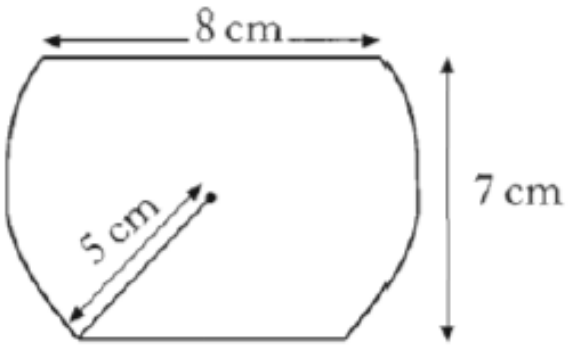
N5 Practice Paper E, P2, Q7

6. A badge is made from a circle of radius 5 centimetres.

Segments are taken off the top and bottom of the circle as shown.

The straight edges are parallel.



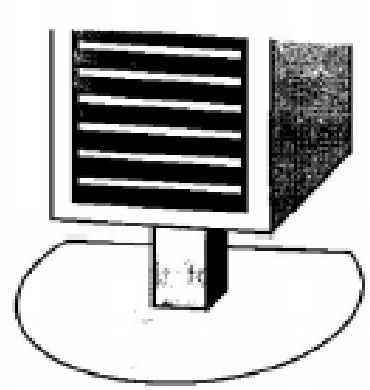
The badge measures 7 centimetres from the top to the bottom.

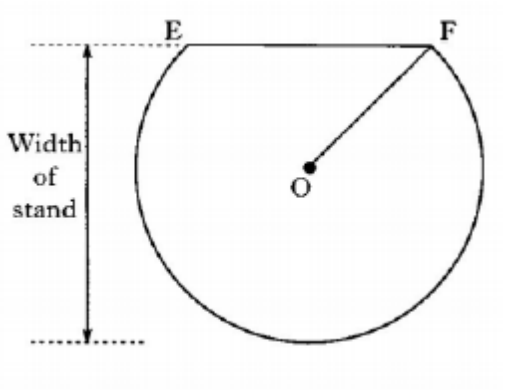
The top is 8 centimetres wide.

Calculate the width of the base. (5 marks)

N5 Practice Paper F, P1, Q6

7. The diagram shows the base of a loudspeaker stand which has the shape of part of a circle.



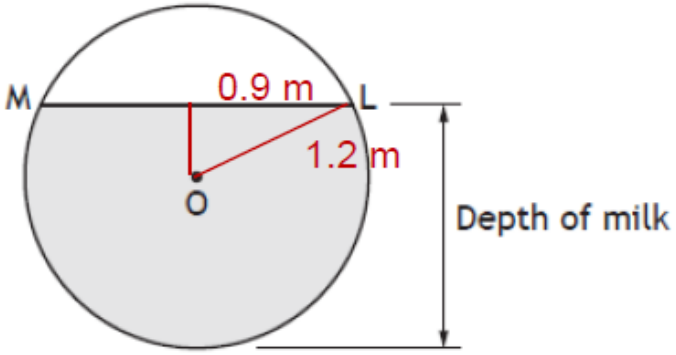


- The centre of the stand is O
- EF is a chord of the circle
- EF is 18 centimetres
- The radius, OF, of the circle is 15 centimetres

Find the width of the stand (4 marks)

Worked Solutions

1.



Draw a right angled triangle as above (1 mark)

Half of ML (short side of triangle) $= \frac{1.8}{2} = 0.9\ m$

Using Pythagoras Theorem: $x^2 = y^2 + z^2$

Short side subtract: $(short\ side)^2 = 1.2^2 - 0.9^2$

Take the square root: $short\ side = \sqrt{(1.2^2 - \ 0.9^2)}$

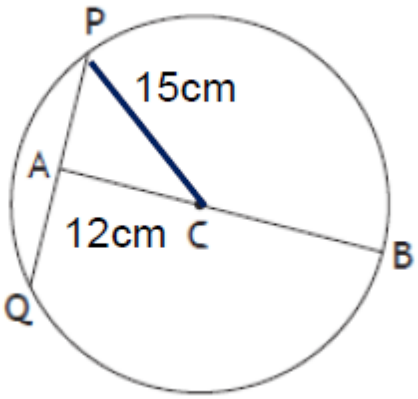
Simplify: $short\ side = 0.79\ m$ (2 marks)

Depth of Milk = Circle Radius + Short Side of Triangle

$= 0.79 \ + \ 1.2$

$= 1.99$ m (1 mark)

2.



(1 mark)

Since CB = 15 cm, then PC =15 cm (radius)

AC = AB – CB = 27 – 15 = 12 cm

Pythagoras Theorem: $x^2 = y^2 + z^2$

Short side subtract: $AP^2 = 15^2 - 12^2$ (1 mark)

Simplify: $AP^2 = 81$ (1 mark)

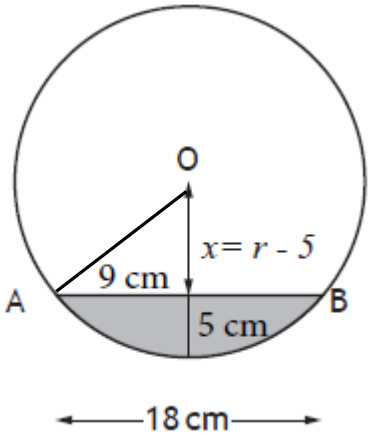
Simplify: $AP = \sqrt{81} = 9$

From the diagram above: $PQ = 2 \times AP$

Substitute 9 for AP: $PQ = 2 \times 9$

Simplify: $PQ = 18\,cm$ (1 mark)

3.



(a) From the above diagram it can be seen that:

$$x = radius - depth\ of\ water$$

$$x = r - 5$$ (1 mark)

(b) Using Pythagoras Theorem: $r^2 = (r-5)^2 + 9^2$ (1 mark)

$$r^2 = (r-5)(r-5) + 9^2$$

Multiply out the brackets: $r^2 = r^2 - 5r - 5r + 25 + 81$

Simplify: $r^2 = r^2 - 10r + 106$ (1 mark)

Take the letters to the LHS: $r^2 - r^2 + 10r = 106$

Simplify: $10r = 106$

Divide by 10 $r = 10.6$

The radius of the pipe is 10.6 cm (1 mark)

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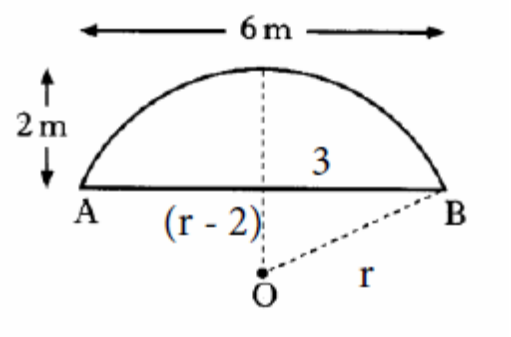
4.



Look for the right angled triangle and fill in the lengths of the sides of the triangle: $3,\ \mathrm{r}\ \&\ (\mathrm{r}-2)$. Pythagoras Theorem can be used to find the length of the radius r:

Using Pythagoras Theorem: $r^2 = (r-2)^2 + 3^2$ (1 mark)

Substitute $(r-2)^2$ for 2 brackets: $r^2 = (r-2)(r-2) + 3^2$

Multiply out the brackets: $r^2 = r(r-2) - 2(r-2) + 9$

Multiply out the brackets again: $r^2 = r^2 - 2r - 2r + 4 + 9$

Simplify: $r^2 = r^2 - 4r + 13$ (1 mark)

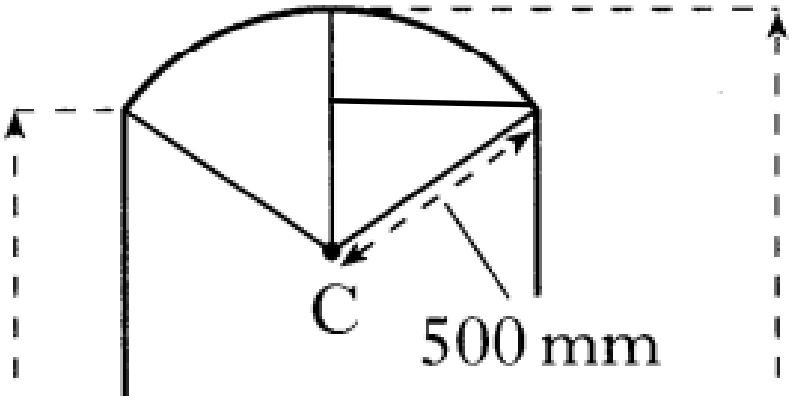
Put the letters (r) LHS & numbers RHS: $r^2 - r^2 + 4r = 13$

Simplify: $4r = 13$ (1 mark)

Divide by 4: $r = 3.25\ m$

The radius of the circle is 3.25 m (1 mark)

5.

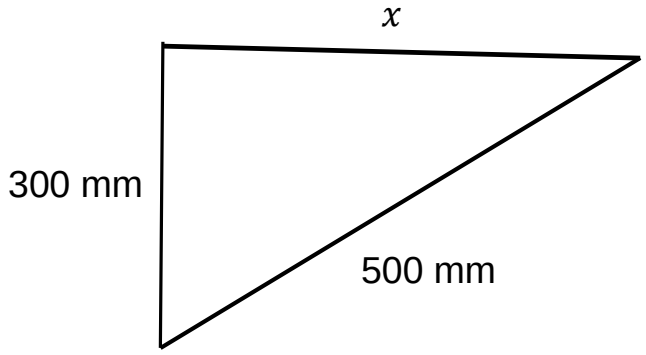


Vertical line from C to the sector top $=$ radius $=$ 500 mm (1 mark)

Sector top to triangle corner $= 2000 - 1800 = 200$ mm

Triangle corner to C $= 500 - 200 = 300$ mm. (1 mark)

This bottom triangle is shown below:

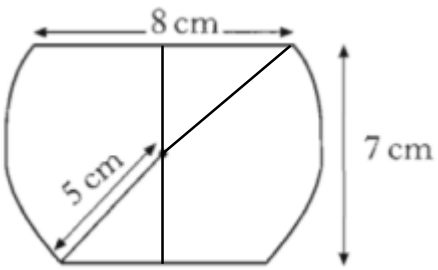


Using Pythagoras: $x^2 = 500^2 - 300^2$

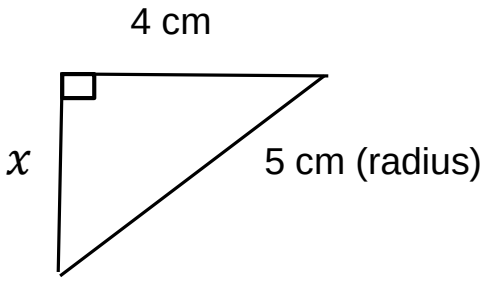
$x = \sqrt{500^2 - 300^2} = 400$ (2 marks)

Vertical edge of the doorway $= 2 \times 400 = 800\ mm$ (1 mark)

6.



With reference to the triangle at the top right in the above shape:



(1 mark)

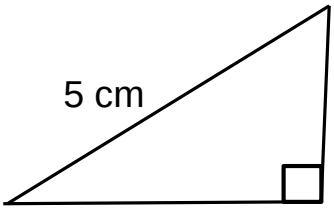
Pythagoras Theorem: $x^2 = 5^2 - 4^2$ (1 mark)

Simplify: $x^2 = 25 - 16$

Simply again: $x^2 = 9$

Take the square root: $x = 9$ (1 mark)

With reference to the triangle at the bottom left in the above shape:



$y^2 = 5^2 - 4^2$

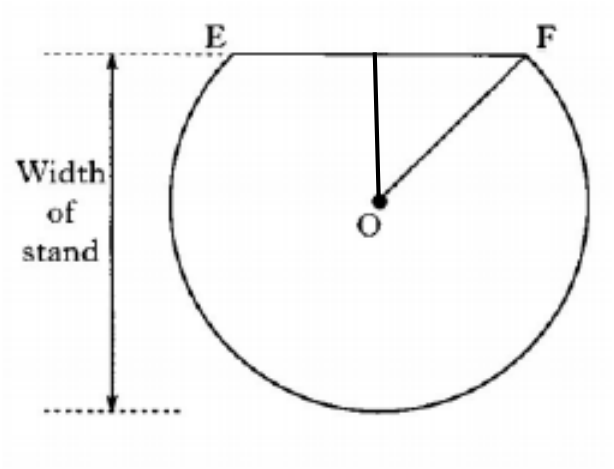
$y^2 = 25 - 16$

$y^2 = 9$

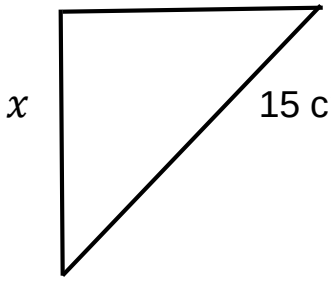
$y = 3$ (1 marks)

Width of base $= 2 \times y = 2 \times 3 = 6\ cm$ (1 mark)

7.



Considering the right angled triangle: 9 cm (half of EF)



(1 mark)

Pythagoras Theorem: $x^2 = 15^2 - 9^2$ (1 mark)

Take the square root: $= \sqrt{15^2 - 9^2}$

Simplify: $= 12\ cm$ (1 mark)

Stand Width = 12 cm + radius of stand

= 12 + 15

= 27 cm (1 mark)