

X100/201

NATIONAL
QUALIFICATIONS
2011

WEDNESDAY, 18 MAY
1.00 PM – 1.45 PM

MATHEMATICS
INTERMEDIATE 2
Units 1, 2 and 3
Paper 1
(Non-calculator)

Read carefully

- 1 You may **NOT** use a calculator.
- 2 Full credit will be given only where the solution contains appropriate working.
- 3 Square-ruled paper is provided. If you make use of this, you should write your name on it clearly and put it inside your answer booklet.



FORMULAE LIST

The roots of $ax^2 + bx + c^2 = 0$ are $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$ or $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Area of a triangle: $\text{Area} = \frac{1}{2}ab \sin C$

Volume of a sphere: $\text{Volume} = \frac{4}{3}\pi r^3$

Volume of a cone: $\text{Volume} = \frac{1}{3}\pi r^2 h$

Volume of a cylinder: $\text{Volume} = \pi r^2 h$

Standard deviation: $s = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2/n}{n-1}}$, where n is the sample size.

ALL questions should be attempted.

1. Sandi takes the bus to work each day.

Over a two week period, she records the number of minutes the bus is late each day. The results are shown below.

5 6 15 0 6 11 2 9 8 7

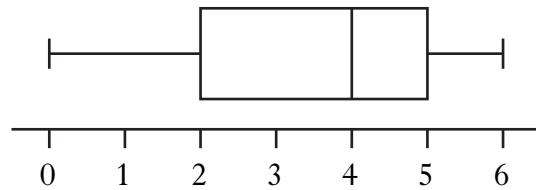
(a) From the above data, find:

- (i) the median; 1
- (ii) the lower quartile; 1
- (iii) the upper quartile. 1

(b) Construct a boxplot for the data. 2

Sandi decides to take the train over the next two week period and records the number of minutes the train is late each day.

The boxplot, drawn below, was constructed for the new data.



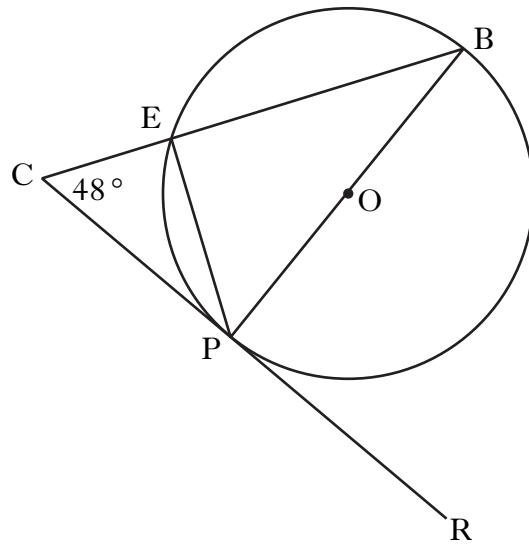
(c) Compare the two boxplots and comment. 1

2. Multiply out the brackets and collect like terms.

$$5x + (3x + 2)(2x - 7) \quad \text{3}$$

[Turn over

3. A circle, centre O, is shown below.



In the circle

- PB is a diameter
- CR is a tangent to the circle at point P
- Angle BCP is 48° .

Calculate the size of angle EPR.

3

4. Three of the following have the same value.

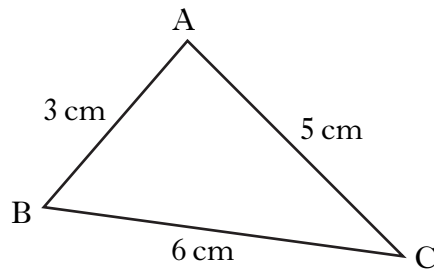
$$2\sqrt{6}, \quad \sqrt{2} \times \sqrt{12}, \quad 3\sqrt{8}, \quad \sqrt{24}.$$

Which one has a different value?

You must give a reason for your answer.

2

5.



In triangle ABC, show that $\cos B = \frac{5}{9}$.

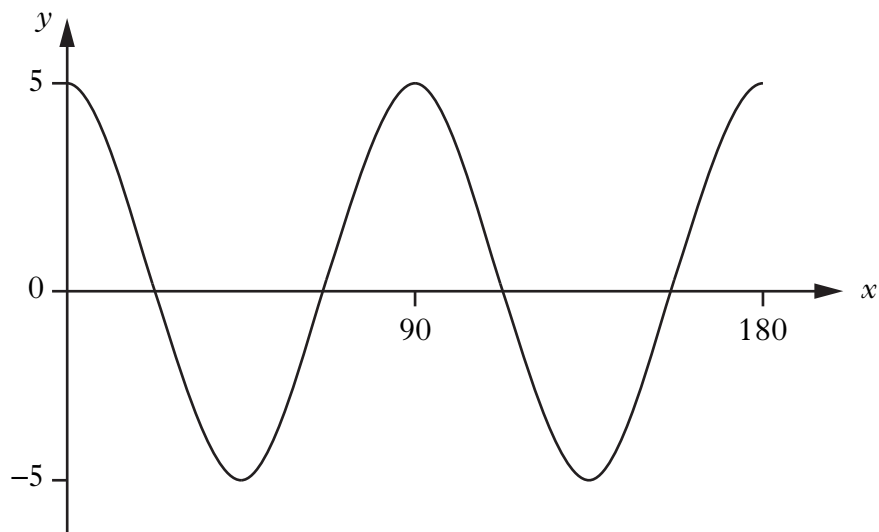
3

6. Evaluate

$$9^{\frac{3}{2}}$$

2

7. Part of the graph of $y = a \cos bx^\circ$ is shown in the diagram.



State the values of a and b .

2

[Turn over

8. A straight line is represented by the equation $y = mx + c$.

Sketch a possible straight line graph to illustrate this equation when $m > 0$ and $c < 0$.

2

9. (a) Factorise $x^2 - 4x - 21$.

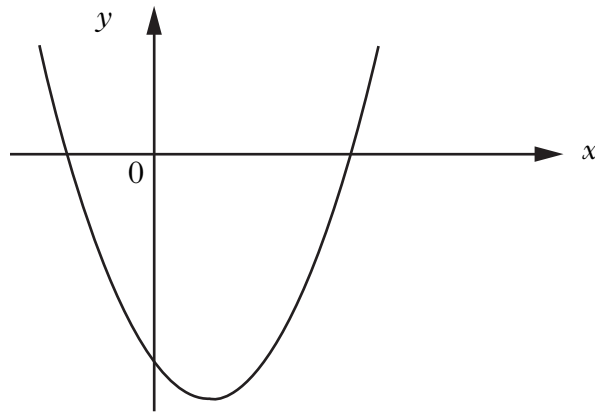
2

(b) Hence write down the roots of the equation

$$x^2 - 4x - 21 = 0.$$

1

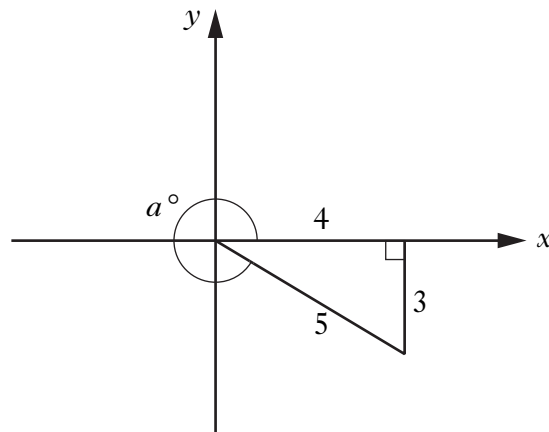
(c) The graph of $y = x^2 - 4x - 21$ is shown in the diagram.



Find the coordinates of the turning point.

3

10.



Write down the value of $\cos a^\circ$.

1

[END OF QUESTION PAPER]

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WEDNESDAY, 18 MAY
2.05 PM – 3.35 PM

MATHEMATICS
INTERMEDIATE 2
Units 1, 2 and 3
Paper 2

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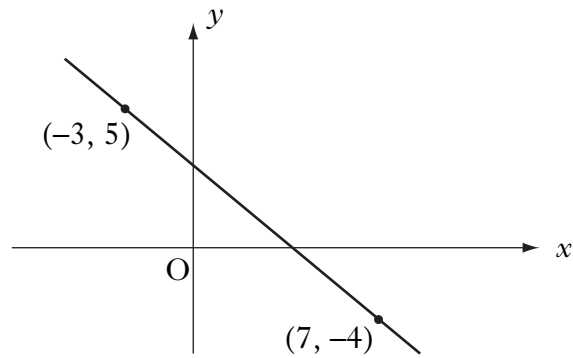
Volume of a cone: $\text{Volume} = \frac{1}{3}\pi r^2 h$

Volume of a cylinder: $\text{Volume} = \pi r^2 h$

Standard deviation: $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n-1}}$, where n is the sample size.

ALL questions should be attempted.

1.



Calculate the gradient of the straight line passing through the points $(-3, 5)$ and $(7, -4)$.

1

2. It is estimated that house prices will increase at the rate of 3.15% per annum.

A house is valued at £134 750. If its value increases at the predicted rate, calculate its value after 3 years.

Give your answer correct to **four** significant figures.

4

3. Change the subject of the formula

$$A = 4\pi r^2$$

to r .

2

[Turn over

4. The Battle of Largs in 1263 is commemorated by a monument known as The Pencil.

This monument is in the shape of a cylinder with a cone on top.



The cylinder part has diameter 3 metres and height 15 metres.

- (a) Calculate the volume of the **cylinder** part of The Pencil.

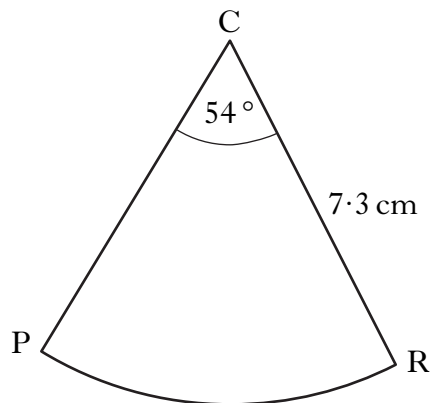
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The volume of the **cone** part of The Pencil is 5.7 cubic metres.

- (b) Calculate the **total** height of The Pencil.

3

5. The diagram below shows a sector of a circle, centre C.



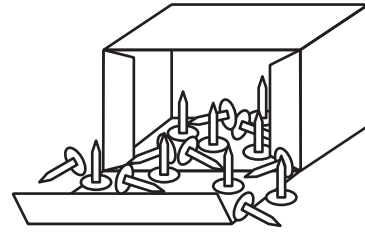
The radius of the circle is 7.3 centimetres and angle PCR is 54° .

Calculate the area of the sector PCR.

3

6. A sample of six boxes contains the following numbers of pins per box.

43 39 41 40 39 44



- (a) For the above data, calculate:
 (i) the mean;
 (ii) the standard deviation.

1
3

The company which produces the pins claims that “the mean number of pins per box is 40 ± 2 and the standard deviation is less than 3”.

- (b) Does the data in part (a) support the claim made by the company?
 Give reasons for your answer.

2

7. Alan is taking part in a quiz. He is awarded x points for each correct answer and y points for each wrong answer. During the quiz, Alan gets 24 questions correct and 6 wrong. He scores 60 points.

- (a) Write down an equation in x and y which satisfies the above condition.

1

Helen also takes part in the quiz. She gets 20 questions correct and 10 wrong. She scores 40 points.

- (b) Write down a second equation in x and y which satisfies this condition.

1

- (c) Calculate the score for David who gets 17 correct and 13 wrong.

4

8. Simplify

$$\frac{3x - 15}{(x - 5)^2}$$

2

9. Express

$$\frac{3}{x} - \frac{4}{x+1}, \quad x \neq 0, \quad x \neq -1$$

as a single fraction in its simplest form.

3

10. Solve the equation

$$2 \tan x^\circ - 3 = 5, \quad 0 \leq x \leq 360.$$

3

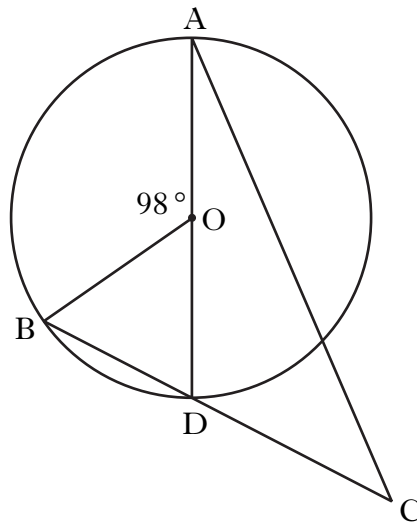
11. Solve the equation

$$4x^2 - 7x + 1 = 0,$$

giving the roots correct to 1 decimal place.

4

12.



AD is a diameter of a circle, centre O.

B is a point on the circumference of the circle.

The chord BD is extended to a point C, outside the circle.

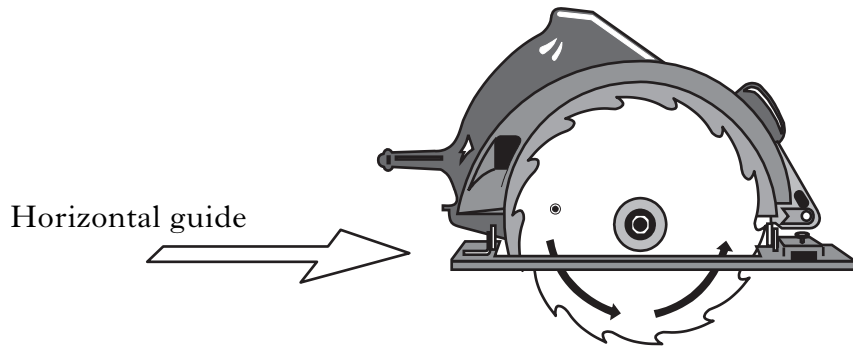
Angle BOA = 98° .

DC = 9 centimetres. The radius of the circle is 7 centimetres.

Calculate the length of AC.

5

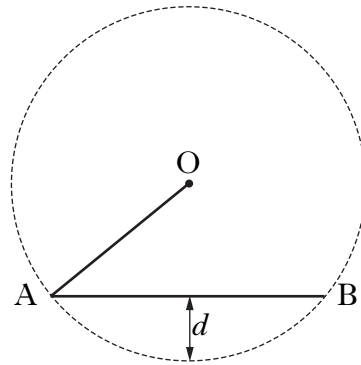
13. A circular saw can be adjusted to change the depth of blade that is exposed below the horizontal guide.



The circle, centre O, below represents the blade and the line AB represents part of the horizontal guide.

This blade has a radius of 110 millimetres.

If AB has length 140 millimetres, calculate the depth, d millimetres, of saw exposed.



4

14. Prove that

$$\frac{\sin^2 A}{1 - \sin^2 A} = \tan^2 A.$$

2

[END OF QUESTION PAPER]

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