X100/11/02

MATHEMATICS
INTERMEDIATE 2
Units 1, 2 and 3
Paper 2

Read carefully

1 **Calculators may be used in this paper.**

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.

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FORMULAE LIST

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

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

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

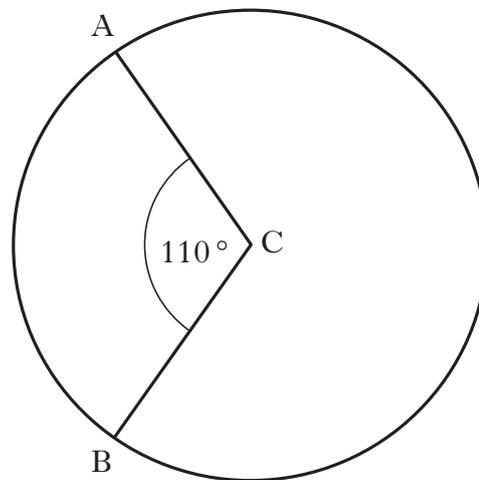Area of a triangle: $\text{Area} = \frac{1}{2}ab \sin C$

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

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

The circumference of the circle is 40·8 centimetres.

Calculate the length of the minor arc AB.   **2**

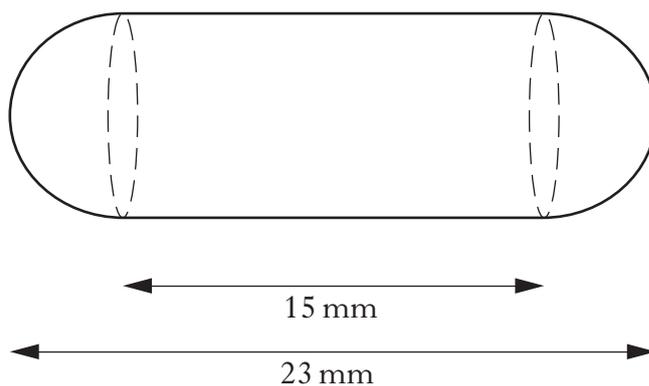2.   Multiply out the brackets and collect like terms.

$$(3x - 5)(x^2 + 2x - 6)$$ **3**

[Turn over

3. A health food shop produces cod liver oil capsules for its customers.

Each capsule is in the shape of a cylinder with hemispherical ends as shown in the diagram below.

The total length of the capsule is 23 millimetres and the length of the cylinder is 15 millimetres.

Calculate the volume of one cod liver oil capsule.

4

4. Solve the equation

$$3x^2 + 7x - 5 = 0,$$

giving the roots correct to one decimal place.   **4**

5. A ten-pin bowling team recorded the following six scores in a match.

                134   102   127   98   104   131

(*a*) For this sample calculate:

   (i) the mean;

   (ii) the standard deviation.

   Show clearly all your working.   **4**

In their second match their six scores have a mean of 116 and a standard deviation of 12·2.

(*b*) Consider the 5 statements written below.

   1   The total of the scores is the same in both matches.

   2   The total of the scores is greater in the first match.

   3   The total of the scores is greater in the second match.

   4   In the first match the scores are more spread out.

   5   In the second match the scores are more spread out.

   Which of these statements is/are true?   **2**

6. Three groups are booking a holiday. The first group consists of 6 adults and 2 children. The total cost of their holiday is £3148.

Let *x* pounds be the cost for an adult and *y* pounds be the cost for a child.

(*a*) Write down an equation in *x* and *y* which satisfies the above information.   **1**

The second group books the same holiday for 5 adults and 3 children. The total cost of their holiday is £3022.

(*b*) Write down a second equation in *x* and *y* which satisfies this information.   **1**

(*c*) The third group books the same holiday for 2 adults and 4 children. The travel agent calculates that the total cost is £2056.

   Has this group been overcharged?

   Justify your answer.   **4**

7. Express as a single fraction

$$\frac{a}{b}+\frac{b}{a}, \;\; a \neq 0, \;\; b \neq 0.$$

2

8. Solve the equation $5 \cos x° - 3 = 1, \;\; 0 \leq x \leq 360.$

3

9. A formula used to calculate lighting efficiency is
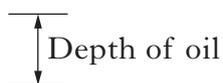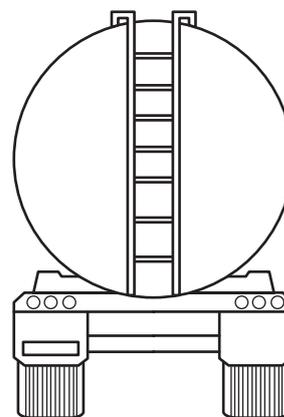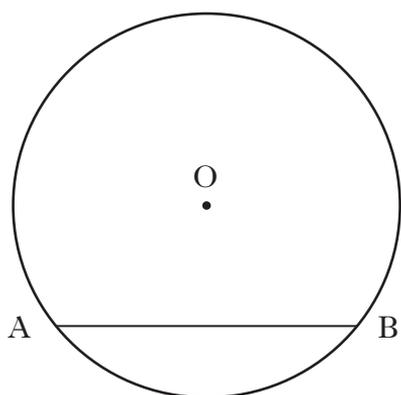
$$E \;=\; \frac{I}{D^2}.$$

Change the subject of this formula to D.

3

10. A tanker delivers oil to garages.

The tank has a circular cross-section as shown in the diagram below.

The radius of the circle, centre O, is 1·9 metres.

The width of the surface of the oil, represented by AB in the diagram, is 2·2 metres.
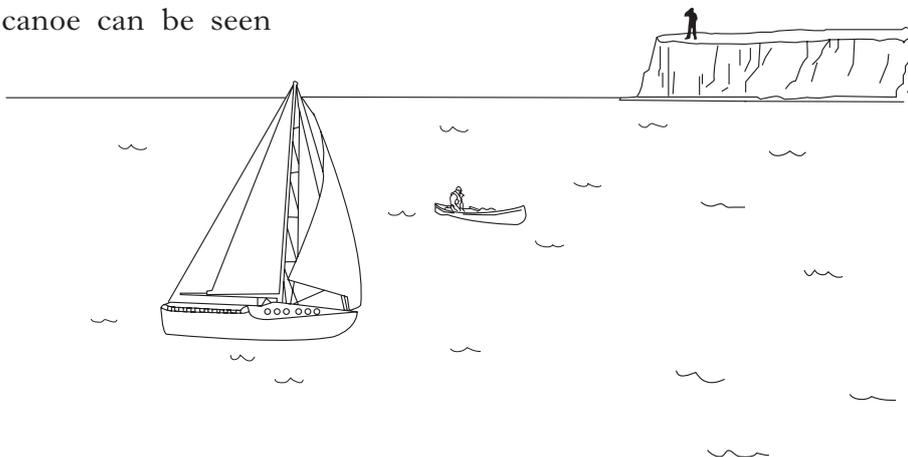
Calculate the depth of the oil in the tanker.

4

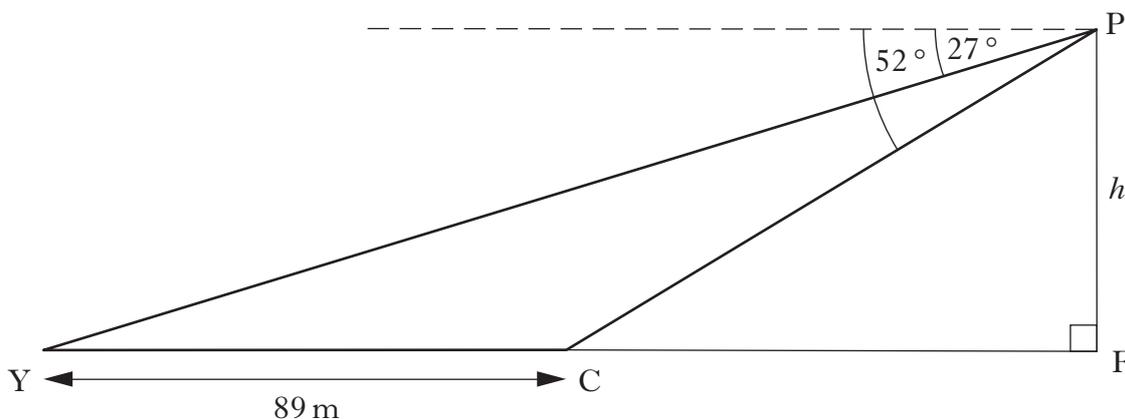**11.** Simplify, expressing your answer with positive indices.

$$(x^2 \, y^4) \div (x^{-3} \, y^6)$$

2

12. A yacht and a canoe can be seen from a clifftop.

In the diagram below, Y and C represent the positions of the yacht and the canoe.

From a point P on the clifftop:

* the angle of depression of the yacht is 27 °;
* the angle of depression of the canoe is 52 °.

The distance between the yacht and the canoe is 89 metres.

Calculate the height, *h*, metres, of the cliff.

5

[Turn over

13. Due to the threat of global warming, scientists recommended in 2010 that the emissions of greenhouse gases should be reduced by 50% by the year 2050.

The government decided to reduce the emissions of greenhouse gases by 15% **every ten years**, starting in the year 2010.

Will the scientists' recommendations have been achieved by 2050?

You must give a reason for your answer.   **4**

14. Simplify $\dfrac{\cos x^\circ \ \tan x^\circ}{\sin x^\circ}$.   **2**

[*END OF QUESTION PAPER*]