C

2500/404

NATIONAL QUALIFICATIONS 2000

THURSDAY, 18 MAY
1.00 PM – 3.15 PM

MATHEMATICS STANDARD GRADE
Credit Level

1 Answer as many questions as you can.

2 Full credit will be given only where the solution contains appropriate working.

3 Square-ruled paper is provided.

SCOTTISH QUALIFICATIONS AUTHORITY

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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: Area $=\frac{1}{2}ab\sin C$

KU	RA

1. In January 1999, it was estimated that the number of monkeys in a colony was 5000.

The number of monkeys is decreasing at the rate of 12% per year.

How many monkeys are expected to be in this colony in January 2002?

Give your answer **to the nearest 10**. **4**

2. The mass of water on the earth's surface is $1{\cdot}41 \times 10^{18}$ tonnes.

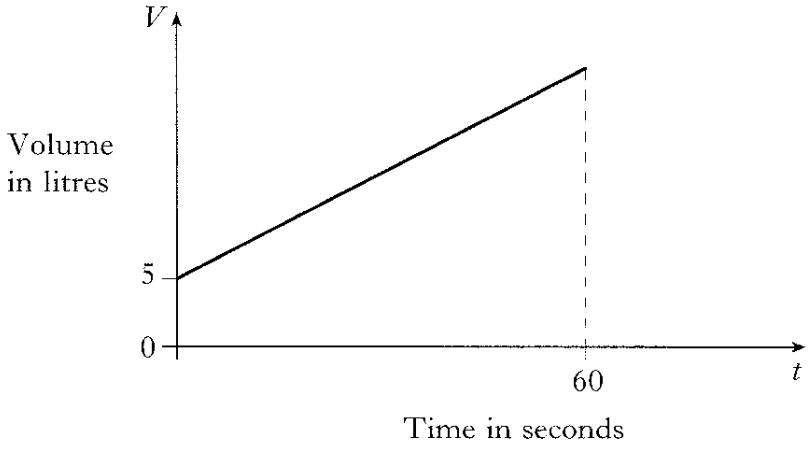
The total mass of the earth is $5{\cdot}97 \times 10^{21}$ tonnes.

Express the mass of water on the earth's surface as a percentage of the total mass of the earth.

Give your answer in **scientific notation**. **3**

3. The tank of a car contains 5 litres of petrol.

The graph below shows how the volume of petrol in this tank changes as a further 45 litres of petrol is pumped in at a steady rate for 60 seconds.

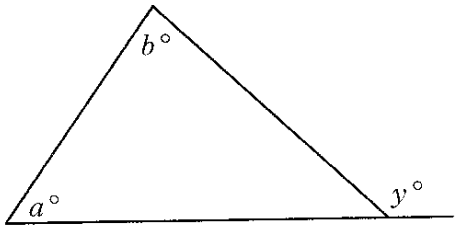


Find the equation of the straight line in terms of V and t. **4**

[Turn over

KU	RA

4.



Use the information in the above diagram to find a relationship connecting a, b and y. **2**

5. Solve the equation $x^2 + 3x - 5 = 0$.

Give your answer **correct to 2 significant figures**. **4**

6. Jamie conducted a survey.

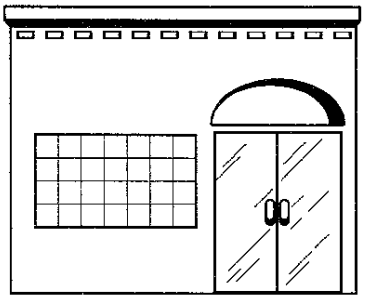
He asked his classmates how they had travelled to school that day.

Here are their replies:

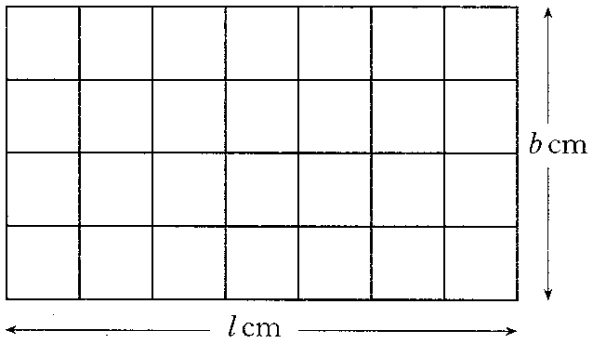
Walk	13
Bus	9
Car	6
Cycle	2

Draw an appropriate statistical diagram to illustrate this information. **4**

7.



A rectangular window has length, l centimetres and breadth, b centimetres.



A security grid is made to fit this window. The grid has 5 horizontal wires and 8 vertical wires.

(*a*) The perimeter of the window is 260 centimetres.
Use this information to write down an equation involving l and b. **1**

(*b*) In total, 770 centimetres of wire are used.
Write down another equation involving l and b. **2**

(*c*) Find the length and breadth of the window. **3**

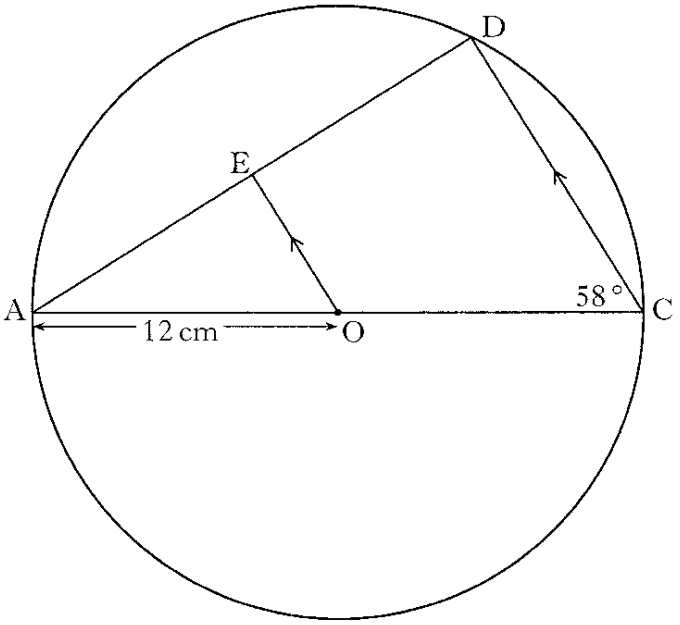
8. $$P = 4 + \frac{5}{W}$$

Change the subject of the formula to W. **3**

[Turn over

KU	RA

9.



AC is a diameter of the circle with centre, O, and radius 12 centimetres.

AD is a chord of the circle.

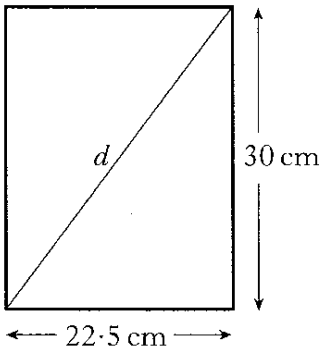
OE is parallel to CD.

Angle ACD is 58°.

Calculate the length of ED. **4**

10. A **rectangular** picture frame is to be made.

It is 30 centimetres high and 22·5 centimetres wide, as shown.



To check that the frame is rectangular, the diagonal, d, is measured.

It is 37·3 centimetres long.

Is the frame rectangular? **4**

	KU	RA

11. **1, 3, 5, 7, ...**

The **first** odd number can be expressed as $1 = 1^2 - 0^2$.

The **second** odd number can be expressed as $3 = 2^2 - 1^2$.

The **third** odd number can be expressed as $5 = 3^2 - 2^2$.

(*a*) Express the **fourth** odd number in this form. **1**

(*b*) Express the number 19 in this form. **1**

(*c*) Write down a formula for the n^{th} odd number and simplify this expression. **2**

(*d*) **Prove** that the product of two consecutive odd numbers is always odd. **3**

12. Solve **algebraically** the inequality

$$2y < 3 - (y + 6).$$ **3**

13. A frictional force is necessary for a car to round a bend.

The frictional force, F kilonewtons, varies directly as the square of the car's speed, V metres per second, and inversely as the radius of the bend, R metres.

(*a*) Write down a relationship between F, V and R. **1**

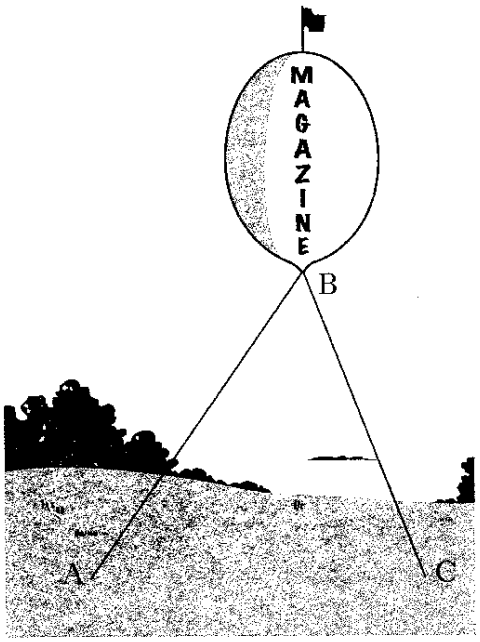
A frictional force of 20 kilonewtons is necessary for a car, travelling at a given speed, to round a bend.

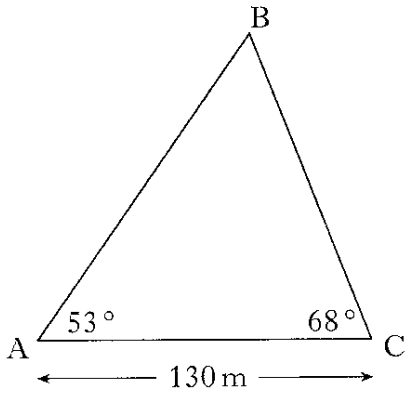
(*b*) Find the frictional force necessary for the same car, travelling at **twice** the given speed, to round the same bend. **2**

[Turn over

KU	RA

14. A newspaper group advertises a new magazine on a helium balloon.





From the base of the balloon, B, two holding wires are attached to the ground at A and C.

The distance from A to C is 130 metres.

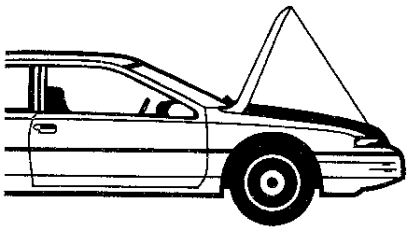
From A, the angle of elevation of B is 53°.

From C, the angle of elevation of B is 68°.

Calculate the height of point B above the ground.

Do not use a scale drawing. **5**

15.



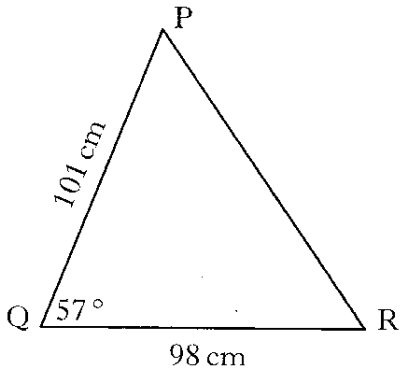
The bonnet of a car is held open, at an angle of 57°, by a metal rod.

In the diagram,

PQ represents the bonnet

PR represents the metal rod

QR represents the distance from the base of the bonnet to the front of the car.



PQ is 101 centimetres.

QR is 98 centimetres.

Calculate the length of the metal rod, PR.

Do not use a scale drawing. **4**

16. Triangle ABC has an area of 14 square centimetres.

AB is 6 centimetres and AC is 7 centimetres.

Calculate the possible **sizes** of angle BAC. **4**

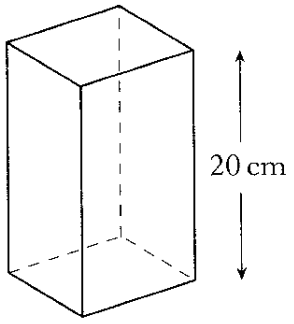
17. (*a*) Factorise $x^2 - 16$. **1**

(*b*) Express $\frac{5(2x-3)}{4x^2-9}$ in its simplest form. **2**

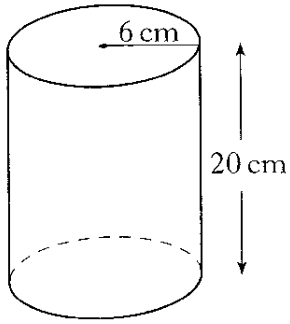
[Turn over

KU	RA

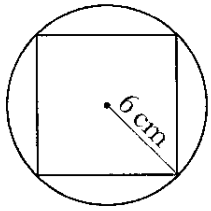
18. A glass vase, in the shape of a cuboid with a square base, is 20 centimetres high.



It is packed in a cardboard cylinder with radius 6 centimetres and height 20 centimetres.



The corners of the vase touch the inside of the cylinder as shown.



Show that the volume of the space between the vase and the cylinder is $720(\pi - 2)$ cubic centimetres. **5**

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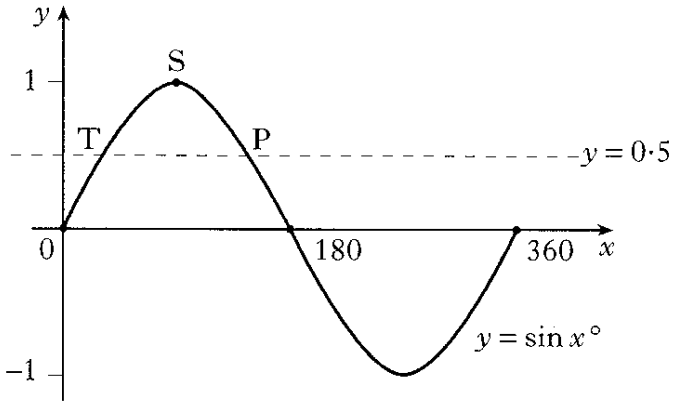
19.



The diagram shows the graph of $y = \sin x°$, $0 \leq x \leq 360$.

(*a*) Write down the coordinates of point S. **1**

The straight line $y = 0{\cdot}5$ cuts the graph at T and P.

(*b*) Find the coordinates of T and P. **2**

20. (*a*) Remove the brackets and simplify

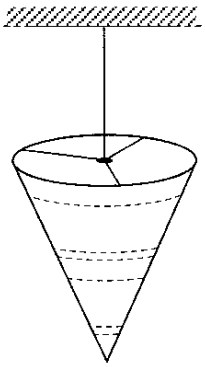
$$a^{\frac{1}{2}}\left(a + \frac{1}{a}\right).$$ **2**

(*b*) Express $\sqrt{18} - \sqrt{2}$ as a surd in its simplest form. **2**

[Turn over for Question 21 on *Page twelve*

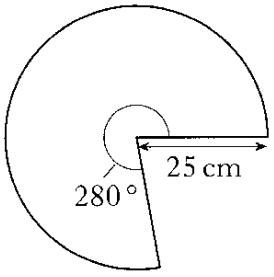
	KU	RA

21. A lampshade is made in the shape of a cone, as shown.



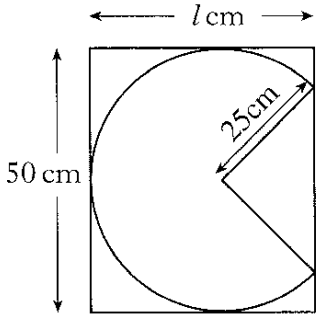
The shape of the material used for the lampshade is a sector of a circle.

The circle has radius 25 centimetres and the angle of the sector is 280°.



(*a*) Find the area of the sector of the circle. | 3 |

Each sector is cut from a rectangular piece of material, 50 centimetres wide.



(*b*) Find, to the nearest centimetre, the **minimum** length, l, required for the piece of material. | | 4 |

[END OF QUESTION PAPER]