

C

[2500/125] 1994

SCOTTISH CERTIFICATE OF EDUCATION

**MATHEMATICS**

Standard Grade—CREDIT LEVEL

Wednesday, 11th May—1.30 p.m. to 3.45 p.m.

Answer as many questions as you can.

In this paper good thinking is looked for as well as correct answers. Your working gives an indication of your thinking so SHOW YOUR WORKING CLEARLY.

You may use a calculator.

Square-ruled paper is provided.

**FORMULAE LIST**

The roots of  $ax^2 + bx + c = 0$  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:** Area =  $\frac{1}{2}ab \sin C$

1. Solve the equation

$$5 + 3a = a - 15.$$

KU	RA
3	

2. The number of people suffering from a virus is 12 million.

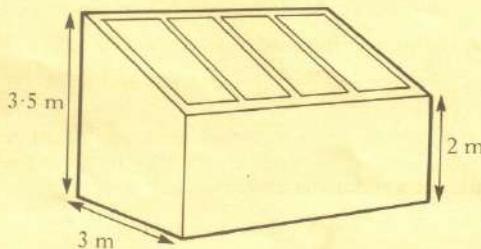
For each of the next three years, the number of people suffering from the virus is expected to be 5% more than the number in the previous year.

How many people are expected to be suffering from the virus in 3 years time?

**Give your answer in millions.**

3

3. The Scott family want to build a conservatory as shown below.



The conservatory is to be 3 metres wide. The height of the conservatory at the lower end is to be 2 metres and at the higher end 3.5 metres.

To obtain planning permission, the roof must slope at an angle of  $(25 \pm 2)$  degrees to the horizontal.

Should planning permission be granted?

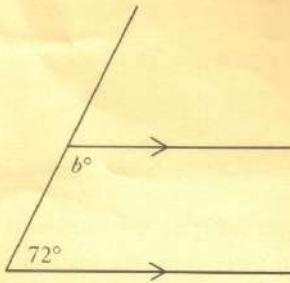
**Justify your answer.**

4

**[Turn over**

4. The diagram opposite shows two parallel lines meeting a third at  $72^\circ$ .

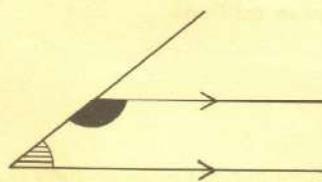
(a) Find the value of  $b$ .



KU RA

1

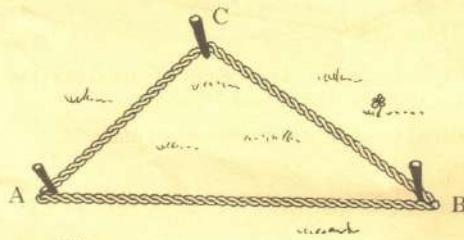
(b) The diagram opposite shows the general case of two parallel lines meeting a third line.



Prove that, in every case, the sum of the shaded angles is  $180^\circ$ .

3

5. A loop of rope is used to mark out a triangular plot, ABC.



The loop of rope measures 6 metres.

Pegs are positioned at A and B such that  $AB = 2.5$  metres.

The third peg is positioned at C such that  $BC = 2$  metres.

Prove that angle  $ACB = 90^\circ$ .

**Do not use a scale drawing.**

4

6. The sequence of odd numbers starting with 3 is 3, 5, 7, 9, 11, ...

Consecutive numbers from this sequence can be added using the following pattern

$$3 + 5 + 7 + 9 = 4 \times 6$$

$$3 + 5 + 7 + 9 + 11 = 5 \times 7$$

$$3 + 5 + 7 + 9 + 11 + 13 = 6 \times 8$$

(a) Express  $3 + 5 + \dots + 25$  in the same way.

(b) The first  $n$  numbers in this sequence are added. Find a formula for the total.

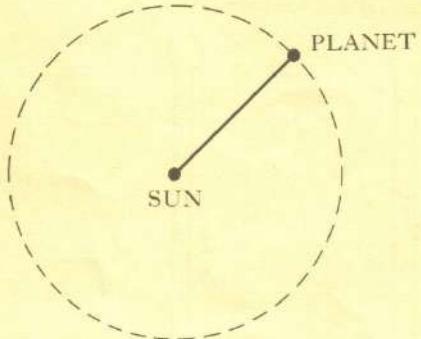
KU	RA
	2
	3

7. A planet takes 88 days to travel round the Sun.

The approximate path of the planet round the Sun is a circle with diameter  $1.2 \times 10^7$  kilometres.

Find the speed of the planet as it travels round the Sun.

Give your answer in kilometres per hour, correct to 2 significant figures.

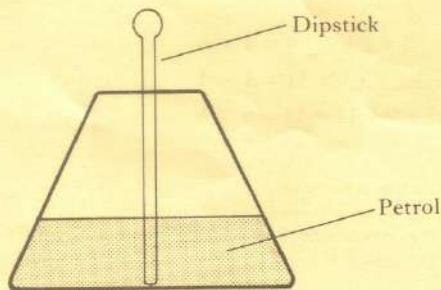


4

[Turn over

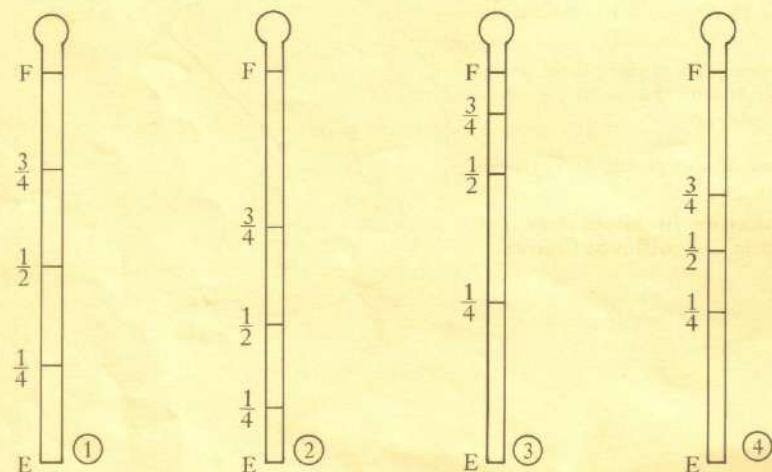
8. The diagram below shows the cross-section of a petrol tank.

KU RA



A dipstick is used to check the level of the petrol in the tank.

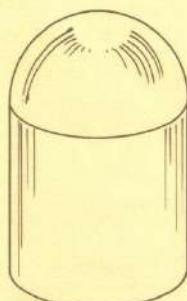
The dipstick has marks to show empty (E), quarter full (¶), half full (½), three quarters full (¾) and totally full (F).



(a) Which dipstick, 1—4, should be used with the tank?  
**Explain your answer fully.**

3

(b) Here is another petrol tank.



Sketch a graph to show how the depth of the petrol varies with the volume of petrol in the tank.

3

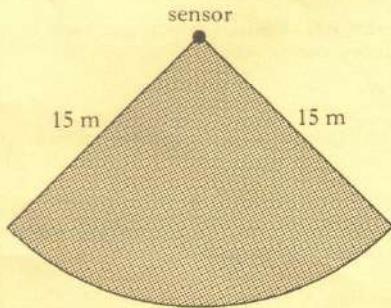
9. (a) Remove the brackets and simplify

$$(2y - 3)^2.$$

(b) Factorise  $2x^2 + 7x - 4$ .

KU	RA
2	
2	

10. A sensor in a security system covers a horizontal area in the shape of a sector of a circle of radius 15 m.



The area of the sector is 200 square metres.

Find the length of the arc of the sector.

4

[Turn over

11. A cable car is used to carry sightseers up a mountain.

For safety reasons, the cable car company must consider the total weight of sightseers in a cable car.

They assume the average weight of an adult is 75 kilograms and the average weight of a child is 35 kilograms.

(a) Write down a formula for the **total** weight,  $W$  kilograms, of  $x$  adults and  $y$  children.

(b) In the busy season, the company sets the following conditions.

(i) 10 passengers must be carried at any one time.  
(ii) Every child must be accompanied by **at least** one adult.  
(iii) The maximum total weight which can be carried is 700 kilograms.

List all the combinations of adults and children which can now be carried in the cable car to meet all the above conditions.

Show all your working clearly.

KU	RA
----	----

2

4

12. The number of letters,  $N$ , which can be typed on a sheet of paper varies inversely as the square of the size,  $s$ , of the letters used.

(a) Write down a relationship connecting  $N$  and  $s$ .

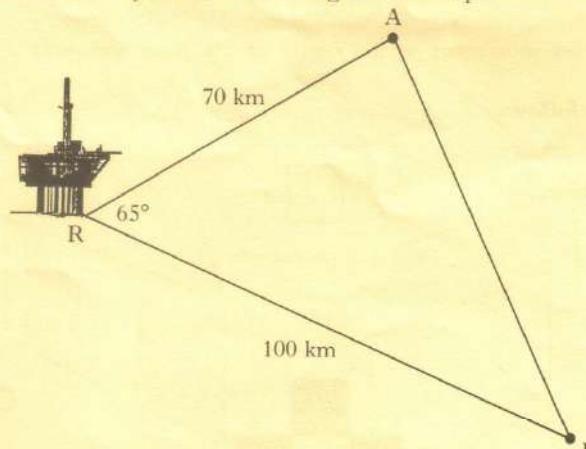
1

(b) The size of the letters used is doubled.

What effect does this have on the number of letters which can be typed on the sheet of paper?

2

13. The diagram shows the positions of an oilrig and two ships.



The oilrig at R is 70 kilometres from a ship at A and 100 kilometres from a ship at B. Angle ARB =  $65^\circ$ .

Calculate the distance AB.

**Do not use a scale drawing.**

KU	RA
----	----

4

14. A bottle bank is prism shaped, as shown in figure 1.

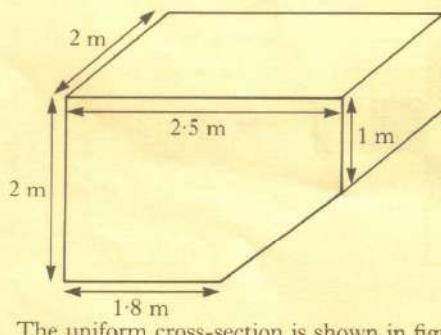


figure 1

The uniform cross-section is shown in figure 2.

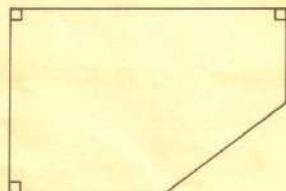


figure 2

Find the volume of the bottle bank.

4

15. A large floor is to be covered with black and grey square tiles to make a chequered pattern.

The person laying the tiles must start at the centre of the floor and work outwards.

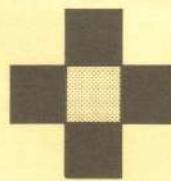
**The instructions are as follows.**

1. Lay a grey tile in the centre of the floor.



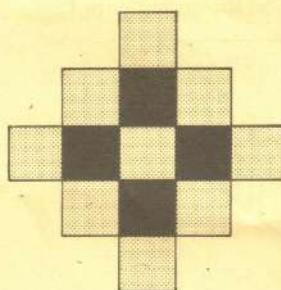
1st Arrangement

2. Place black tiles against the edges of the grey tile.



2nd Arrangement

3. Place grey tiles against the edges of all the black tiles.



3rd Arrangement

4. Place black tiles against the edges of all the grey tiles.

5. And so on . . .

(a) How many tiles are there in the 4th arrangement?

2

(b) The number of tiles,  $T$ , needed to make the  $N$ th arrangement is given by the formula

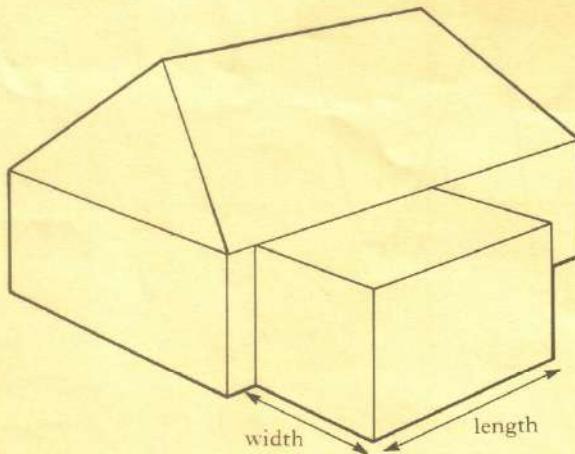
$$T = 2N^2 + aN + b.$$

Find the values of  $a$  and  $b$ .

4

16. A family want to build an extension at the rear of their house.

KU	RA



An architect advises that the extension should have its length 2 metres more than its width.

(a) If the width of the extension is  $w$  metres, write down an expression for its length.

1

Planning regulations state that the area of the ground floor of the extension must not exceed 40% of the area of the ground floor of the original house.

(b) The ground floor of the original house is 12 metres by 10 metres.

Show that, if the largest extension is to be built,  $w^2 + 2w - 48 = 0$ .

3

(c) Find the dimensions of the largest extension which can be built.

2

17. Solve the equation

$$5 \sin x^\circ + 2 = 0, \quad \text{for } 0^\circ \leq x < 360^\circ.$$

3

18. (a) Express as a single fraction in its simplest form

$$\frac{3}{x} + \frac{2-x}{x^2}, \quad x \neq 0.$$

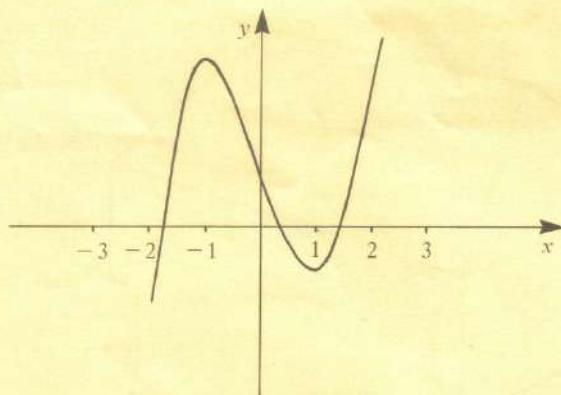
3

(b) Express  $\frac{3}{\sqrt{5}}$  as a fraction with a rational denominator.

2

19. Part of the graph of  $y = x^3 - 3x + 1$  is shown in the diagram.

KU RA

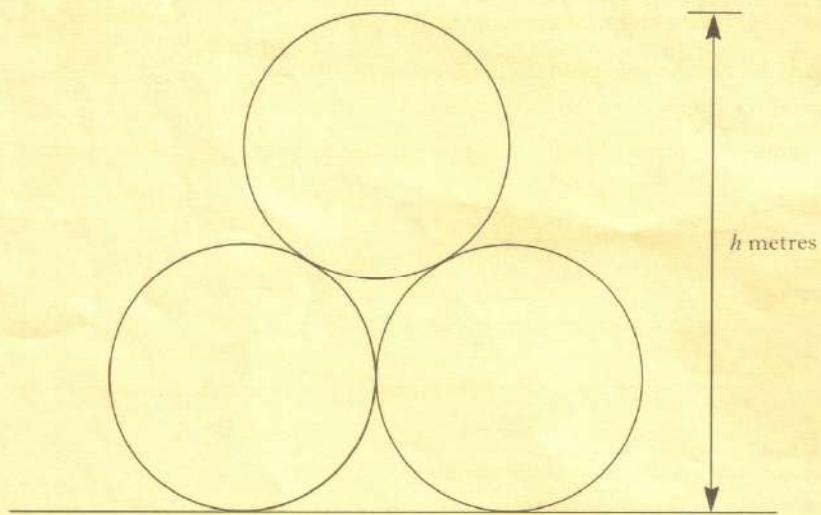


Use iteration to find the value of the **negative** root of  $x^3 - 3x + 1 = 0$ , correct to one decimal place.

Show all your working clearly.

4

20. Three pipes are stored on horizontal ground as shown in the diagram.



Each pipe has a circular cross-section with radius 1 metre.

Calculate the height,  $h$  metres, of the stacked pipes. (Ignore the thickness of the pipes.)

Give your answer in metres correct, to two decimal places.

4

[END OF QUESTION PAPER]