C

[2500/229] 1993

SCOTTISH CERTIFICATE OF EDUCATION

MATHEMATICS

Standard Grade—CREDIT LEVEL

Tuesday, 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.

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

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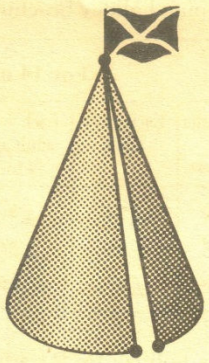
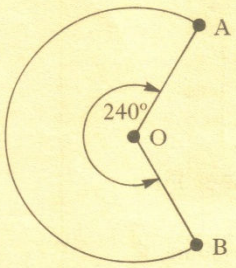
1. The diagram shows a tent.



The shape of the material used to make the tent is a sector of a circle as shown below.



O is the centre of the circle.
OA and OB are radii of length 3 metres.
Angle AOB is 240°.

Calculate the area of this piece of material. **3**

2. One hundred milligrams of a drug are given to a patient.

At the end of each hour the number of milligrams of the drug left in the body is 10% less than at the beginning of that hour.

How many milligrams of the drug are left in the body at the end of four hours? **3**

3. The total number of visitors to an exhibition was $2{\cdot}925 \times 10^7$.

The exhibition was open each day from 5 June to 29 September **inclusive**.

Calculate the average number of visitors per day to the exhibition. **3**

KU	RA

4. An extract from a camping holiday brochure is shown below.

Season	For 14 nights					Over 14 nights
	Two adults	Each extra adult	Each young adult aged 14 to 17	Each child aged 10 to 13	Each child aged 0 to 9	Each additional night per family
Low	£399	£74	£40	Free	Free	£19
Mid	£555	£85	£50	Free	Free	£29
High	£699	£95	£60	£46	Free	£39

(*a*) Find the cost of a holiday for 2 adults and a child, aged 8, for 17 nights during mid season. — 2

(*b*) Write down a formula to find the cost, £C, of a holiday in mid season for 2 adults and a child aged 8 lasting t nights, where t is greater than 14. — 3

5. A tank contains 240 litres of water.

When the tap is opened, water flows from the tank at a steady rate of 20 litres per minute.

(*a*) On the 2 mm square-ruled paper provided, draw a graph of the volume, V litres, of water in the tank against the time, t minutes. — 3

(*b*) Write down an equation connecting V and t. — 2

6. The following number pattern can be used to sum consecutive square whole numbers.

$$1^2 + 2^2 = \frac{2 \times 3 \times 5}{6}$$

$$1^2 + 2^2 + 3^2 = \frac{3 \times 4 \times 7}{6}$$

$$1^2 + 2^2 + 3^2 + 4^2 = \frac{4 \times 5 \times 9}{6}$$

(*a*) Express $1^2 + 2^2 + 3^2 + \ldots + 10^2$ in the same way. — 1

(*b*) Express $1^2 + 2^2 + 3^2 + \ldots + n^2$ in the same way. — 2

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7. Solve the system of equations

$$5a + 3b = 9$$

$$7a - 2b = 25.$$

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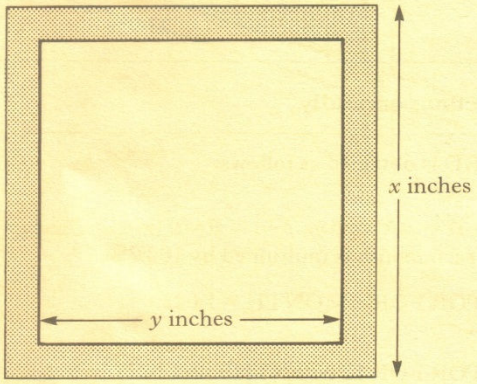
8.



A square picture frame is shown above.

The border of the frame (shaded in the diagram) has uniform width and an area of 48 square inches.

(*a*) Show that $(x - y)(x + y) = 48$. | 2 |

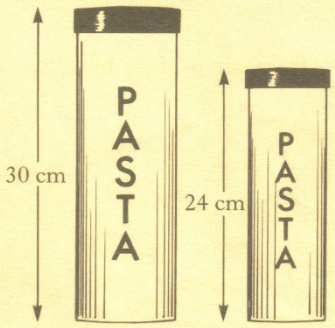
(*b*) Given that x and y are whole numbers each greater than 10, find suitable replacements for x and y. | 3 |

9. The diagram opposite shows two storage jars which are mathematically similar.

The volume of the large jar is 1·2 litres.

Find the volume of the smaller jar.

Give your answer in litres correct to 2 significant figures.



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10. The table below shows some interest rates for credit cards.

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CREDIT CARD INTEREST RATES		
Name of Card	*Monthly Rate*	*Annual Percentage Rate (APR)*
FLEXICARD	2·2%	29·8%
SHOPCARD	2·1%	
TRUSTYCARD		23·9%

Read the following instructions carefully

The APR for FLEXICARD is obtained as follows:

MONTHLY RATE = 2·2%.

The amount outstanding each month is multiplied by 102·2%.

MULTIPLYING FACTOR FOR 1 MONTH = 1·022
because 102·2% = 1·022.

MULTIPLYING FACTOR FOR 12 MONTHS = $(1{\cdot}022)^{12}$.

$(1{\cdot}022)^{12}$ = 1·298 CORRECT TO 3 DECIMAL PLACES.

The APR is therefore 29·8% correct to one decimal place.

(*a*) Use the instructions shown above to calculate the APR for SHOPCARD. 2

(*b*) Calculate the **monthly rate** for TRUSTYCARD. 4

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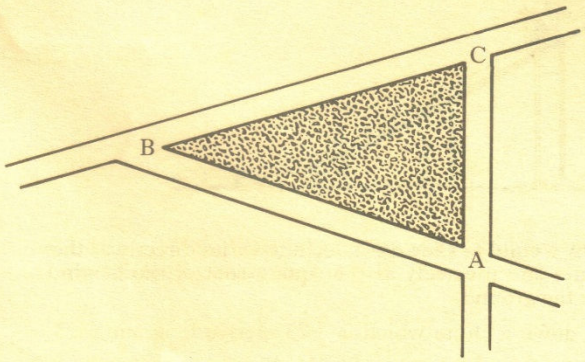
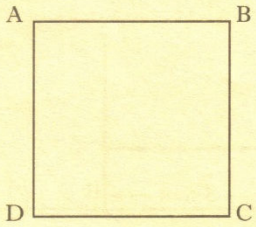
11. A traffic island, ABC, is shown below.



Find the area of the traffic island if AB = 12·6 metres, AC = 10 metres and angle BAC = 72°. **2**

12.



(*a*) ABCD is a square of side 2 cm.
Write down the ratio of the length of AB to the length of AC. **2**

(*b*) Show that in **every** square the ratio of the length of a side to the length of a diagonal is $1 : \sqrt{2}$. **3**

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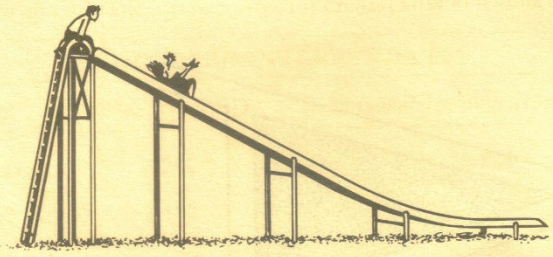
13.



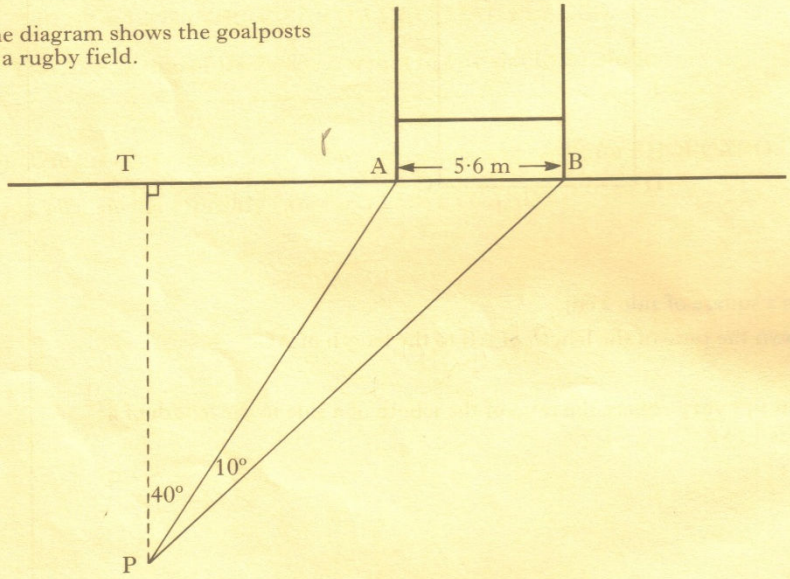
The time, T seconds, taken by a child to slide down a chute varies directly as the length, L metres, of the chute and inversely as the square root of the height, H metres, of the chute above the ground.

It takes 10 seconds to slide down a chute which is 3·75 metres long and 2·25 metres high.

(*a*) Find a formula connecting T, L and H. **3**

(*b*) How long does it take to slide down a chute which is 5 metres long and 2·56 metres high? **2**

14. The diagram shows the goalposts on a rugby field.



To take a kick at goal, a player moves from T to position P.

TP is perpendicular to TB.
Angle TPA = 40° and angle APB = 10°.

The distance AB between the goal posts is 5·6 metres.

Find the distance from T to P. **6**

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15. (*a*) Multiply out the brackets and simplify $(3a + 2b)(5a - 4b)$.	2	
(*b*) Solve the equation $2x^2 + 5x - 12 = 0$.	3	
16. The volume of water, V millions of gallons, stored in a reservoir during any month is to be predicted by using the formula $V = 1 + 0{\cdot}5 \cos (30t)^\circ$ where t is the number of the month. (For January $t = 1$, February $t = 2 \ldots$)		
(*a*) Find the volume of water in the reservoir in October.		3
(*b*) The local council would need to consider water rationing during any month in which the volume of water stored is likely to be less than 0·55 million gallons. Will the local council need to consider water rationing? **Justify your answer.**		3
17. (*a*) A function f is given by $f(x) = 4^x$. Find the value of $f\left(\frac{3}{2}\right)$.	2	
(*b*) Express $\sqrt{32} + \sqrt{8}$ as a surd in its simplest form.	3	

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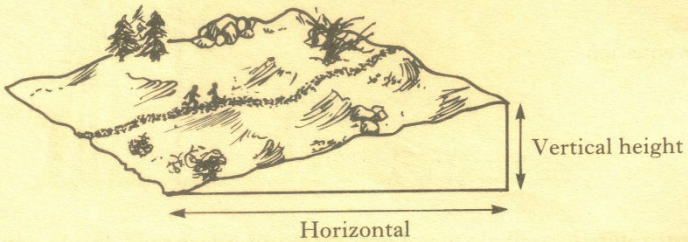
18. The total time a walk takes in hillwalking depends on the horizontal distance covered (h kilometres) and the vertical height climbed (v metres).



For **each kilometre** of horizontal distance, 12 minutes should be allowed.

(*a*) (i) Write down the time which should be allowed for h kilometres of horizontal distance. — 1

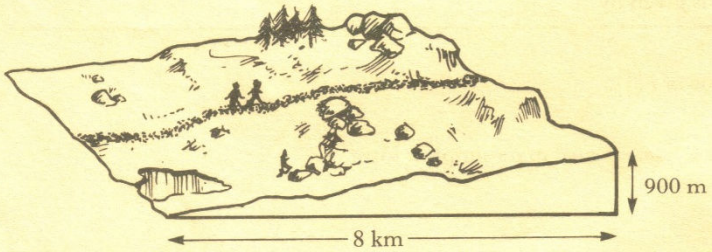
(ii) For **each 100 metres** of vertical height, 10 minutes should be allowed.

Write down the time which should be allowed for v metres of vertical height. — 2

(iii) Show that the **total** time T **hours** which should be allowed for the walk is given by the formula

$$T = \frac{120\,h + v}{600}.$$ — 3

(*b*) For safety reasons, hillwalkers should be off the hills by 1900 hours.



Would it be safe to start the walk shown above at 1300 hours?

Justify your answer. — 3

[END OF QUESTION PAPER]