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2500/104

SCOTTISH CERTIFICATE OF EDUCATION 1998

FRIDAY, 8 MAY
1.20 PM – 3.35 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.

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

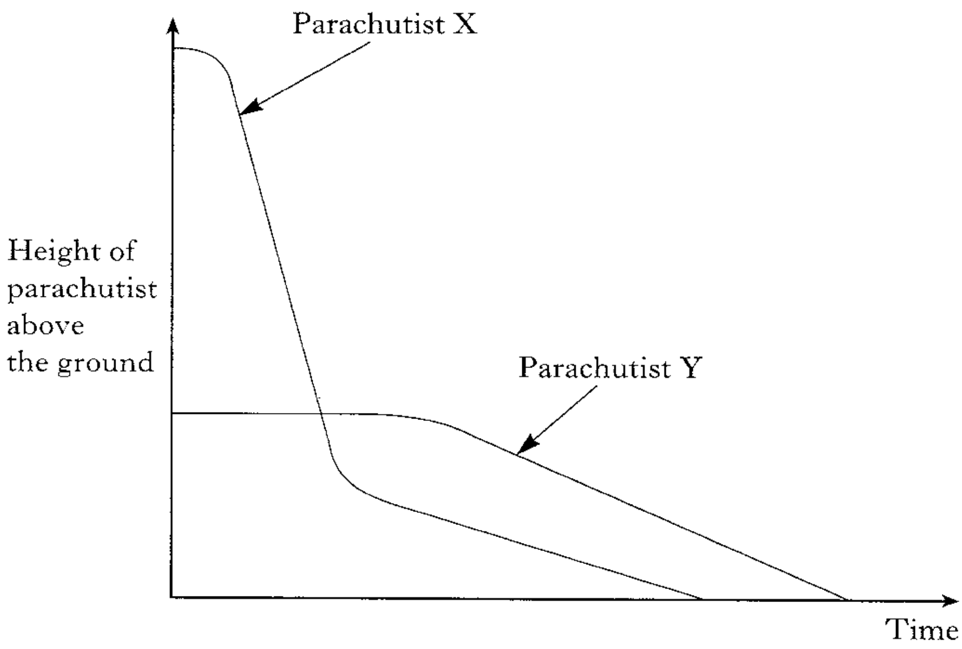
1. The annual profit (£) of a company was $3{\cdot}2 \times 10^9$ for the year 1997.

What profit did the company make per second?

Give your answer to **three significant figures**. **2** (KU)

2. Two parachutists, X and Y, jump from two separate aircrafts at different times.

The graph shows how their height above the ground changes over a period of time.



(*a*) Which parachutist jumped first? **1** (RA)

(*b*) Which parachutist did not open his parachute immediately after jumping?

Explain your answer clearly. **2** (RA)

[Turn over

KU	RA

3. A skip is prism shaped as shown in figure 1.

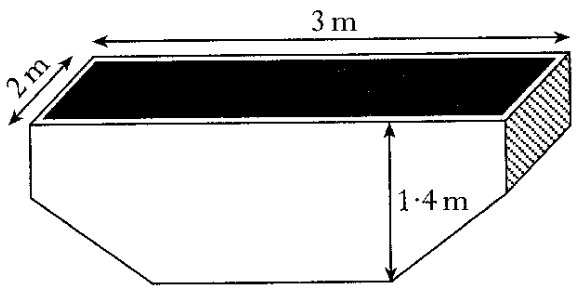


figure 1

The cross-section of the skip, with measurements in metres, is shown in figure 2.

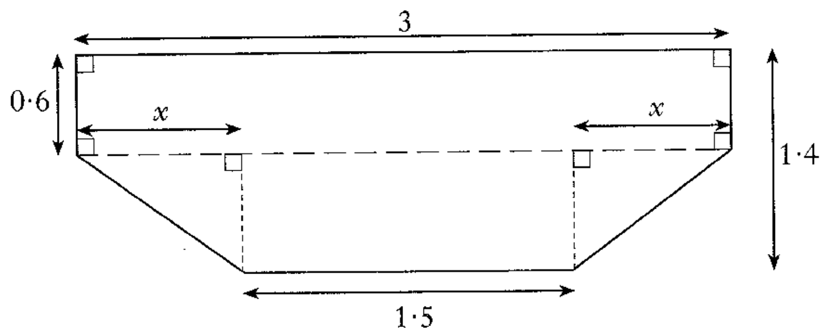


figure 2

(a) Find the value of x. **1**

(b) Find the volume of the skip in cubic metres. **3**

	KU	RA

4. A sequence of terms, starting with 1, is

1, 5, 9, 13, 17, ...

Consecutive terms in this sequence are formed by adding 4 to the previous term.

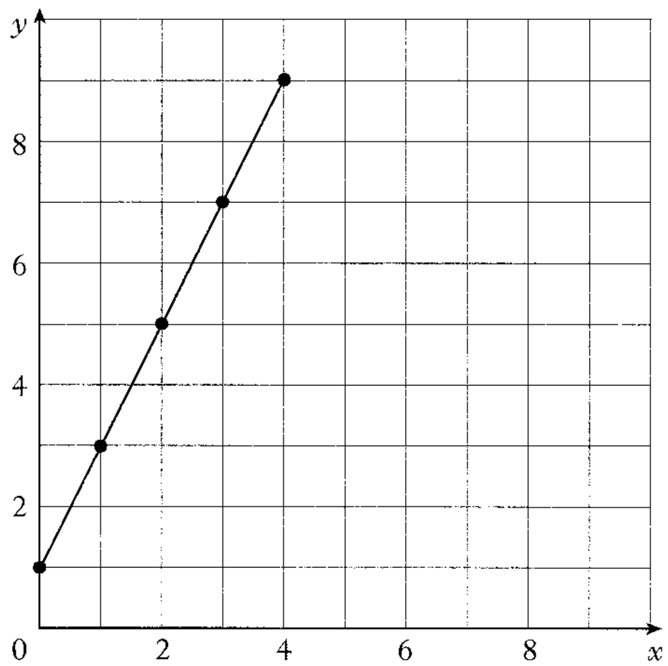
The total of consecutive terms of this sequence can be found using the following pattern.

Total of the first 2 terms:	$1 + 5$	$= 2 \times 3$
Total of the first 3 terms:	$1 + 5 + 9$	$= 3 \times 5$
Total of the first 4 terms:	$1 + 5 + 9 + 13$	$= 4 \times 7$
Total of the first 5 terms:	$1 + 5 + 9 + 13 + 17$	$= 5 \times 9$

(*a*) Express the total of the first 9 terms of this sequence in the same way. **2**

(*b*) The first *n* terms of this sequence are added. Write down an expression, in *n*, for the total. **3**

5.



Find the equation of the straight line. **3**

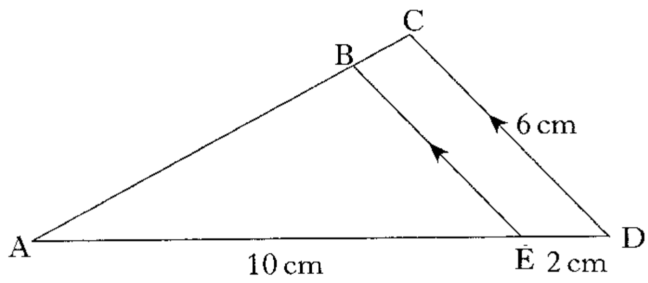
[Turn over

6. Triangles ABE and ACD, with some of their measurements, are shown opposite.

Triangle ABE is similar to triangle ACD.

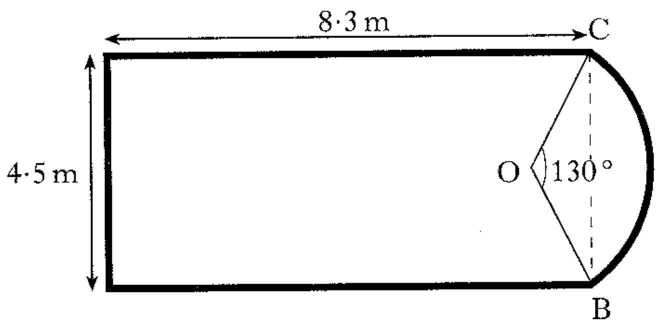
Calculate the length of BE.

Do not use a scale drawing.



KU	RA
3	

7. The diagram below shows a ceiling in the shape of a rectangle and a segment of a circle.



The rectangle measures 8·3 metres by 4·5 metres.

OB and OC are radii of the circle and angle BOC is 130°.

(*a*) Find the length of OB. 3

A border has to be fitted round the perimeter of the ceiling.

(*b*) Find the length of border required. 4

KU	RA

8. Figure 1 shows the circular cross-section of a tunnel with a horizontal floor.

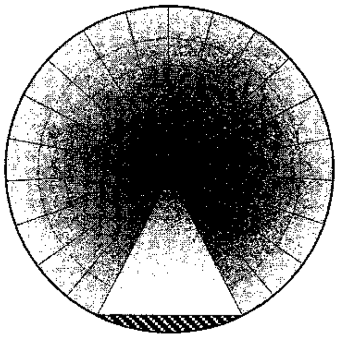


figure 1

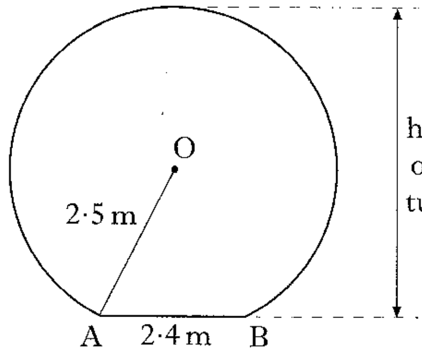


figure 2

In figure 2, AB represents the floor. AB is 2·4 metres.

The radius, OA, of the cross-section is 2·5 metres.

Find the height of the tunnel. **4** (KU)

9. The cost of taking a school group to the theatre can be calculated from the information shown below.

*** 1 adult goes free for every 10 pupils ***

Number of pupils	*Cost per pupil*	*Cost per paying adult*
less than 10	£5·00	£8·00
10 to 19	£4·50	£7·00
20 to 29	£4·00	£6·00
30 to 39	£3·00	£5·00

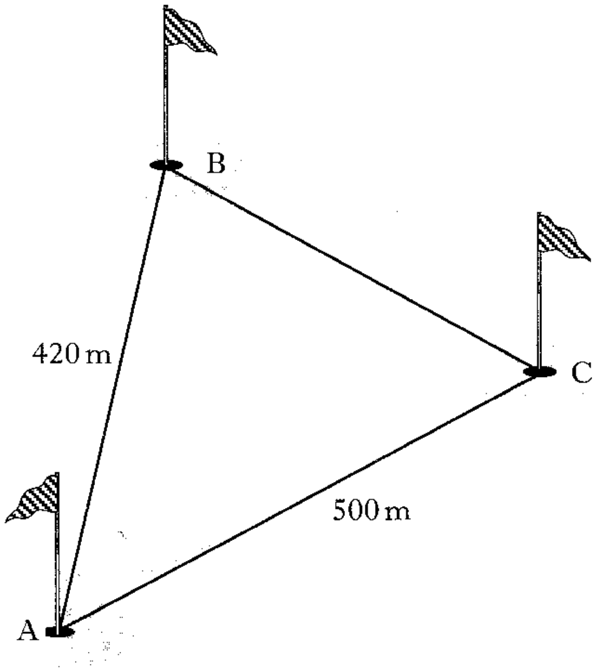
(*a*) Find the cost for a group of 12 pupils and 3 adults. **2** (RA)

(*b*) Write down a formula to find the cost, £C, of taking a group of p pupils and d adults where $20 \leq p \leq 29$. **4** (RA)

[Turn over

KU	RA

10. The diagram shows part of a golf course.



The distance AB is 420 metres, the distance AC is 500 metres and angle BAC = 52°.

Calculate the distance BC.

Do not use a scale drawing. 3

11. (*a*) Solve, **algebraically**, the system of equations

$$2a + 4b = -7$$
$$3a - 5b = 17.$$ 3

(*b*) Change the subject of the formula to k

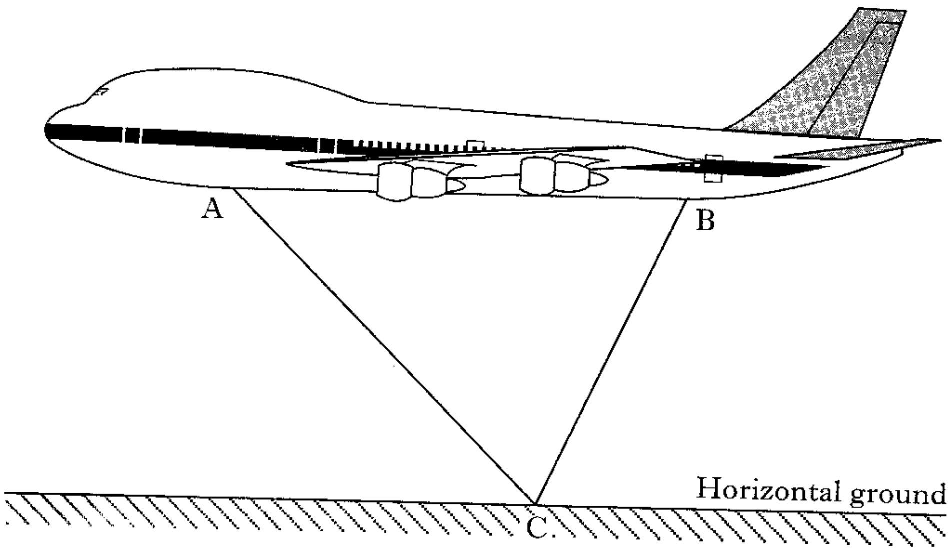
$$d = \frac{k - m}{t}.$$ 2

(*c*) Solve, **algebraically**, the equation

$$x^2 = 7x.$$ 3

KU	RA

12. An aeroplane is flying parallel to the ground.



Lights have been fitted at A and B as shown in the diagram.

When the aeroplane is flying at a certain height, the beams from these lights meet exactly on the ground at C.

The angle of depression of the beam of light from A to C is 50°.

The angle of depression of the beam of light from B to C is 70°.

The distance AB is 20 metres.

Find the height of the aeroplane above C. 6

13. The time, T minutes, taken for a stadium to empty varies directly as the number of spectators, S, and inversely as the number of open exits, E.

(a) Write down a relationship connecting T, S and E. 1

It takes 12 minutes for a stadium to empty when there are 20 000 spectators and 20 open exits.

(b) How long does it take the stadium to empty when there are 36 000 spectators and 24 open exits? 3

[Turn over

KU | RA

14. A 3×3 square has been identified on the calendar below.

The numbers in the diagonally opposite corners of the square are multiplied. These products are then subtracted in the order shown below.

$$(23 \times 11) - (25 \times 9) = 28$$

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

(*a*) Repeat the above process for a different 3×3 square.

Show clearly all your working. 1

(*b*) Prove that **in every** 3×3 square on the calendar above the process gives the answer 28. 3

15. Solve, **algebraically**, the equation

$7\cos x° - 2 = 0, \quad \text{for } 0 \leq x < 360.$ 3

16. Traffic authorities are investigating the number of cars travelling along a busy stretch of road.

They assume that all cars are travelling at a speed of v metres per second.

The number of cars, N, which pass a particular point on the road in one minute is given by the formula

$$N = \frac{30v}{2+v}.$$

In one minute, 26 cars pass a point on the road.

Find the speed of the cars in metres per second. 3

KU	RA

17. (*a*) Factorise $4a^2 - 9b^2$. **2**

(*b*) Express as a single fraction in its simplest form

$$\frac{1}{2x} - \frac{1}{3x}, \quad x \neq 0.$$ **2**

18. On a certain day the depth, D metres, of water at a fishing port, t hours after midnight, is given by the formula

$D = 12{\cdot}5 + 9{\cdot}5\sin(30t)^\circ$.

(*a*) Find the depth of the water at 1.30 pm. **3**

(*b*) The depth of water in the harbour is recorded each hour. What is the maximum difference in the depths of water in the harbour over the 24 hour period?

Show clearly all your working. **3**

19. (*a*) Multiply out the brackets

$$\sqrt{2}(\sqrt{6} - \sqrt{2}).$$

Express your answer as a **surd** in its simplest form. **2**

(*b*) Express $\dfrac{b^{\frac{1}{2}} \times b^{\frac{3}{2}}}{b}$ in its simplest form. **2**

[*END OF QUESTION PAPER*]