بسم الله الرحمن الرحيم

<u>مقابل هذا المجهود ارجو منكم الدعاء لي بالمغفرة ولابنائي الهداية والنجاح والتوفيق</u>

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IGCSE

MATHEMATICS

Examination

PAPER 4

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Mathematics

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PAPER 4

JUNE 1988 — 2 h 30 min

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2. Mathematical tables

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The total of the marks for this paper is 130.

The number of marks available is shown in brackets [ ] at the end of each question or part question.

This Question Paper consists of 7 printed pages and 1 blank page.

[Turn over

0580/4 MATHEMATICS

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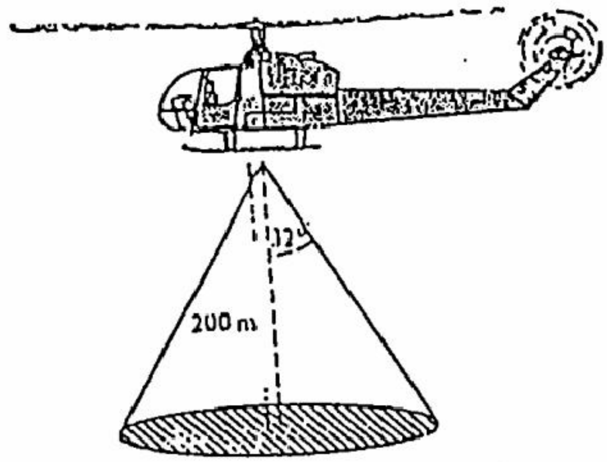
The total of the marks for this paper is 75.

The intended marks for questions or parts of questions are given in brackets [ ].

1



[In this question take π to be 3.142. 1 hectare = 10 000 m^2.]

On a still day, a helicopter hovers at a height of 200 m and sprays the ground with fertilizer. The shaded part of the diagram shows the circular area sprayed.

(*a*) If the "angle of spray" is 32°, calculate the sprayed area in square metres. Give your answer correct to three significant figures. [5]

(*b*) The farmer wants to spray a circular area of 3 hectares from the same height. What "angle of spray" should he use? [6]

---

2 Answer the whole of this question on a sheet of plain paper.

Draw a circle of radius 4 cm, whose centre *O* is 6 cm from a straight line *l*. [1]

(*a*) Construct

(i) the locus of points which are 3 cm from the line *l*, [2]

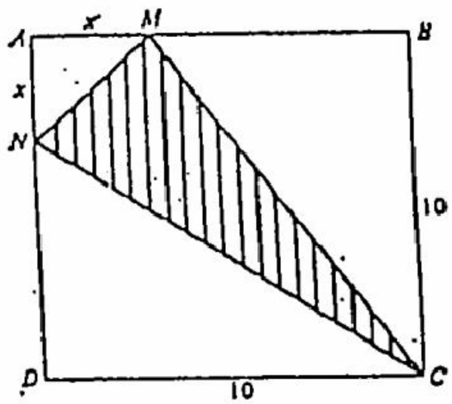
(ii) the locus of points which are 7 cm from *O*. [2]

(*b*) Hence construct a circle of radius 3 cm which touches the line *l* and also touches the circle of radius 4 cm externally. [3]

3 (a) James buys 3 large ice-cream cornets and 2 small ice-cream cornets. They cost him \$3.35. Susan buys 2 large ones and 3 small ones. They cost her \$3.15.

Use algebra to find the cost of one large cornet, and the cost of one small cornet. [5]

(b)



Points M and N are marked on the sides AB, AD of a square $ABCD$ of side 10 cm.

$$AM = AN = x\text{ cm}.$$

The area of the shaded triangle is 30 cm^2.

(i) By considering areas, show that

$$x^2 - 20x + 60 = 0.$$ [3]

(ii) Solve the equation $x^2 - 20x + 60 = 0$. Hence find the value of x, correct to two decimal places. [4]

---

4 (a) Solve the equation

$$15 - 2x = 7.$$ [2]

(b) Find the range of values of x for which

$$15 - 2x \geqslant 7.$$ [1]

(c) Find $\{x : 15 - 2x \geqslant 7\} \cap \{x : 5x - 2 > 10 - x\}$. [4]

---

5 Answer the whole of this question on a sheet of graph paper.

Take 1 cm to represent 1 unit on each axis, and mark each axis from -7 to $+7$.

(a) Draw and label triangle A, with vertices (1, 2), (1, 3) and (4, 2). [2]

(b) Triangle A is mapped on to triangle B by the transformation represented by the matrix

$$R = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$$

Draw and label triangle B on your diagram. [3]

4

(c) Another transformation is represented by the matrix

$$H = \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}$$

(i) Express **HR** as a single matrix. [2]

(ii) Given that HR $(A) = C$, draw and label triangle C on your diagram. [2]

(d) Describe, in full,

(i) the transformation represented by the matrix R, [2]

(ii) the transformation represented by the matrix H. [2]

---

6 Answer the whole of this question on a sheet of graph paper.

(a) Given that $y = \frac{5}{x}$, copy and complete the following table, in which values of y are correct to two decimal places.

x	0.5	0.7	1	1.5	2	2.5	3	4	5	6	8
y	10	7.14					1.67				0.63

[2]

(b) Using a scale of 2 cm to represent 1 unit on each axis, draw the graph of $y = \frac{5}{x}$ for $0.5 \leqslant x \leqslant 8$. [3]

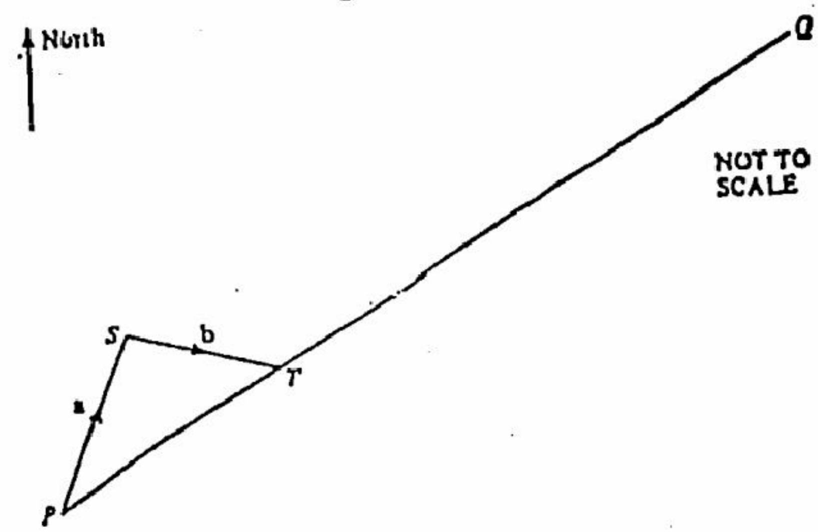
(c) By drawing a tangent, find the gradient of the curve $y = \frac{5}{x}$ at the point where $x = 2$. [3]

(d) On the same axes, draw the graph of $2x + y = 9$. [2]

(e) Write down the equation which is satisfied by the x-coordinates of the points of intersection of the two graphs.

Express your answer in the form $ax^2 + bx + c = 0$, where a, b and c are integral constants. [3]

7



Aristotle Jones wants to sail his yacht from P to Q. In order to reach T from P, he has to sail along PS (vector **a**) and then along ST (vector **b**). This is called a "tack".

(*a*) Write the vector $\vec{PT}$ in terms of **a** and **b**. [1]

(*b*) $\begin{pmatrix} x \\ y \end{pmatrix}$ is a vector with components x km East and y km North.

If $\mathbf{a} = \begin{pmatrix} \frac{1}{4} \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} \frac{3}{4} \\ -\frac{1}{4} \end{pmatrix}$, find

(i) the components of $\vec{PT}$, [2]

(ii) the length of $\vec{PT}$. [2]

(*c*) The distance from P to Q is 15 km.

(i) How many tacks does he need to take to reach Q? [2]

(ii) Write the vector $\vec{PQ}$ in terms of **a** and **b**. [1]

(*d*) Find the bearing of Q from P. [3]

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MATHEMATICS

PAPER 4

NOVEMBER 1988 — 2 h 30 min

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This Question Paper consists of 7 printed pages and 1 blank page.

1 It is given that

$$y = \frac{3x^2}{4 - z}.$$

(*a*) Find the value of y when $x = 3$ and $z = 2$. [2]

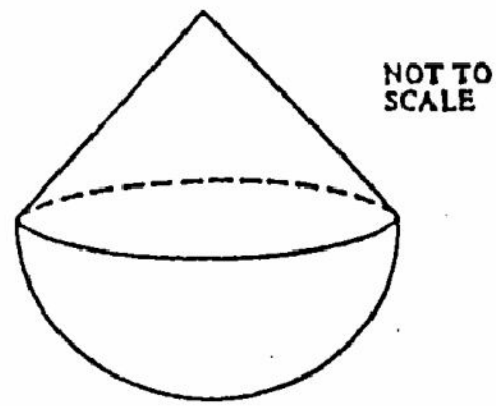
(*b*) Find the value of z when $x = 2$ and $y = 3$. [2]

(*c*) Find both possible values of x when $y = -8$ and $z = 10$. [2]

(*d*) The value of x is doubled, and z remains unchanged.
What effect does this have upon the value of y? [2]

(*e*) Make z the subject of the formula $y = \frac{3x^2}{4 - z}$. [3]

2



A glass paperweight consists of a cone mounted on a hemisphere. The common radius (r) is 4 centimetres; the height of the cone (h) is 5 centimetres. You are given that:

The volume of a cone is $\frac{1}{3}\pi r^2 h$;

The volume of a sphere is $\frac{4}{3}\pi r^3$;

The curved surface area of a cone is $\pi r l$ (slant height l);

The surface area of a sphere is $4\pi r^2$.

Take π to be 3.142.

(*a*) Calculate

(i) the volume of the paperweight, [4]

(ii) the surface area of the paperweight. [5]

(*b*) The mass of the paperweight is $\frac{1}{2}$ kg. Calculate the density of the glass, in grams per cubic centimetre. [3]

---

3 Answer the whole of this question on a sheet of graph paper.

Using a scale of 1 centimetre to represent 1 unit on each axis, draw a pair of axes for $0 \leqslant x \leqslant 16$ and $0 \leqslant y \leqslant 10$.

(a) On your axes:

(i) draw the line $y = x$; [1]

(ii) mark the two points $A(10, 0)$ and $B(14, 3)$; [1]

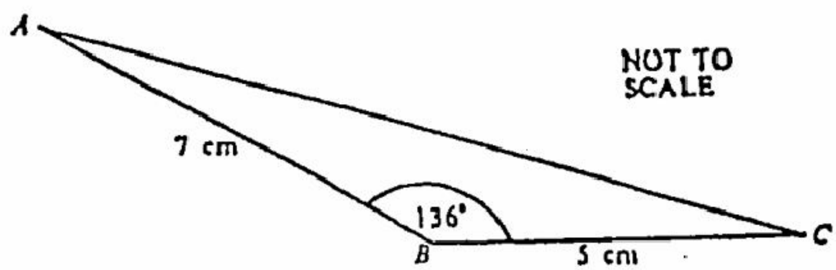
(iii) draw the locus of points which are equidistant from the points A and B; [2]

(iv) draw the locus of points which are equidistant from the line $y = x$ and the x-axis; [2]

(v) draw the circle which touches the x-axis at A, and which passes through B. [3]

(b) Which other line, already drawn, does the circle touch? [1]

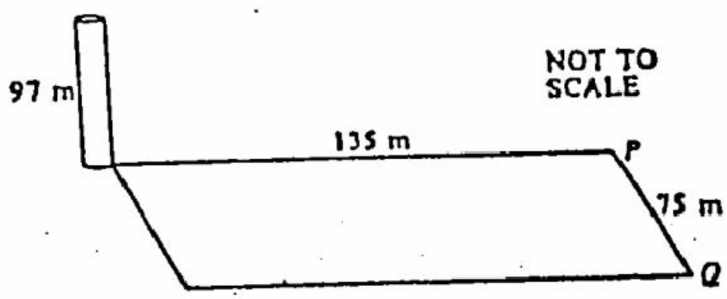
4 (a) In triangle ABC, $AB = 7$ cm, $BC = 5$ cm and $A\hat{B}C = 136°$.



(i) Calculate the length of AC. [3]

(ii) Calculate the area of the triangle ABC. [3]

(b) The Piazza San Marco in Venice is a rectangle 135 metres long and 75 metres wide. The Campanile tower stands in one corner, and it is 97 metres high.

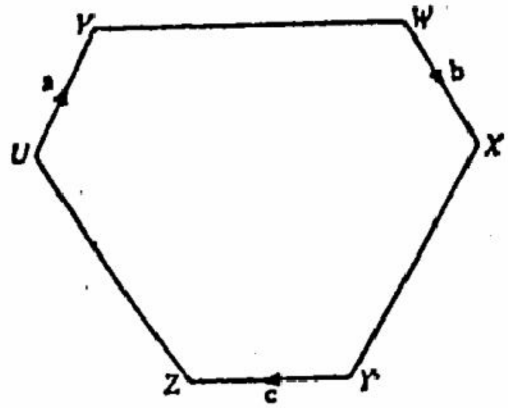


Calculate the angle of elevation of the top of the tower

(i) from P, [2]

(ii) from Q. [4]

5



In the diagram, opposite sides of the hexagon are parallel and are in the ratio 1 : 2.

Given that $\overrightarrow{UV} = \mathbf{a}$, $\overrightarrow{WX} = \mathbf{b}$ and $\overrightarrow{YZ} = \mathbf{c}$,

(a) (i) write down the vector representing $\overrightarrow{YX}$; [1]

(ii) hence show that $\overrightarrow{YW} = 2\mathbf{a} - \mathbf{b}$; [2]

(iii) use similar methods to write down $\overrightarrow{UY}$ and $\overrightarrow{WU}$. [2]

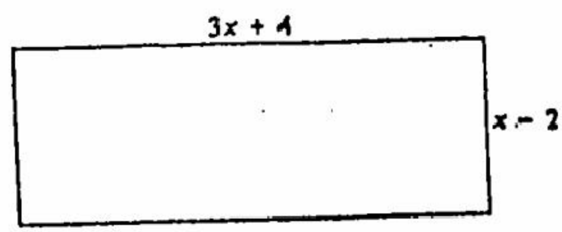
(b) Write down, in terms of a, b and c,

$$\overrightarrow{YW} + \overrightarrow{WU} + \overrightarrow{UY},$$

expressing your answer in its simplest form. [2]

(c) Write down a vector equation which follows from the result of part (b). [2]

6



The rectangle has length $(3x + 4)$ cm and width $(x - 2)$ cm.

(a) Write down and simplify an expression for the perimeter of the rectangle. [2]

(b) Write down an expression for the area of the rectangle. [1]

(c) If the area of the rectangle is 57 cm², show that

$$3x^2 - 2x - 65 = 0.$$ [3]

(d) Solve the quadratic equation $3x^2 - 2x - 65 = 0$. [3]

(e) Write down the length and width of the rectangle when its area is 57 cm². [2]

7 (a) On each of two short holes on his golf course, Mr. A. Rabbit can take 3, 4, 5, 6, 7 or 8 strokes. All outcomes are equally likely.

Consider these two holes only.

(i) What is the probability that he takes a total of 6 strokes? [1]

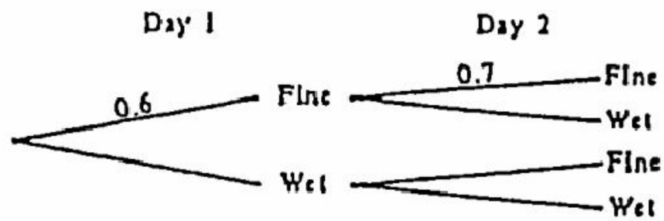
(ii) What is the probability that he takes a total of 13 strokes? [2]

(iii) What is his most likely total? [1]

(b) If the weather is fine today, the probability that it will be fine tomorrow is 0.7. This and the other probabilities are shown in the following matrix.

$$\begin{array}{ccc} & & \text{TOMORROW} \\ & & \begin{array}{cc}\text{Fine} & \text{Wet}\end{array} \\ \text{TODAY} & \begin{array}{c}\text{Fine} \\ \text{Wet}\end{array} & \begin{pmatrix} 0.7 & 0.3 \\ 0.4 & 0.6 \end{pmatrix} \end{array}$$

Given also that the probability of the weather being fine on any one day is 0.6, copy and complete the tree diagram below, to represent all this information.



[2]

Calculate the probability of

(i) two fine days, [1]

(ii) a wet day followed by a fine day, [1]

(iii) one fine day and one wet day, in either order. [2]

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MATHEMATICS

PAPER 4

JUNE 1989

2 h 30 min

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[Turn over

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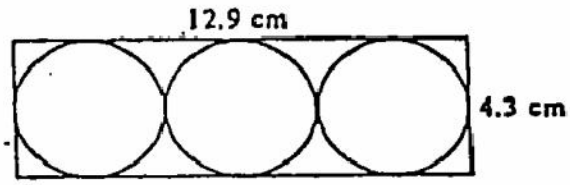
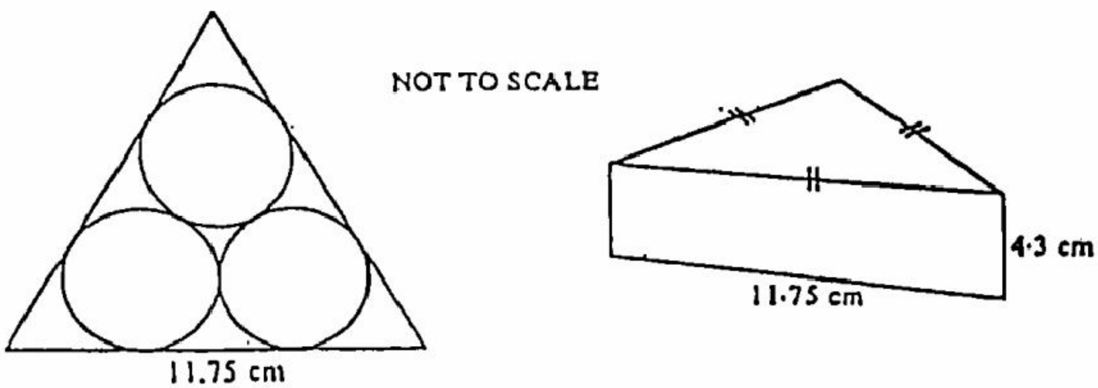
1 . A firm which manufactures golf balls is experimenting with the packaging of its product. 3 golf balls, each of radius 2.15 centimetres, are packaged in a rectangular box, a cross section of which is shown in the diagram below. The box is 12.9 centimetres long, 4.3 centimetres wide and 4.3 centimetres high.



(*a*) Given that the volume of a sphere of radius r is $\frac{4}{3}\pi r^3$, calculate the amount of space within the box which is unfilled. [5]

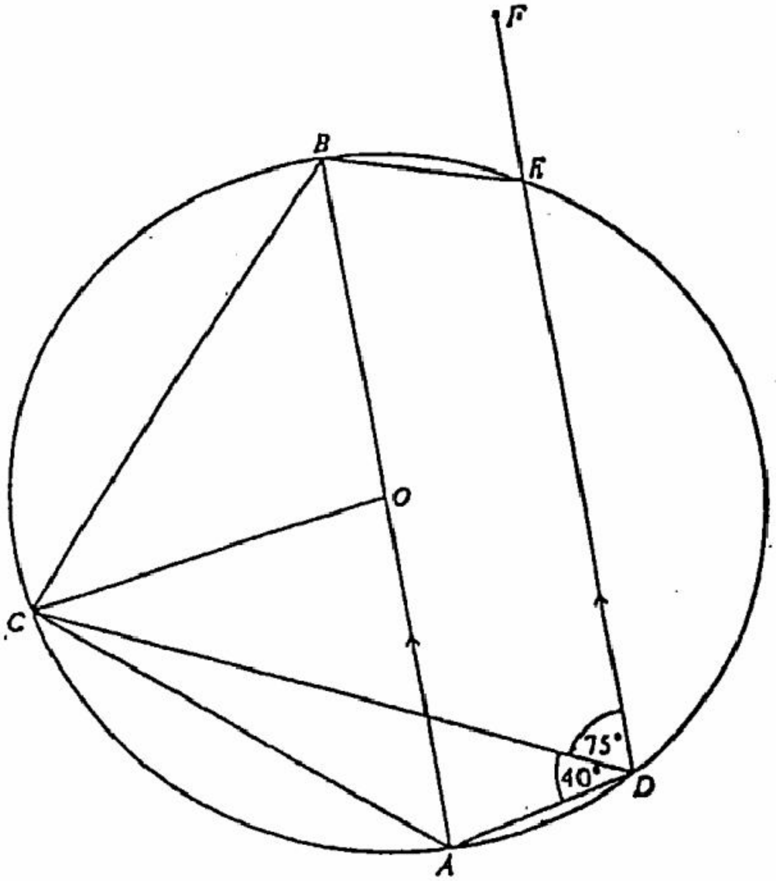
The marketing department suggests that an equilateral triangular box of side 11.75 centimetres and height 4.3 centimetres might be more attractive. The diagrams show a plan and side view of the new box.



(*b*) Calculate the amount of space within this new box which is unfilled. [6]

[π is approximately 3.142]

2.



In the diagram above, DEF is parallel to the diameter, AB, of the circle, centre O.
Points C, D and E lie on the circumference of the circle.

Given that $A\hat{D}C = 40°$ and $C\hat{D}E = 75°$ calculate,

(a) $A\hat{B}C$, [2]

(b) $A\hat{O}C$, [2]

(c) $O\hat{B}E$, [2]

(d) $B\hat{E}F$, [2]

(e) $C\hat{A}D$. [2]

3 Graph paper must be used for the whole of this question.

t	0	1	2	3	4	5	6	7
v	0	4	6.2	7.1	6.8	6.1	5.2	4.7

The table above shows the speed of a car, v metres per second, at time t seconds.

(*a*) Draw a graph of v against t, using a scale of 2 centimetres to represent 1 second horizontally and 2 centimetres to represent 1 metre per second vertically. [3]

(*b*) Use your graph to find

(i) the maximum speed attained during this period of time, [1]

(ii) the acceleration when $t = 2$, [3]

(iii) the total distance travelled between $t = 4$ and $t = 6$, [3]

(iv) the average speed between $t = 4$ and $t = 6$. [2]

(*c*) Find the range of values of t for which the gradient is negative.
Explain what the negative gradient means in terms of the motion of the car. [2]

---

4 Einstein's formula

$$E = mc^2$$

states that E units of energy are produced when a decrease in mass of m kilograms occurs.

The velocity of light, c, is 3×10^8 metres per second.

There are 1 million milligrams in a kilogram.

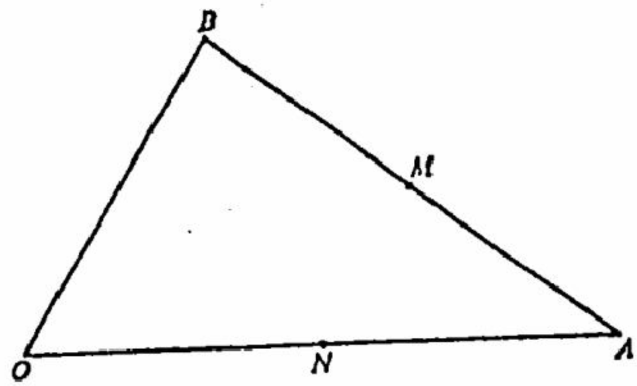
(*a*) Write 2 milligrams in kilograms, using standard form. [2]

(*b*) Use Einstein's formula to work out the number of units of energy produced by a decrease in mass of 2 milligrams. [2]

(*c*) An electric light bulb uses 100 units of energy each second. How many units does it use in 1 hour? [1]

(*d*) Find how many electric light bulbs could be lit for 1 hour by a decrease in mass of 2 milligrams. [2]

15



In the triangle OAB, M is the mid-point of AB and N is the mid-point of OA.

(a) Given that $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$,

express, in terms of a and b, the vectors

(i) $\overrightarrow{AB}$,

(ii) $\overrightarrow{AM}$,

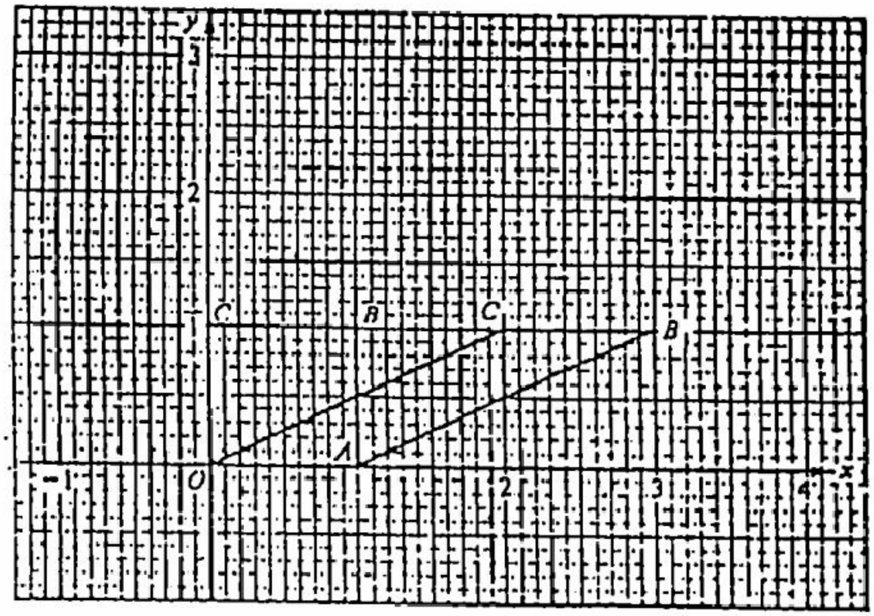
(iii) $\overrightarrow{OM}$,

(iv) $\overrightarrow{BN}$. [6]

(b) P lies on OM such that $OP = \frac{2}{3}OM$. Express $\overrightarrow{BP}$ in terms of a and b. [3]

(c) Express $\overrightarrow{BP}$ in terms of $\overrightarrow{BN}$.
Explain the geometrical significance of this relationship. [3]

6



The diagram above shows the square $OABC$, of area 1 square unit, and the parallelogram OAB_1C_1.

(*a*) Describe fully the single transformation which maps $OABC$ onto OAB_1C_1. [2]

(*b*) Given that $P = \begin{pmatrix} 1 & x \\ 0 & 1 \end{pmatrix}$ represents this transformation, find the value of x. [2]

(*c*) (i) Find the area of OAB_1C_1. [1]

(ii) State what effect the transformation represented by P has on the area of any shape. [1]

(*d*) The matrix $Q = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ represents a single transformation. Describe fully this transformation. [2]

(*e*) Using your value of x from part (*b*), express PQ as a single matrix. [2]

(*f*) (i) Find the inverse of Q. [1]

(ii) Describe in words the transformation represented by the inverse of Q. [2]

7 A triangle ABC has sides of length

$$AB = 2x - 3y + 14,$$
$$BC = 5y - 4x,$$
$$CA = 4x - 6.$$

(*a*) In any triangle the sum of the lengths of any two sides is greater than the length of the third side. For example

$$AB + BC > CA.$$

Use this inequality to show that

$$3x - y - 10 < 0.$$ [2]

(*b*) Deduce a second inequality involving x and y from the statement

$$CA + AB > BC,$$

simplifying your answer as far as possible. [2]

(*c*) Using these inequalities, and given that $y =$ [illegible], find the range of possible values of x. [4]

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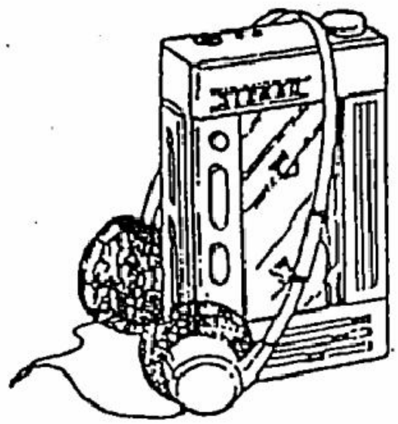
1 

(*a*) A firm manufactures personal stereo radios and has calculated that, by selling them at $40 each, a profit of 25% would be made on the cost of manufacture.

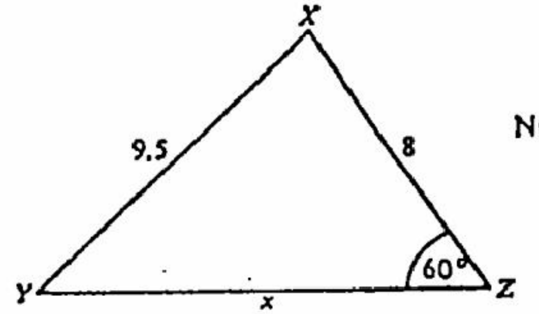
Calculate the cost of manufacture of a radio. [2]

(*b*) 2000 of these radios were manufactured. 23 of them were found to be imperfect because of small scratches on their cases. The perfect ones were still sold for $40, whilst the imperfect ones were sold for $12.

Calculate the total profit made by the firm assuming that all 2000 radios were sold. [5]

(*c*) Express the total profit as a percentage of the total cost of manufacture. [3]

2



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In the triangle XYZ, angle $XZY = 60°$, $XY = 9.5$ cm, $XZ = 8$ cm and $YZ = x$ cm.

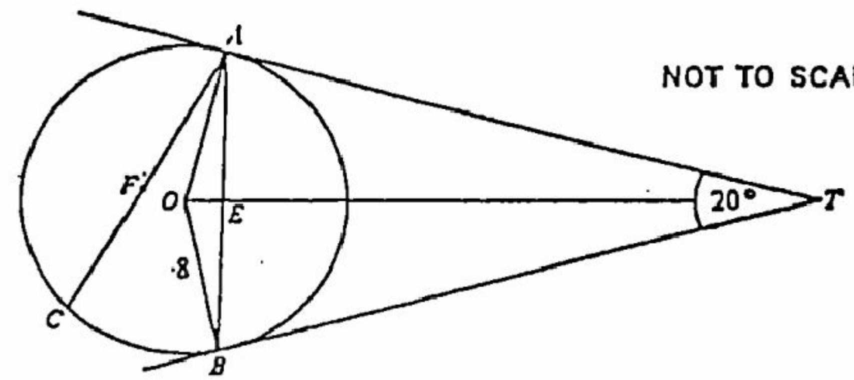
(*a*) (i) Use the cosine rule to show that x satisfies the equation

$$4x^2 - 32x - 105 = 0.$$ [4]

(ii) By solving this quadratic equation, find the length of YZ. [3]

(*b*) Calculate angle XYZ. [3]

3



NOT TO SCALE

Two tangents are drawn from the point T meeting the circle, centre O and radius 8 cm, at the points A and B. Angle $BTA = 20°$.

(*a*) Calculate the length of OT. [3]

(*b*) The lines OT and AB meet at E. Calculate the length of OE. [3]

(*c*) Chord AC, with mid-point F, is the same length as AB.

(i) State the length of OF. [1]

(ii) Calculate angle ACB. [2]

0580/4 MATHEMATICS

4 Answer the whole of this question on a sheet of graph paper.

(a) Given that $y = x + \frac{6}{x}$, copy and complete the following table.

x	1	2	2.5	3	4	5	6
$\frac{6}{x}$			2.4				1
y			4.9				7

[3]

(b) Using a scale of 2 centimetres to represent 1 unit on each axis draw the graph of $y = x + \frac{6}{x}$ for $1 \leqslant x \leqslant 6$. [3]

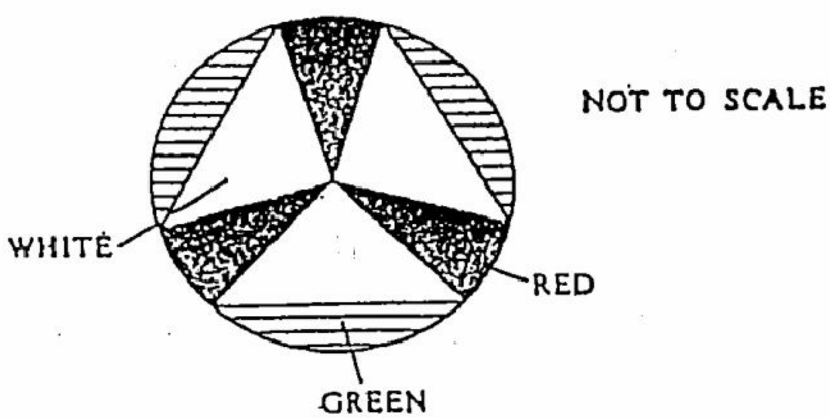
(c) Use your graph to solve the equation

$$x + \frac{6}{x} = 5.5.$$ [3]

(d) Show clearly how the equations of the curve $y = x + \frac{6}{x}$ and the straight line $y = 6$ can be combined to give the equation

$$x^2 - 6x + 6 = 0.$$ [3]

5



The diagram above shows a new logo, designed in red, white and green, for a car company. The radius of the circle is 5 centimetres.

The three red sectors each have an angle of 30° at the centre of the circle.

The three white triangles each have a right angle at the centre of the circle.

(*a*) Calculate

(i) the area of a red sector, [3]

(ii) the area of a green segment, [4]

(iii) the length of the hypotenuse of a white triangle. [3]

(π is approximately 3.142)

(*b*) Describe fully the symmetry of the logo. [4]

---

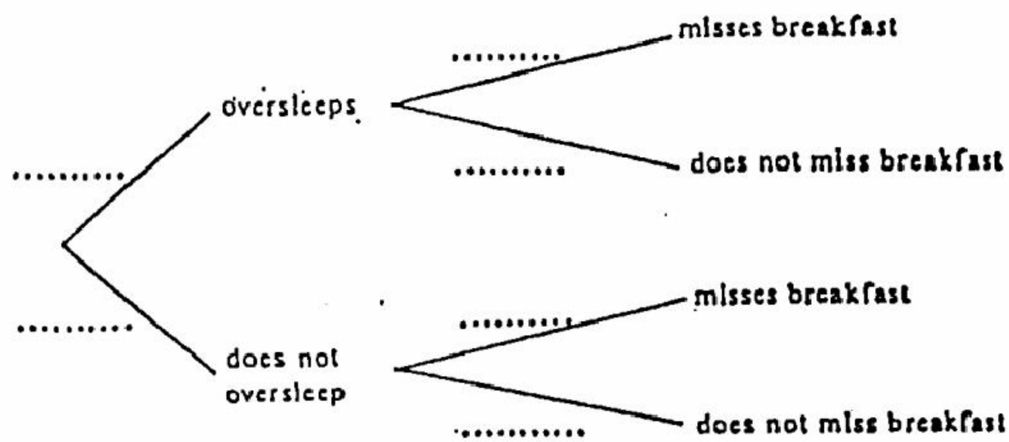
6 A teacher has an unfortunate habit of oversleeping in the morning.

The probability that he oversleeps is 0.3.

When he oversleeps there is a probability of 0.6 that he misses breakfast.

Even when he does not oversleep there is a probability of 0.2 that he misses breakfast.

(*a*) Copy and complete the tree diagram below to show this information, marking clearly on the dotted lines on each branch the probability of that outcome.



[3]

(*b*) What is the probability that he

(i) oversleeps and misses breakfast, [2]

(ii) misses breakfast? [3]

(*c*) What is the probability that he misses breakfast two days in succession? [2]

0580/4 & 0580/5 MATHEMATICS

7 Answer the whole of this question on a sheet of graph paper.

The vertices of the parallelogram $OPQR$ are $O(0,0)$, $P(2,0)$, $Q(3,1)$ and $R(1,1)$.

(a) (i) Using a scale of 2 cm to represent 1 unit on each axis, draw x and y axes for $-4 \leqslant x \leqslant 4$ and $-4 \leqslant y \leqslant 4$.

Draw and label the parallelogram $OPQR$. [1]

(ii) A rotation through 90° anticlockwise about O maps $OPQR$ onto $OP_1Q_1R_1$. Draw $OP_1Q_1R_1$. [2]

(iii) A reflection in the x-axis maps $OP_1Q_1R_1$ onto $OP_2Q_2R_2$. Draw $OP_2Q_2R_2$. [2]

(iv) Write down the single transformation which would map $OP_2Q_2R_2$ back onto the original parallelogram $OPQR$. [2]

(b) A shear, with the x-axis invariant and with (3, 1) mapped onto (2, 1), maps the parallelogram $OPQR$ onto $OP_3Q_3R_3$.

(i) What special name is given to the shape $OP_3Q_3R_3$? [1]

(ii) Find the matrix which represents this transformation. [2]

0580/4 IGCSE JUNE
0581/4

MATHEMATICS
PAPER 4

Monday 4 JUNE 1990 Afternoon 2 h 30 min

Additional materials provided by the Syndicate:
1. Mathematical tables 2. 2 sheets of graph paper
Additional materials provided by the school/candidate:
3. Electronic calculator 4. Geometrical instruments

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

Instructions to candidates:

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Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

The total of the marks for this paper is 130.

The intended marks for questions or parts of questions are given in brackets [ ].

This Question Paper consists of 8 printed pages.

9013

[Turn over

1 A gardener has 357 tulip bulbs to plant.

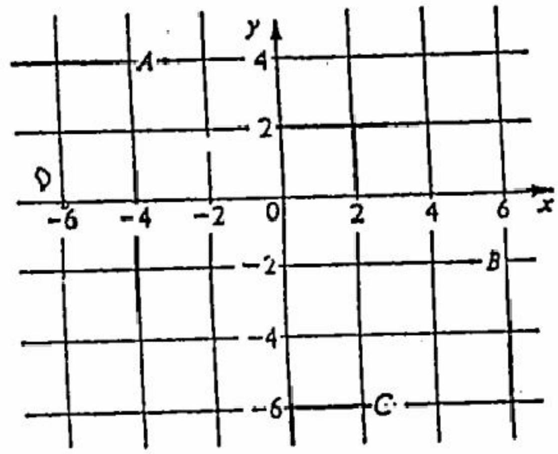
(*a*) If she planted a rectangle of 15 rows, with 23 bulbs in each row, how many bulbs would be left over? [2]

(*b*) How many bulbs would there be in the largest square that she could plant? [2]

(*c*) (i) If she plants x rows, with y bulbs in each row, write down a formula for the number of bulbs left over. [2]

(ii) If $10 < x < 20$ and $y > 20$, find the value of x and the value of y such that no bulbs are left over. [2]

2



$A(-3, 4)$, $B(5, -2)$ and $C(2, -6)$ are three vertices of a parallelogram $ABCD$.

(*a*) Write down the vector $\overrightarrow{BA}$ in the form $\begin{pmatrix} p \\ q \end{pmatrix}$ [2]

(*b*) Find the coordinates of the vertex D. [2]

(*c*) Calculate the lengths of the line segments AB, BC and AC. [3]

(*d*) Use your answers in part (*c*) to show that the parallelogram $ABCD$ is a rectangle. [2]

(*e*) Calculate the area of $ABCD$. [2]

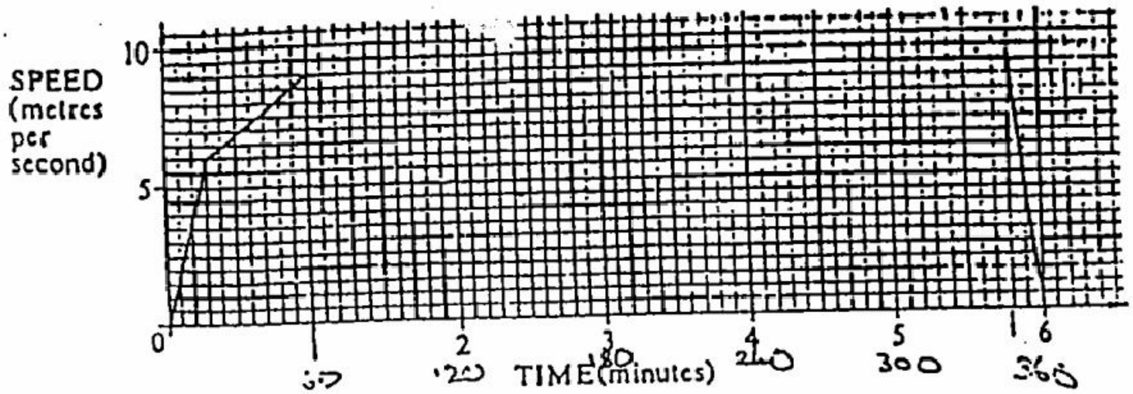
(*f*) The equation of the line through A and B is

$$y = -\frac{3}{4}x + \frac{7}{4}.$$

(i) What is the gradient of this line?

(ii) Write down the coordinates of the point at which this line cuts the y-axis. [2]

3



The diagram shows the speed-time graph of a boy cycling from home to school.

(a) How long does the journey take him? [1]

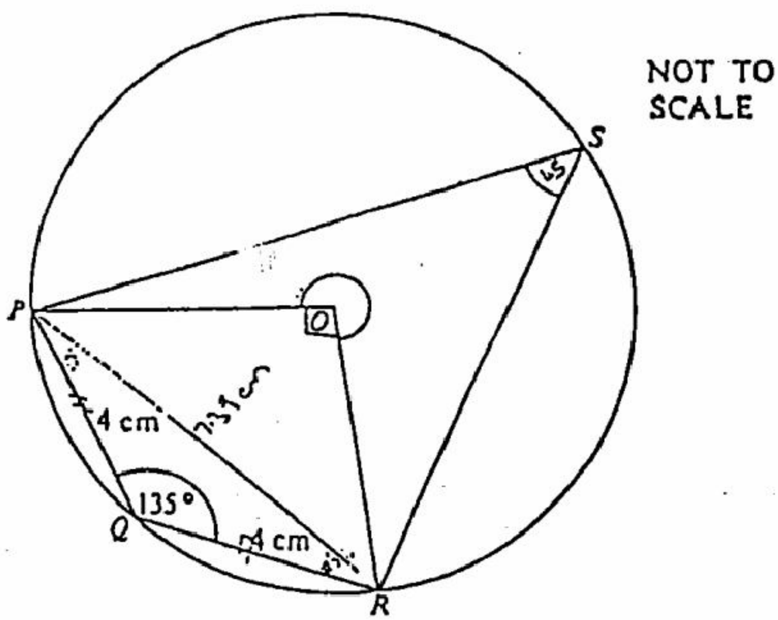
(b) After how many seconds does he first reach the speed of 6 metres per second? [1]

(c) What is his maximum speed? [1]

(d) Describe his journey, in as much detail as possible. [4]

(e) Calculate, in metres, the distance between his home and the school. [4]

4



In the diagram, P, Q, R and S are points on the circle, centre O.

Angle $PQR = 135°$ and $PQ = QR = 4$ cm.

Calculate

(a) angle PSR, [2]

(b) the marked angle POR, [2]

(c) the length of the chord PR, [3]

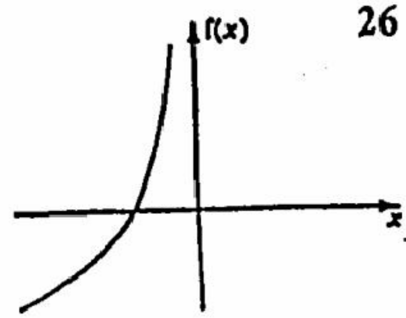
(d) the radius of the circle. [4]

5 Answer the whole of this question on a sheet of graph paper.

The graph of

$$f(x) = x - \frac{4}{x}$$

consists of two separate branches. One of these branches is shown in the sketch graph.



(a) Copy and complete this table of values for $f(x) = x - \frac{4}{x}$.

x	-5	-4	-3	-2	-1	-0.8	0.8	1	2	3	4	5
$f(x)$	-4.2	-3	-1.7		3	4.2	-4.2	-3	0	1.7	3	4.2

[2]

(b) Using a scale of 2 cm to represent 1 unit on each axis, draw the graph of the function. [4]

(c) Describe the symmetry of the graph. [2]

(d) Use your graph to find both solutions of the equation $x - \frac{4}{x} = -1.6$. [2]

(e) Draw the tangent to the curve at the point where $x = 3$. Hence estimate the gradient of the curve at that point. [3]

6 (a) Solve the equation

$$2x^2 - 3x - 6 = 0.$$

giving your answers correct to two decimal places. [5]

(b)

(i) A French loaf is 72 cm long. It is cut into slices, each x cm long, so that none of it is left over.

Write down an expression for the number of slices obtained. [1]

(ii) A second loaf is also 72 cm long. It is also cut up completely into equal slices. Each slice is 1 cm longer than each slice of the first loaf.

Write down an expression for the number of slices obtained from the second loaf. [1]

(iii) If there are six more slices from the first loaf than from the second, form an equation in terms of x. Show that it reduces to

$$x^2 + x - 12 = 0.$$ [3]

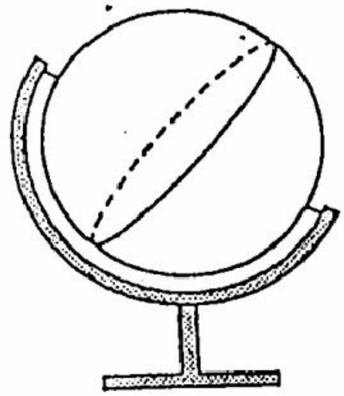
(iv) Solve this equation, and hence state the length of the slices from each loaf. [3]

7 (a) (i) A scale of 1 : 350 000 is the same as 1 cm : N km. Find the value of N. [2]

(ii) On a map, drawn to a scale of 1 : 350 000, the approximate area of Ascension Island is 7 cm^2.

Use your answer to part (i) to find the approximate area of Ascension Island, in square kilometres. [3]

(b)



(i) A classroom globe is a sphere of radius 0.6 m. Calculate the volume of the globe in cubic metres. [2]

[Volume of a sphere of radius r is $\frac{4}{3}\pi r^3$.]
π is approximately 3.142.

(ii) The earth is a sphere of radius 6000 km approximately. Express this radius in metres. [1]

(iii) Find the ratio

Radius of earth : Radius of classroom globe,

giving your answer in the form $10^n : 1$. [2]

(iv) By what number (again as a power of 10) should you multiply your answer to (b) (i) in order to obtain an approximate value, in cubic metres, of the volume of the earth? [2]

8 Answer the whole of this question on a sheet of graph paper.

(a) The graph below shows the cumulative frequency of live births (in thousands) in Scotland in 1936, plotted against mother's age.

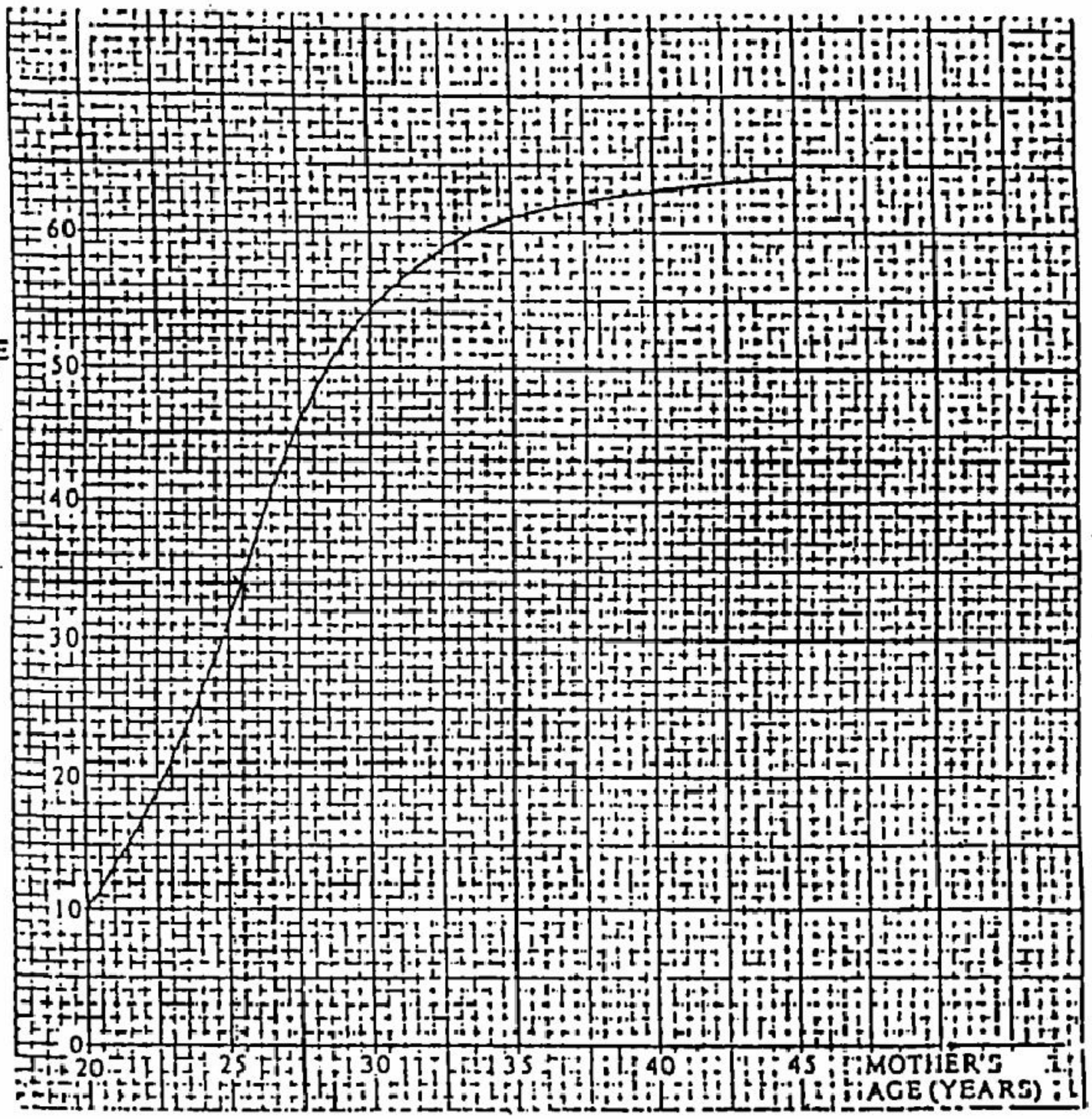
Using the graph,

(i) find the total number of live births in Scotland in 1936, [1]

(ii) find the number of live births in which the mother's age was less than 30 years, [1]

(iii) estimate the median age. [1]

CUMULATIVE FREQUENCY (thousands)



(*b*) The table below shows the number of live births in Scotland in 1986.

Mother's age (x years)	Frequency (thousands)
$15 \leqslant x < 20$	5
$20 \leqslant x < 25$	18
$25 \leqslant x < 30$	22
$30 \leqslant x < 35$	15
$35 \leqslant x < 40$	3.5
$40 \leqslant x < 45$	0.5

(i) Copy and complete the cumulative frequency table below for this data.

Mother's age (in years)	Cumulative frequency (thousands)
less than 20	5
less than 25	23
less than 30	
....	
....	

[2]

(ii) Draw the cumulative frequency diagram for this data.
Use the same scales as for the graph in part (*a*). [4]

(iii) Use your graph to estimate the median age. [2]

(iv) Use your graph to estimate the interquartile range. [2]

(*c*) Write a comment comparing the ages at which Scottish women became mothers in 1936 and 1986. [1]

---

9 In the pentagon $ABCDE$, interior angles A, B, C and D are all equal to 120°.

(*a*) Calculate angle E. [3]

(*b*) Draw a sketch of the pentagon, and explain why AB is parallel to ED. [2]

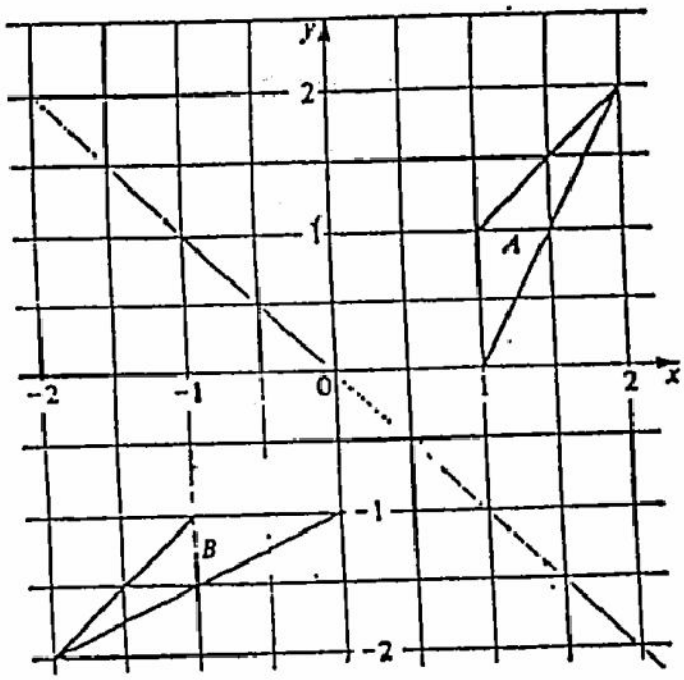
(*c*) Which other two sides are parallel? [1]

(*d*) In addition, $AB = BC = CD = 3$ cm. Draw the pentagon accurately. [3]

(*e*) Draw and label the line of symmetry in your diagram. [1]

(*f*) By taking suitable measurements from your diagram, or otherwise, calculate the area of the pentagon. You must show your method clearly. [4]

10



(*a*) Describe fully the single transformation that will map triangle *A* on to triangle *B*. [2]

(*b*) Find the matrix X of the transformation that you have described in part (*a*). [2]

(*c*) Describe fully the transformation represented by the matrix Y, where $Y = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ [2]

(*d*) Find YX. [2]

(*e*) What single transformation does YX represent? [2]

---

11 (*a*) Work out

(i) 26×93 and 62×39,

(ii) 36×42 and 63×24. [2]

(*b*) Find another pair of multiplications with the same property. [3]

For the remainder of the question pq, rs, qp and sr each represent a 2 digit number.

(*c*) In parts (*a*) and (*b*),

pq times *rs* = *qp* times *sr*.

State a relationship between *p*, *q*, *r* and *s*. [2]

(*d*) 26 can be written $(10 \times 2 + 6)$.

pq can be written $(10p + q)$.

Therefore, the multiplication of *pq* and *rs* can be written $(10p + q)(10r + s)$.

Use this idea to prove your statement in part (*c*). [4]

0580/4
0581/4

IGCSE NOV
MATHEMATICS
PAPER 4

Thursday 15 NOVEMBER 1990 2 h 30 min

Additional materials provided by the Syndicate:
1. Mathematical tables 2. 3 sheets of graph paper

Additional materials provided by the school/candidate:
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UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

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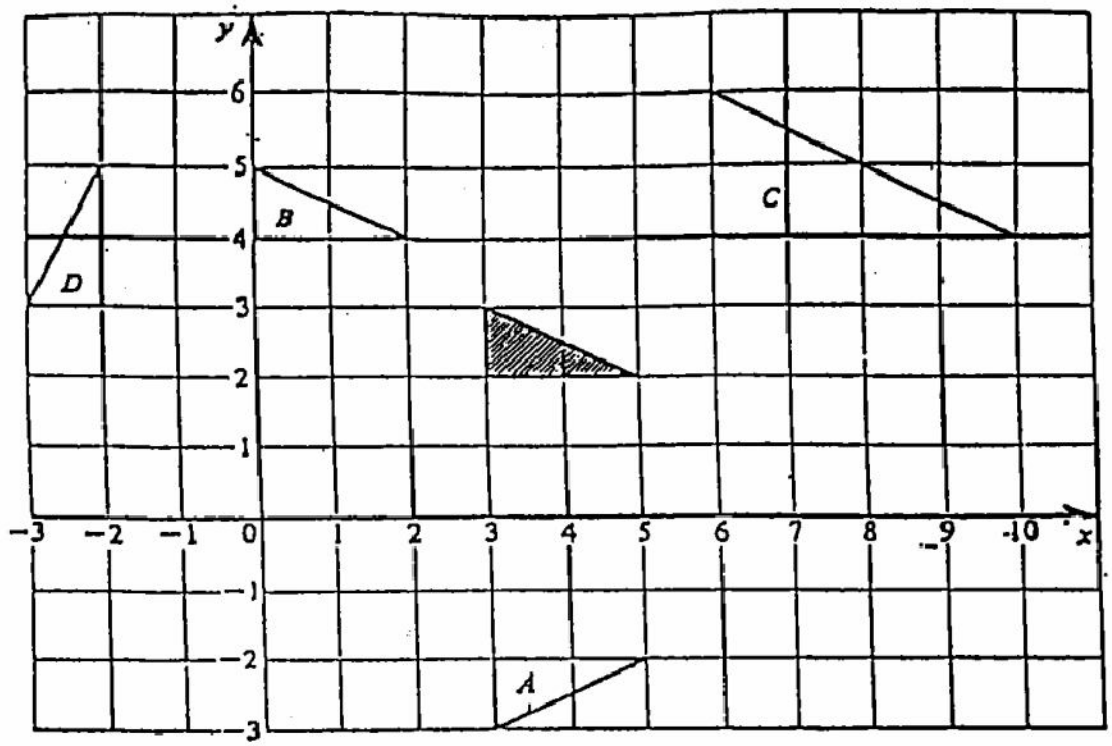
The total of the marks for this paper is 130.

The intended marks for questions or parts of questions are given in brackets [ ].

This Question Paper consists of 7 printed pages and 1 blank page.

9569 [Turn over

1 

Describe fully the transformations of the shaded triangle on to triangles *A*, *B*, *C* and *D*. [9]

---

2 A ball is thrown vertically upwards.

After t seconds the height, h metres, of the ball is given by the formula

$$h = 14t - 5t^2.$$

(*a*) Find the height of the ball after 1 second. [1]

(*b*) Find the height of the ball after $2\frac{1}{2}$ seconds. [2]

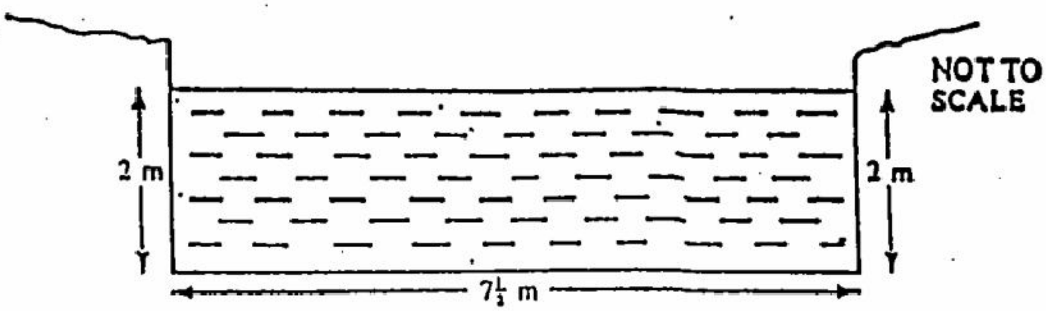
(*c*) The answer to (*b*) is less than the answer to (*a*).

Explain why this is so. [2]

(*d*) When $h = 8$, find the two possible values of t. [4]

(*e*) Calculate the two times when the ball is at a height of 5 metres. Give your answers correct to two decimal places. [5]

3



The diagram shows the rectangular cross-section of a canal. It is $7\frac{1}{2}$ metres wide and the water is 2 metres deep.

(*a*) Calculate the area of the cross-section of the water in the canal, in square metres. [1]

(*b*) The water flows at the rate of $\frac{3}{4}$ km/h.

Calculate the volume of water passing a fixed point on the canal bank in one minute. Give your answer in cubic metres. [5]

(*c*) The mass of one cubic centimetre of water is 1 gram.

Find the mass, in kilograms, of one cubic metre of water. [3]

(*d*) Calculate the mass of water passing a fixed point on the bank every minute. [2]

---

4 (*a*)

$$X = \begin{pmatrix} 4 & -1 \\ 3 & 2 \end{pmatrix}, \qquad Y = \begin{pmatrix} 0 & 5 \\ -4 & -2 \end{pmatrix}$$

Find (i) $2X$,

(ii) $X + Y$,

(iii) the determinant of X,

(iv) X^{-1}.

[5]

(*b*)

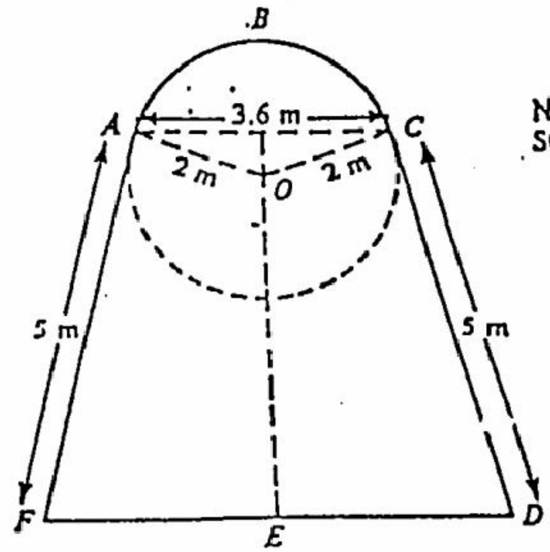
$$\begin{pmatrix} a & b & c \end{pmatrix} \begin{pmatrix} a & 0 & 0 \\ -c & 3 & -1 \\ b & 2 & 4 \end{pmatrix} = \begin{pmatrix} 9 & 11 & 15 \end{pmatrix}$$

(i) Multiply out the matrices on the left hand side and hence write down three equations. [3]

(ii) a, b and c all represent positive integers.

By solving your equations, or otherwise, find the value of a, of b and of c. [4]

5



The shape $ABCDEF$ consists of a trapezium $ACDF$ and a minor segment ABC of a circle, centre O. The lines FA and DC are tangents to the circle at A and C respectively.

The radius of the circle is 2 m.

$AC = 3.6$ m and $AF = CD = 5$ m.

π is approximately 3.142.

(a) Show that angle AOC is 128.3°, correct to one decimal place. [2]

(b) Calculate the area of the sector $OABC$. [2]

(c) Calculate the area of the triangle OAC and hence the area of the minor segment ABC. [3]

(d) Show that the perpendicular distance between AC and FD is 4.5 m. [2]

(e) Find the area of the trapezium $ACDF$ and hence the area of the whole shape $ABCDEF$. [4]

---

6 A farmer makes a sheep pen, in the shape of a quadrilateral, out of four pieces of fencing. Each side of the quadrilateral is 3 metres long and one of the angles is 60°

(a) Using a scale of 1 to 30, make an accurate drawing of the quadrilateral. [3]

(b) Mark in its axes of symmetry with broken lines (------) and describe how they cut each other. [3]

(c) What is the special geometrical name of this shape? [1]

(d) Calculate the area enclosed by the sheep pen, giving your answer in square metres. [3]

(e) By changing the angles (but leaving the lengths of the sides unchanged), the area enclosed by the sheep pen can be varied. What is the greatest possible area that can be enclosed? [2]

7 The whole of this question should be answered on a sheet of graph paper.

The table gives some values of the function

$$f(x) = x^3 \cdot \quad \cdot ^2 - 11x + 12.$$

x	-3.5	-3	-2	-1	0	1	2	3	4	4.5
$f(x)$	-16.9	0	18	20	12	0	-10	-12	0	13.1

(a) Using a scale of 2 cm to represent 1 unit on the x-axis and 2 cm to represent 5 units on the $f(x)$ axis, plot the given points and hence draw the graph of the function for values of x in the range $-3.5 \leqslant x \leqslant 4.5$. [4]

(b) (i) Calculate $f(5)$.

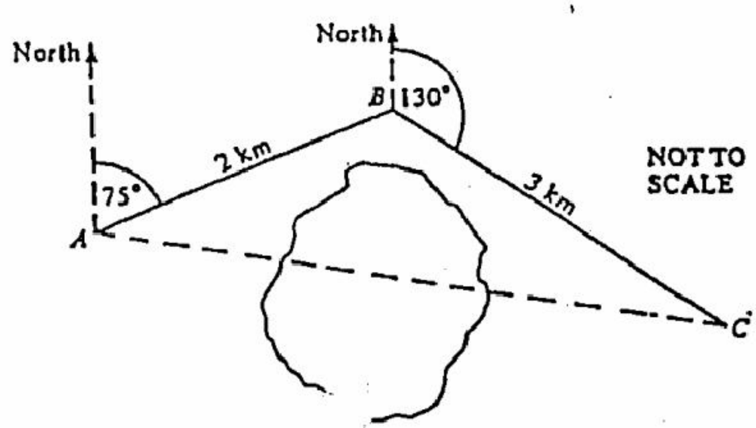
(ii) Hence describe how the graph continues when $x > 4.5$.

[2]

(c) By drawing a suitable tangent, estimate the gradient of the curve at the point where $x = 4$. [3]

(d) State the coordinates of the two points on the curve at which the gradient is zero. [3]

8



In order to sail round a small island, a fisherman steers his boat for 2 km on a bearing 075° from A to B and then for 3 km on a bearing 130° from B to C.

(a) Show that angle ABC is 125°. [2]

(b) Calculate the direct distance from A to C. [4]

(c) Calculate the bearing of C from A. [3]

9 The whole of this question should be answered on a sheet of graph paper.

Rapid Delivery Services have to deliver 1350 parcels to the next town. Their lorries can take 150 parcels at a time and their vans can take 90 parcels at a time.

(*a*) If x lorries and y vans are used, show that

$$5x + 3y \geqslant 45. \quad [2]$$

(*b*) Only twelve drivers are available, so twelve vehicles at most can be used. Write down another inequality which must be satisfied by x and y. [2]

(*c*) At least four vans must be used. Write this as a third inequality. [2]

(*d*) Using a scale of 2 cm to represent 2 vehicles on each axis, draw x and y axes and number each of them from 0 to 16. Represent the three inequalities on your graph. Indicate clearly, by shading the unwanted regions, the region within which (x, y) must lie. [6]

(*e*) The cost of one lorry journey is $30 and the cost of one van journey is $20. Use your graph to find how many lorries and how many vans will be needed to deliver the parcels at the least cost. What is that least cost? [3]

---

10 The whole of this question should be answered on a sheet of graph paper.

A survey of the age distribution of the population of Great Britain was made in 1989. The data obtained was expressed in two ways, as shown in the following tables.

Age, x, in years	$0 \leqslant x < 10$	$10 \leqslant x < 20$	$20 \leqslant x < 30$	$30 \leqslant x < 40$	$40 \leqslant x < 50$	$50 \leqslant x < 60$	$60 \leqslant x < 70$	$70 \leqslant x < 80$	$80 \leqslant x < 90$	$90 \leqslant x < 100$
Frequency (millions)	6.5	6.5	8	7	6.5	5.5	5	3.5	1.5	0.2

Age, x, in years	$x < 10$	$x < 20$	$x < 30$	$x < 40$	$x < 50$	$x < 60$	$x < 70$	$x < 80$	$x < 90$	$x < 100$
Cumulative frequency (millions)	6.5	13	21	A	34.5	B	45	48.5	C	50.2

(*a*) Find the value of A, of B and of C. [2]

(*b*) Using a scale of 1 cm to represent 10 years horizontally and 2 cm to represent 5 millions vertically, draw a cumulative frequency diagram to represent this distribution. [5]

(*c*) Use your diagram to estimate

(i) the median,

(ii) the lower quartile,

(iii) the inter-quartile range. [3]

(*d*) Showing your working clearly, calculate the mean age of the population as accurately as you can from the data given. [6]

---

11 Sarah Jane has a set of holiday photographs (fewer than a hundred) which she is going to put into a photograph album.

If she puts 2 photographs on each page, she will have 1 photograph left over.

If she puts 3 photographs on each page, she will have 2 photographs left over.

If she puts 4 photographs on each page, she will have 3 photographs left over.

If she puts 5 photographs on each page, she will have 4 photographs left over.

How many photographs does she have altogether?

You must show how you arrive at your answer. [5]

0580/4
0581/4

IGCSE JUNE

MATHEMATICS

PAPER 4

Wednesday 12 JUNE 1991 Morning 2 h 30 min

Additional materials provided by the Syndicate:
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The number of marks available is shown in brackets [ ] *after each question or part question.*

This Question Paper consists of 7 printed pages and 1 blank page.

1

Hazel Green sells $2\frac{1}{2}$ litre tins of paint in her shop for $14.30 each.

(a) (i) Express this price in dollars per litre. [1]
(ii) At this price, how many millilitres of paint do you get for $1? [2]

(b) Hazel makes a profit of 30% on the cost price of the tin of paint.
Calculate the cost price. [2]

(c) In a sale, she reduces the price of the tin of paint to $11.44.
Calculate
(i) the percentage reduction in the selling price of the tin of paint, [2]
(ii) the percentage profit she now makes on the cost price. [2]

(d) A 5 litre tin of paint is priced in the sale at $21.12.
Calculate the price of this tin in pounds sterling, given that £1 = $1.65. [2]

---

2 The formula

$$A = 180 - \frac{360}{n}$$

gives the size of each interior angle, $A°$, of a regular polygon with n sides.

(a) Find the value of A when n equals
(i) 180,
(ii) 360,
(iii) 720,
(iv) 7200. [2]

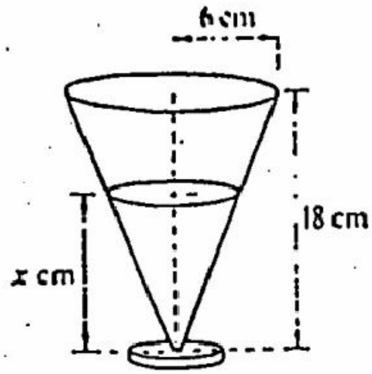
(b) As n becomes very large,
(i) what value does A approach, [1]
(ii) what shape does the polygon approach? [1]

(c) Find the value of n when $A = 162$. [2]

(d) Make n the subject of the formula. [3]

(e) Three regular polygons, two of which are octagons, meet at a point so that they fit together without any gaps.
Showing all your working, identify the third polygon. [2]

3 A glass is in the shape of an inverted cone of radius 6 cm and height 18 cm.



(*a*) Calculate the capacity of the glass.
[The volume of a cone of radius r and height h is $\frac{1}{3}\pi r^2 h$, and π is approximately 3.142] [2]

(*b*) Milk is poured into the glass to a height of 9 cm. Calculate the volume of milk in the glass. [2]

(*c*) If the height of milk in the glass is x cm,
- (i) find the radius of its surface, in terms of x, [1]
- (ii) find a formula for the volume of milk, in terms of π and x, [3]
- (iii) show that, when $x = 9$, your formula gives the same answer as in part (*b*). [2]

---

4 **The whole of this question should be answered on a sheet of graph paper.**

A farmer keeps x goats and y cows. Each goat costs $2 a day to feed and each cow costs $4 a day to feed. The farmer can only afford to spend $32 a day on animal food.

(*a*) Show that $x + 2y \leqslant 16$. [2]

(*b*) The farmer has room for no more than 12 animals.
He wants to keep at least 6 goats and at least 3 cows.
Write down three more inequalities. [3]

(*c*) Using a scale of 1 cm to represent 1 unit on each axis, represent the four inequalities on a graph. [4]

(*d*) One possible combination which satisfies all the inequalities is 6 goats and 4 cows. Write down all the other possible combinations. [3]

(*e*) If he makes a profit of $50 on each goat and $80 on each cow, which combination will give him the greatest profit? Calculate the profit in this case. [2]

---

5 (*a*) Find the solution set of the inequality
$$3 - 2x < 11.$$ [2]

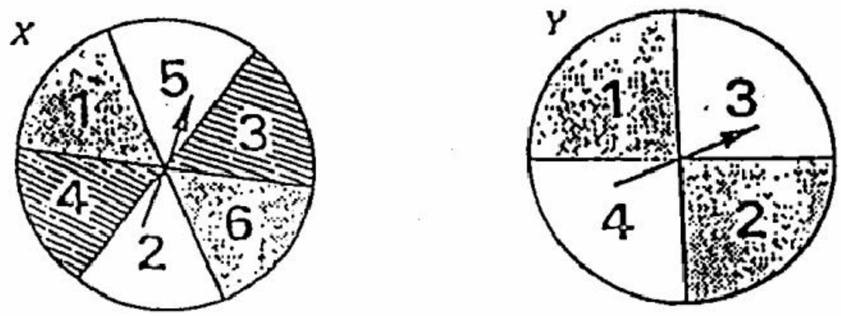
(*b*) (i) Solve the equation
$$x^2 + x - 30 = 0.$$ [2]

(ii) Solve the equation
$$x^2 + x - 15 = 0,$$ [4]
giving your answers correct to two decimal places.

(*c*) Simplify, as far as possible,
$$\frac{a+b}{a^2 + ab - 2b^2} - \frac{2}{3a - 3b}.$$ [4]

---

6 When the arrow on spinner X is spun it is equally likely to stop on any of the numbers 1, 2, 3, 4, 5 or 6.
Similarly the arrow on spinner Y is equally likely to stop on 1, 2, 3 or 4.



(*a*) Copy and complete the possibility diagram below, showing the possible totals when both arrows are spun.

		SPINNER X					
		1	2	3	4	5	6
SPINNER Y	1	2					
	2				6		
	3					8	
	4			7			

[2]

(*b*) What is the probability of a total of
   (i) 2,
   (ii) 7,
   (iii) 12? [3]

(*c*) Which totals are the most probable? [1]

(*d*) The sectors on the two spinners are dotted, white or striped.
What is the probability of
   (i) both arrows pointing to a dotted sector, [2]
   (ii) one arrow pointing to a dotted sector, and one arrow pointing to a white sector? [3]

7 The whole of this question should be answered on a sheet of graph paper.

(*a*) Copy and complete the given table of values for the function

$$y = 3^x$$

x	-1	0	1	1.5	2	2.5	3	3.5	4
y				5.2	9	15.6	27	46.8	

[3]

(Where appropriate, y values are given correct to one place of decimals.)

(*b*) Using a scale of 2 cm to represent 1 unit on the x-axis, and 2 cm to represent 10 units on the y-axis, draw the graph of $y = 3^x$ for values of x from -1 to 4 inclusive. [4]

(*c*) What happens to y when x is both negative and very large? [1]

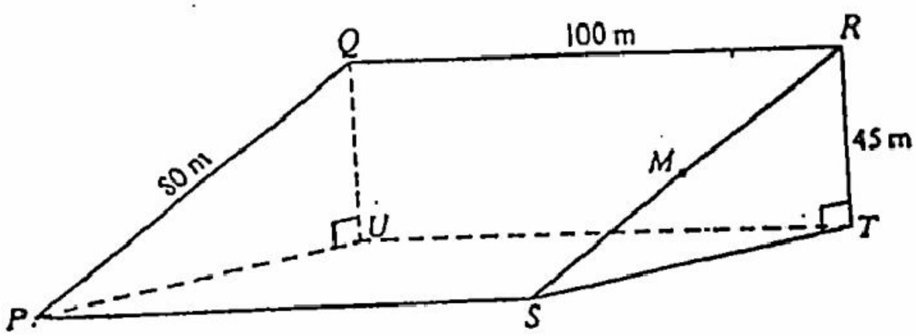
(*d*) Use your graph to find the value of

(i) y when $x = 1.2$, [1]

(ii) x when $y = 20$. [1]

(*e*) By drawing a suitable tangent, estimate the gradient of the graph when $x = 2$. [2]

8



The diagram represents an artificial ski slope.

The surface of the slope, $PQRS$, is a rectangle.

T is a point vertically below R, and U is vertically below Q, so that $PSTU$ is a horizontal rectangle.

M is the midpoint of RS.

$PQ = 80$ m, $QR = 100$ m and $RT = 45$ m.

(*a*) Calculate angle RST. [2]

(*b*) Carol skis down the slope along the line RP.

Calculate (i) the length of RP, [2]

(ii) the angle that her path makes with the horizontal. [2]

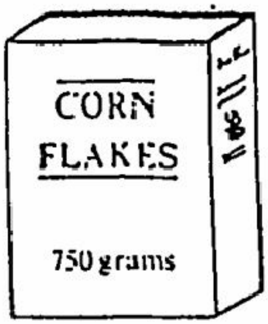
(*c*) She returns to the top of the slope by walking from P to M and then from M to Q.

Find (i) the distance that she has to walk, [3]

(ii) the angle of depression of M from Q. [2]

3 The whole of this question should be answered on a sheet of graph paper.

In a standards testing survey, the mass of cornflakes in 200 packets was found, and the following results were obtained.



Mass (m) of cornflakes in grams	Number of packets (Frequency)
$746 \leqslant m < 748$	5
$748 \leqslant m < 750$	11
$750 \leqslant m < 752$	22
$752 \leqslant m < 754$	52
$754 \leqslant m < 756$	68
$756 \leqslant m < 758$	36
$758 \leqslant m < 760$	6

(*a*) State the modal class. [1]

(*b*) Copy and complete the following cumulative frequency table.

Mass (m) in grams	*Cumulative frequency*
$m < 748$	5
$m < 750$	16
$m < 752$	38
......	......
......	......
......	......
$m < 760$	200

[2]

(*c*) Using a scale of 2 cm to represent 2 grams horizontally, and 2 cm to represent 20 packets vertically, draw a cumulative frequency diagram. [4]

(*d*) Use your diagram to estimate

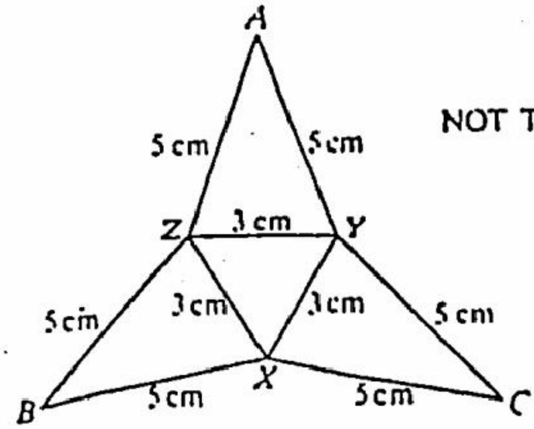
(i) the median mass,

(ii) the interquartile range. [3]

(*e*) To avoid complaints, all packets whose contents had a mass of less than 751 grams were rejected.

What percentage of the packets was rejected? [2]

10



NOT TO SCALE

(*a*) Using ruler and compasses only, construct the shape in the diagram. The three shorter sides are each 3 cm long, and the six longer sides are each 5 cm long. [3]

(*b*) What special name is given to

(i) $\triangle XYZ$,

(ii) $\triangle AYZ$? [2]

(*c*) From your drawing, measure and write down the size of

(i) $Z\hat{A}Y$,

(ii) $B\hat{X}C$. [2]

(*d*) Check your answer to (*c*)(i) by using trigonometry. [2]

(*e*) Describe the symmetry of the shape as fully as possible. [3]

(*f*) Name the three dimensional solid which would be formed by folding the shape along XY, YZ and ZX, so that A, B and C coincide. [1]

(*g*) How many (i) vertices,

(ii) edges would the solid have? [2]

---

11 (*a*) Prove, for all non-zero values of p and q, that

$$\left(1+\frac{p}{q}\right)\left(1+\frac{q}{p}\right)=\left(1+\frac{p}{q}\right)+\left(1+\frac{q}{p}\right).$$ [4]

(*b*) (i) By substituting $p = 3$ and $q = 2$ show that the above identity reduces to

$$2\tfrac{1}{2}\times 1\tfrac{2}{3} = 2\tfrac{1}{2} + 1\tfrac{2}{3}.$$ [1]

(ii) By evaluating $2\tfrac{1}{2}\times 1\tfrac{2}{3}$ and $2\tfrac{1}{2} + 1\tfrac{2}{3}$ prove that the statement in (*b*)(i) is true. [2]

(*c*) By choosing other integer values of p and q, where p and q are different, write down four other statements similar to that in part (*b*)(i).

Include at least one statement in which the value of p is negative. [4]

0580/4
0581/4

IGCSE NOV

MATHEMATICS

PAPER 4

Thursday 14 NOVEMBER 1991 2 h 30 min

Additional materials provided by the Syndicate:
1. 4 sheets of graph paper
2. Mathematical tables

Additional materials provided by the school/candidate:
3. Electronic calculator
4. Geometrical instruments

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

Instructions to candidates:

You should answer all *the questions on the separate sheets of paper provided.*

Show all your working on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

Write your name and examination number on each separate piece of writing paper or graph paper you use. If you use more than one sheet of paper for your answers, all answer sheets should be placed in correct order and fastened together.

Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

The total of the marks for this paper is 130.

The number of marks available is shown in brackets [ ] at the end of each question or part question.

This Question Paper consists of 7 printed pages and 1 blank page.

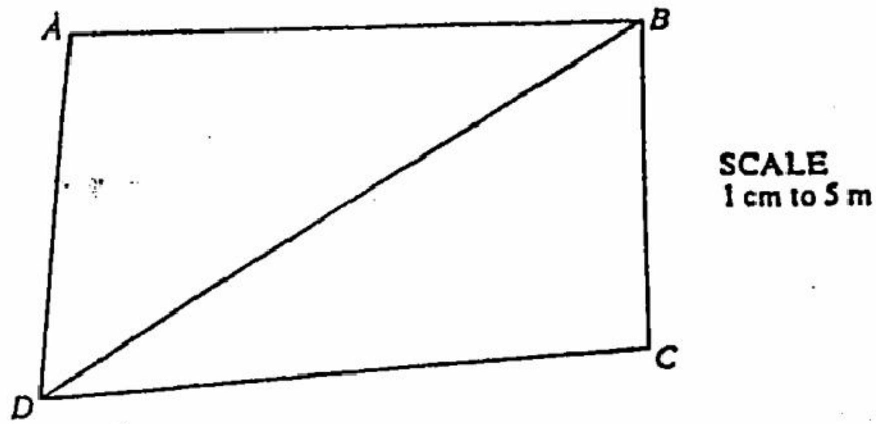
[Turn over

1 (a) The front page of a newspaper is rectangular and measures 60 cm by 40 cm, correct to the nearest centimetre.

Between what limits does the area of the front page lie?

Write your answer in the form .... $cm^2 \leqslant$ area $<$ .... cm^2. [3]

(b)



The diagram is an accurate plan of a garden.

(i) Measure the sides of the diagram and the diagonal BD. Using the given scale, express the five lengths in metres. [2]

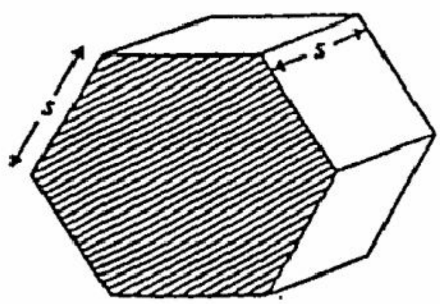
(ii) Correct each of the five lengths to the nearest 5 metres. [2]

(iii) Draw another plan of the garden, using the approximated measurements and the same scale. [2]

(iv) Write down the single word which completes the following statement.

"After approximating the measurements to the nearest 5 metres, the shape of the garden becomes a ____________." [1]

2



The volume of a regular hexagonal prism is given by the formula

$$V = 2.6 s^3,$$

where s is the length of each edge of the prism.

(a) Find V if $s = 3.3$ cm.

(b) Make s the subject of the formula. [2]

(c) (i) Use trigonometry to obtain an expression for the area of the (shaded) hexagon, in terms of s. [4]

(ii) Hence show that the original formula is approximately correct. [1]

3 In 1772, a German astronomer named Bode gave this table for the distance of each of the planets from the Sun.

Planet	Bode's number		Actual distance (in Bode units)
Mercury	4		3.9
Venus	7	(3 + 4)	7.2
Earth	10	(6 + 4)	10.0
Mars	16	(12 + 4)	15.2
----	--	-----	---
Jupiter	52	(48 + 4)	52.0
Saturn	100	(96 + 4)	95.4

(*a*) What is the missing Bode's number? (This led to the discovery of the Asteroid Belt.) [2]

(*b*) Bode's numbers were used to forecast the position of Uranus, the next planet further out than Saturn, and it was discovered in 1781.

(i) What was Bode's number for Uranus? [1]

(ii) The actual distance of Uranus from the Sun was 193 units.

Express the error in Bode's number as a percentage of the actual distance. [3]

(*c*) The distance of the Earth from the Sun, given as 10.0 in the table above, is 1.49×10^8 kilometres.

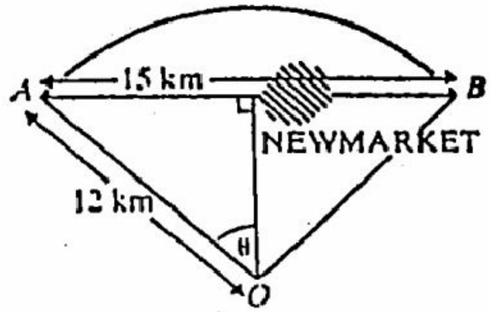
Calculate the distance from the Sun of

(i) Mercury,

(ii) Jupiter,

giving your answers in kilometres, in standard form. [4]

4



The main road, from A to B, through Newmarket, is straight for 15 kilometres. The ring road, around Newmarket, is an arc AB of a circle, centre O, of radius 12 kilometres.

(*a*) (i) Calculate the size of the angle marked θ in the diagram. [2]

(ii) Use your answer to (*a*)(i) to show that, correct to three significant figures, the length of the ring road between A and B is 16.2 kilometres. [4]

(π is approximately 3.142)

(*b*) Mr. Carson can drive at a steady 100 km/h along the ring road. If he drives from A to B through Newmarket, he can average 80 km/h for 12 kilometres but averages only 40 km/h for the 3 kilometres through the town.

Calculate, to the nearest minute, the amount of time that he saves by driving round the ring road. [5]

---

5 In the quadrilateral $PQRS$, $\vec{PQ} = \mathbf{a}$, $\vec{QR} = \mathbf{b}$ and $\vec{SR} = 2\mathbf{a}$.

(*a*) Write down two things that this tells you about the line segments PQ and SR. [2]

(*b*) Express $\vec{PR}$ and $\vec{SP}$ in terms of a and b. [3]

(*c*) If $\mathbf{a} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$,

(i) make an accurate drawing of the quadrilateral $PQRS$, using a scale of 1 cm to represent 1 unit. [3]

(ii) calculate the area of triangle PQR. [3]

---

6 A game warden is standing 100 metres due East of a look-out tower.

(*a*) The angle of elevation of the top of the tower, from where he stands, is 9°.

Calculate the height of the tower. [2]

(*b*) A tourist, at the top of the tower, sights a rhinoceros at a distance of 150 metres from the foot of the tower, and on a bearing of 220°.

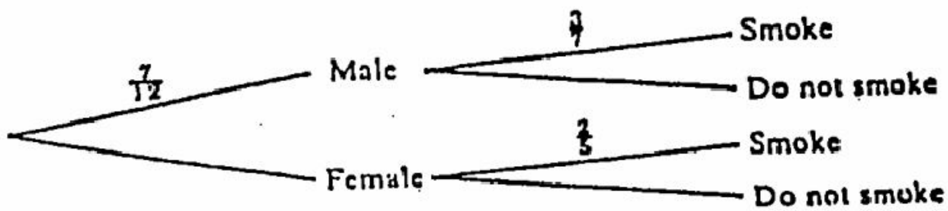
(i) Draw a sketch showing the positions of the foot of the tower, the game warden and the rhinoceros. [2]

(ii) Calculate the distance between the game warden and the rhinoceros. [3]

(*c*) Calculate the angle of depression of the rhinoceros from the top of the tower. [2]

---

7 Six hundred students were asked if they smoked. The results were recorded and probabilities were calculated. Some of the probabilities are shown on the tree diagram below.



(*a*) Copy and complete the tree diagram. [3]

(*b*) How many of the students who were asked were male? [1]

(*c*) One of the students is selected at random.

What is the probability that the person selected is

(i) a male who smokes. [2]

(ii) a non-smoker? [3]

---

8 Answer the whole of this question on a sheet of graph paper.

x	0.6	1	1.5	2	2.5	3	3.5	4	4.5	5
y	p	−5.9	−3.7	−2.3	−1.1	0.3	1.9	3.8	q	r

Some of the values for the function

$$y = \frac{x^3}{12} - \frac{6}{x}$$

are shown in the table above. Values of y are given correct to one decimal place.

(*a*) Find the values of p, q and r. [3]

(*b*) Using a scale of 2 cm to represent 1 unit on the x-axis, and 1 cm to represent 1 unit on the y-axis, draw the graph of $y = \frac{x^3}{12} - \frac{6}{x}$ for $0.6 \leqslant x \leqslant 5$. [5]

(*c*) Find, from your graph, correct to 1 decimal place, the value of x for which

$$\frac{x^3}{12} - \frac{6}{x} = 0.$$ [2]

(*d*) Draw the tangent to the curve at the point where $x = 1$, and hence estimate the gradient of the curve at that point. [3]

9 (*a*) Using ruler and compasses only construct,

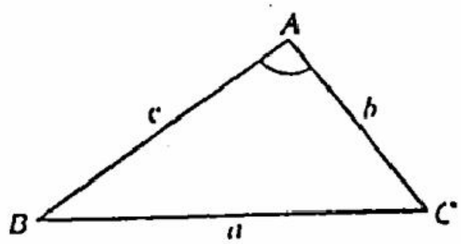
(i) triangle PQR with $PQ = 10$ cm, $QR = 9$ cm and $RP = 7$ cm.. [1]

(ii) the perpendicular bisectors of PQ and QR, [3]

(iii) the circle, with its centre at the point where the perpendicular bisectors meet, passing through P, Q and R. [1]

(This is the *circumcircle* of triangle PQR.)

(*b*)



A formula for the area (Δ) of triangle ABC is

$$\Delta = \tfrac{1}{2}bc \sin A.$$

It is also given that

$$\frac{a}{\sin A} = 2R,$$

where R is the radius of the circumcircle.

(i) Combine these two formulae to show that

$$\Delta = \frac{abc}{4R}.$$ [3]

(ii) Measure the radius of the circumcircle you have drawn in part (*a*), and hence calculate the area of triangle PQR. [3]

---

10 The table shows the distribution of emergency admissions to a hospital per day over a period of two months.

Number of Admissions	Frequency
[illegible]	10
10–19	25
20–29	15
30–39	8
40–49	2

(*a*) State the modal class of the distribution. [1]

(*b*) (i) Write down the mid-interval value in the class interval 10–19. [1]

(ii) Calculate an estimate of the mean number of admissions per day. [4]

(*c*) Calculate an estimate of the median number of admissions per day. [3]

(*d*) Construct a histogram to represent this information. [3]

11 (*a*) Factorise, if possible.

(i) $9a^2 - 4b^2$.

(ii) $9a^2 + 4b^2$.

(iii) $2x^2 + 7x - 4$. [4]

(*b*) Factorise completely

$$6ax - 4bx + 3ay - 2by.$$ [2]

(*c*) Solve the quadratic equation

$$(x - 3)^2 = 5,$$

giving your answers correct to two decimal places. [4]

(*d*) The sum, S, of the first n positive integers is given by the formula

$$S = \tfrac{1}{2}n(n + 1).$$

(i) Use the formula to find the value of

$$1 + 2 + 3 + 4 + \dots\dots\dots + 99 + 100.$$ [1]

(ii) Find n when $S = 465$. [3]

---

12 Answer the whole of this question on a sheet of graph paper.

The vertices of a rectangle $OPQR$ are $O(0, 0)$, $P(2, 0)$, $Q(2, 5)$ and $R(0, 5)$.

(*a*) Taking 1 cm to represent 1 unit on each axis and marking each axis from -6 to $+6$, draw and label the rectangle $OPQR$. [2]

(*b*) The rectangle $OPQR$ is mapped onto rectangle $OP_1Q_1R_1$ by the transformation represented by the matrix L, where

$$\mathbf{L} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}.$$

Draw and label the rectangle $OP_1Q_1R_1$ on your diagram, and describe the transformation fully in geometrical terms. [3]

(*c*) Reflect the original rectangle $OPQR$ in the y-axis.

Label the new rectangle $OP_2Q_2R_2$.

Write down the matrix M which represents this transformation. [3]

(*d*) The rectangle $OP_1Q_1R_1$ can be mapped onto the rectangle $OP_2Q_2R_2$ by a single transformation represented by the matrix N.

(i) Describe this transformation fully in geometrical terms. [2]

(ii) Write down the matrix N which represents this transformation. [1]

(iii) State a relationship between the matrices L, M and N. [1]

0580/4 0581/4 IGCSE JUNE

MATHEMATICS

PAPER 4

Wednesday 10 JUNE 1992 Morning 2 h 30 min

Additional materials provided by the Syndicate:
1. Mathematical tables
2. 3 sheets of graph paper

Additional materials provided by the school/candidate:
3. Electronic calculator
4. Geometrical Instruments
5. Answer paper

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

Instructions to candidates:

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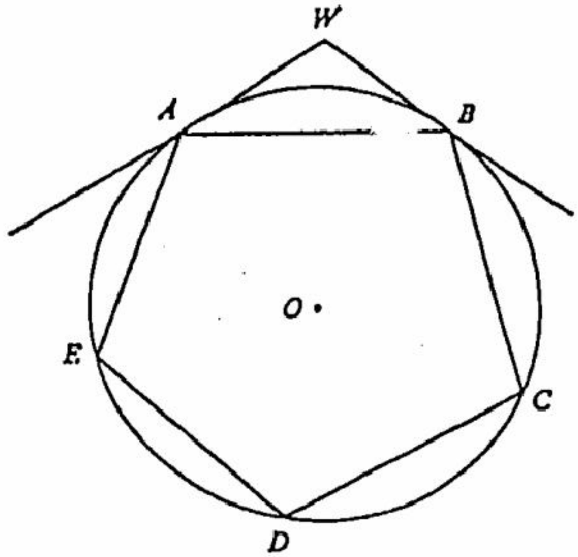
The number of marks available is shown in brackets [ ] *after each question or part question.*

This Question Paper consists of 7 printed pages and 1 blank page.

[Turn over

1 (a)



NOT TO SCALE

The diagram represents a regular pentagon *ABCDE* inscribed in a circle, centre *O*.

The tangents at *A* and *B* meet at *W*.

Calculate (i) angle *BCD*, [2]

(ii) angle *CBD*, [2]

(iii) angle *OAB*, [1]

(iv) angle *WAB*, [1]

(v) angle *AWB*. [2]

(b) The angles of a *hexagon* are in the ratio 3 : 4 : 4 : 4 : 4 : 5.

Calculate the size of the smallest angle. [4]

---

2 (a) (i) Calculate the circumference of a bicycle wheel of diameter 0.64 m.

(π is approximately 3.142.) [2]

(ii) Calculate the number of complete turns the wheel makes when the bicycle travels 700 m. [2]

(b) A rectangular field measures 350 m by 200 m, each measured to the nearest 10 m.

Calculate the limits between which the area of the field must lie. [4]

(c) *A*, *B* and *C* are three similar containers.

Their heights are 40 cm, 30 cm and 15 cm respectively.

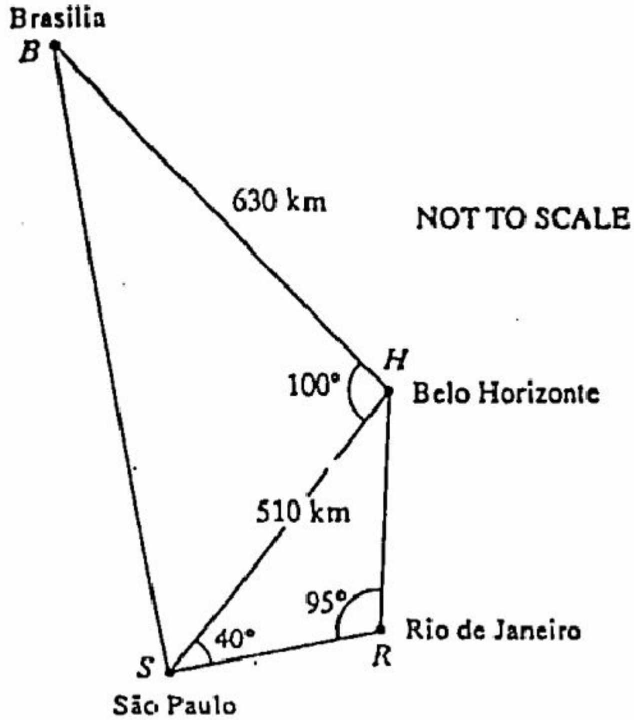
The container *C* has a surface area of 450 cm^2 and has a capacity of 0·8 litres.

Calculate

(i) the surface area of container *A*, [3]

(ii) the capacity of container *B*. [3]

3



The diagram shows some angles and some direct distances between four towns in Brazil.

(*a*) Calculate the direct distance between Brasilia and São Paulo. [4]

(*b*) Calculate the direct distance between Rio de Janeiro and São Paulo. [4]

(*c*) Calculate the area of the quadrilateral *BHRS*. [4]

4 **Answer the whole of this question on a sheet of graph paper.**

A new breed of wheat is being developed and, in an experiment, the heights of 100 plants are measured. The results are shown in the following table.

Height (h) in centimetres	$0 < h \leqslant 3$	$3 < h \leqslant 6$	$6 < h \leqslant 9$	$9 < h \leqslant 12$	$12 < h \leqslant 15$	$15 < h \leqslant 18$	$18 < h \leqslant 21$	$21 < h \leqslant 24$
Number of plants	5	7	12	20	23	18	10	5

(*a*) Calculate the mean height of the plants. [4]

(*b*) The following table shows the cumulative frequencies of the same data.

Height (h) in centimetres	$h \leqslant 3$	$h \leqslant 6$	$h \leqslant 9$	$h \leqslant 12$	$h \leqslant 15$	$h \leqslant 18$	$h \leqslant 21$	$h \leqslant 24$
Cumulative frequency	5	p	24	44	67	85	q	100

(i) Find the value of p and the value of q. [1]

(ii) Using your values for p and q and the information given in the cumulative frequency table, draw a cumulative frequency diagram. Use a scale of 1 cm to represent 2 cm of height and 1 cm to represent 10 plants. [4]

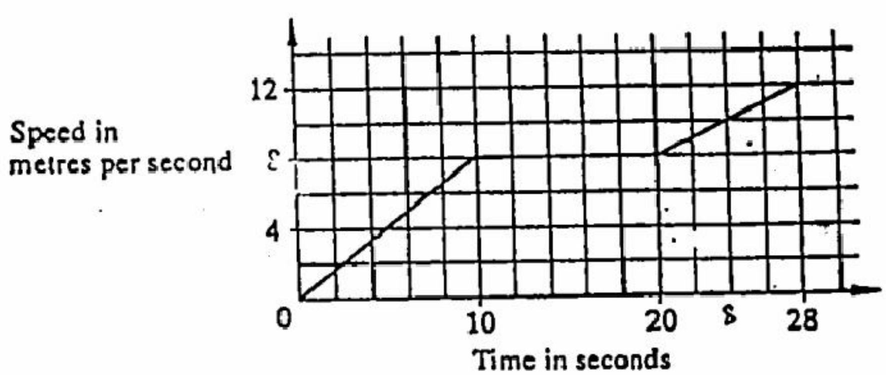
(*c*) From your graph, find

(i) the median height, [1]

(ii) the interquartile range of the heights, [2]

(iii) an estimate of the number of plants with a height greater than 10 cm. [2]

5



The diagram shows the speed–time graph of a car during the first 28 seconds of its motion.

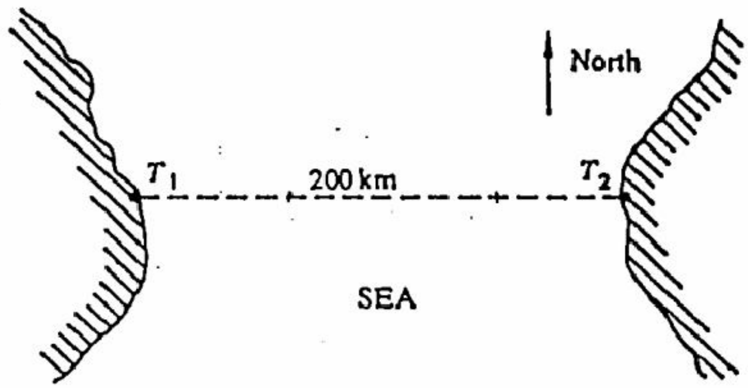
(*a*) Calculate the acceleration during the first 10 seconds. [2]

(*b*) Describe the motion taking place between 10 and 20 seconds. [1]

(*c*) Find the speed at 23 seconds. [2]

(*d*) Calculate the distance travelled during the 28 seconds. [3]

6



T_1 and T_2 are transmitters 200 km apart. T_2 is due East of T_1.

The signals from T_1 can reach a distance of 150 km and those from T_2 can reach a distance of 120 km.

(*a*) Using a scale of 1 cm to represent 20 km, make an accurate drawing to represent the transmitters and the area where signals from both transmitters can reach. [3]

(*b*) A ship is sailing on a bearing of 330° and passes through the point exactly half-way between the two transmitters.

On the same drawing, show accurately the path of the ship. [3]

(*c*) Use your drawing to find the distance the ship sails whilst receiving signals from both transmitters. [2]

(*d*) Given that the speed of the ship is 25 km/h, calculate the length of time during which the ship can receive signals from both transmitters. [2]

---

7 (*a*) (i) If £1 = 9.80 French francs, calculate how much 100 francs are worth in pounds (£), giving your answer correct to two decimal places. [2]

(ii) If £1 = x francs, write down an expression, in terms of x, for the value in pounds of 100 francs. [1]

(*b*) A French holidaymaker toured Britain in 1989 and in 1990.

In 1990, the exchange rate was £1 = x francs.

In 1989, it was £1 = $(x + 1)$ francs.

The holidaymaker found that, for 100 francs, she received £1 more in 1990 than in 1989.

(i) Write down an equation in x and show that it reduces to

$$x^2 + x - 100 = 0.$$ [4]

(ii) Use the above equation to calculate the value of x, giving your answer correct to two decimal places. [4]

(iii) Use your answer to (*b*) (ii) to find the value, in pounds, of 100 francs in the year 1990. Give your answer correct to two decimal places. [1]

8 **Answer the whole of this question on a sheet of graph paper.**

(*a*) The tables of values are for the graphs of $y = x^2$ and $y = 2^x$.

x	-2	-1	0	1	2	3
$y = x^2$	4	p	0	1	4	q

x	-2	-1	0	1	2	3
$y = 2^x$	r	0.5	s	2	4	t

(i) Calculate the values of p, q, r, s and t. [3]

(ii) On the same axes and using a scale of 2 cm to represent 1 unit on both the x and y axes, draw the graphs of $y = x^2$ and $y = 2^x$, for $-2 \leqslant x \leqslant 3$. [6]

(iii) From your graphs, find the two solutions, in the range $-2 \leqslant x \leqslant 3$, of the equation $x^2 = 2^x$. [2]

(*b*) (i) On the same axes, draw the graph of $x + y = 1$. [2]

(ii) Write down the x-coordinates of the points of intersection of the graphs of $y = x^2$ and $x + y = 1$. [2]

(iii) Write down the quadratic equation in x satisfied by these values. [1]

---

9 **Answer the whole of this question on a sheet of graph paper.**

(*a*) Draw x and y axes from -6 to $+6$, using a scale of 1 cm to represent 1 unit.

Draw and label triangle ABC with A (4,3), B (1,3) and C (4,4). [2]

(*b*) The transformation T_1 is represented by the matrix

$$M_1 = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$$

(i) Draw the image of triangle ABC under T_1, labelling it $A_1B_1C_1$. [3]

(ii) Describe fully the single transformation T_1. [2]

(*c*) The transformation T_2 is represented by the matrix

$$M_2 = \begin{pmatrix} -0.8 & 0.6 \\ 0.6 & 0.8 \end{pmatrix}.$$

(i) Draw the image of triangle ABC under T_2, labelling it $A_2B_2C_2$. [3]

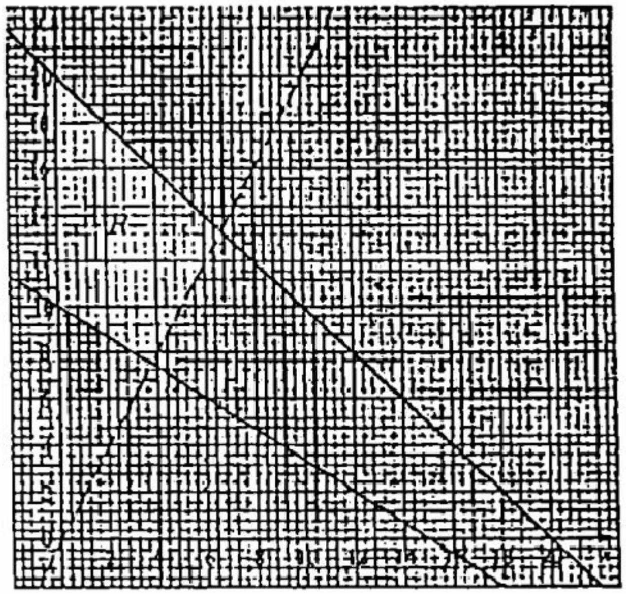
(ii) Describe fully the single transformation T_2. [2]

---

10 (*a*) $\frac{2x+1}{3} \leqslant 2$ and x is a positive integer.

Find all the possible values of x. [2]

(*b*)



A company which carries goods has two types of carton, small ones which hold 20 kg and large ones which hold 30 kg.

For a particular job, the company uses x small cartons and y large cartons.

On the diagram above, the unshaded region, R, represents the requirements of this job.

(i) Write down three inequalities (in addition to $x \geqslant 0$) in x and y which represent these requirements. [5]

(ii) Find the largest number of cartons which could be carried. [1]

(iii) Find the minimum mass which must be carried. [2]

(iv) A small carton costs $1 and a large carton costs $3. Use the diagram to find the cheapest possible cost which satisfies the requirements of the job. [2]

---

11 Give all your answers to this question as fractions.

(*a*) An ordinary die, with six faces numbered 1 to 6, is rolled once.

State the probability that

(i) the uppermost face is a 6, [1]

(ii) the uppermost face is not a 6. [1]

(*b*) In an experiment a student rolls the die until the uppermost face is a 6.

(i) Calculate the probability that the first roll is not a 6 and the second roll is a 6. [2]

(ii) Calculate the probability that the first roll is not a 6, the second roll is not a 6 and the third roll is a 6. [2]

(iii) Without evaluating your answer, find an expression for the probability that the student first gets a 6 with his or her twelfth roll. [2]

0580/4 **IGCSE NOV**
0581/4

MATHEMATICS

PAPER 4

Thursday 12 NOVEMBER 1992 2 h 30 min

Additional materials provided by the Syndicate:
1. Mathematical tables 2. 2 sheets of graph paper

Additional materials provided by the school/candidate:
3. Electronic calculator 4. Geometrical instruments
5. Answer paper

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

Instructions to candidates:

You should answer all *the questions on the separate sheets of paper provided.*

Show all your working on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

Write your name and examination number on each separate piece of writing paper or graph paper you use. If you use more than one sheet of paper for your answers, all answer sheets should be placed in correct order and fastened together.

Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

The total of the marks for this paper is 130.

The number of marks available is shown in brackets [ ] after each question or part question.

This Question Paper consists of 8 printed pages.

[Turn over

1 P is the set of cars which use unleaded petrol.

S is the set of cars which have a sun-roof.

A survey of 100 cars is taken.

68 use unleaded petrol (P) and 35 have a sun-roof (S). 10 are in neither set.

(*a*) Draw a Venn diagram to illustrate this information. [3]

(*b*) Find $n(P \cap S)$, the number of cars in the survey which use unleaded petrol and also have a sun-roof. [1]

(*c*) Find $n(P' \cap S)$, where P' is the complement of P. [1]

(*d*) Shade, in your Venn diagram, $(P \cup S)'$. [1]

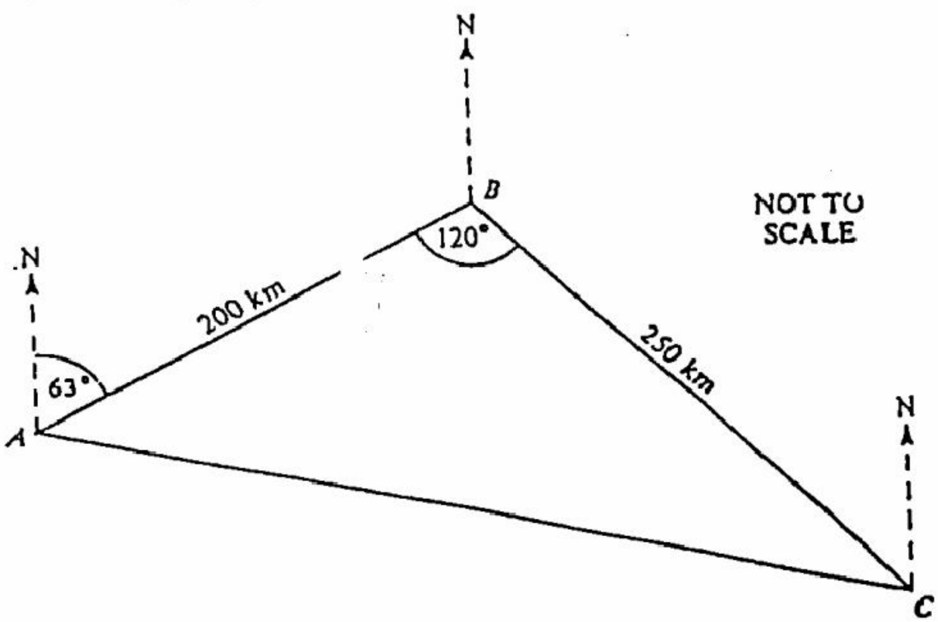
(*e*) Express, as briefly as possible in set notation, the following statement.

"x belongs to the set of cars using unleaded petrol, but not to the set of cars which have a sun-roof." [2]

---

2 An aeroplane takes off from town A and flies to B, where it stops for 1 hour. It then flies on to C.

(*a*) If the aeroplane departs from A at 13·35, and its total time in the air is $1\frac{1}{2}$ hours, at what time does the aeroplane land at C? [2]



(*b*) The diagram above represents the aeroplane's journey. The bearing of B from A is 063°, angle $ABC = 120°$, $AB = 200$ km and $BC = 250$ km.

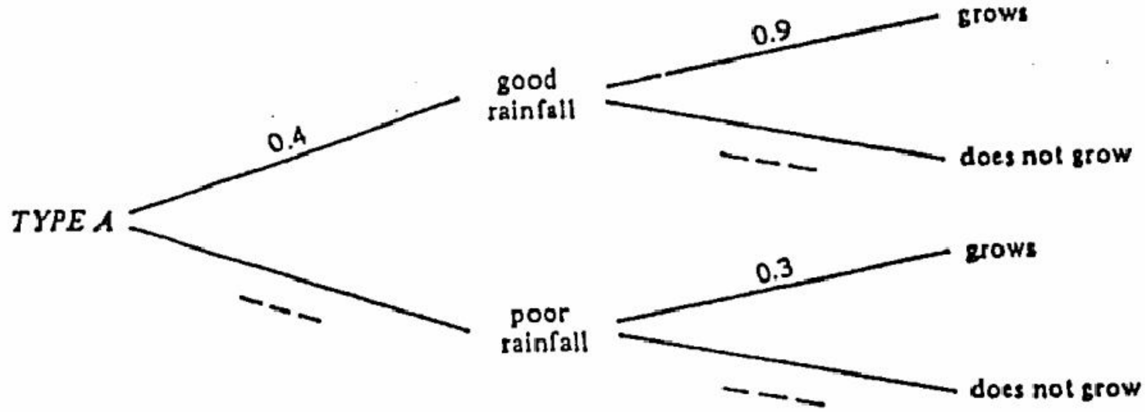
(i) Show, by calculation, that $AC = 391$ km, to the nearest kilometre. [5]

(ii) Calculate angle ACB, to the nearest degree. [4]

(iii) Calculate the bearing of C from A. [2]

---

3 Scientists test two types of seed, A and B, in a country where the probability of good rainfall in any given year is 0.4. Type A seed is found to have a probability of growing of 0.9 when the rainfall is good, but only 0.3 when it is poor.



(a) (i) Copy and complete the tree diagram above for type A seed. [2]

(ii) Calculate the probability that there is good rainfall and type A seed grows. [2]

(iii) Calculate the probability that type A seed grows, whatever the rainfall. [2]

(b) Type B seed is tested in the same country and the probability of good rainfall is again 0.4. Type B seed is found to have a probability of growing of 0.8 when the rainfall is good, and 0.5 when it is poor.

(i) Draw a tree diagram for type B seed, giving the probabilities for each branch. [2]

(ii) Calculate the probability that type B seed grows, whatever the rainfall. [2]

(c) Which type of seed, A or B, would you advise a farmer in this country to use? Give a reason for your answer. [2]

---

4 Answer the whole of this question on a sheet of graph paper.

The following table gives the values of $y = 1 + 4x - x^2$, for $-1 \leqslant x \leqslant 5$.

x	-1	0	1	2	3	4	5
y	-4	1	4	5	4	1	-4

(a) Using a scale of 2 cm to represent 1 unit on each axis, draw the graph of $y = 1 + 4x - x^2$ for $-1 \leqslant x \leqslant 5$. [4]

(b) Draw the tangent to the graph at the point (3, 4) and hence find the gradient of the curve at this point. [4]

(c) Use your graph to estimate, to 1 decimal place, the solutions of the equation

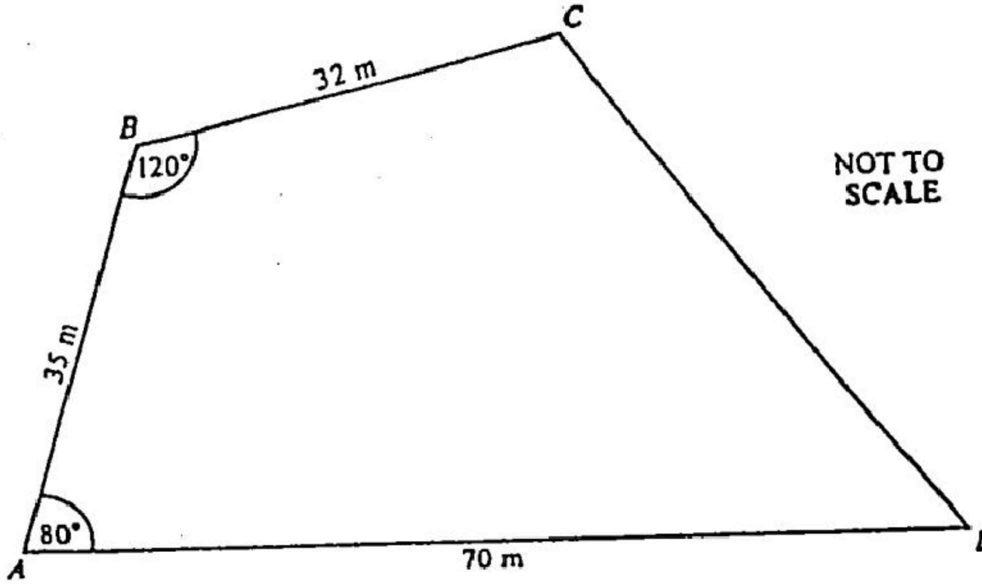
$$1 + 4x - x^2 = 0.$$ [2]

(d) By using the quadratic formula, or otherwise, solve the equation

$$x^2 - 4x - 1 = 0,$$

giving your answers correct to 2 decimal places. [5]

5



The diagram shows a field in which $AB = 35$ m, $AD = 70$ m, $BC = 32$ m, angle $ABC = 120°$ and angle $BAD = 80°$.

(*a*) Using a scale of 1 cm to represent 5 m, construct an accurate plan of the field. Label A, B, C and D on your plan. [4]

(*b*) A post P is situated in the field, so that it is equidistant from the sides CD and CB, and also equidistant from the points A and B.

On your diagram construct, using ruler and compasses only,

(i) the locus of points which are equidistant from CD and CB,

(ii) the locus of points which are equidistant from the points A and B.

Label, with the letter P, the point which represents the position of the post. [5]

(*c*) A goat is tied to the post P by a rope of length 20 metres.

Shade the part of the field which the goat cannot reach. [3]

---

6 A train usually completes a journey of 360 km at an average speed of v km/h.

One day engine trouble causes the average speed to be 10 km/h less than usual.

(*a*) Write down, in terms of v, an expression for the time taken, in hours, for the usual journey. [1]

(*b*) Write down a similar expression for the time taken for the slower journey. [2]

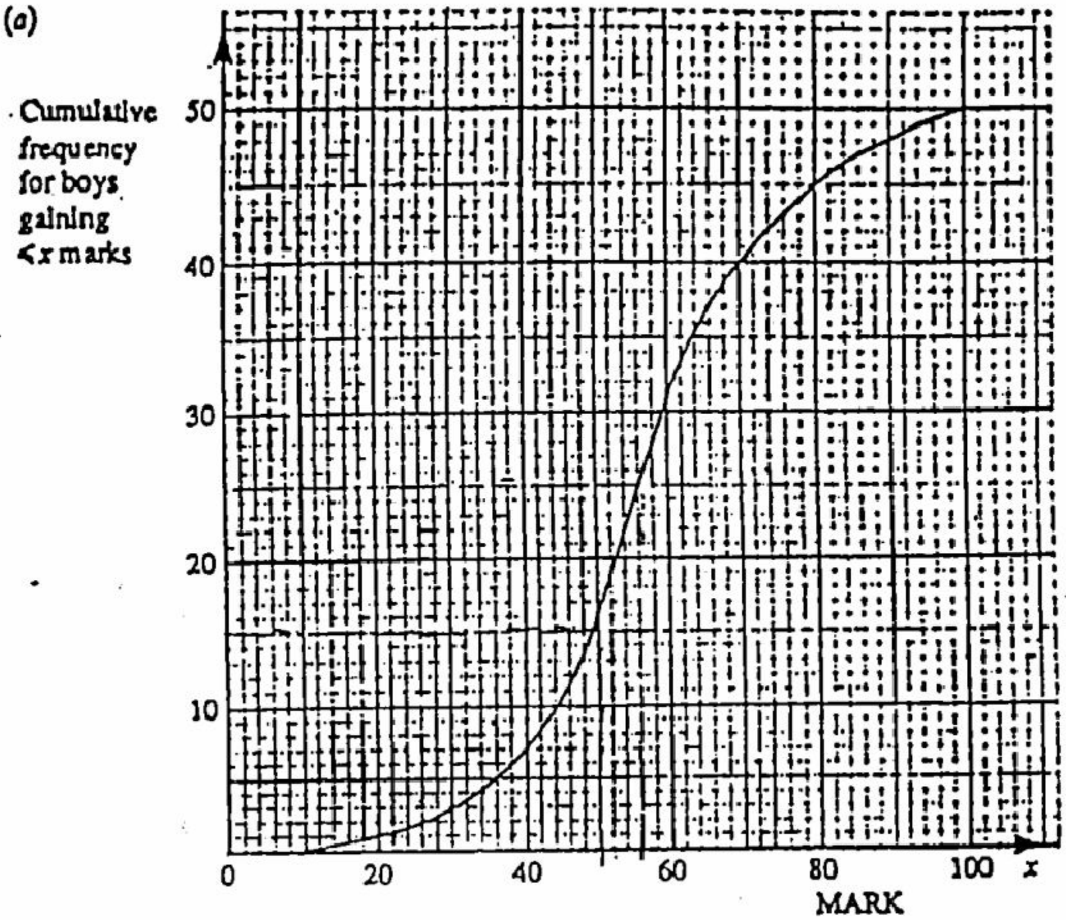
(*c*) The time for the slower journey was 30 minutes more than the time for the usual journey. Write down an equation in v using your answers to (*a*) and (*b*), and hence show that

$$v^2 - 10v - 7200 = 0.$$ [5]

(*d*) Solve the equation $v^2 - 10v - 7200 = 0$, by factorising or otherwise. Write down the usual average speed of the train. [5]

---

7 (*a*)



50 boys take a mathematics examination in which the highest possible mark is 100.

The cumulative frequency diagram for the boys' marks is shown above.

(i) What is the boys' median mark? [1]

(ii) If 70% of the boys pass, how many boys fail? [2]

(iii) What is the pass mark? (It must be an integer.) [2]

(*b*) (i) 80 girls take the same examination and their median mark is 60. Their upper quartile mark is 76 and the interquartile range is 24. What is Q, the girls' lower quartile mark? [2]

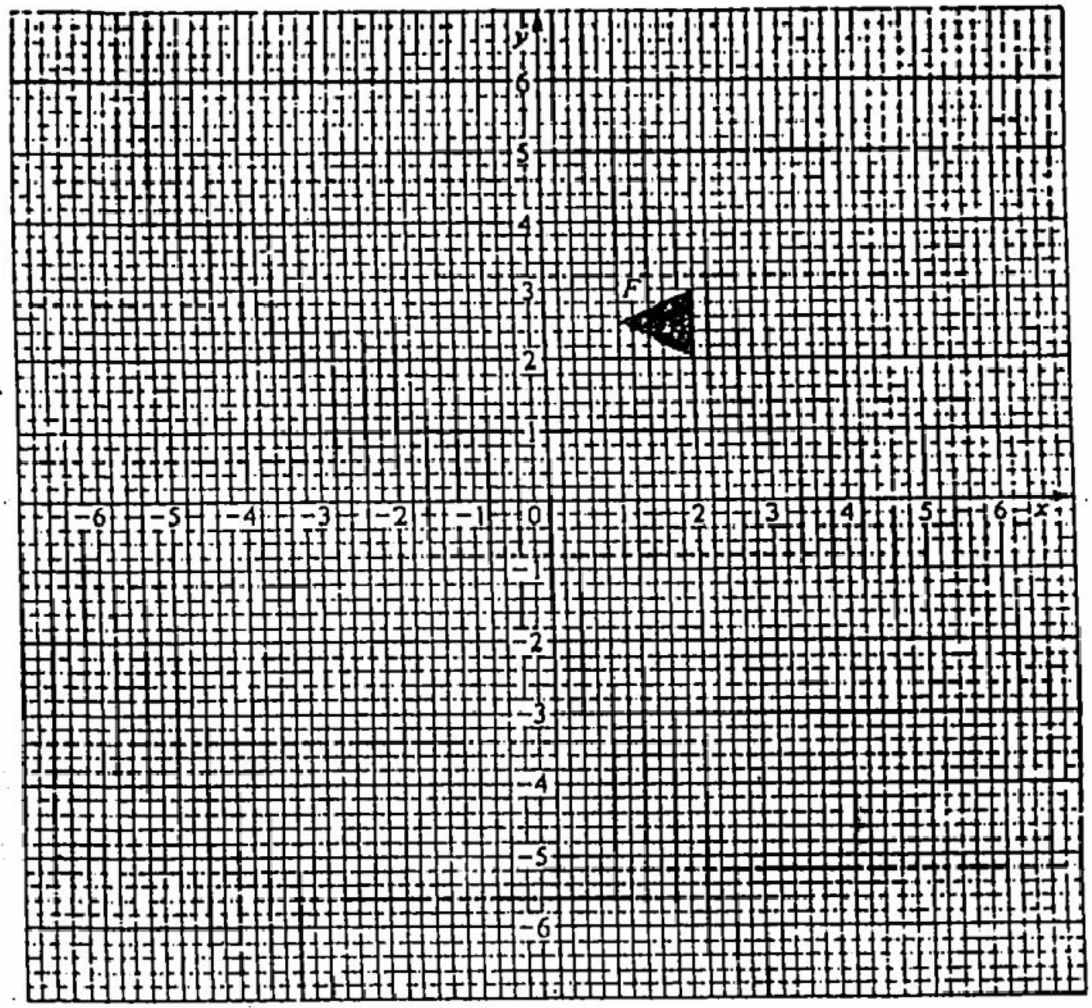
(ii) The top 5 girls score more than 90 marks and the lowest 5 marks are in the interval $20 < x \leqslant 40$.

Using this and all the information in (*b*) (i), copy and complete the following cumulative frequency table for the girls' marks, replacing the letter Q in the table by your answer to (*b*) (i).

Mark (x)	$\leqslant 20$	$\leqslant 40$	$\leqslant Q$	$\leqslant 60$	$\leqslant 76$	$\leqslant 90$	$\leqslant 100$
Cumulative frequency							80

[6]

8 **Answer the whole of this question on a sheet of graph paper.**



(*a*) (i) Copy the above diagram accurately on your graph paper. [1]

(ii) Draw the reflection of F in the line $x = 3$. Label it A. [2]

(iii) Draw the reflection of A in the line $y = 3$. Label it B. [2]

(iv) Draw the rotation of F through 180° about the origin. Label it C. [2]

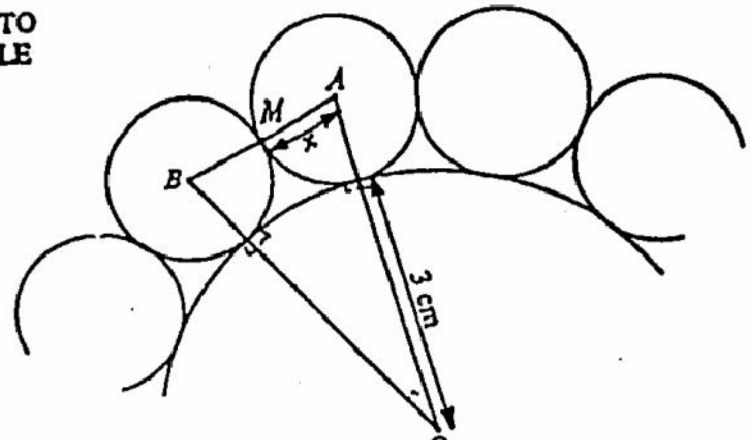
(v) Describe fully the single transformation which maps B onto C. [2]

(*b*) (i) Find the matrix M of the transformation described in (*a*) (iv). [3]

(ii) Calculate the matrix product NM where $N = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ [2]

(iii) Describe fully the single transformation represented by NM. [2]

9



One central circle, of radius 3 cm and centre O, is completely surrounded by other circles which touch it and touch each other, as shown in the diagram. These outer circles are identical to each other.

(*a*) If the radius of each outer circle is x cm, write down the following lengths in terms of x.

(i) OA. [1]

(ii) OB. [1]

(iii) AB. [1]

(*b*) On one occasion there are 6 circles completely surrounding the central circle.

(i) Calculate angle AOB. [1]

(ii) What special type of triangle is AOB in this case? [1]

(iii) Use your previous answers to find x. [2]

(*c*) On another occasion there are 20 small circles completely surrounding the central circle.

(i) Calculate angle AOB. [1]

(ii) M is the mid-point of AB. Consider the triangle MAO and write down an equation involving x and a trigonometric ratio. [3]

(iii) Solve this equation to find x correct to 2 decimal places. [3]

10

n	1	2	3	4
n^2	1		9	
n^4	1		81	

(a) Copy and complete the table of values above. [2]

(b) In the table below,

$$p = 1^2 + 2^2,$$
$$q = 1^2 + 2^2 + 3^2 + 4^2,$$
$$r = 3(2^2) + 3(2) - 1,$$
$$s = 3(3^2) + 3(3) - 1,$$
$$t = 1^4 + 2^4 + 3^4,$$
$$u = 1^4 + 2^4 + 3^4 + 4^4.$$

Calculate the values of p, q, r, s, t and u. [6]

n	1	2	3	4	....	20
Row X	1	p	14	q	....	
Row Y	5	r	s	59	....	
Row Z	1	17	t	u	....	

(c) For the first four values of n in the table, consider the (Row X value) × (Row Y value) and the Row Z value. Find a formula which connects Row X and Row Y with Row Z. [2]

(d) (i) The value in Row X for $n = 20$ can be found by putting $n = 20$ into the formula $X = \frac{n(n+1)(2n+1)}{6}$. Find this value of X. [1]

(ii) The value in Row Y for $n = 20$ can be found by putting $n = 20$ into the formula $Y = 3n^2 + 3n - 1$. Find this value of Y exactly. [1]

(e) Use your answers to parts (c) and (d) to find the exact value of

$$1^4 + 2^4 + 3^4 + \ldots\ldots\ldots + 19^4 + 20^4.$$ [2]

0580/4 0581/4 IGCSE JUNE

MATHEMATICS

PAPER 4

Wednesday 9 JUNE 1993 Morning 2 h 30 min

Additional materials:
- Answer paper
- Electronic calculator
- Geometrical instruments
- Graph paper (2 sheets)
- Mathematical tables

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

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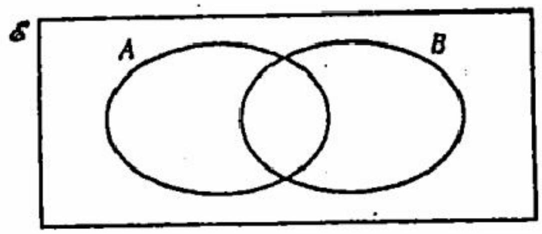
The number of marks available is shown in brackets [ ] after each question or part question.

1 (a)



Copy the above diagram twice.

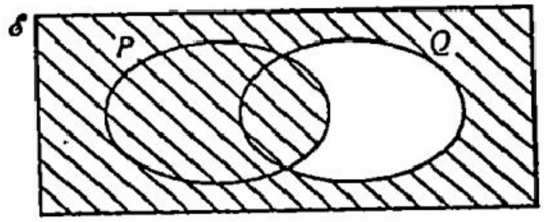
(i) In your first diagram, shade the region which represents

$(A \cup B)'$. [1]

(ii) In your second diagram, shade the region which represents

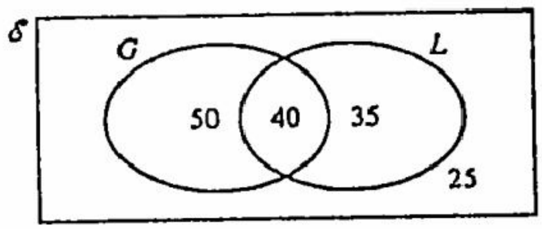
$A \cap B'$. [1]

(b)



Describe, in set notation, the shaded region in the diagram. [2]

(c)



& = {students in an international school}
G = {girls}
L = {students who speak more than one language}

The Venn diagram shows the number of students in each subset, in a school of 150 students.

(i) How many girls speak only one language? [1]

(ii) How many boys are there in the school? [1]

Give your answers to parts (iii) to (vi) as fractions in their lowest terms.

(iii) A student is selected at random. What is the probability that this student speaks more than one language? [1]

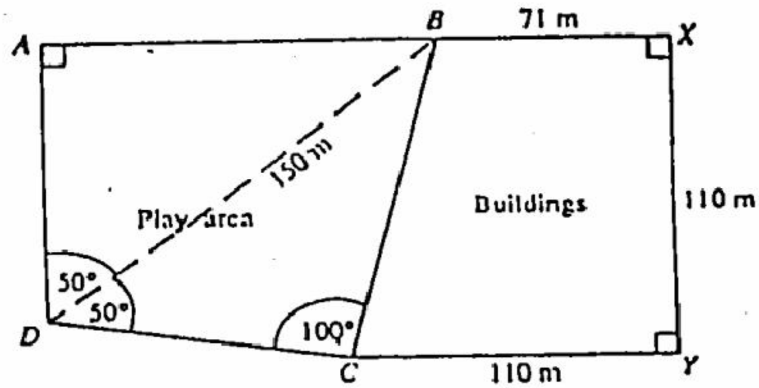
(iv) A girl is selected at random. What is the probability that she speaks more than one language? [1]

(v) A student who speaks more than one language is selected at random. What is the probability that this student is a girl? [1]

(vi) Two students are selected at random. What is the probability that they are both boys? [3]

2

NOT TO SCALE



The diagram shows the plan for a new school.

ABX is a straight line. The angles at A, X and Y are each 90°. Angle ADB = 50°, angle BDC = 50° and angle DCB = 100°. DB = 150 m, BX = 71 m and XY = CY = 110 m.

(a) Calculate, correct to three significant figures,

(i) the area of $BXYC$, [2]

(ii) the length of AD, [2]

(iii) the length of AB, [2]

(iv) the length of BC. [3]

(b) Using your answers to part (a), calculate the total area of the school grounds, $AXYCD$. Give your answer correct to two significant figures. [5]

---

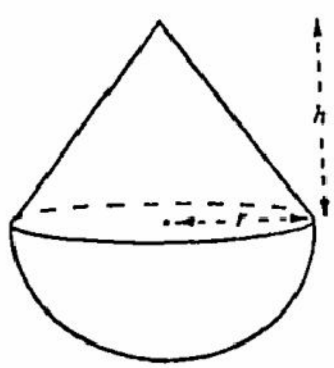
3 (a) A water tank is in the shape of a cuboid, measuring 150 cm by 100 cm by 80 cm.

(i) How many litres of water would the tank contain when full? [3]

(ii) The tank is initially empty and water flows into it from a pipe. The cross-sectional area of the pipe is 2.1 cm^2 and the water flows along the pipe at a rate of 35 cm/s.

By calculating the volume of water flowing from the pipe in 1 second, find the time taken to fill the tank. Give your answer in hours and minutes, correct to the nearest minute. [5]

(b)



The diagram shows a hemisphere of radius r, attached to a cone of base radius r and height h.

The total volume, V, of the solid is given by the formula

$$V = \tfrac{1}{3}\pi r^2 h + \tfrac{2}{3}\pi r^3.$$

(i) Calculate the volume when r = 8 cm and h = 10 cm. [π is approximately 3.142.] [2]

(ii) Find a formula for h in terms of π, r and V.

Give your answer as a single fraction, in its simplest form. [3]

---

4 Answer the whole of this question on a sheet of graph paper.

(a)

x	1	1.5	2	3	4	5	6
$y = \frac{6}{x}$	p	4	3	q	1.5	r	1

The above table is for the function

$$f : x \to \frac{6}{x}.$$

(i) Calculate the values of p, q and r. [2]

(ii) Using a scale of 2 cm to represent 1 unit on each axis, draw a pair of axes for $0 \leqslant x \leqslant 6$ and $0 \leqslant y \leqslant 8$.

Draw the graph of $y = \frac{6}{x}$ for $1 \leqslant x \leqslant 6$. [3]

(b) By drawing a suitable tangent, estimate the gradient of the curve $y = \frac{6}{x}$ at the point (2, 3). [3]

(c)

x	0	1	2	3	4	5	6
$y = \frac{x^2}{5}$	0	k	0.8	l	3.2	m	7.2

The above table is for the function

$$g : x \to \frac{x^2}{5}.$$

(i) Calculate the values of k, l and m. [2]

(ii) Draw, on the axes already used for part (a) (ii), the graph of

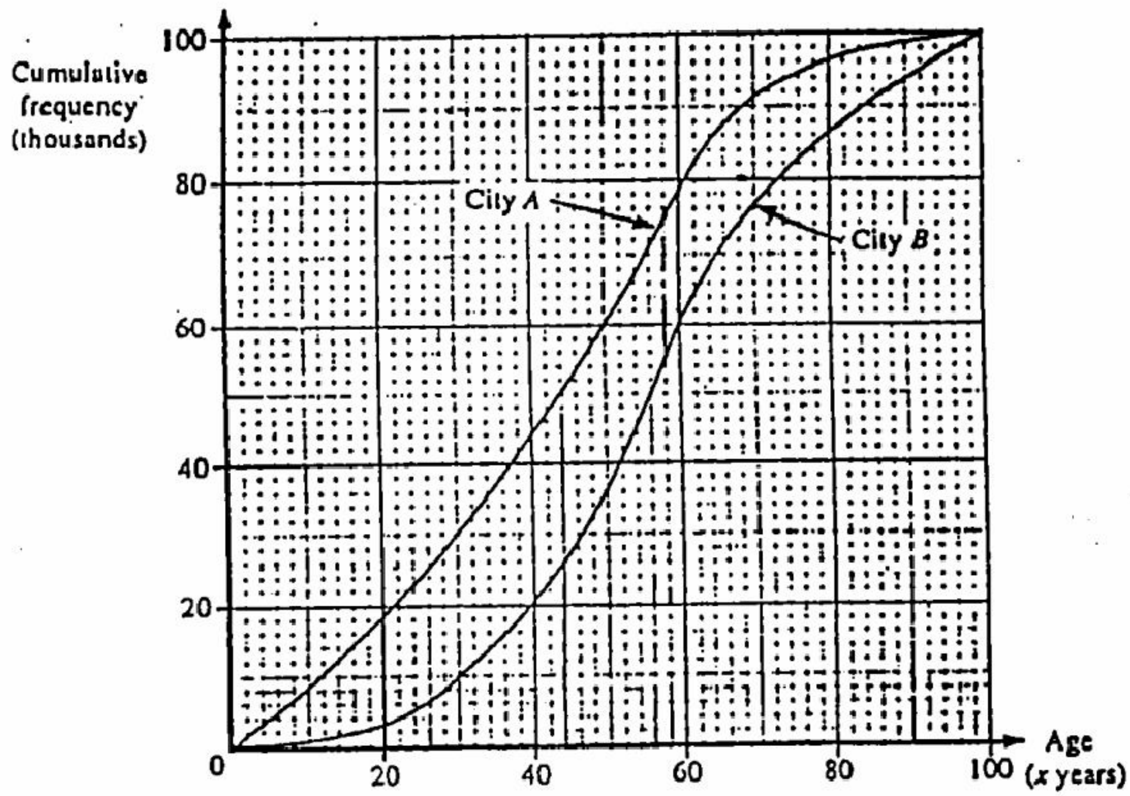
$$y = \frac{x^2}{5} \quad \text{for} \quad 0 \leqslant x \leqslant 6.$$ [3]

(d) (i) Write down the x-coordinate of the point of intersection of the curves

$$y = \frac{6}{x} \quad \text{and} \quad y = \frac{x^2}{5}.$$ [1]

(ii) Use the equations of the two curves to show that the exact value of x is $30^{\frac{1}{3}}$ [2]

5



City A and city B each have a population of 100 000 people.

The above cumulative frequency graphs show the number of people less than x years old.

Use the graphs to answer the following questions.

(a) What is the median age in each city? [2]

(b) What is the interquartile range of the ages of the people in city A? [3]

(c) How many people are less than 20 years old

(i) in city A, [1]

(ii) in city B? [1]

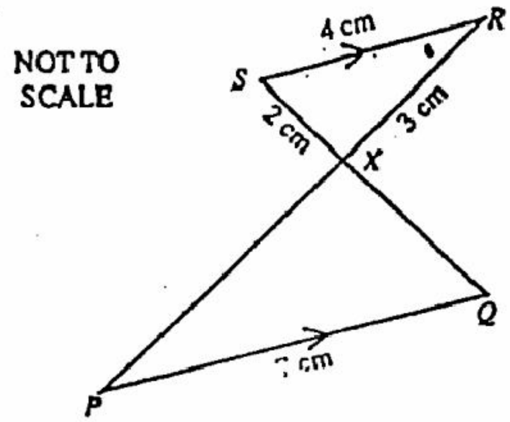
(d) How many people are at least 70 years old

(i) in city A, [1]

(ii) in city B? [1]

(e) In ten years time, which city would you expect to have the larger population? Give one reason for your answer. [2]

6 (a)



In the diagram, SR is parallel to PQ.

$SR = 4$ cm, $SX = 2$ cm, $RX = 3$ cm and $PQ = 7$ cm.

(i) Explain why the triangles RSX and PQX are similar. [2]

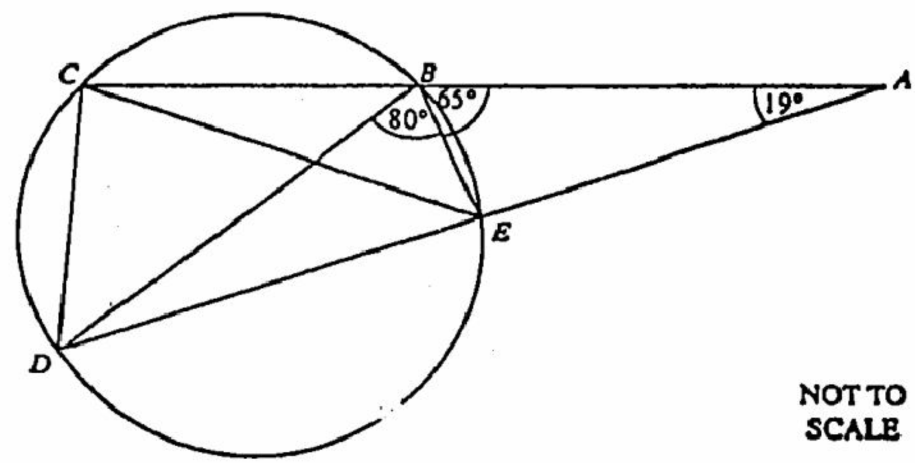
(ii) Calculate the length of PX and the length of QX. [3]

(iii) It is also given that the area of triangle RSX is 2.90 cm^2.

Calculate the area of triangle PQX, correct to two significant figures. [3]

(iv) Use trigonometry to calculate the size of angle SRX, to the nearest degree. [4]

(b)



In the diagram, the points B, C, D and E lie on the circle. ABC and AED are straight lines.

Angle $ABE = 65°$, angle $BAE = 19°$ and angle $DBE = 80°$.

Calculate

(i) angle CDE, [2]

(ii) angle CDB, [2]

(iii) angle BCE. [2]

7 (a) The lengths, in centimetres, of the sides of a right-angled triangle are

$$x, x+2 \text{ and } x+5.$$

(i) Use Pythagoras' theorem to write down an equation in x. Show that it simplifies to

$$x^2 - 6x - 21 = 0.$$ [3]

(ii) Solve the equation $x^2 - 6x - 21 = 0$, giving your answers correct to two decimal places. [5]

(iii) Write down the length of the hypotenuse of the triangle. [1]

(b) A student walks y kilometres at 3 km/h.

(i) Write down an expression for the time, in hours, that he takes. [1]

He then walks a further $y + 3$ kilometres at 4 km/h.

The total walking time is 4 hours 50 minutes.

(ii) Write down an equation in y and solve it. [4]

(iii) Find the total distance walked by the student. [1]

---

8 **Answer the whole of this question on a sheet of graph paper.**

(a) Draw and label x and y axes from -6 to $+6$ using a scale of 1 cm to represent 1 unit on each axis.

Draw the triangle whose vertices are A (2, 2), B (5, 2) and C (5, 3). [1]

(b) M is the matrix $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ which represents the transformation T.

Draw accurately the image of triangle ABC under the transformation T, labelling it PQR. [3]

(c) N is the matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ which represents the transformation U.

Draw accurately the image of triangle ABC under the transformation U, labelling it XYZ. [3]

(d) (i) Describe fully the single transformation which maps triangle PQR onto triangle XYZ. [2]

(ii) Find the matrix which represents this transformation. [2]

(e) (i) Calculate the matrix NM. [2]

(ii) This matrix represents the transformation V.

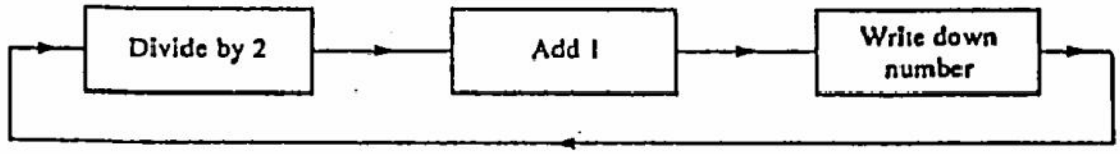
Draw accurately the image of triangle ABC under the transformation V, labelling it FGH. [2]

(iii) State whether the transformation V is equivalent to "transformation T followed by transformation U" or to "transformation U followed by transformation T". [1]

9 In this question you are asked to look at what happens to given numbers when you repeat a set of instructions several times.

In each case, when the instructions are repeated many times, a certain number is approached. This number is called the *limit*.

(a)



(i) Starting with the number 7, the following numbers are calculated by repeating the instructions in the diagram.

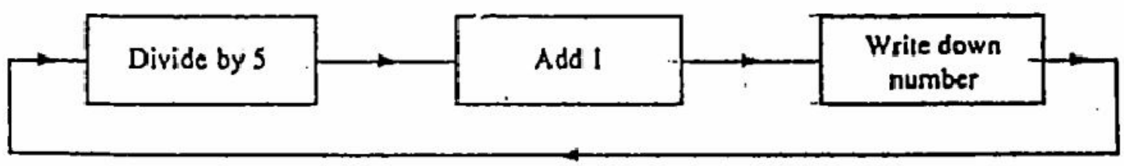
$$7 \longrightarrow 4.5$$
$$4.5 \longrightarrow 3.25$$
$$3.25 \longrightarrow 2.625$$
$$2.625 \longrightarrow 2.3125$$
$$2.3125 \longrightarrow p$$
$$p \longrightarrow q$$

Calculate the exact values of p and q. [2]

(ii) Start with the number 0.5 and repeat the above instructions six times, setting out your working as in part (i). [3]

(iii) In parts (i) and (ii) the *limit* is the same whole number. Suggest the value of this *limit*. [2]

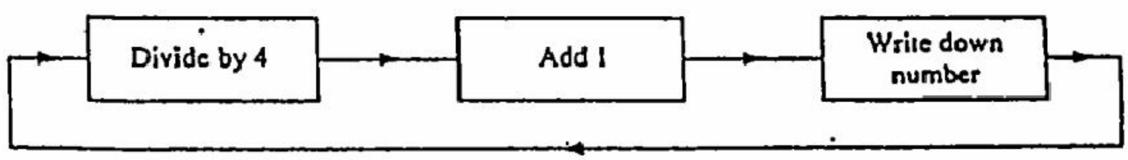
(b)



Start with the number 8 and repeat the instructions in the diagram several times.

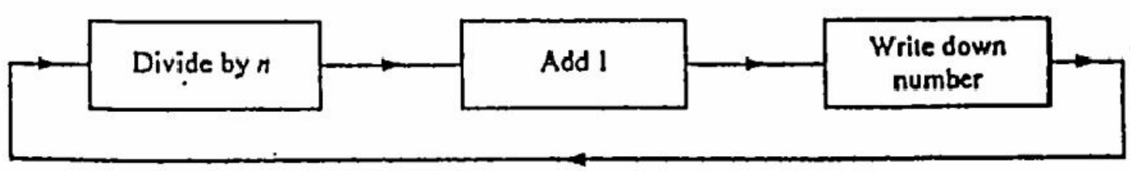
The *limit* in this case is an exact fraction. Find this *limit*. [3]

(c)



Start with any number and repeat the instructions in the diagram several times. The *limit* is another exact fraction. Find this *limit*. [2]

(d)



Use your answers to (a), (b) and (c) to find the *limit*, in terms of n, in this case. [3]

0580/4 IGCSE NOV
0581/4

MATHEMATICS

PAPER 4

Thursday 11 NOVEMBER 1993 Morning 2 h 30 min

Additional materials:
- Answer paper
- Electronic calculator
- Geometrical instruments
- Graph paper (1 sheet)
- Mathematical tables

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

Instructions to candidates:

You should answer **all** *the questions on the separate sheets of paper provided.*

Show all your working on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

Write your name and examination number on each separate piece of writing paper or graph paper you use. If you use more than one sheet of paper for your answers, all answer sheets should be placed in correct order and fastened together.

Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

The total of the marks for this paper is 130.

The number of marks available is shown in brackets [ ] at the end of each question or part question.

This Question Paper consists of 8 printed pages.

1 Klaus and Heidi plan a holiday in the U.S.A. in August.

(a) Klaus decides to change 800 Deutschmarks (DM) into dollars in January when the exchange rate is \$1 = DM1.68. A bank charge of 1% is then deducted. Calculate how much he receives, to the nearest dollar. [3]

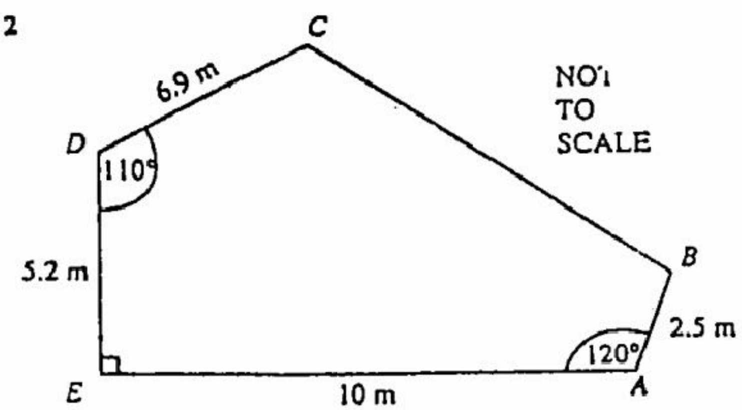
(b) (i) Heidi invests her DM800 in a bank at an annual rate of 9% simple interest. Calculate the amount she has after 6 months. [3]

(ii) She now changes this amount into dollars. The exchange rate is \$1 = DM1.87, but this time there is no bank charge. Calculate how much Heidi receives, to the nearest dollar. [2]

(c) Who made the better decision? [1]

(d) They bring a total of \$120 back with them and exchange it for Deutschmarks at a rate of \$1 = DM1.72 with no bank charge. Calculate how much they receive, to the nearest Deutschmark. [2]

2



The diagram represents a garden *ABCDE*.

AB = 2.5 m, *AE* = 10 m, *ED* = 5.2 m and *DC* = 6.9 m.

Angle *EAB* = 120°, angle *DEA* = 90° and angle *EDC* = 110°.

(a) (i) Using a scale of 1 cm to represent 1 m, construct an accurate plan of the garden. [4]

(ii) Construct the locus of points equidistant from *CD* and *CB*. [2]

(iii) Construct the locus of points 6 metres from *A*. [2]

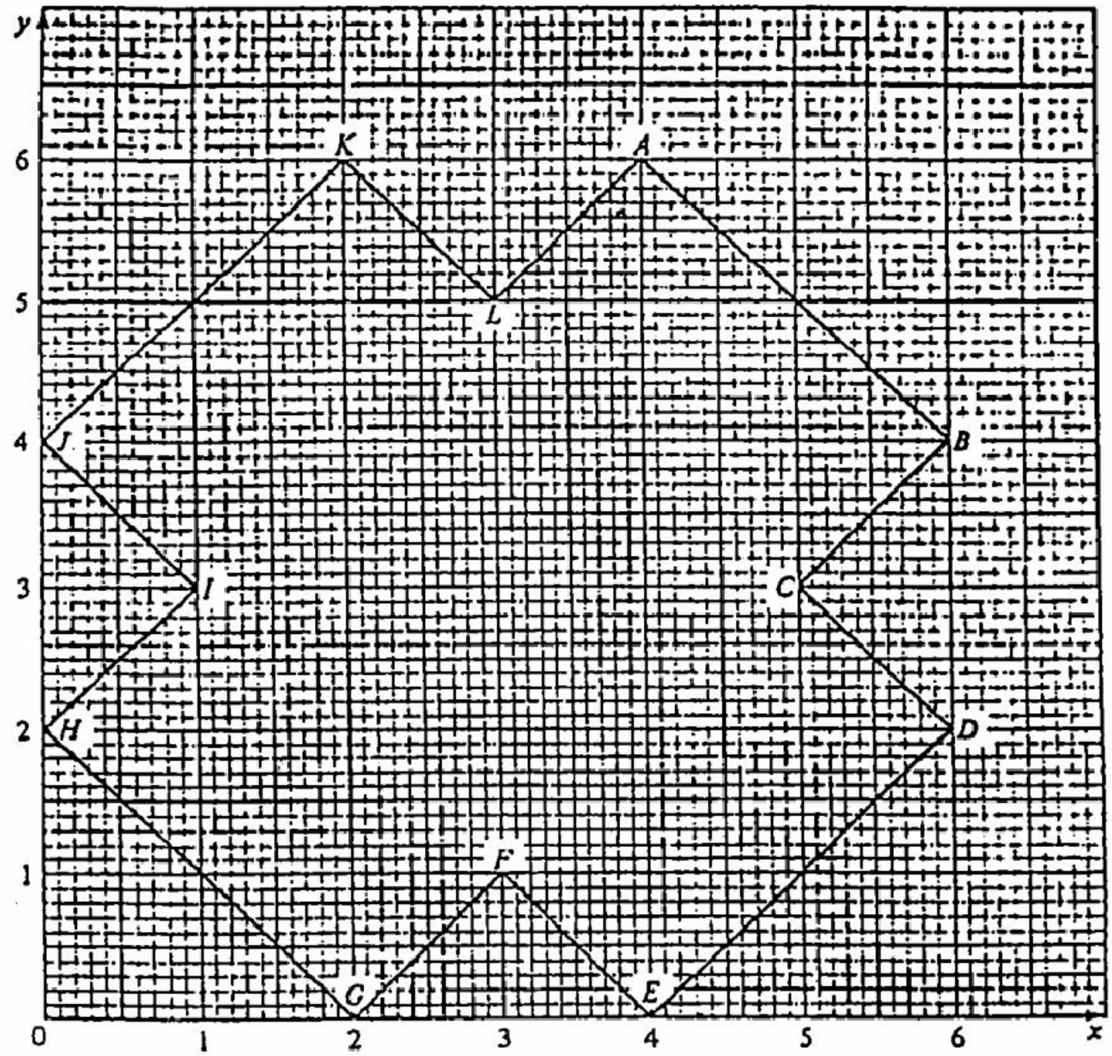
A fountain is to be placed nearer to *CD* than to *CB* and no more than 6 metres from *A*.

(b) (i) Shade, and label *R*, the region within which the fountain could be placed in the garden. [1]

(ii) Construct the locus of points in the garden 3.4 metres from *AE*. [2]

(iii) Is it possible for the fountain to be 3.4 metres from *AE* and in the region *R*? [1]

3



(a) How many lines of symmetry does the shape in the diagram possess? [2]

(b) State the vector which translates AB onto HG. [2]

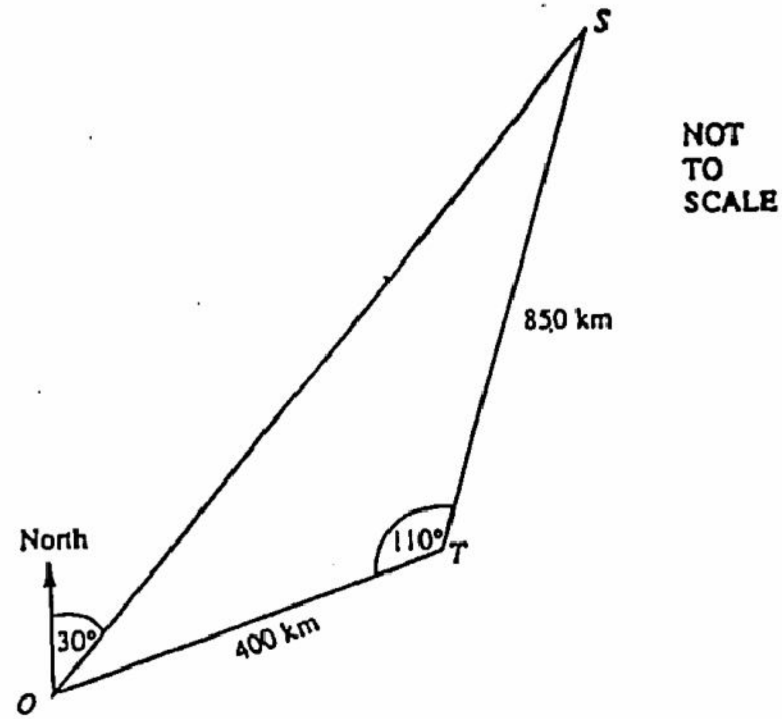
(c) Find the equation of the line in which AB is the reflection of HG. [2]

(d) Describe fully the transformation which maps A onto K and B onto J. [2]

(e) Describe fully the transformation which maps A onto D and B onto E. [3]

(f) The matrix $\begin{pmatrix} 1 & 3 \\ -1 & 7 \end{pmatrix}$ transforms $F(3, 1)$ onto another point on the diagram. Calculate the coordinates of this point and state its letter name. [3]

4



The diagram shows the relative positions of Osaka (O), Tokyo (T) and Sapporo (S) in Japan.
$ST = 850$ km, $TO = 400$ km and angle $S\hat{T}O = 110°$.

(a) Calculate OS, the distance from Osaka to Sapporo. [5]

(b) Calculate the angle SOT, to the nearest degree. [4]

(c) The bearing of Sapporo from Osaka is 030°.
Find the bearing of Osaka from Tokyo. [3]

(d) A plane flew from Sapporo to Tokyo at an average speed of 500 km/h. It left Sapporo at 09 30.
At what time did it arrive in Tokyo? [3]

5 In a football stadium, ticket prices are $15 for a seat and $8 for a standing place.

Initially the stadium has 10 000 seats and 20 000 standing places.

(a) Calculate the amount of money taken when the stadium is full. [2]

It is possible to replace some of the standing places with extra seats.

Each extra seat takes away two standing places.

(b) Extra seats are put in until only 4000 standing places remain.

(i) Find the number of seats now in the stadium. [2]

(ii) Find the total amount of money taken for a full stadium. [2]

(iii) If all 4000 standing places are full, find the number of seats which must be sold for a total amount of $200 000 to be taken. [2]

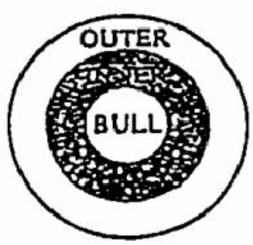
(c) On another occasion, x standing places remain.

(i) Write down and simplify an expression in terms of x for the number of seats that there are now. [3]

(ii) Given also that there are twice as many seats as standing places, form an equation in x and solve it.

Hence find the maximum number of spectators the stadium can hold in this case. [4]

---

6 

NOT TO SCALE

The diagram shows an archery target, consisting of a central circle called the "bull", an "inner" ring and an "outer" ring. These are formed by three concentric circles, radii 10 cm, 20 cm and 30 cm respectively.

(a) Show that the ratio of the areas of bull : inner : outer is 1 : 3 : 5. [4]

(b) If an arrow is equally likely to land anywhere on the target, what is the probability that it hits the bull? [2]

(c) Alexander is a good archer, and the probabilities that he hits the bull, the inner and the outer are $\frac{2}{5}$, $\frac{1}{2}$ and $\frac{1}{10}$ respectively.

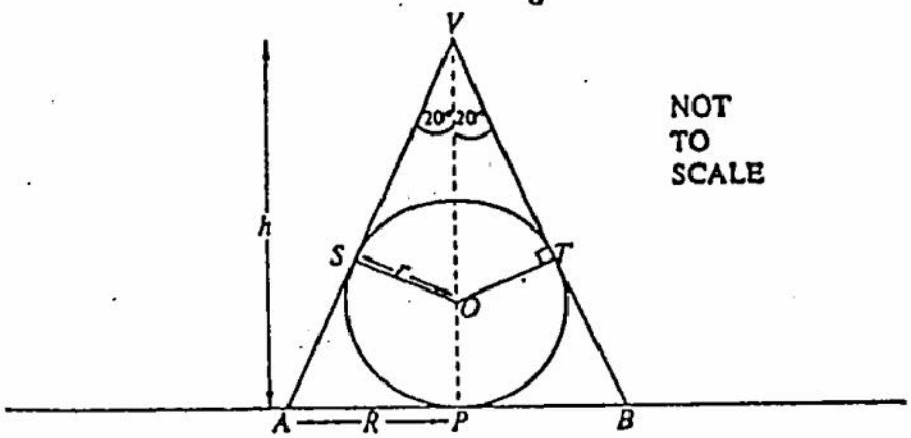
Using a tree diagram, or otherwise, answer the following questions.

(i) He shoots 2 arrows. What is the probability that they both hit the outer? [2]

(ii) There is a $10 prize for hitting the bull, $2 for hitting the inner, but no prize for hitting the outer. What is the probability that Alexander wins exactly $12 with 2 shots? [4]

(iii) Alexander takes 3 shots. What is the probability that he wins $30? [3]

7



The diagram shows a vertical cross-sectic.. f a solid sphere and a hollow cone, both resting on a horizontal table. The sphere, centre O, touches the cone at S and T. Angle AVP = angle PVB = 20°.

(a) (i) Explain why angle VTO = 90°. [1]

(ii) Calculate angle TOS. [1]

(iii) Calculate angle TPS. [2]

(b) The radius of the sphere, r, is 10 cm.

(i) Calculate VO. [3]

(ii) Show that the height of the cone, h, is 39.2 cm. [1]

(iii) Show that the base radius of the cone, R, is 14.3 cm. [2]

(c) [The volume of a cone is $\frac{1}{3}\pi R^2 h$. The volume of a sphere is $\frac{4}{3}\pi r^3$. π is approximately 3.142.]

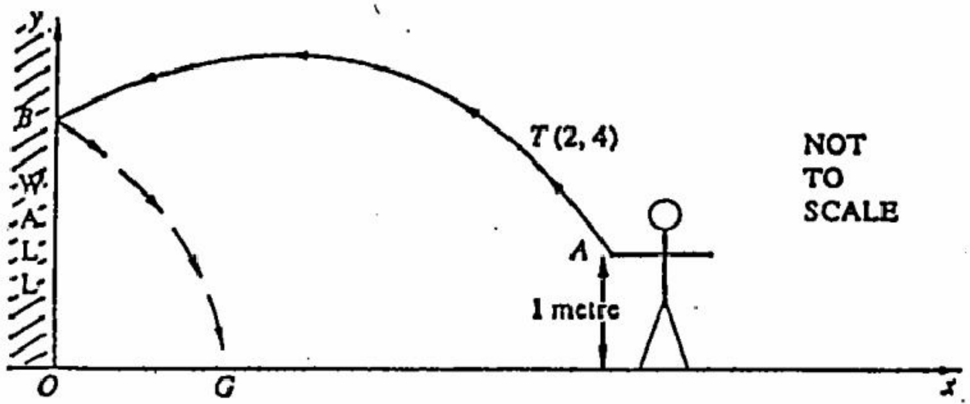
Using the values for r, h and R given in part (b), calculate

(i) the volume of the cone, [2]

(ii) the volume of the sphere, [2]

(iii) the volume of the empty space inside the cone, as a percentage of the volume of the cone. [3]

8



Anna throws a ball from a point A, one metre above the ground, towards a wall. The ball travels along the arrowed path from A to B, given by the equation $y = 4 + 2x - x^2$, where the x-axis represents the horizontal ground and the y-axis represents the wall.

(a) Show that the x-coordinate of A satisfies the equation $x^2 - 2x - 3 = 0$. [1]

(b) Solve the equation $x^2 - 2x - 3 = 0$ and state the x-coordinate of A. [3]

(c) The ball rebounds from the wall at B to the ground at G. The equation of its path BG is $y = 4 - 2x - x^2$.

Solve the equation $x^2 + 2x - 4 = 0$, and hence state the x-coordinate of G to 2 decimal places. [5]

Answer the rest of this question on a sheet of graph paper.

(d) Draw axes on a sheet of graph paper, using a scale of 4 cm to represent 1 m on both x and y axes. Use the tables below, together with your answers to (b) and (c), to draw the path of the ball from A to B and then B to G.

$y = 4 + 2x - x^2$

x	0	0.5	1	1.5	2	2.5	
y	4	4.75	5	4.75	4	2.75	1

$y = 4 - 2x - x^2$

x	0	0.5	1	
y	4	2.75	1	0

[6]

(e) How far from the wall is the ball when it is only 0.5 m above the ground? [1]

(f) Draw the tangent to your graph at T (2, 4).

Calculate the gradient of the curve at this point. [4]

9 (a) Show that

$$\frac{1}{n} - \frac{1}{n+1} = \frac{1}{n(n+1)}.$$ [2]

(b) Copy the following table, completing the rows for $n = 2, 3, 4, 99$ and 100.

n	$\frac{1}{n} - \frac{1}{n+1}$	$\frac{1}{n(n+1)}$
1	$\frac{1}{1} - \frac{1}{2}$	$\frac{1}{1 \times 2}$
2	.... −	....
3	.... −	....
4	.... −	....
↓	↓ ↓	↓
99	.... −	....
100	.... −	$\frac{1}{100 \times 101}$

[5]

(c) Use part (a) and your table to find another expression for

$$\frac{1}{1 \times 2} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \text{........................} + \frac{1}{100 \times 101}.$$

Write your answer as a single fraction. [4]

International General Certificate of Secondary Education
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

MATHEMATICS 0580/4, 0581/4

PAPER 4

Wednesday 8 JUNE 1994 Morning 2 hours 30 minutes

Additional materials:
Answer paper
Electronic calculator
Geometrical instruments
Graph paper (2 sheets)
Mathematical tables

TIME 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer all questions.

Write your answers and working on the sepa :e answer paper provided.

All working must be clearly shown. It should be done on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total of the marks for this paper is 130.

Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

1 (a) Show that an interior angle of a regular pentagon is 108°. [2]

(b) (i) Draw accurately a regular pentagon *ABCDE* whose sides are of length 8 cm. [3]

(ii) Using straight edge and compasses only, construct

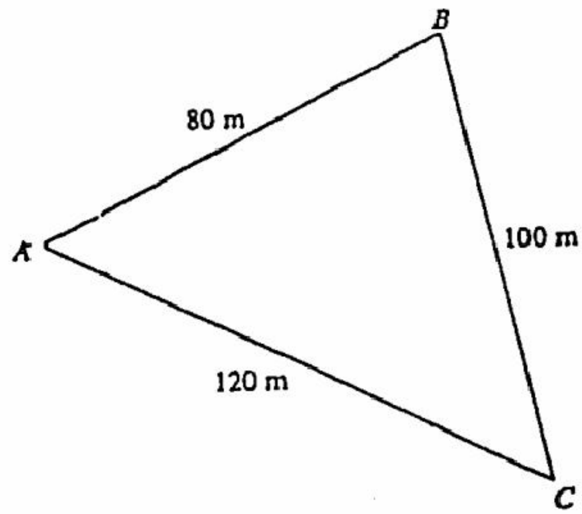
(a) the perpendicular bisector of *DE*,

(b) the bisector of angle *A*. [4]

(iii) *X* is the point which is equidistant from *D* and *E* and equidistant from *AB* and *AE*. Mark the point *X* on your diagram. Measure and write down the length of *AX*. [2]

(iv) Shade the region inside the pentagon which contains the points which are nearer to *E* than *D* and nearer to *AE* than *AB*. [2]

2



NOT TO SCALE

In a fitness exercise, students run across a field from *A* to *B*, then from *B* to *C* and then from *C* to *A*.

(a) A student runs from *A* to *B* in 10 seconds.

Calculate his speed in (i) metres/second, [1]

(ii) kilometres/hour. [2]

(b) Another student runs from *A* to *B* in 10.5 seconds, from *B* to *C* in 13 seconds and from *C* to *A* at a speed of 8.5 m/s.

Calculate her overall average speed in metres/second. [4]

(c) Showing all your working, calculate angle *BAC*. [4]

(d) The bearing of *B* from *A* is 062°.

Calculate (i) the bearing of *C* from *A*, [1]

(ii) the bearing of *A* from *C*. [2]

3 $f(x) = 3x^2 - 2x - 4$ and $g(x) = 4 - 3x$.

(a) State the value of $f(-2)$. [2]

(b) Solve the equation $f(x) = -3$. [3]

(c) Solve the equation $f(x) = 0$, giving your answers correct to 2 decimal places. [5]

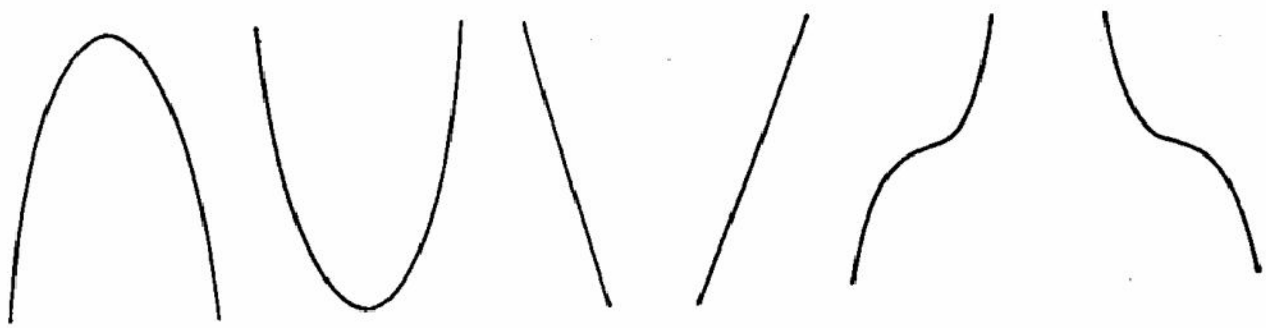
(d) Solve for x the equation $g(x) = 2g(x) - 1$. [2]

(e) Find $g^{-1}(x)$. [2]

(f) Study the six sketches A, B, C, D, E and F. Which one could be the graph of

(i) $y = f(x)$,

(ii) $y = g(x)$?



A B C D E F [2]

---

4 Answer the whole of this question on a sheet of graph paper.

In a school gardening project, teachers and students carry earth to a vegetable plot.

A teacher can carry 24 kg and a student can carry 20 kg.

Each person makes one trip.

Altogether at least 240 kg of earth must be carried.

There are x teachers and y students.

(a) Show that $6x + 5y \geqslant 60$. [1]

(b) There must not be more than 13 people carrying earth, and there must be at least 4 teachers and at least 3 students.

Write down three more inequalities in x and/or y. [3]

(c) (i) Draw x and y axes from 0 to 14, using 1 cm to represent 1 unit of x and y. [1]

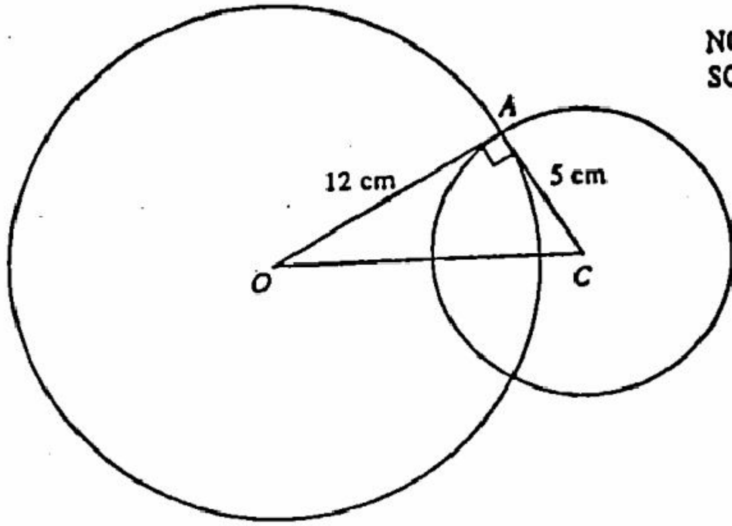
(ii) On your grid, represent the information in parts (a) and (b). Shade the unwanted regions. [6]

(d) From your graph, find

(i) the least number of people required, [1]

(ii) the greatest amount of earth which can be carried. [2]

5



The diagram shows two circles, centres O and C, of radii 12 cm and 5 cm, which cut each other at right angles.

(a) Show, by calculation, that the distance between the centres is 13 cm. [2]

(b) State the radius of the circle which passes through O, A and C. [1]

(c) Calculate angle AOC. [2]

(d) CO is extended to meet the larger circle at P.

What is the size of angle APC? [2]

(e) Q is the point on the larger circle such that the line AQ is parallel to the line CO.

What is the size of angle AOQ? [2]

(f) What is the size of angle APQ? [1]

(g) R is a point on the minor arc AQ of the larger circle.

What is the size of angle QRA? [1]

6 Answer the whole of this question on a sheet of graph paper.

(a) (i) Draw x and y axes from -6 to $+6$, using 1 cm to represent 1 unit of x and y. [1]

(ii) Draw the triangle ABC with $A(2, 1)$, $B(5, 1)$ and $C(5, 5)$. [1]

(b) (i) Draw the image of triangle ABC under the transformation represented by the matrix $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ and label it $A_1B_1C_1$. [3]

(ii) Describe this single transformation. [2]

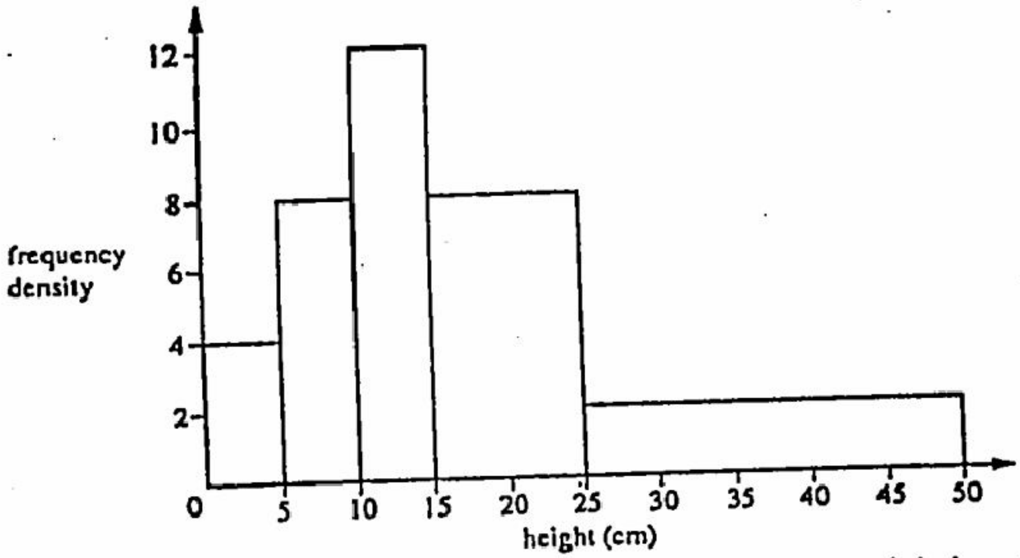
(c) (i) Draw the image of triangle ABC under a reflection in the line $y = -x$ and label it $A_2B_2C_2$. [2]

(ii) Find the matrix which represents this transformation. [2]

(d) (i) Describe fully the single transformation which maps triangle $A_1B_1C_1$ onto triangle $A_2B_2C_2$. [3]

(ii) Find the matrix which represents this transformation. [2]

7



The histogram represents the frequencies of heights of flowers as measured during an experiment.

(a) Copy and complete the table.

Height (h) cm	Frequency
$0 < h \leq 5$	20
$5 < h \leq 10$	40
$10 < h \leq 15$	
$15 < h \leq 25$	
$25 < h \leq 50$	

[3]

(b) Calculate an estimate of the mean height of the flowers. [4]

(c) Copy and complete the table.

Height (h) cm	Cumulative Frequency
$h \leq 5$	20
$h \leq 10$	
$h \leq 15$	
$h \leq 25$	
$h \leq 50$	250

[3]

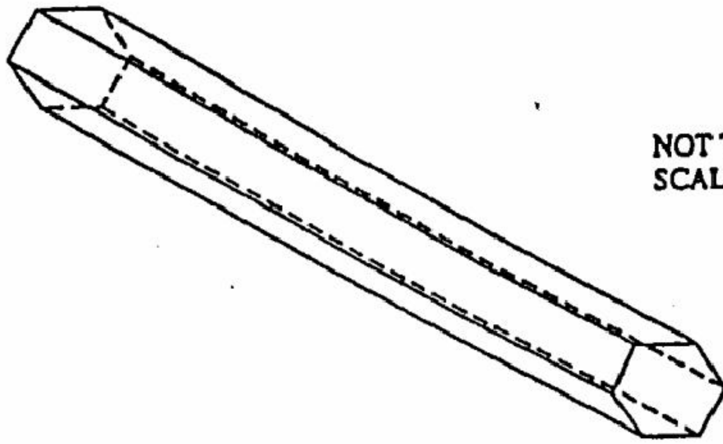
(d) (i) Which class interval contains the median height? [1]

(ii) Calculate an estimate of the median height of the flowers, correct to the nearest centimetre. [2]

(e) A flower is picked at random. State the probability that it has a height greater than 10 cm. Give your answer as a fraction. [1]

(f) Two flowers are picked at random from the 250 flowers. Calculate the probability that both flowers have a height greater than 10 cm. Give your answer as a decimal. [2]

8



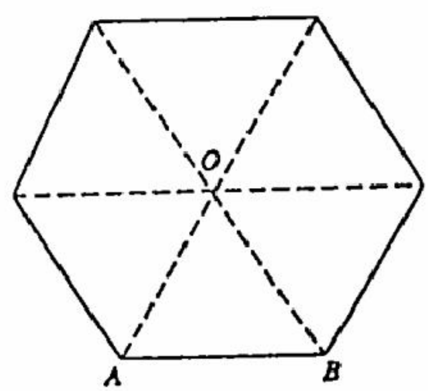
The diagram shows a prism of cross-sectional area 0.42 cm^2 and volume 7.56 cm^3.

(a) Calculate the length of the prism. [2]

(b) The prism is made of wood and 1 cm^3 of this wood has a mass of 0.88 g. Calculate the mass of the prism. [2]

(c) The prisms are made from a block o. wood of volume 0.5 m^3. It is known that 25% of the wood is wasted.
Calculate the number of prisms which can be made, giving your answer to the nearest thousand. [5]

(d)



The cross-section of the prism is a regular hexagon of area 0.42 cm^2.

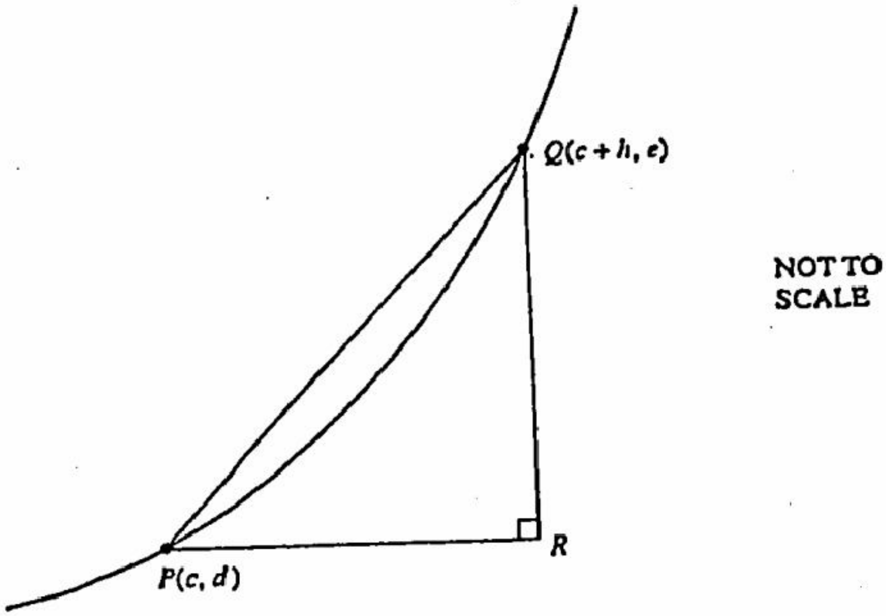
(i) State the area of triangle OAB. [1]

(ii) What special type of triangle is triangle OAB? [1]

(iii) Given that the length of AB is x cm, find an expression for the area of triangle OAB in terms of x.
Hence find the length of AB correct to the nearest millimetre. [4]

9 (a) Calculate the gradient of the straight line joining the points (3, 18) and (3.5, 24.5). [2]

(b)



The diagram shows part of the curve

$$y = 2x^2.$$

(i) P is the point (c, d). Write down d in terms of c. [1]

(ii) Q is the point $(c + h, e)$. Write down e in terms of c and h. [1]

(iii) Write down the length of PR.

Find an expression for the length of QR in terms of c and h, and simplify your answer. [3]

(iv) Show that the gradient of the line PQ is

$$4c + 2h.$$ [2]

(v) If P is the point (3, 18) and Q is the point (3.5, 24.5), state the value of c and the value of h, and use these values to show that (b) (iv) gives the same answer as (a). [2]

(vi) If P is the point (3, 18) and Q is the point (3.1, 19.22) state the value of c and the value of h, and use (b) (iv) to find the gradient of the line PQ. [2]

(vii) If P is the point (3, 18) and Q gets closer and closer to P, what happens

(a) to the value of h, [1]

(b) to the value of the gradient of the line PQ? [1]

International General Certificate of Secondary Education
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

MATHEMATICS 0580/4, 0581/4

PAPER 4

Friday 18 NOVEMBER 1994 Morning 2 hours 30 minutes

Additional materials:
- Answer paper
- Electronic calculator
- Geometrical instruments
- Graph paper (2 sheets)
- Mathematical tables

TIME 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer all questions.

Write your answers and working on the separate answer paper provided.

All working must be clearly shown. It should be done on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total of the marks for this paper is 130.

Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

1 Alexis, Biatriz and Carlos are business partners.

(a) 60% of each week's income is used for the business.

The rest is divided between Alexis, Biat..iz and Carlos in the ratio 5:3:1.

(i) Calculate how much they each receive in a week when the income is \$9000. [4]

(ii) Calculate the income in a week when Carlos receives \$420. [3]

(b) Alexis buys Carlos' share of the business for \$16 000, which he borrows from the bank at a rate of 12% simple interest per year.

How much interest will he have to repay in 6 months? [3]

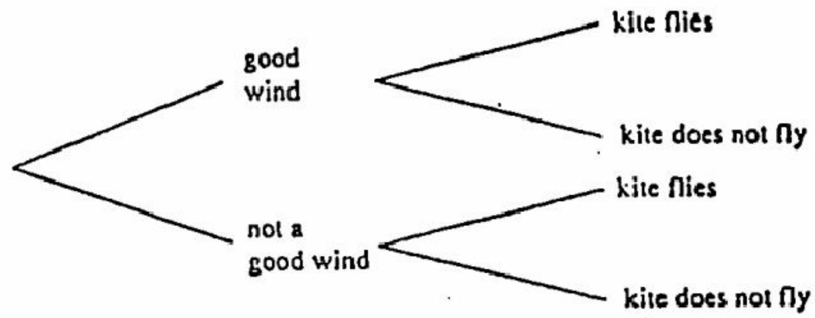
---

2 Mahmoud enjoys flying his kite. On any given day, the probability that there is a good wind is $\frac{3}{4}$.

If there is a good wind, the probability that the kite will fly is $\frac{7}{8}$.

If there is not a good wind, the probability that the kite will fly is $\frac{1}{16}$.

(a) (i)



Copy the given tree diagram.

Write on your diagram the prob...ility for each branch. [3]

(ii) What is the probability of a good wind and the kite flying? [2]

(iii) Find the probability that, whatever the wind, the kite does not fly. [2]

(b) If the kite flies, the probability that it sticks in a tree is $\frac{1}{3}$.

Calculate the probability that, whatever the wind, the kite sticks in a tree. [2]

(c)

Wind strength	1	2	3	4	5	6	7	8	9
Number of days	3	5	6	8	6	7	9	5	1

The table shows the wind strength measured on each of 50 days.

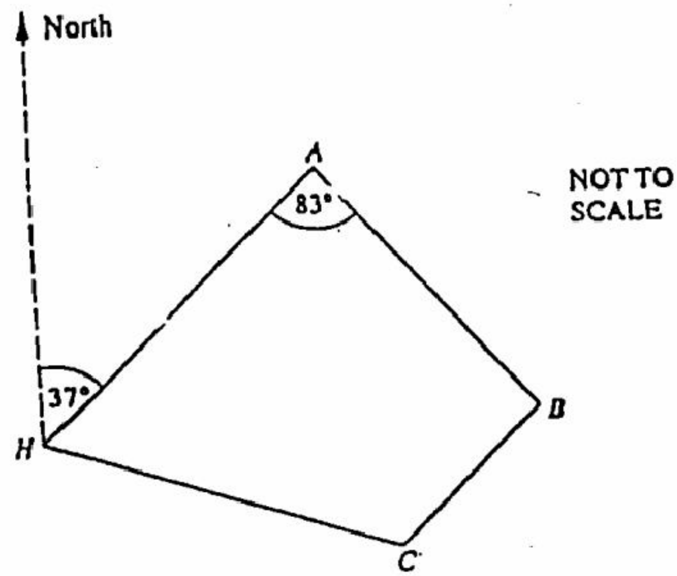
(i) State the mode and find the median wind strength. [2]

(ii) Calculate the mean wind strength. [3]

(iii) A 'good wind' has strength x such that $3 \leqslant x \leqslant 7$.

Estimate the probability of a good wind from this data. [2]

3



An aeroplane leaves its base H and flies to A, B and C before returning to H.
The bearing of A from H is 037° and angle HAB is 83°.
$\overrightarrow{HA} = 2\overrightarrow{CB}$.

(a) Calculate the bearing of

(i) B from A, [2]

(ii) C from B. [2]

(b) HA = 120 km and AB = 100 km. Using a scale of 1 cm to represent 10 km, construct a scale drawing of the quadrilateral $ABCD$.

Hence find the distance, in kilometres, from C to H. [4]

---

4 Answer the whole of this question on a sheet of graph paper.

A farmer keeps x cows and y sheep, where $x \geqslant 4$ and $y \geqslant 10$.

(a) On your graph paper, draw axes from 0 to 60, using a scale of 2 cm to represent 10 units on each axis.
Draw and label the lines $x = 4$ and $y = 10$. [3]

(b) The total number of cows and sheep must not be more than 49.
Write this as an inequality and draw the appropriate line on your graph. [2]

(c) Shade the unwanted regions of the graph. [1]

(d) The farmer makes \$100 profit per cow and \$50 per sheep.
What is his maximum profit? [2]

5 (a) Factorise completely

(i) $3xa + 6xb - 9xc$. [2]

(ii) $x^2 - 10x - 24$. [2]

(iii) $10x^2 - 7x + 1$. [2]

(b)
$$y = \frac{a}{x} + bx.$$

(i) When $x = 1$, $y = 2$ and when $x = 2$, $y = -5$.

Find the value of a and the value of b. [4]

(ii) When $y = 16$, use your values of a and b to show that the equation $y = \frac{a}{x} + bx$ becomes

$$2x^2 + 8x - 3 = 0.$$ [2]

Solve this equation, giving your answers correct to 2 decimal places. [5]

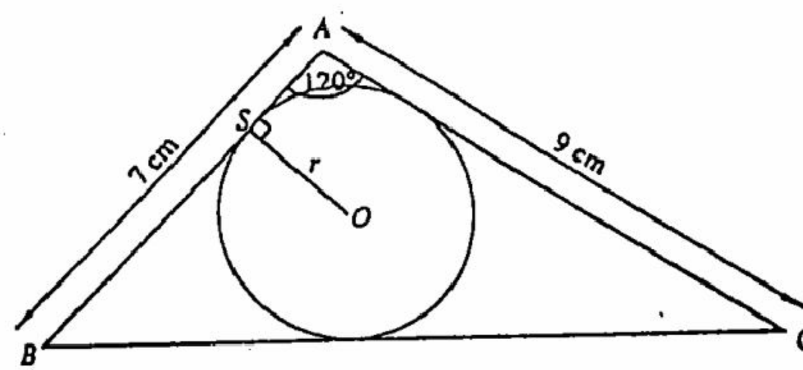
---

6 In triangle ABC, $AB = 7$ cm, $AC = 9$ cm and angle $BAC = 120°$.

(a) Calculate (i) the length BC, [4]

(ii) the angle ABC. [4]

(b)



The three sides of triangle ABC are tangents to a circle, centre O, radius r cm.

The circle touches AB at S.

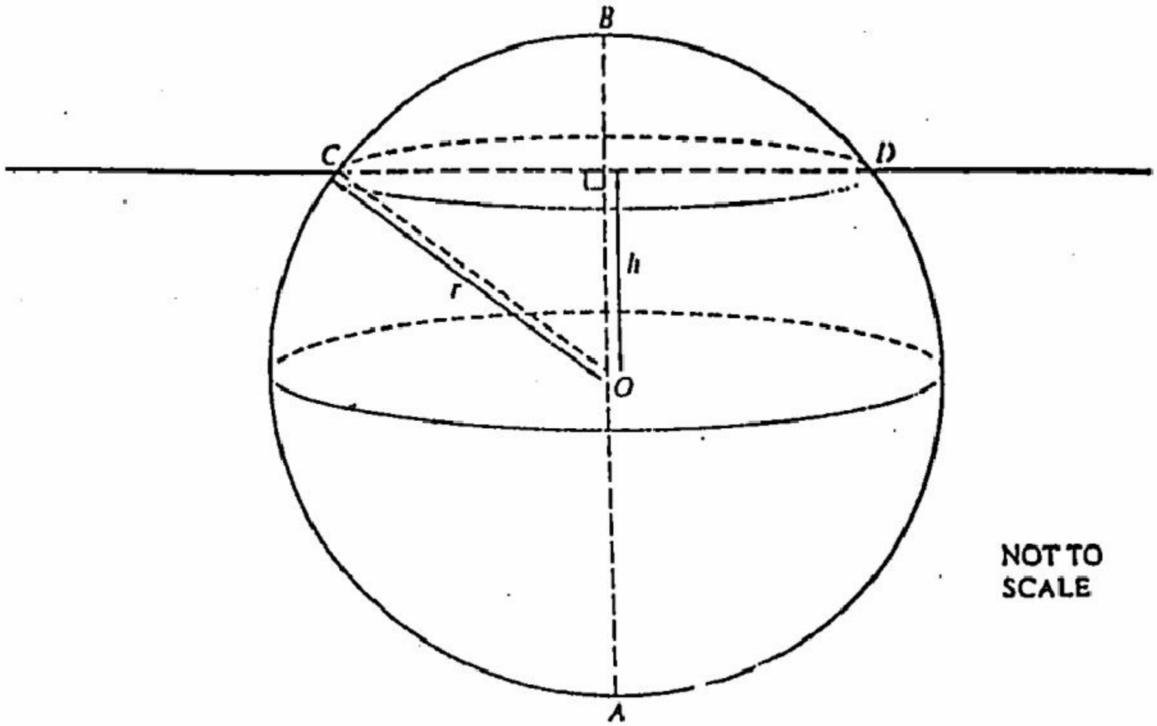
(i) Find the size of angle OAS and .... size of angle OBS. [2]

(ii) Use trigonometry in the triangle OAS to write AS in terms of r. [2]

(iii) Use trigonometry in the triangle OBS to write BS in terms of r. [2]

(iv) Use the fact that $AB = 7$ cm to form an equation in r, and solve it. [3]

7



A spherical ball, radius r, diameter AB, is floating in water with its centre O at a depth h below the surface.

CD is a diameter of the circular cross-section formed at the surface. [π is approximately 3.142]

If $r = 13$ cm and $h = 5$ cm, calculate

(a) (i) the length of CD, [3]

(ii) the angle COD, [2]

(iii) the length of the arc CBD, [3]

(iv) the distance from C to D round the semicircle, diameter CD. [2]

(b) (i) The area of surface above the water level is given by the formula $2\pi r(r-h)$.

Find the area above the water level. [1]

(ii) The total surface area of a sphere is $4\pi r^2$.

Find the area above the water level as a percentage of the total surface area of the sphere. [3]

8 Answer the whole of this question on a sheet of graph paper.

(a) In a chemical reaction, the mass M grams of a chemical is given by the formula

$$M = 160 \times 2^{-t},$$

where t is the time in minutes, after the start.

A table of values for t and M is given below.

t	0	1	2	3	4	5	6	7
M	p	80	40	20	q	5	r	1.25

(i) Find p, q and r. [3]

(ii) Draw the graph of M against t for $0 \leq t \leq 7$.

Use a scale of 2 cm to represent 1 minute on the horizontal t-axis and 1 cm to represent 10 grams on the vertical M-axis. [4]

(iii) Draw a suitable tangent to your graph and use it to estimate the rate of change of mass when $t = 2$. [3]

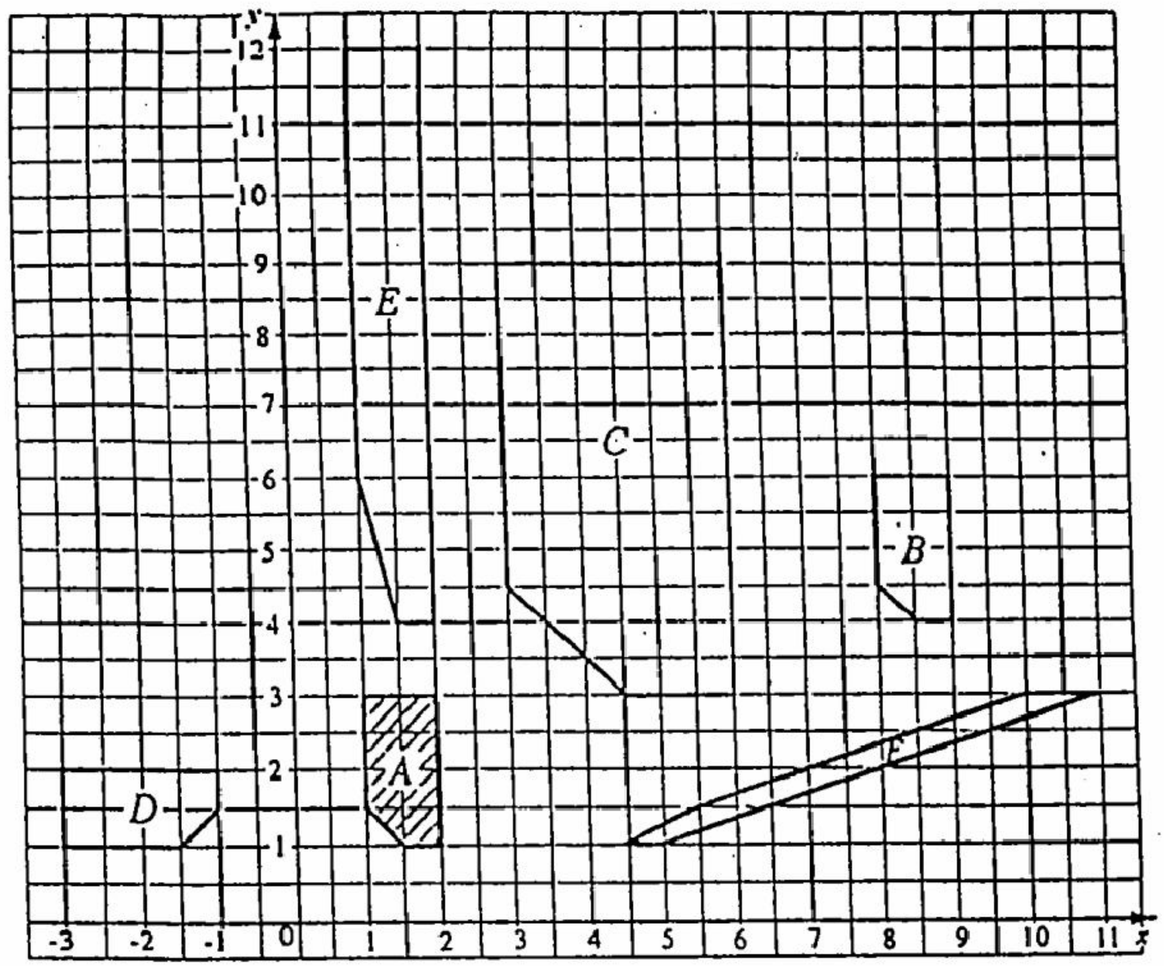
(b) The other chemical in the same reaction has mass m grams which is given by

$$m = 160 - M.$$

(i) For what value of t do the two chemicals have equal mass? [2]

(ii) State a single transformation which would give the graph for m from the graph for M. [2]

9



(a) In each case describe fully the single transformation which maps A onto

(i) B, [2]

(ii) C, [2]

(iii) D, [2]

(iv) E, [2]

(v) F. [2]

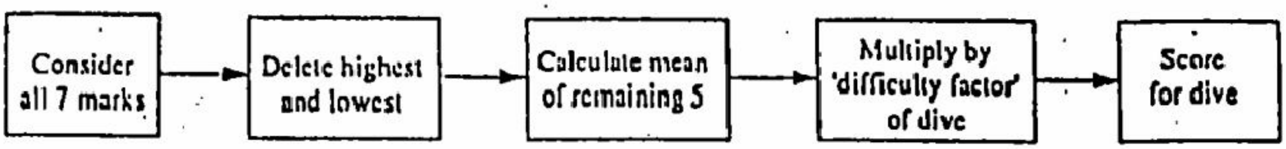
(b) State which shapes have an area equal to that of A. [2]

(c) Find the matrix which transforms A onto E. [2]

(d) The matrix which transforms A onto F is $\begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}$.

Find the matrix which transforms F onto A. [2]

10 In an Olympic diving competition, 7 judges each award a mark between 0 and 10 for a dive. The final score for the dive is found by following the instructions below.



(a) 3 competitors obtained marks for their first dive as shown in the table below.

Competitor	Marks							Mean	'Difficulty factor'	Score
Claus	~~6.8~~	8.0	7.0	7.3	7.0	~~8.0~~	7.7	7.4	1.5	11.1
Erik	7.2	6.9	7.3	6.8	7.1	6.7	7.0	a	1.8	b
Javed	4.9	4.3	4.7	5.2	5.1	5.1	5.3	c	2.3	d

The score for Claus has been worked out.

Calculate the values of a, b, c and d. [4]

(b) Miguel performed a dive with 'difficulty factor' 2.2.

The marks from the judges were 8.0, [illegible], 6.5, 7.3, 7.6, 8.2 and x.

The lowest and highest marks were 6.5 and 8.2.

The score for the dive was 16.5.

Calculate the value of x. [4]

(c) Tarik's marks for a dive were 7.0, 7.1, 7.1, 7.1, 7.1, y and z.

When the highest and lowest marks were deleted, the mean of the remaining 5 marks was 7.2.

Find a possible pair of values for y and z. [2]

International General Certificate of Secondary Education
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

MATHEMATICS 0580/4, 0581/4

PAPER 4

Wednesday 7 JUNE 1995 Morning 2 hours 30 minutes

Additional materials:
- Answer paper
- Electronic calculator
- Geometrical instruments
- Graph paper (2 sheets)
- Mathematical tables (optional)

TIME 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **all** questions.

Write your answers and working on the separate answer paper provided.

All working must be clearly shown. It should be done on the same sheet as the rest of the answer. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

If you use more than one sheet of paper, fasten the sheets together.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total of the marks for this paper is 130.

Electronic calculators should be used.

Three figure accuracy is required in your answers except where stated otherwise.

This question paper consists of 8 printed pages.

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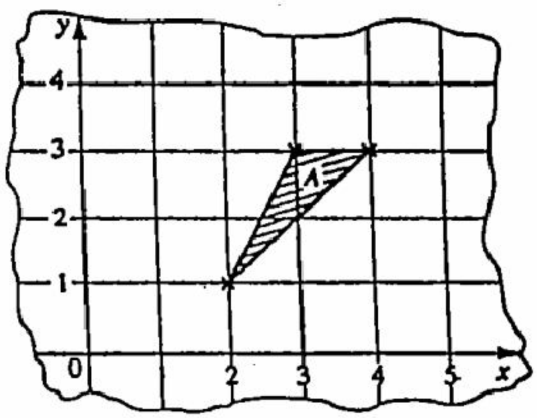
1 **Answer the whole of this question on a sheet of graph paper.**



The diagram shows triangle A, with vertices (2, 1), (3, 3) and (4, 3).

(a) Using a scale of 1 cm to represent 1 unit, draw on your graph paper an x-axis for $-6 \leqslant x \leqslant 8$ and a y-axis for $-6 \leqslant y \leqslant 8$. Draw triangle A. [1]

(b) Draw the enlargement of triangle A, centre (0, 0), scale factor 2. Label it B. [2]

(c) Draw the rotation of triangle A, through 90° anticlockwise about (0, 0). Label it C. [2]

(d) Draw the reflection of triangle A in the line $y = -1$. Label it D. [2]

(e) Draw the translation of triangle A by the vector $\begin{pmatrix}-2\\-4\end{pmatrix}$. Label it E. [2]

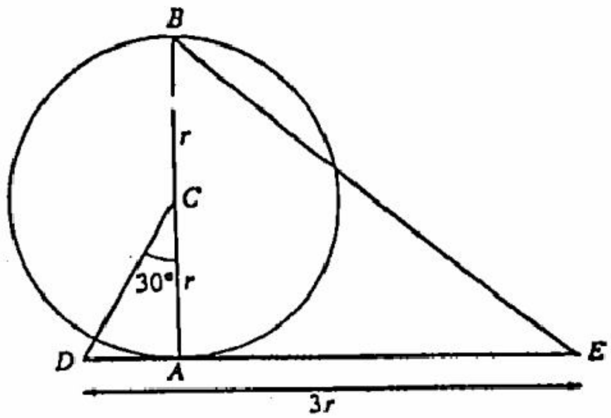
(f) (i) A transformation is represented by the matrix $\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$. Draw the image of triangle A under this transformation. Label it F. [2]

(ii) Describe fully the single transf··rmation which maps A onto F. [2]

(g) (i) Describe fully the single transformation which maps F onto C. [2]

(ii) Find the matrix for this transformation. [2]

2



BCA is the diameter of a circle, centre *C*, radius *r*. *DAE* is a tangent to the circle at *A*.
$DE = 3r$ and angle $DCA = 30°$.

(a) (i) Draw the diagram accurately when $r = 3$ cm. [5]

(ii) Measure and write down the length of *BE* in your diagram. [1]

(iii) Calculate the length of the semicircular arc *BA* when $r = 3$ cm. [2]

[π is approximately 3.142.]

(b) In the case when $r = 10$ cm, calculate, to 2 decimal places,

(i) the length of *DA*, [3]

(ii) the length of *AE*, [1]

(iii) the length of *BE*, [3]

(iv) the length of the semicircular arc *BA*. [1]

(c) Comment on the relationship between the length of *BE* and the length of the semicircular arc *BA*. [1]

3 Ahmed earns $20 000 each year.

(a) In 1991, he paid no tax on the first $3000 of his earnings.

He paid 25% of the rest as tax.

Show that he paid $4250 as tax. [2]

(b) In 1992, he paid no tax on the first $4000 of his earnings.

He paid 30% of the rest as tax.

Calculate how much he paid as tax. [2]

(c) In 1993, he paid no tax on the first $x of his earnings.

He paid 30% of the rest as tax.

(i) Find an expression in terms of x for the amount of tax he paid. [2]

(ii) Calculate the value of x if he paid $4950 as tax. [3]

---

4 Answer the whole of this question on a sheet of graph paper.

A table of values for $y = \frac{6}{x^2}$ is given below.

(The values of y are correct to 1 decimal place.)

x	−4	−3	−2	−1.5	−1	−0.8		0.8	1	1.5	2	3	4
y	p	0.7	1.5	2.7	q	r		r	q	2.7	1.5	0.7	p

(a) Calculate the values of p, q and r. [3]

(b) Using a scale of 2 cm to represent 1 unit on the x-axis and 1 cm to represent 1 unit on the y-axis, draw the graph of $y = \frac{6}{x^2}$ for $-4 \leq x \leq -0.8$ and $0.8 \leq x \leq 4$. [5]

(c) Draw the line $y = 2x + 7$ on your graph. [2]

(d) The graphs meet when $2x + 7 = \frac{6}{x^2}$.

Write down the three solutions of this equation, giving your answers correct to 1 decimal place. [3]

(e) By drawing a suitable tangent to your curve, estimate the gradient of the curve when $x = 2$. [4]

5 In this question, give all your probabilities as fractions in their lowest terms.

(a)

Six chairs are placed in a row.

Alain is equally likely to sit on any one of the chairs.

(i) What is the probability that Alain sits on one of the end chairs? [1]

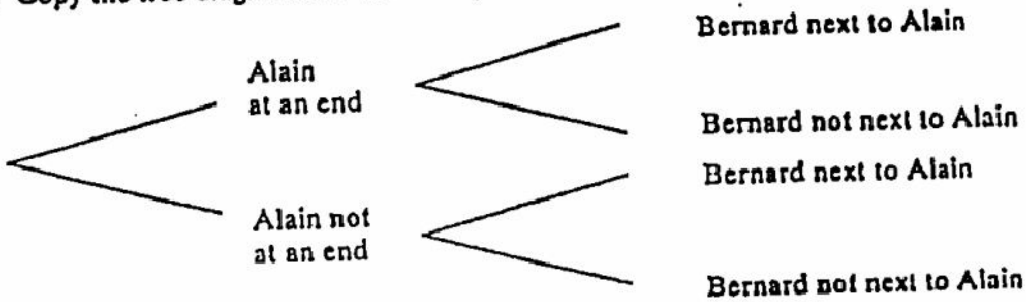
(ii) After Alain has sat down, Bernard chooses any chair at random.

What is the probability that Bernard sits next to Alain,

(a) if Alain is sitting at an end, [1]

(b) if Alain is not sitting at an end? [1]

(iii) Copy the tree diagram and write the probabilities on each branch.



[3]

(iv) Find the probability that Bernard sits next to Alain, wherever Alain sits. [3]

(b)

The six chairs are placed in a circle and Alain and Bernard sit down.

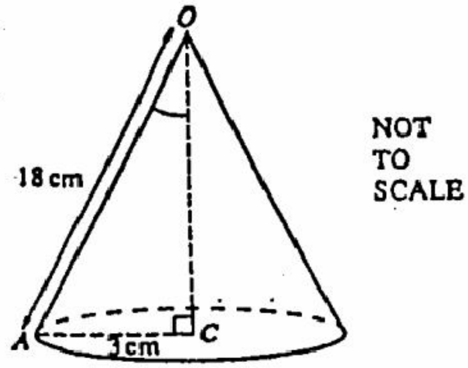
What is the probability that Bernard sits next to Alain? [1]

(c) There are n chairs in a circle and Alain and Bernard sit down.

The probability that Bernard sits next to Alain is $\frac{1}{4}$.

Find the value of n. [2]

6 (a)



(i) The diagram shows a hollow cone with base radius $AC = 3$ cm and edge $OA = 18$ cm.

Calculate (a) the height OC, [2]

(b) angle AOC, [2]

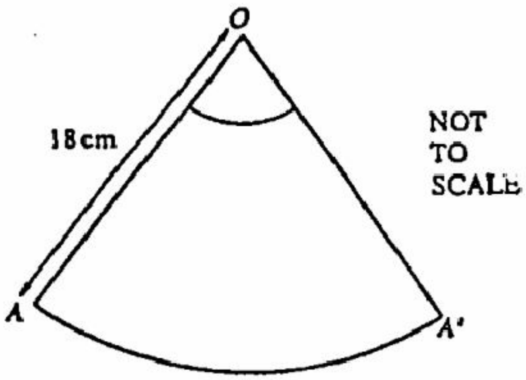
(c) the circumference of the base. [1]

[π is approximately 3.142.]

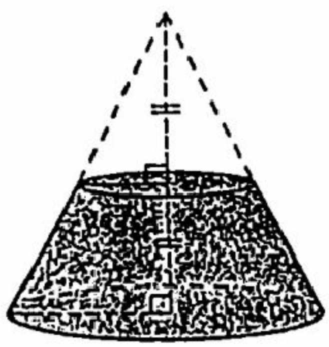
(ii) The cone is cut along the line OA and opened out to form the sector AOA'.

Calculate (a) the circumference of a circle of radius 18 cm, [1]

(b) angle AOA'. [3]



(b)



The top part of a solid cone is removed.

The height of the remaining solid is half the height of the original cone.

(i) Write down, in the form $1 : n$, the ratios

(a) the base radius of the cone removed : the base radius of the original cone, [1]

(b) the curved surface area of the cone removed : the curved surface area of the original cone. [1]

(c) the volume of the cone removed : the volume of the original cone. [1]

(ii) The curved surface area of the original cone was 24π cm^2.

Calculate, in terms of π, the curved surface area of the remaining solid. [2]

(iii) The volume of the original cone was V cm^3.

Give the volume of the remaining solid in terms of V. [2]