

SPECIMEN PAPER 2

[Short question paper;
Extended level]

TIME 1 h 30 m

Instructions to candidates

Answer **all** questions.

If working is needed for any question it must be shown.

The total of the marks for this paper is 70.

Electronic calculators should be used.

If the degree of accuracy is not specified in the question and if the answer is not exact, the answer should be given to three significant figures. Answers in degrees should be given to one decimal place.

For π , use either your calculator value or 3.142.

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

1. Find $\sqrt{\frac{16}{25}}$. [1]

2. How many minutes are there between 19:35 and midnight? [1]

3. For what range of values of x is $4x - 5 < 19$? [2]

4.



The road sign on the left stood at the top of a steep hill.

It was replaced by the road sign on the right.

(a) Explain why the two signs are equivalent. [1]

(b) If the old sign had been 1:7, what would the percentage on the new sign be? [1]

5. Find the value of $4ab$ when $a = 5 \times 10^4$ and $b = 7 \times 10^{-9}$.
Give your answer in standard form. [2]

6. Find the value of $9^{\frac{1}{2}} \times 125^{\frac{1}{3}} \times 4^{\circ}$. [2]

7. An armchair is advertised for sale at \$240. This is a 40% reduction on its original price. Work out the original price. [2]

8. (a) Change the following fractions to decimals, showing your full calculator display in each case:

(i) $\frac{9}{20}$ (ii) $\frac{4}{9}$ (iii) $\frac{33}{74}$ [1]

(b) Which one of the above fractions is closest to $\frac{1}{\sqrt{5}}$? [1]

9. (a) What is the gradient of the line $y = 8 - 3x$? [1]

(b) Find $\{(x, y) : y = 8 - 3x\} \cap \{(x, y) : x = 5\}$ [2]

10. To the nearest half metre, a room is 4 metres long and $2\frac{1}{2}$ metres wide.

(a) The actual length of the room is l metres.
Write down the upper and lower limits of l . [1]

(b) The actual area of the floor of the room is A square metres.
Calculate the upper and lower limits of A . [2]

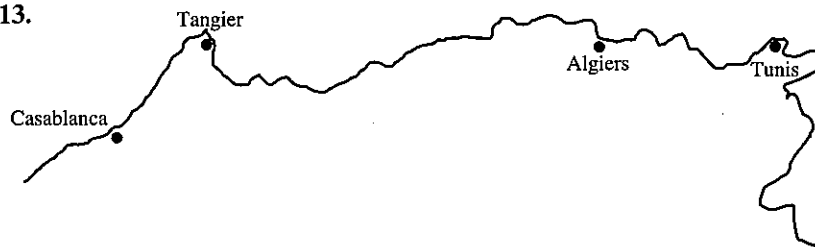
11. Solve the simultaneous equations:

$$\begin{aligned} 3x + 2y &= 10 \\ 2x - 3y &= 11 \end{aligned} \quad [3]$$

12. A bicycle wheel has a radius of 40 cm.
How many times does it revolve during a journey of 10 km?
Give your answer to the nearest 100.

[For π , use either your calculator value of 3.142.] [3]

13.



The map shows four cities on the north coast of Africa.

- (a) Use your protractor to find the bearing of
(i) Tunis from Algiers, [1]
(ii) Casablanca from Tangier. [1]

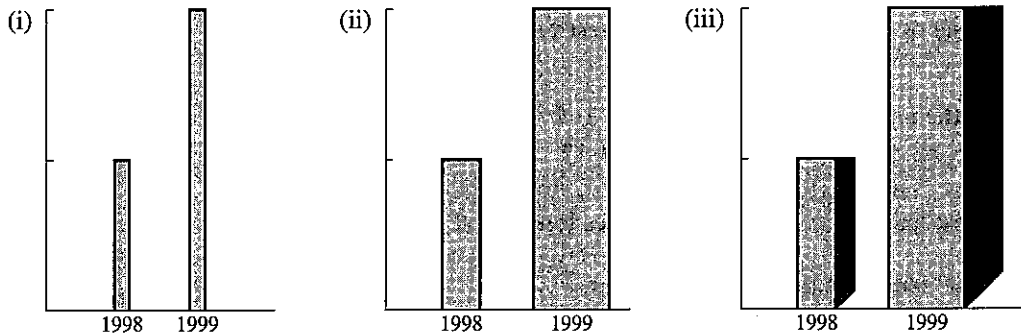
(b) The scale of the map is 1 : 20 000 000.
Find the shortest distance in kilometres from Casablanca to Tunis. [1]

14. A hat of size N in Britain is equivalent to a hat of size C in mainland Europe.

(a) Find the value of $8N$ when N equals: (i) $6\frac{3}{4}$ (ii) $7\frac{1}{8}$ [2]

(b) $C = 55$ when $N = 6\frac{3}{4}$ and $C = 58$ when $N = 7\frac{1}{8}$.
Write down a formula connecting C and N . [1]

15. In 1999, twice as many books were borrowed from the school library as in 1998. The school librarian draws three possible diagrams to represent this.



- (a) Which diagram shows the information most fairly? [1]
 (b) What do the other two diagrams imply about the ratio $\frac{\text{Number of books borrowed in 1999}}{\text{Number of books borrowed in 1998}}$? [2]

16. On graph paper, draw coordinate axes from -8 to $+8$ in both the x - and y -directions. Mark the point $P(2, 0)$. Draw the triangle A with vertices $(2, 1)$, $(5, 2)$ and $(5, 4)$.

- (a) On the diagram enlarge triangle A with centre of enlargement P and scale factor -2 . [2]
 (b) The area of triangle A is 3 square units. What is the area of the enlarged triangle? [1]

17. y varies inversely with x .

- (a) Write this statement as an equation in x , y and k , where k is a constant. [1]
 (b) If x decreases by 20%, find the percentage change in y . [3]

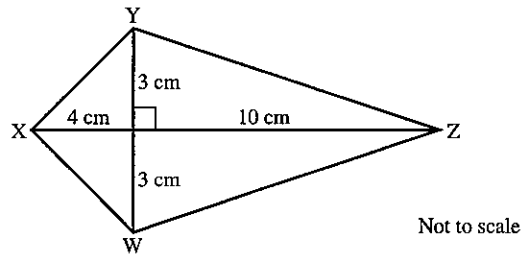
18. $y = \frac{6}{x} + x$

- (a) Find the values of y which correspond to values of x between 1 and 5 inclusive. [2]
 (b) On graph paper, draw an x -axis from 0 to 6 and a y -axis from 0 to 8. Plot the points you have found in part (a) on the graph paper, and join them up with a smooth curve. [2]

19. Triangle A has vertices $(0, 3)$, $(2, 3)$ and $(2, 5)$.
 Triangle B has vertices $(5, 2)$, $(7, 2)$ and $(7, 4)$.

- (a) Write down the vector of the translation which will map triangle A onto triangle B. [1]
 (b) On graph paper, draw triangle A and then rotate it anticlockwise through 90° about the point $(-2, 3)$. Label the rotated triangle C. [1]
 (c) Describe fully the rotation that will map triangle C onto triangle B. [2]

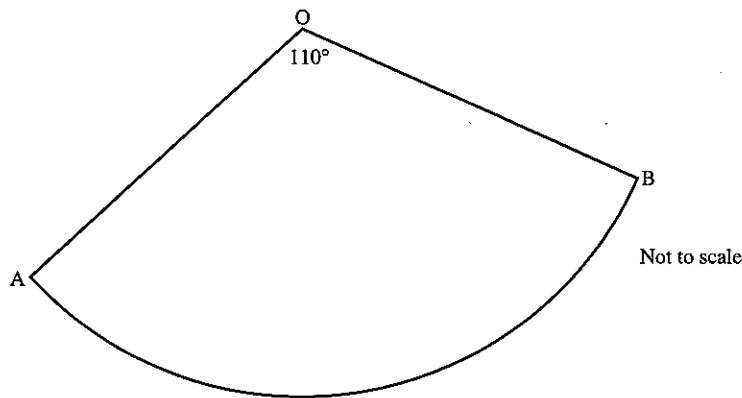
20.



In the quadrilateral $WXYZ$, XZ is perpendicular to WY .

- (a) Calculate the lengths of the four sides of quadrilateral $WXYZ$. [2]
- (b) Calculate the size of angle YZW . [2]

21.



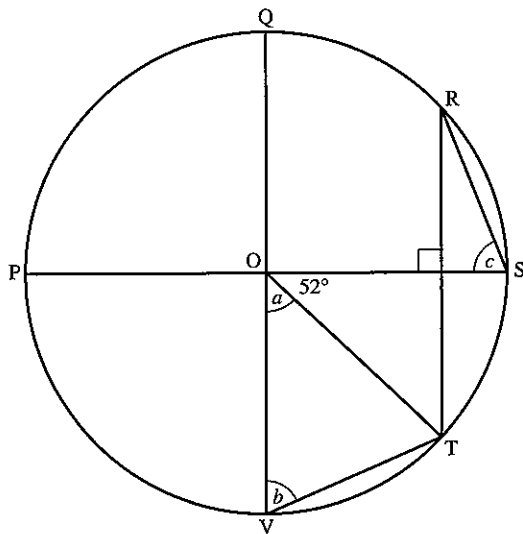
- (a) Draw a sector OAB of a circle, centre O , radius 5 cm and angle $AOB = 110^\circ$. [1]
- (b) Calculate the length of the arc AB . [2]
- (c) Calculate the area of the sector OAB . [2]

22. The table shows the population of the world in thousands of millions, from 1750 to 1975.

Year	1750	1815	1850	1900	1950	1975
Population (thousands of millions)	0.65	1	1.4	2.3	3.7	4.4

- (a) Using a scale of 2 cm to 50 years on the horizontal axis, and 2 cm to 1 000 000 000 people on the vertical axis, plot the points from the table and join them with a smooth curve. [1]
- (b) Read off the world population in 1925.
Write down your answer (i) in words or figures, [1]
(ii) in standard form. [1]
- (c) By drawing a suitable tangent, estimate the rate of population growth in 1900. [2]
- (d) Extend the graph to estimate the population of the world in 2020. [1]

23.



Not to scale

In the diagram, O is the centre of the circle.
 QV is parallel to RT , PS is perpendicular to RT and angle $SOT = 52^\circ$.
 Find the angles marked a , b and c .

[5]

SPECIMEN PAPER 4

[Long, multi-facet question paper;
Extended level]

TIME 2 h 30 m

Instructions to candidates

Answer **all** questions.

All working must be clearly shown. Marks will be given for working which shows that you know how to solve the problem even if you get the answer wrong.

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.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator or a value of 3.142.

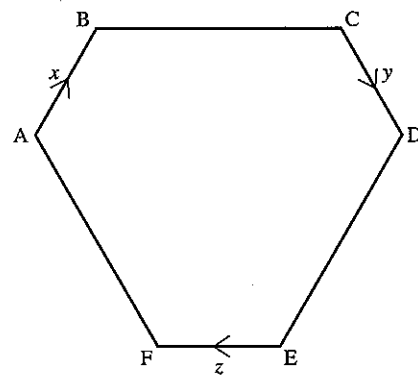
1. $r = \frac{2p^2}{q-3}$

- (a) Find the value of r when (i) $p = 6$ and $q = 5$, [1]
(ii) $p = -4$ and $q = -1$. [1]
(b) Find the value of q when $p = 3$ and $r = 12$. [2]
(c) Find both possible values of p when $q = 8$ and $r = 10$. [2]
(d) The value of p is tripled and q remains unchanged. [2]
What effect does this have on the value of r ? [3]
(e) Make p the subject of the formula. [3]

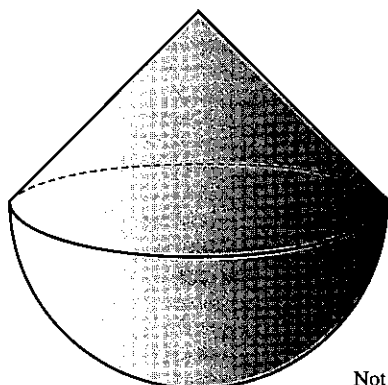
2. Opposite sides of the hexagon in the diagram are parallel, and are in the ratio 2:1.

$\overrightarrow{AB} = \mathbf{x}$, $\overrightarrow{CD} = \mathbf{y}$, and $\overrightarrow{EF} = \mathbf{z}$.

- (a) (i) Write down the vector \overrightarrow{ED} , [1]
(ii) Hence show that $\overrightarrow{EC} = 2\mathbf{x} - \mathbf{y}$, [1]
(iii) Find the vectors \overrightarrow{AE} and \overrightarrow{CA} . [2]
(b) Write down in terms of \mathbf{x} , \mathbf{y} and \mathbf{z} :
 $\overrightarrow{AE} + \overrightarrow{EC} + \overrightarrow{CA}$ [2]
expressing your answer in its simplest form.
(c) Write down a vector equation which follows from the result of part (b). [2]
(d) Use the above results to determine whether or not BE is parallel to CD . [2]



3.



Not to scale

A glass paperweight consists of a cone mounted on a hemisphere. The common radius (r) is 3 cm; the height of the cone (h) is 4 cm. You are given:

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 $4\pi r^2$.

- (a) Calculate (i) the volume of the paperweight, [4]
 (ii) the surface area of the paperweight. [5]
 (b) 1 cm^3 of the glass of which the paperweight is made weighs 2.85 g. Calculate the mass of the paperweight. [2]

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

Using a scale of 1 cm to represent 1 unit on each axis, draw a pair of axes for $0 \leq x \leq 18$ and $0 \leq y \leq 14$.

- (a) On your axes:
 (i) draw the line $y = 2x$, [2]
 (ii) mark the two points A(10, 0) and B(16, 5), [1]
 (iii) construct the locus of points which are equidistant from the points A and B, [3]
 (iv) construct the locus of points which are equidistant from the line $y = x$ and the x -axis, [3]
 (v) draw the circle which touches the x -axis at A, and which passes through B. [2]
 (b) Which other line, already drawn, does the circle touch? [1]
 (c) Draw the tangent to the circle at B, and write down the coordinates of the point at which it cuts the x -axis. [2]

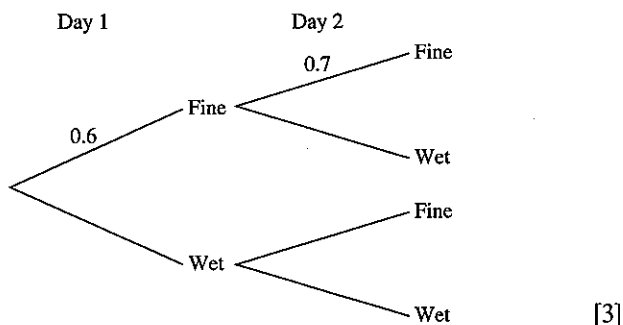
5. (a) In triangle ABC, $AB = 9 \text{ cm}$, $BC = 7 \text{ cm}$ and angle $ABC = 128^\circ$. Calculate (i) the length of AC, [4]
 (ii) the area of triangle ABC. [3]
 (b) The market place in Newark, Nottinghamshire is a rectangle PQRS. $PQ = 105 \text{ m}$ and $QR = 65 \text{ m}$. In corner S stands the church. It is 40 m high. Work out the angle of elevation of the top of the church
 (i) from P, [2]
 (ii) from Q. [4]

6. A rectangle has length $(3x - 8)$ cm and width $(2x - 7)$ 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 91 cm^2 , show that $6x^2 - 37x - 35 = 0$ [3]
 - (d) (i) Factorise $6x^2 - 37x - 35$. [3]
 (ii) Solve the quadratic equation $6x^2 - 37x - 35 = 0$. [3]
 - (e) Write down the length and width of the rectangle when its area is 91 cm^2 . [2]

7. (a) On each of the first two holes on his golf course, a golfer can take 3, 4, 5, 6, 7 or 8 strokes. All outcomes are equally likely. Consider these two holes only.
- (i) Draw a possibility diagram, showing all his possible scores and totals. [2]
 - (ii) What is the probability that he takes a total of 16 strokes? [1]
 - (iii) What is the probability that he takes a total of 10 strokes? [2]
 - (iv) 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 this matrix.

		TOMORROW	
		fine	wet
TODAY	fine	0.7	0.3
	wet	0.4	0.6

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.



- Calculate the probability of:
- (i) two fine days, [2]
 - (ii) a wet day followed by a fine day, [2]
 - (iii) one fine day and one wet day. [2]

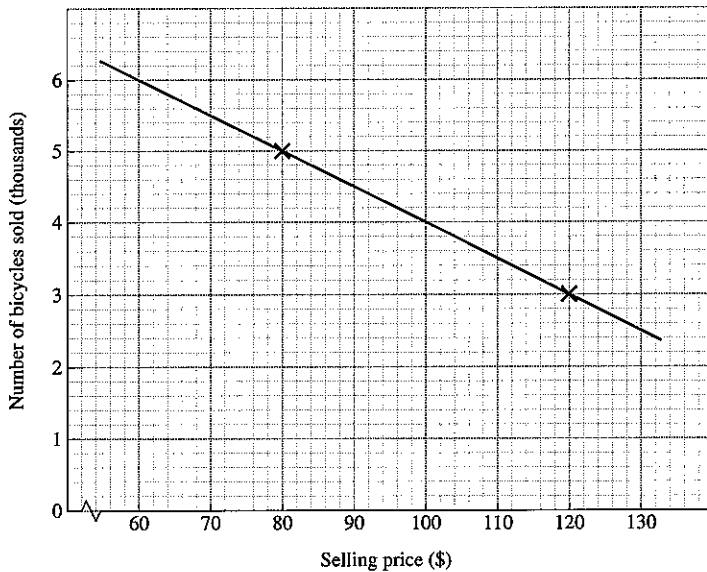
8. The table shows the number of hours of sunshine each day over a six week period in a seaside town.

Number of hours of sunshine (N)	$0 \leq N \leq 2$	$2 < N \leq 4$	$4 < N \leq 6$	$6 < N \leq 8$	$8 < N \leq 10$	$10 < N \leq 12$
Frequency	9	8	6	2	4	13

- (a) Work out an estimate of the mean number of hours of sunshine each day. [4]
- (b) (i) Which is the modal class? [1]
- (ii) Find the median number of hours of sunshine. [2]
- (c) Would you choose the mean, median or mode for publicity to attract visitors to the town? [1]
- (d) Draw a histogram for the data, using the three class intervals $0 \leq N \leq 4$, $4 < N \leq 10$ and $10 < N \leq 12$. [5]

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

A new model of bicycle is about to be marketed. It is estimated that if the selling price is fixed at \$80, then 5000 bicycles will be sold; if it is fixed at \$120, then only 3000 bicycles will be sold. These two points are plotted and connected with a straight line, as below:



(a) Copy and complete the following table, by reading values from the graph and by calculation.

Selling price (\$)	Number of bicycles sold	Sales revenue (\$)
60		
70		
80	5000	400 000
90		
100		
110		
120	3000	360 000

[4]

- (b) Using a horizontal scale of 2 cm to represent \$10 (starting at \$60) and a vertical scale of 2 cm to represent \$20 000, draw the graph of selling price against sales revenue. [5]
- (c) (i) Use your graph to find what the selling price should be in order to achieve the greatest sales revenue. [2]
- (ii) How many bicycles should be made at that price? [2]

10. This is a Fibonacci sequence

1, 3, 4, 7, 11, 18, 29, 47, ...

- (a) Write down the next three terms in the sequence. [3]
- (b) The matrix M is $\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$.
- (i) 11 and 18 are two consecutive terms.
Pre-multiply them by M , that is, work out $\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 18 \\ 11 \end{pmatrix}$. [2]
- (ii) Choose another pair of consecutive terms and pre-multiply them by M . [2]
- (iii) Describe what happens when two consecutive terms in the Fibonacci sequence are pre-multiplied by M . [2]
- (c) (i) Work out M^2 . [2]
- (ii) Work out $M^2 \begin{pmatrix} 18 \\ 11 \end{pmatrix}$. [2]
- (iii) Describe what has happened in (c) (ii). [1]
- (d) Show how this process will continue with M^3 and M^4 . [4]