MATHEMATICS

0580/04
0581/04

Paper 4 (Extended)

October/November 2004

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
                        Electronic calculator
                        Geometrical instruments
                        Graph paper (2 sheets)
                        Mathematical tables (optional)
                        Tracing paper (optional)

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate Answer Booklet/Paper provided.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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.
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.
Answers in degrees should be given to one decimal place.
For π use either your calculator value or 3.142.

This document consists of **8** printed pages.

[Turn over

1   The population of Newtown is 45 000.
    The population of Villeneuve is 39 000.

    (a) Calculate the ratio of these populations in its simplest form.   [1]

    (b) In Newtown, 28% of the population are below the age of twenty.
    Calculate how many people in Newtown are below the age of twenty.   [2]

    (c) In Villeneuve, 16 000 people are below the age of twenty.
    Calculate the percentage of people in Villeneuve below the age of twenty.   [2]

    (d) The population of Newtown is 125% **greater** than it was fifty years ago.
    Calculate the population of Newtown fifty years ago.   [2]

    (e) The two towns are combined and made into one city called Monocity.
    In Monocity the ratio of
                      men : women :children   is   12 : 13 : 5.
    Calculate the number of children in Monocity.   [2]

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

    (a) $$f(x) = \frac{12}{x+1}$$

x	0	1	2	3	4	5	6	7	8	9	10	11
$f(x)$	p	6	4	3	2.4	2	1.71	q	1.33	r	1.09	1

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

    (ii) Draw the graph of $y = f(x)$ for $0 \leqslant x \leqslant 11$.
    Use a scale of 1cm to 1 unit on each axis.   [5]

    (iii) By drawing a suitable line, find an estimate of the gradient of the graph at the point (3, 3).   [3]

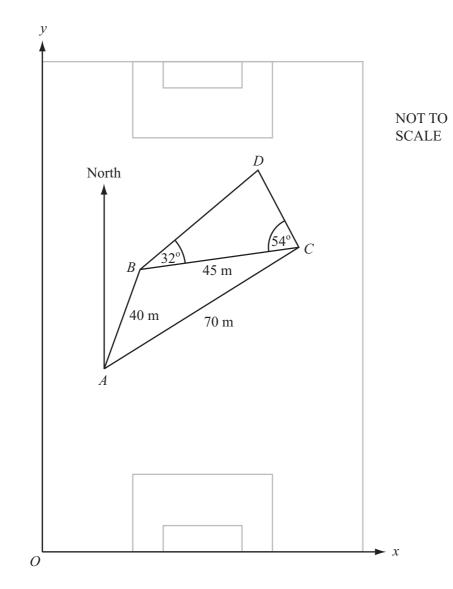   **(b)** On the same grid draw the graph of $y = 8 - x$ for $0 \leqslant x \leqslant 8$.   [2]

    (c) **(i)** Show that the equation $f(x) = 8 - x$ simplifies to $x^2 - 7x + 4 = 0$.   [2]

    (ii) **Use your graph** to solve this equation, giving your answers correct to 1 decimal place.   [2]

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3 Water flows through a pipe into an empty cylindrical tank.
The tank has a radius of 40 cm and a height of 110 cm.

(a) Calculate the volume of the tank. [2]

(b) The pipe has a cross-sectional area of 1.6 cm^2.
The water comes out of the pipe at a speed of 14 cm/s.
How long does it take to fill the tank?
Give your answer in hours and minutes, correct to the nearest minute. [4]

(c) All the water from the tank is added to a pond which has a surface area of 70 m^2.
Work out the increase in the depth of water in the pond.
Give your answer in millimetres, correct to the nearest millimetre. [4]

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

(a) Draw x- and y-axes from –8 to 8 using a scale of 1cm to 1 unit.
Draw triangle ABC with A (2, 2), B (5, 2) and C (5, 4). [2]

(b) Draw the image of triangle ABC under a translation of $\begin{pmatrix} -9 \\ 3 \end{pmatrix}$.

Label it $A_1B_1C_1$. [2]

(c) Draw the image of triangle ABC under a reflection in the line $y = -1$.
Label it $A_2B_2C_2$. [2]

(d) Draw the image of triangle ABC under an enlargement, scale factor 2, centre (6,0).
Label it $A_3B_3C_3$. [2]

(e) The matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ represents a transformation.

   (i) Draw the image of triangle ABC under this transformation. Label it $A_4B_4C_4$. [2]

   (ii) Describe fully this single transformation. [2]

(f) **(i)** Draw the image of triangle ABC under a stretch, factor 1.5, with the y-axis invariant.
Label it $A_5B_5C_5$. [2]

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

5

North

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(a) During a soccer match a player runs from *A* to *B* and then from *B* to *C* as shown in the diagram.
$AB = 40$ m, $BC = 45$ m and $AC = 70$ m.

    (i) Show by calculation that angle $BAC = 37°$, correct to the nearest degree. [3]

    (ii) The bearing of *C* from *A* is 051°. Find the bearing of *B* from *A*. [1]

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

(b) *x*- and *y*-axes are shown in the diagram.

$\overrightarrow{AC} = \begin{pmatrix} p \\ q \end{pmatrix}$, where *p* and *q* are measured in metres.

    (i) Show that $p = 54.4$. [2]

    (ii) Find the value of *q*. [2]

(c) Another player is standing at *D*.
$BC = 45$ m, angle $BCD = 54°$ and angle $DBC = 32°$.
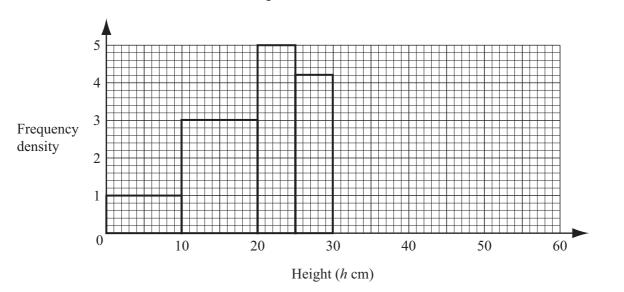Calculate the length of *BD*. [4]

6 **(a)** Students are given marks 0, 1, 2, 3 or 4 for a piece of work.
The table shows the number of students getting each mark.

Mark	0	1	2	3	4
Frequency	3	10	12	9	x

   (i) The mean mark is 2.125.
Find the value of x.   [4]

   (ii) Write down the lower quartile mark.   [1]

(b) The heights (h centimetres) of flowers in a shop are shown in the histogram below.
All the flowers are less than 60 cm high.
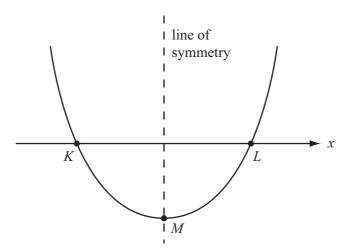One bar has not been drawn on the histogram.

   (i) There are 25 flowers in the interval $20 < h \leqslant 25$.
How many flowers are there in the intervals

   (a) $25 < h \leqslant 30$,   [1]

   (b) $10 < h \leqslant 20$?   [1]

   (ii) There are 42 flowers in the interval $30 < h \leqslant 60$.
This can be shown by a single bar on the histogram.
Calculate the height of this bar.   [2]

   (iii) Calculate an estimate of the mean height of the flowers.   [3]

7   A sketch of the graph of the quadratic function $y = px^2 + qx + r$ is shown in the diagram.

The graph cuts the x-axis at K and L.
The point M lies on the graph and on the line of symmetry.

(a) When $p = 1, \quad q = -2, \quad r = -3$, find

    (i)   the y-coordinate of the point where $x = 4$,   [1]

    (ii)   the coordinates of K and L,   [3]

    (iii)   the coordinates of M.   [2]

(b) Describe how the above sketch of the graph would change in each of the following cases.

    (i)   p is negative.   [1]

    (ii) $p = 1, \quad q = r = 0$.   [1]

(c) Another quadratic function is $y = ax^2 + bx + c$.

    (i)   Its graph passes through the origin.
       Write down the value of c.   [1]

    (ii)   The graph also passes through the points (3, 0) and (4, 8).
        Find the values of a and b.   [4]

8 **(a)** The technical data of a car includes the following information.

Type of road	Petrol used per 100 km
Main roads	9.2 litres
Other roads	8.0 litres

    (i) How much petrol is used on a journey of 350 km on a main road? [1]

    (ii) On other roads, how far can the car travel on 44 litres of petrol? [1]

    (iii) A journey consists of 200 km on a main road and 160 km on other roads.

        (a) How much petrol is used? [2]

        (b) Work out the amount of petrol used per 100 km of this journey. [1]

  (b) A model of a car has a scale of 1 : 25.

    (i) The length of the car is 3.95 m.
Calculate the length of the model.
Give your answer in centimetres. [3]

    (ii) The painted surface area of the model is 128 cm^2.
Calculate the painted surface area of the car, giving your answer in square centimetres. [2]

    (iii) The size of the luggage space of the car is 250 litres.
Calculate the size of the luggage space of the model, giving your answer in millilitres. [3]

9 **(a)** f(x) = 2 – 3x and g(x) = x^2.

    (i) Solve the equation f(x) = 7 – x. [2]

    (ii) Find f^{-1}(x). [2]

    (iii) Find the value of gf(2) – fg(2). [3]

    (iv) Find fg(x). [1]

  (b) h(x) = x^x.

    (i) Find the value of h(2). [1]

    (ii) Find the value of h(–3), giving your answer as a fraction. [1]

    (iii) Find the value of h(7.5), giving your answer in standard form. [2]

    (iv) h(–0.5) is not a real number. Explain why. [1]

    (v) Find the integer value for which h(x) = 3125. [1]

10 Quadrilaterals P and Q each have diagonals which

- are unequal,
- intersect at right angles.

P has two lines of symmetry. Q has one line of symmetry.

(a) (i) Sketch quadrilateral P.
　　　Write down its geometrical name. [2]

　　(ii) Sketch quadrilateral Q.
　　　Write down its geometrical name. [2]

(b) In quadrilateral P, an angle between one diagonal and a side is $x°$.
　　Write down, in terms of x, the four angles of quadrilateral P. [2]

(c) The diagonals of quadrilateral Q have lengths 20 cm and 12 cm.
　　Calculate the area of quadrilateral Q. [2]

(d) Quadrilateral P has the same area as quadrilateral Q.
　　The lengths of the diagonals and sides of quadrilateral P are all integer values.
　　Find the length of a side of quadrilateral P. [3]