Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number

Candidate Number

Mathematics

Paper 1 (Non-Calculator)

Higher Tier

Thursday 2 November 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
1MA1/1H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.
Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may not be used.**

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

6/6/6/7/2/

Pearson

Please note that these worked solutions have neither been provided nor approved by Pearson Education and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue should be written in the exam.

Anything written in green in a rectangle doesn't have to be written in the exam.

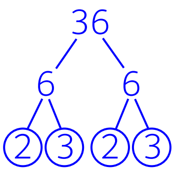
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Write 36 as a product of its prime factors.



Doing a prime factor tree by splitting each number into two factors and stopping at prime numbers. 2 and 3 are prime as they are only divisible by themselves and 1

Writing each of the circled primes as a product

$2 \times 2 \times 3 \times 3$

(Total for Question 1 is 2 marks)

2 Kiaria is 7 years older than Jay.
Martha is twice as old as Kiaria.
The sum of their three ages is 77

Find the ratio of Jay's age to Kiaria's age to Martha's age.

$J + 7$ ← Let J be Jay's age. Kiaria must be J + 7

$2(J + 7)$ ← Expressing Martha's age in terms of J. Expanding the bracket gives 2J + 14

$J + J + 7 + 2J + 14$ ← Adding Jay's age, Kiaria's age and Martha's age all in terms of J to express the sum of their ages

$4J + 21 = 77$ ← Collecting like terms. J + J + 2J = 4J and 7 + 14 = 21. Setting equal to the value of the sum, 77

$4J = 56$ ← Subtracting 21 from both sides eliminates the +21 on the left and gets the J term on its own

$56 \div 4 = 14$ (short division: 4 into 5 ¹6 gives 1 4) ← Dividing both sides by 4 eliminates the 4 on the left and finds that J = 14. So Jay is 14 years old

$14 + 7$ ← Kiaria is 7 years older than Jay. So Kiaria is 21 year old

21×2 ← Martha is twice as old as Kiaria. So Martha is 42 years old

Writing their ages as a ratio. There is no need to simplify

14 : 21 : 42

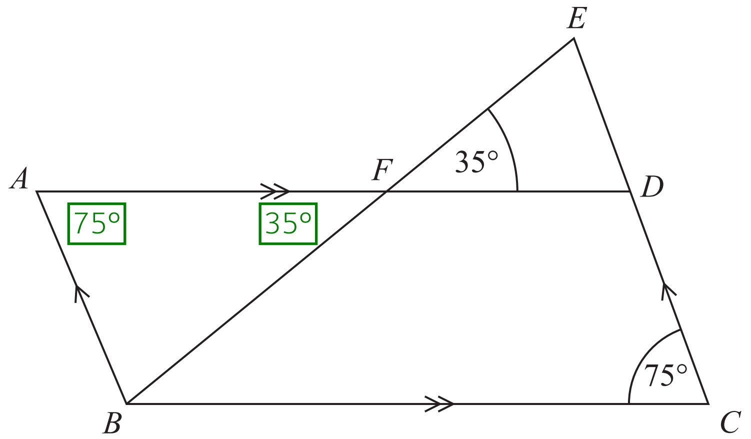
(Total for Question 2 is 4 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

3



ABCD is a parallelogram.
EDC is a straight line.
F is the point on *AD* so that *BFE* is a straight line.

Angle *EFD* = 35°
Angle *DCB* = 75°

Show that angle *ABF* = 70°
Give a reason for each stage of your working.

Angle BAF = 75° as opposite angles in a parallelogram are equal

Angle BAF is opposite angle BCD in the parallelogram

Angle AFB = 35° as vertically opposite angles are equal

Angle AFB is vertically opposite to angle DFE

$$\begin{array}{r} 75 \\ +35 \\ \hline 110 \end{array}$$

Adding angles BAF and AFB works out that there are 110° in the triangle ABF so far

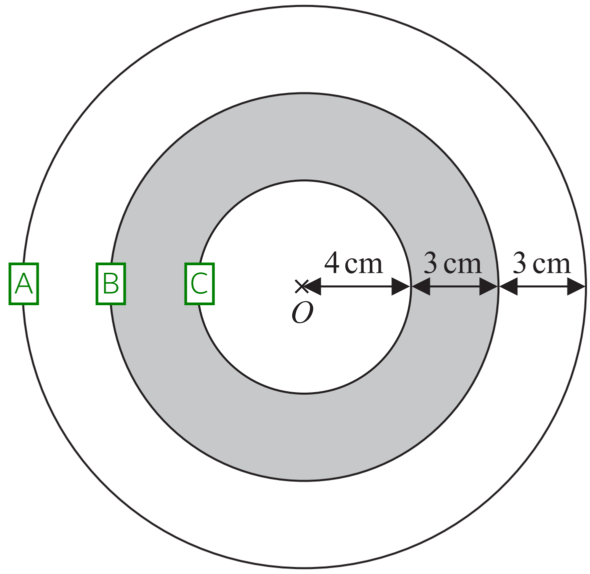
$$\begin{array}{r} 180 \\ -110 \\ \hline 70 \end{array}$$

Subtracting this 110° from 180° leaves angle ABF

Angle ABF is 70° as there are 180° in a triangle

(Total for Question 3 is 4 marks)

4 The diagram shows a logo made from three circles.



Each circle has centre O.

Daisy says that exactly $\frac{1}{3}$ of the logo is shaded.

Is Daisy correct?
You must show all your working.

$\pi \times 10^2 = 100\pi$ ← This works out that the area of circle A is 100π cm^2, which is the area of the whole logo. Area of circle = $\pi \times$ radius^2. The radius of circle A is 4 + 3 + 3 = 10 cm

$\pi \times 7^2 = 49\pi$ ← This works out that the area of circle B is 49π cm^2. Area of circle = $\pi \times$ radius^2. The radius of circle B is 4 + 3 = 7 cm

$\pi \times 4^2 = 16\pi$ ← This works out that the area of circle C is 16π cm^2. Area of circle = $\pi \times$ radius^2. The radius of circle C is 4 cm

$49\pi - 16\pi$ ← Subtracting the area of circle C from the area of circle B works out that the shaded area is 33π cm^2

$\frac{33\pi}{100\pi} = \frac{33}{100}$ ← Expressing the shaded area as a fraction of the area of the whole logo. Simplifying by dividing both the numerator and denominator by π. It cannot go any simpler as 33 and 100 are not divisible by the same whole numbers to get smaller whole numbers

No ← 33/100 is not exactly 1/3

(Total for Question 4 is 4 marks)

DO NOT WRITE IN THIS AREA

Turn over

5 The table shows information about the weekly earnings of 20 people who work in a shop.

Weekly earnings (£x)	Frequency	A	B
$150 < x \leqslant 250$	1	200	200
$250 < x \leqslant 350$	11	300	3300
$350 < x \leqslant 450$	5	400	2000
$450 < x \leqslant 550$	0	500	0
$550 < x \leqslant 650$	3	600	1800
			7300 ← C

(a) Work out an estimate for the mean of the weekly earnings.

A: Writing down the midpoint for each interval. Each interval is 100 wide and 100 ÷ 2 = 50. So adding 50 to the lower bound of each interval gives the midpoint.

B: Multiplying the midpoints by the frequencies for each interval estimates the total earnings for each interval.

C: Adding all the estimated totals estimates the overall total earnings of all of the people

$7300 \div 20 = 365$ ← Dividing the estimated £7300 total by the 20 people estimates the mean

£ 365

(3)

Nadiya says,

"The mean may **not** be the best average to use to represent this information."

(b) Do you agree with Nadiya?
You must justify your answer.

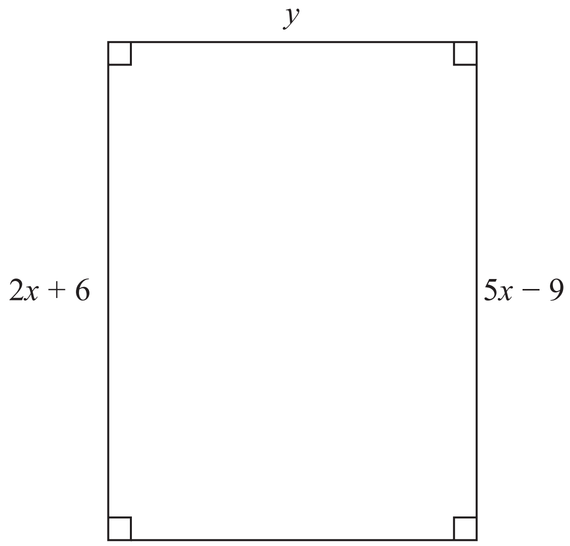
Yes as it is effected by outliers

Median is usually used for earnings as it excludes the outliers

(1)

(Total for Question 5 is 4 marks)

6 Here is a rectangle.



All measurements are in centimetres.

The area of the rectangle is $48\,\text{cm}^2$.

Show that $y = 3$

$2x + 6 = 5x - 9$ ← Opposite sides of a rectangle are equal. So setting the opposite sides involving x equal to each other

$6 = 3x - 9$ ← Subtract 2x from both sides to get all the x on the same side

$15 = 3x$ ← Adding 9 to both sides to get the x term on its own

$5 = x$ ← Dividing both sides by 3 gets x on its own

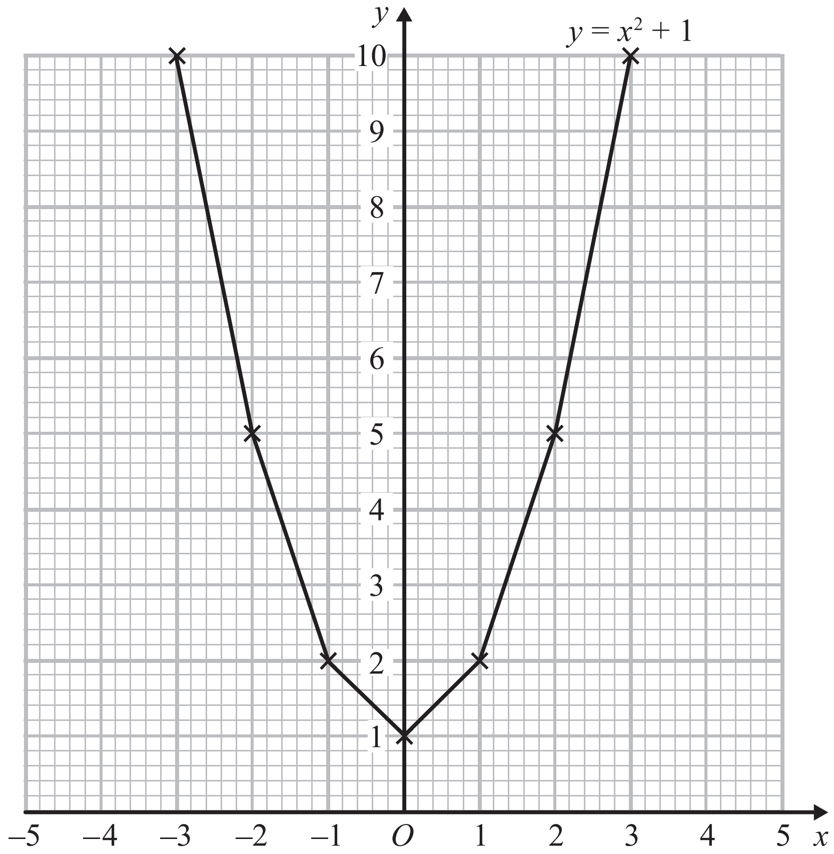
$2(5) + 6$ ← Substituting 5 for x in 2x + 6 finds that the length of the rectangle is 16 cm

$y = 48 \div 16 = 3$ ← Area of rectangle = length × width. So width = area of rectangle ÷ length

(Total for Question 6 is 4 marks)

7 Brogan needs to draw the graph of $y = x^2 + 1$

Here is her graph.



Write down one thing that is wrong with Brogan's graph.

Should be a curve

The points plotted are correct but the points between them are wrong

(Total for Question 7 is 1 mark)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

8 Write these numbers in order of size.
Start with the smallest number.

$0.2\dot{4}\dot{6}$ $\quad$ $0.24\dot{6}$ $\quad$ $0.\dot{2}4\dot{6}$ $\quad$ 0.246

0.2464 $\quad$ 0.2466 $\quad$ 0.2462 $\quad$ 0.2460

Writing all the numbers truncated to 4 decimal places makes them easier to compare

$0.246,\ 0.\dot{2}4\dot{6},\ 0.2\dot{4}\dot{6},\ 0.24\dot{6}$

(Total for Question 8 is 2 marks)

---

9 James and Peter cycled along the same 50 km route.
James took $2\frac{1}{2}$ hours to cycle the 50 km.

Peter started to cycle 5 minutes after James started to cycle.
Peter caught up with James when they had both cycled 15 km.

James and Peter both cycled at constant speeds.

Work out Peter's speed.

d / s t ← Writing a formula triangle for distance, speed, time

$50 \div \frac{5}{2}$ ← Covering s in the formula triangle finds that speed = distance ÷ time. Dividing the 50 km by the 5/2 hours (this is the $2^1/_2$ hours converted to an improper fraction) works out James' speed

$50 \times \frac{2}{5}$ ← To divide by a fraction: keep the 1st number, change the division to a multiplication, flip the 2nd fraction. To multiply by a fraction: divide the number by the denominator then multiply the result by the numerator. So 50 ÷ 5 = 10 then 10 × 2 = 20 km/h for James' speed

$\frac{15}{20} = \frac{3}{4}$ ← Covering t in the formula triangle finds that time = distance ÷ speed. Dividing the 15 km by the 20 km/h works out James' time to do the 15 km. Expressing it as a fraction and simplifying by dividing both the numerator and denominator by 5. Then 3/4 of an hour is 45 minutes

$\frac{40}{60} = \frac{4}{6} = \frac{2}{3}$ ← It took Peter 5 minutes less to do the 15 km so took 40 minutes. 1 hour = 60 minutes so putting the 40 minutes over 60 converts it to hours. Simplifying the fraction to make it easier to work with

$15 \div \frac{2}{3}$ ← Covering s in the formula triangle finds that speed = distance ÷ time. Dividing the 15 km by the 2/3 hours works out Peter's speed

$15 \times \frac{3}{2}$ ← To divide by a fraction: keep the 1st number, change the division to a multiplication, flip the 2nd fraction

15 does not divide by 2 to give a whole number. So instead multiplying the 15 by the numerator and leaving it as a fraction →

$\frac{45}{2}$ km/h

(Total for Question 9 is 5 marks)

10 (a) Write down the value of $100^{\frac{1}{2}}$

The 1/2 means to do the square root

10 ....

(1)

(b) Find the value of $125^{\frac{2}{3}}$

The denominator of 3 means to cube root, which gives 5.
Then the numerator of 2 means to square, which gives 25

25 ....

(2)

(Total for Question 10 is 3 marks)

---

11 3 teas and 2 coffees have a total cost of £7.80
5 teas and 4 coffees have a total cost of £14.20

Work out the cost of one tea and the cost of one coffee.

$3T + 2C = 780$ ← 1st equation. 3 teas and 2 coffees have a total cost of 780p

$5T + 4C = 1420$ ← 2nd equation. 5 teas and 4 coffees have a total cost of 1420p

$6T + 4C = 1560$ ← 3rd equation. The 1st equation is multiplied by 2 to give the same number of C as the 2nd equation

$T = 140$ ← Doing simultaneous equations by subtracting the 2nd equation from the 3rd equation to cancel out the C. So the cost of one tea is 140p, which is £1.40

$420 + 2C = 780$ ← Substituting 140 for T in the 1st equation

$2C = 360$ ← Subtracting 420 from both sides to get the C term on its own

$C = 180$ ← Dividing both sides by 2 finds that the cost of one coffee is 180p, which is £1.80

$780 \times 2 = 1560$ $\quad 1560 - 1420 = 140$ $\quad 140 \times 3 = 420$ $\quad 780 - 420 = 360$ $\quad 360 \div 2 = 180$

tea £ 1.40 ....

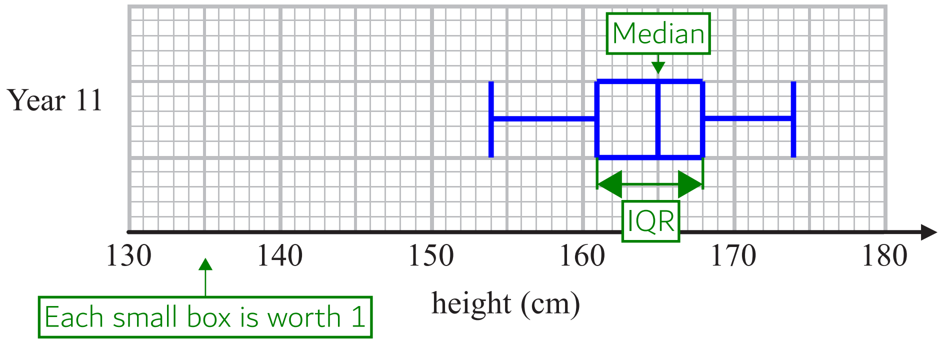
coffee £ 1.80 ....

(Total for Question 11 is 4 marks)

12 The table shows information about the heights, in cm, of a group of Year 11 girls.

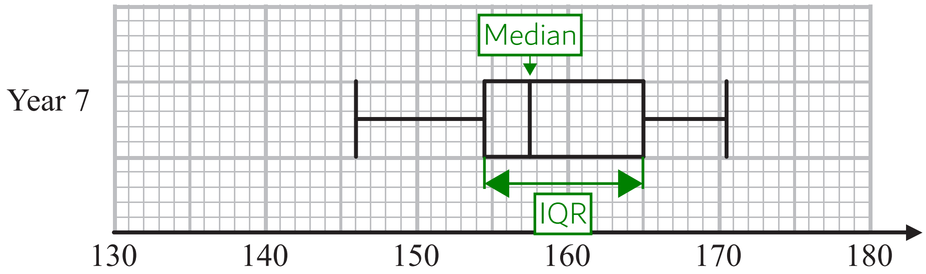
	height (cm)
least height	154
median	165
lower quartile	161
interquartile range	7
range	20

(a) Draw a box plot for this information.



(3)

The box plot below shows information about the heights, in cm, of a group of Year 7 girls.



(b) Compare the distribution of heights of the Year 7 girls with the distribution of heights of the Year 11 girls.

The median for Year 11 is higher. The interquartile range of Year 11 is lower

(2)

(Total for Question 12 is 5 marks)

13 A factory makes 450 pies every day.
The pies are chicken pies or steak pies.

Each day Milo takes a sample of 15 pies to check.

The proportion of the pies in his sample that are chicken is the same as the proportion of the pies made that day that are chicken.

On Monday Milo calculated that he needed exactly 4 chicken pies in his sample.

(a) Work out the total number of chicken pies that were made on Monday.

$450 \div 15 = 030$, $\times 4$

4/15 of the sample were chicken so 4/15 of the 450 pies were chicken

120

(2)

On Tuesday, the number of steak pies Milo needs in his sample is 6 correct to the nearest whole number.

Milo takes at random a pie from the 450 pies made on Tuesday.

(b) Work out the lower bound of the probability that the pie is a steak pie.

$\frac{5.5}{15}$

The lowest possible number which rounds to 6 to the nearest whole number is 5.5 so this is the lower bound of the number needed in his sample. The proportion of steak pies is therefore 5.5/15 as 5.5 out of the sample of 15 are steak and this is equal to the probability

Multiplying the numerator and denominator by 2 to eliminate the decimals

$\frac{11}{30}$

(2)

(Total for Question 13 is 4 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

14 The ratio $(y + x):(y - x)$ is equivalent to $k:1$

Show that $y = \dfrac{x(k+1)}{k-1}$

$\dfrac{y + x}{y - x} = k$ ← To get 1 on the right side of the ratio, (y - x) needs to be divided by (y - x). To keep the ratio equivalent, the left side needs to also be divided by (y - x). Doing this will give k

$y + x = k(y - x)$ ← Multiply both sides by (y - x) to eliminate y as a denominator

$= ky - kx$ ← Expanding the brackets

$kx + x = ky - y$ ← Bringing all the y terms to one side by subtracting y from both sides. Then moving all the other terms to the other side by adding kx to both sides

$x(k + 1) = y(k - 1)$ ← Factorising both sides

$y = \dfrac{x(k + 1)}{k - 1}$ ← Dividing both sides by (k - 1) to make y the subject

(Total for Question 14 is 3 marks)

---

15 $x = 0.4\dot{3}\dot{6}$

Prove algebraically that x can be written as $\dfrac{24}{55}$

$100x = 43.6\dot{3}\dot{6}$ ← There are 2 recurring digits in x. So multiplying by ten 2 times writes a different decimal with the recurring digits in the same decimal places

$99x = 43.2$ ← Subtracting x from 100x cancels out the recurring digits

$x = \dfrac{43.2}{99} = \dfrac{24}{55}$ ← Dividing both sides by 99 to express x as a fraction. This will simplify to 24/55

(Total for Question 15 is 3 marks)

16 y is directly proportional to $\sqrt[3]{x}$

$y = 1\frac{1}{6}$ when $x = 8$

Find the value of y when $x = 64$

$\frac{7}{6} \times 2$ ← x was multiplied by 8 from 8 to 64. So y will be multiplied by $\sqrt[3]{8}$, which is 2. Expressing the mixed fraction as an improper fraction

$\frac{14}{6}$

(Total for Question 16 is 3 marks)

---

17 n is an integer.

Prove algebraically that the sum of $\frac{1}{2}n(n + 1)$ and $\frac{1}{2}(n + 1)(n + 2)$ is always a square number.

$\frac{1}{2}n(n + 1) + \frac{1}{2}(n + 1)(n + 2)$ ← Expressing the sum of both expressions

$\frac{1}{2}n^2 + \frac{1}{2}n + \frac{1}{2}n^2 + n + \frac{1}{2}n + 1$ ← Expanding the brackets

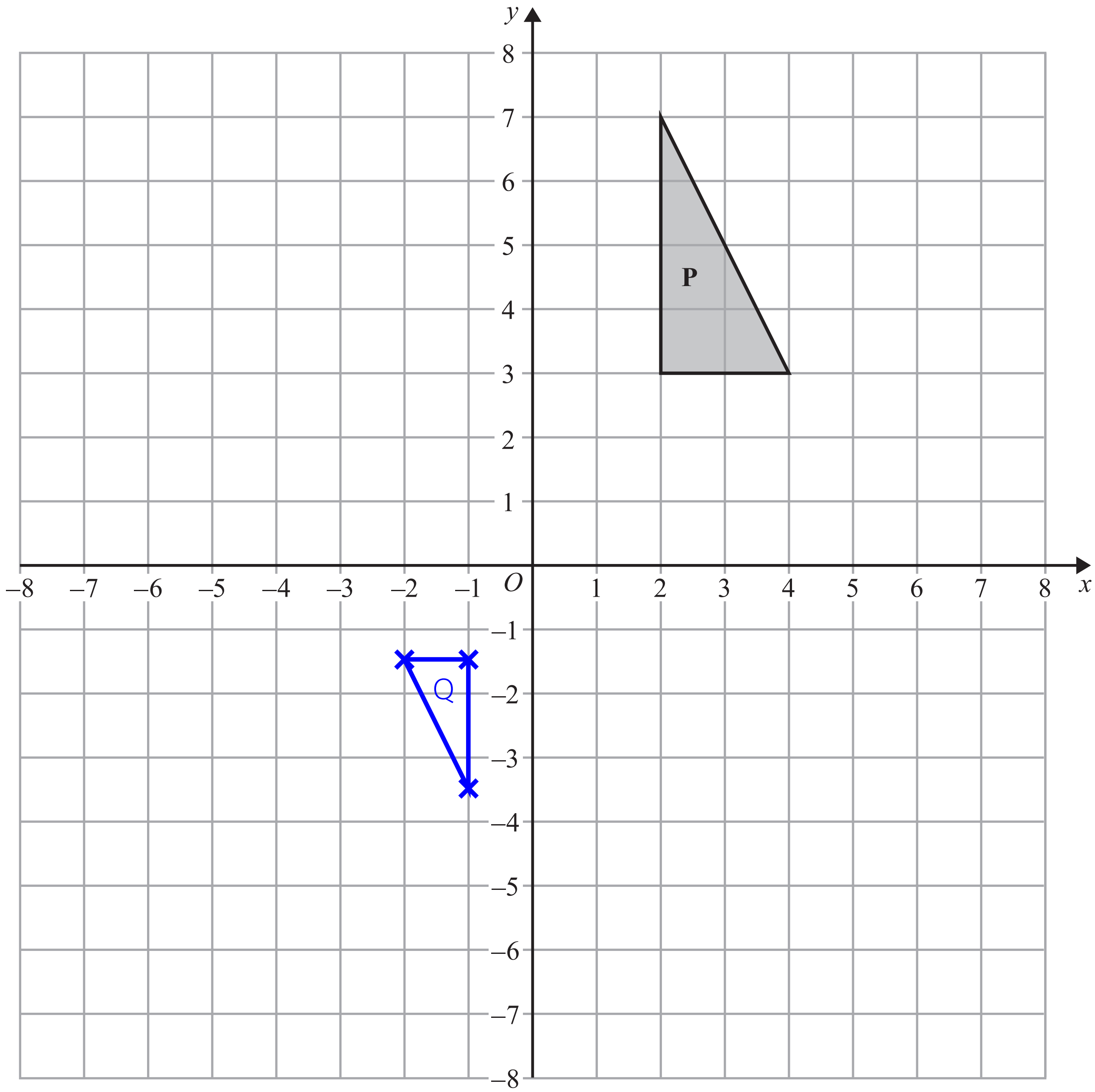
$n^2 + 2n + 1$ ← Collecting like terms

$(n + 1)(n + 1)$ ← Factorising by finding two numbers which add to the 2 and multiply to the 1 and putting these in brackets with n

$(n + 1)^2$, which is a square number ← The bracket is multiplied by itself so is squared. As n is an integer, n + 1 must also be an integer. Squaring an integer gives a square number

(Total for Question 17 is 2 marks)

18



Enlarge shape **P** by scale factor $-\frac{1}{2}$ with centre of enlargement (0, 0).

Label your image **Q**.

(Total for Question 18 is 2 marks)

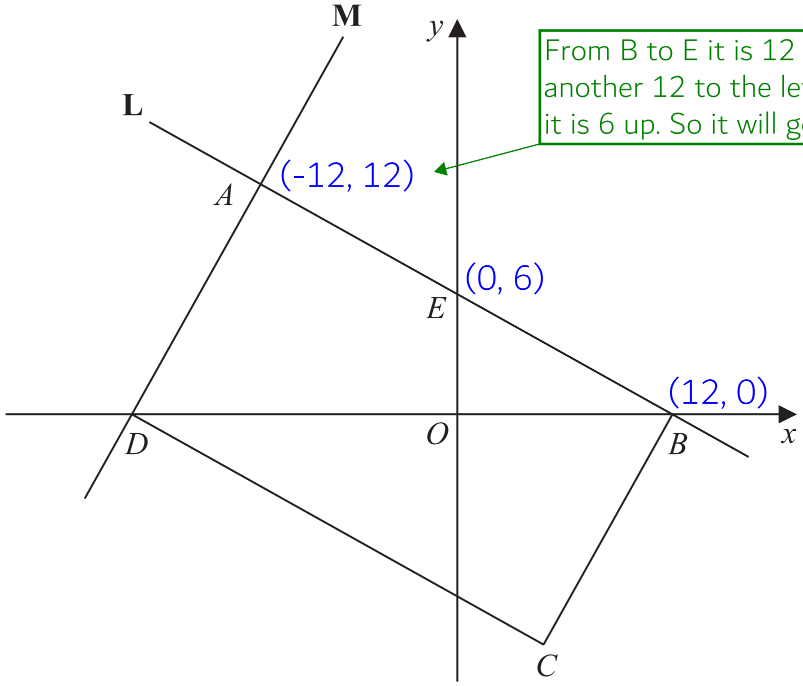
$$\begin{pmatrix}2\\3\end{pmatrix} \times -\frac{1}{2} = \begin{pmatrix}-1\\-1.5\end{pmatrix}$$

$$\begin{pmatrix}2\\7\end{pmatrix} \times -\frac{1}{2} = \begin{pmatrix}-1\\-3.5\end{pmatrix}$$

$$\begin{pmatrix}4\\3\end{pmatrix} \times -\frac{1}{2} = \begin{pmatrix}-2\\-1.5\end{pmatrix}$$

Writing the vector from (0, 0) to each corner of the triangle. Multiplying these vectors by the scale factor -1/2. Then doing the resulting vectors from (0, 0) to work out where the corners of the image Q are

19



From B to E it is 12 to the left. So it will go another 12 to the left from E to A. From B to E it is 6 up. So it will go another 6 up from E to A

ABCD is a rectangle.

A, *E* and *B* are points on the straight line **L** with equation $x + 2y = 12$
A and *D* are points on the straight line **M**.

$AE = EB$

Find an equation for **M**.

$x + 2(0) = 12$ ← At point B, y = 0. Substituting this into the equation of L

$x = 12$ ← So the coordinates of B are (12 , 0)

$0 + 2y = 12$ ← At point E, x = 0. Substituting this into the equation of L

$y = 6$ ← Dividing both sides by 2 gets y on its own. So the coordinates of E are (0, 6)

$\frac{-6}{12} = \frac{-1}{2}$ ← Gradient = (change in y)/(change in x). Between E and B, y has changed by -6 and x has changed by 12. Simplifying the fraction to make it easier to work with

$y = 2x + c$ ← The general equation of a straight line is y = mx + c, where m is the gradient and c is the y-intercept. The gradient of M is the negative reciprocal (which means to flip the fraction and change the sign) of the gradient of L as they are perpendicular

$c = 12 - 2(-12)$ ← Subtracting 2x from both sides and substituting in the coordinates of A

c = 36. Putting this back into the equation

$y = 2x + 36$

(Total for Question 19 is 4 marks)

DO NOT WRITE IN THIS AREA

20 The table shows some values of x and y that satisfy the equation $y = a\cos x° + b$

x	0	30	60	90	120	150	180
y	3	$1+\sqrt{3}$	2	1	0	$1-\sqrt{3}$	-1

Find the value of y when $x = 45$

0 30 45 60 90
4 3 2 1 0 ← Listing the angles 0, 30, 45, 60, 90 degrees. Listing 4, 3, 2, 1, 0 under these. Square rooting them and putting them over 2 works out the cos values

$1 = a\cos 90 + b$ ← Substituting 90 for x as cos90 = 0 and this will eliminate the a so we can work out b

$b = 1$ ← 1 = 0 + b

$3 = a\cos 0 + 1$ ← Substituting 0 for x as cos0 = 1 and this is easy to work with

$3 = a + 1$ ← a × 1 = a

$a = 2$ ← Subtracting 1 from both sides gets a on its own

$y = 2\cos 45 + 1$ ← Substituting 45 for x and substituting in the values of a and b

$= 2 \times \frac{\sqrt{2}}{2} + 1$ ← cos45 = √2/2

2 × √2/2 = √2 → $\sqrt{2} + 1$

(Total for Question 20 is 4 marks)

---

21 Show that $\frac{6-\sqrt{8}}{\sqrt{2}-1}$ can be written in the form $a + b\sqrt{2}$ where a and b are integers.

$\sqrt{8} = \sqrt{4}\sqrt{2} = 2\sqrt{2}$ ← Simplifying √8 using √a × √b = √ab. Either a or b must be a square number for it to simplify

$\frac{6-2\sqrt{2}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1}$ ← Substituting 2√2 for √8 and rationalising the denominator by multiplying both the numerator and denominator by √2 + 1 (which is the √2 - 1 with the sign in the middle flipped)

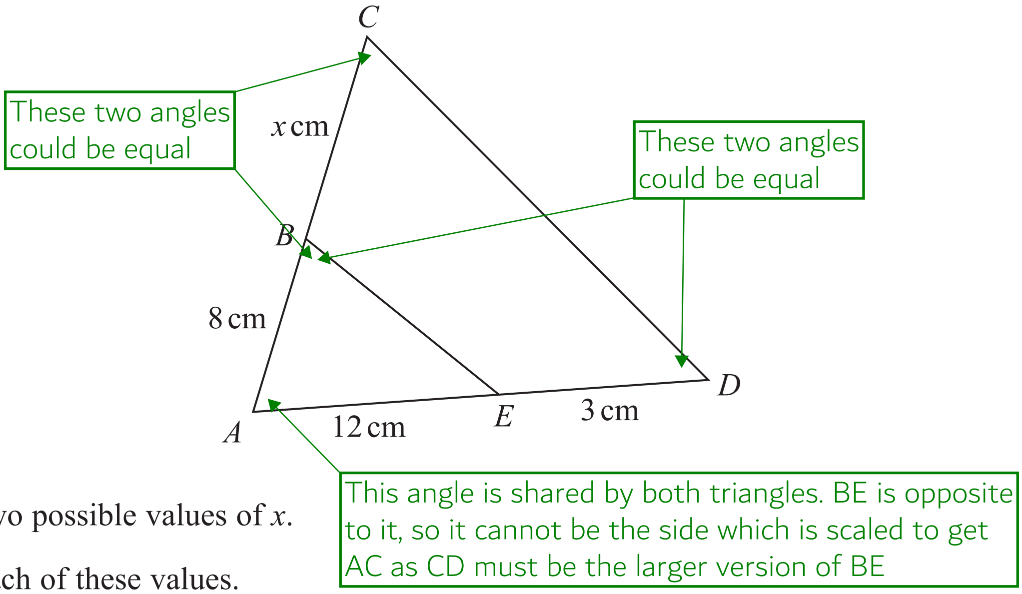
$\frac{6\sqrt{2} + 6 - 4 - 2\sqrt{2}}{2 + \sqrt{2} - \sqrt{2} - 1}$ ← Multiplying the numerators and multiplying the denominators in a similar way to expanding brackets. -2√2 × √2 = -2 × 2 = -4

$\frac{4\sqrt{2} + 2}{1}$ ← Collecting like terms

$2 + 4\sqrt{2}$ ← Dividing by 1 has no effect

(Total for Question 21 is 3 marks)

22 The two triangles in the diagram are similar.



There are two possible values of x.

Work out each of these values.
State any assumptions you make in your working.

Assuming AE is scaled to get AD and AB is scaled to get AC

As the triangles are similar, multiplying the sides of the smaller triangle by the scale factor will give the sides of the larger triangle. AE could be the smaller version of AD and AB could be the smaller version of AC

$\frac{15}{12} = \frac{5}{4}$ ← AD = 12 + 3 = 15 cm. Dividing AD by AE gives a possible scale factor. Simplifying the fraction

$8 \times \frac{5}{4}$ ← Multiplying AB by the scale factor works out that AC would be 10 cm

$x = 10 - 8$ ← Subtracting AB from AC works out x

$x = 2$ ← This is one of the possible values of x

Assuming AB is scaled to get AD and AE is scaled to get AC

As the triangles are similar, multiplying the sides of the smaller triangle by the scale factor will give the sides of the larger triangle. AB could be the smaller version of AD and AE could be the smaller version of AC

$12 \times \frac{15}{8}$ ← AD = 12 + 3 = 15 cm. Dividing AD by AB gives a possible scale factor. Multiplying AD by the scale factor works out what AC would be

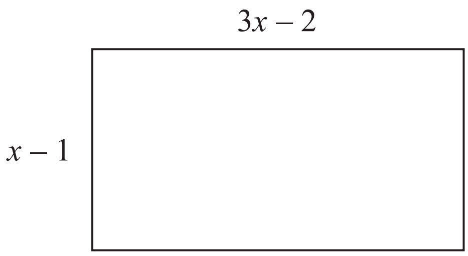
$3 \times \frac{15}{2}$ ← Simplifying the multiplication by dividing both the 12 and 8 by 4. This works out that AC would be 45/2 cm

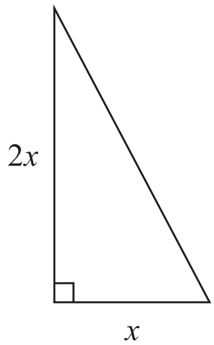
$x = \frac{45}{2} - \frac{16}{2}$ ← Subtracting AB from AC works out x. Expressing 8 as 16/2 so that the denominators are the same

$x = \frac{29}{2}$ ← This is one of the possible values of x

(Total for Question 22 is 5 marks)

23 Here is a rectangle and a right-angled triangle.





All measurements are in centimetres.
The area of the rectangle is greater than the area of the triangle.

Find the set of possible values of x.

$(3x - 2)(x - 1) > \frac{1}{2} \times x \times 2x$ ← Area of rectangle = length × width. Area of triangle = 1/2 × base × height. Setting the area of the rectangle greater than the area of the triangle

$3x^2 - 3x - 2x + 2 > x^2$ ← Expanding the brackets and simplifying the right side

$2x^2 - 5x + 2 > 0$ ← Subtracting x^2 from both sides and collecting like terms to put into the quadratic form

$(2x - 1)(x - 2) = 0$ ← Factorising the left side and setting equal to 0. The only way of getting $2x^2$ is if 2x is in one of the brackets and x is in the other. The only numbers which multiply to 2 are 1 and 2 and these must both be negative for it to also expand to give -5x. Putting -1 in the 1st bracket and -2 in the 2nd bracket would expand to give $2x^2 - 5x + 2$

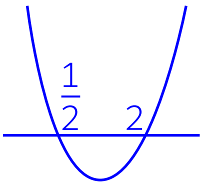
$2x - 1 = 0$ ← One of the two brackets must equal to 0

$2x = 1$ ← Adding 1 to both sides gets the x term on its own

$x = \frac{1}{2}$ ← Dividing both sides by 2 gets x on its own

$x - 2 = 0$ ← One of the two brackets must equal to 0

$x = 2$ ← Adding 2 to both sides gets x on its own



← Sketching a graph and indicating the x-intercepts. It is u-shaped as it is a positive x^2 graph

It has a value greater than 0 to the left of x = 1/2 and to the right of x = 2. x cannot be less than 1/2 as x - 1 would give a negative length and length must be positive. So x must be greater than 2

$x > 2$

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS