Write your name here

| Surname | Other names |
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**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/



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**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 indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

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

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

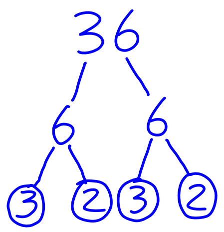
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

**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.




$2^2 \times 3^2$

**(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.

$$\underbrace{J}_{\text{Jay's age}}+\underbrace{J+7}_{\text{Kiaria is 7 years older than Jay}}+\underbrace{2(J+7)}_{\text{Martha is twice as old as Kiaria}}=\underbrace{77}_{\text{The sum of their three ages is 77}}$$

$4J+21=77$ ← Collected like terms and simplified

$J=\frac{77-21}{4}=14$ ← Rearranged to make J the subject

Jay is 14 so Kiaria must be 21 and Martha must be 42

14 : 21 : 42

**(Total for Question 2 is 4 marks)**

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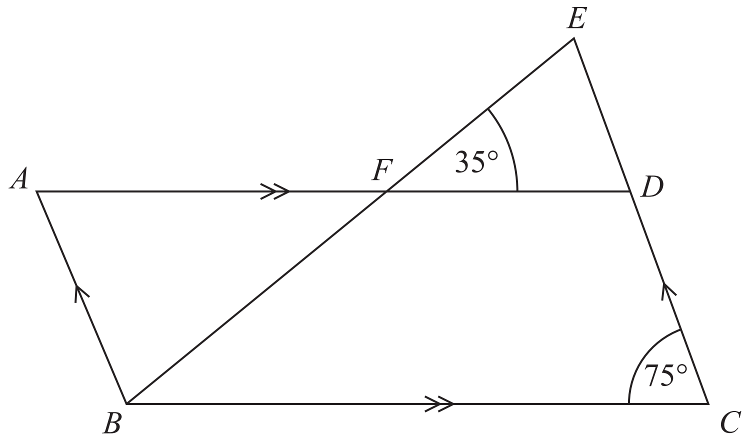
**3**




*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.

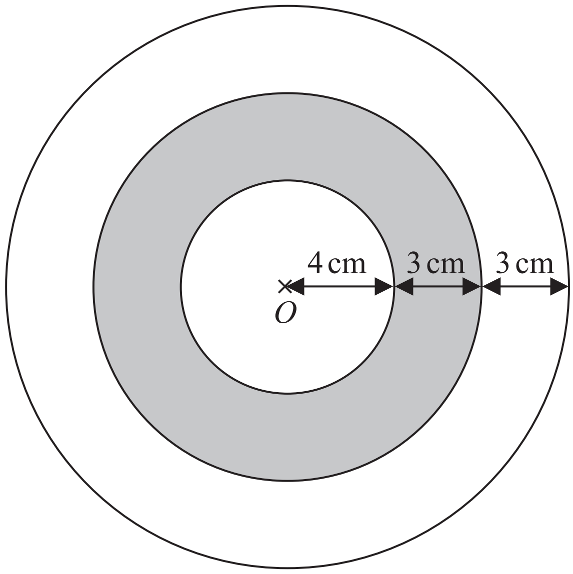
Angle BAF is 75° as opposite angles in a parallelogram are equal.

Angle BFA is 35° as vertically opposite angles are equal.

180 - 75 - 35 = 70
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.

$$\frac{\pi \times 7^2 - \pi \times 4^2}{\pi \times 10^2}$$

Expressing the shaded area as a fraction of the total area. Area of circle = π x radius$^2$

$$\frac{49\pi - 16\pi}{100\pi}$$

$$\frac{33\pi}{100\pi} = \frac{33}{100}$$

No

33/100 is not equal to 1/3

**(Total for Question 4 is 4 marks)**

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

| Weekly earnings (£$x$) | Frequency | Mid | Fx |
|---|---|---|---|
| $150 < x \leqslant 250$ | 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 |
| | | | 7,300 |

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

Working out the midpoint of each category then multiplying the midpoint by the frequency to get an estimated total for each category. Then adding up the totals to get an overall total

365

20 | 7 3 0 0

Mean = total/number

£ 365

**(3)**

Nadiya says,

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

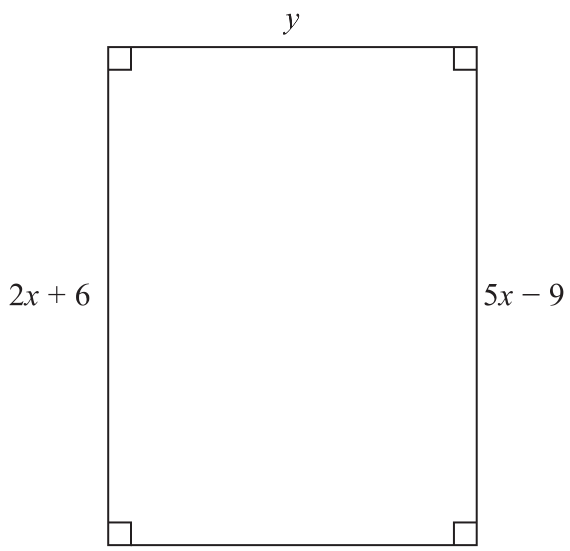
(b) Do you agree with Nadiya?
You must justify your answer.

Yes as the mean is effected by anomalies

**(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 cm$^2$.

Show that $y = 3$

$2x + 6 = 5x - 9$ — Opposite sides on a rectangle are equal

$15 = 3x$ — Subtract 2x from both sides to get all the x on one side then add 9 to both sides to get the x term on their own

$5 = x$ — Divide both sides by 3 to make x the subject

$2(5) + 6 = 16$ — Substituting x for 5 in an expression for the length of the rectangle to find the length

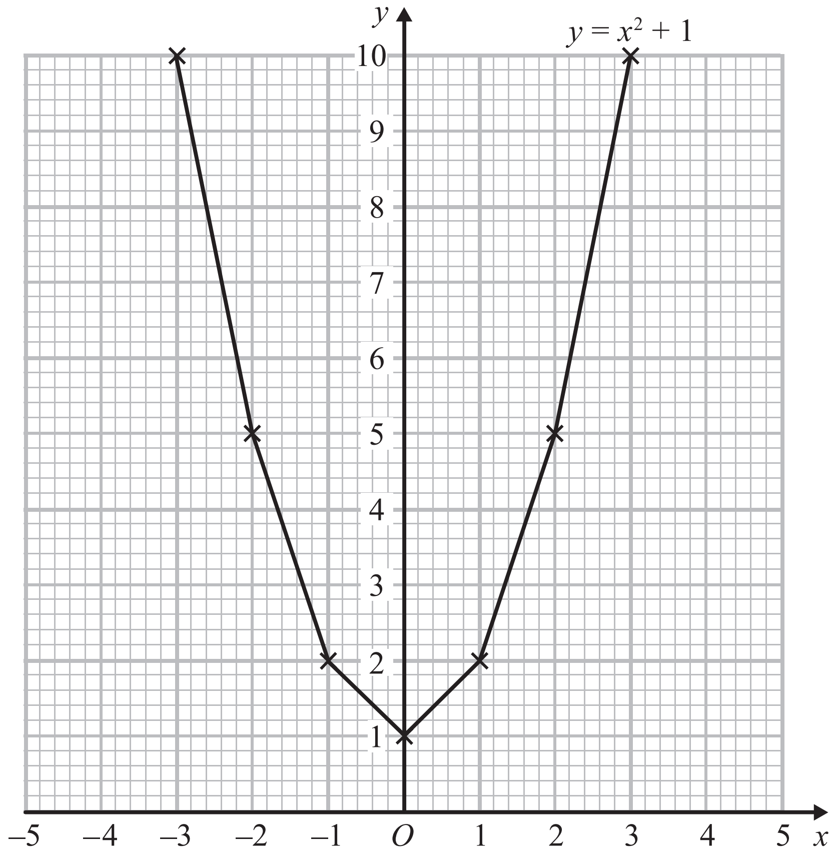
$16y = 48$ — Area of rectangle = length x width Length is 16cm and width is y

$y = 3$ — Dividing both sides by 16 to show that y is 3

**(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

**(Total for Question 7 is 1 mark)**

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

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

0.2464
0.2466
0.2462
0.246

Writing the numbers in a column to compare them. They all have 2 tenths, 4 hundredths and 6 thousandths but the ten-thousandths are all different. The number with the smallest number of ten-thousandths is the smallest

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

**(Total for Question 8 is 2 marks)**

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**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.

$$\frac{D}{S \mid T}$$

$$S_P = \frac{15}{T_P}$$
Peter's speed = 15km/(the time it takes Peter to do 15km)

$$T_P = \frac{15}{S_J} - \frac{5}{60}$$
$T_P$ stands for the time for Peter to do 15km. $S_J$ stands for James' speed. 5 minutes is converted into hours by dividing by 60

$$S_J = \frac{50}{2\frac{1}{2}} = 20$$
Speed = distance/time

$$T_P = \frac{15}{20} - \frac{5}{60} = \frac{2}{3}$$
Substituting James' speed back into the previous equation

$$S_P = \frac{15}{\left(\frac{2}{3}\right)}$$
Substituting the time it takes Peter to do 15km back into the previous equation

22.5 km/h

**(Total for Question 9 is 5 marks)**

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

Power of 1/2 means positive square root

10

**(1)**

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

$(\sqrt[3]{125})^2$

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.

$3t + 2c = 7.80$ ← First equation. 3 teas and 2 coffees have a total cost of £7.80

$5t + 4c = 14.20$ ← Second equation. 5 teas and 4 coffees have a total cost of £14.20

$6t + 4c = 15.60$ ← Third equation. Making the number of c the same as the second equation by multiplying the first equation by 2

$t = 1.40$ ← Subtracting the second equation from the third equation to eliminate the c terms. This finds the price of a tea

$3(1.40) + 2c = 7.80$ ← Substituting the t for 1.40 in the first equation

$c = \frac{7.80 - 3(1.40)}{2}$ ← Making c the subject by subtracting 3(1.40) then dividing by 2

tea £ 1.40

coffee £ 1.80

**(Total for Question 11 is 4 marks)**

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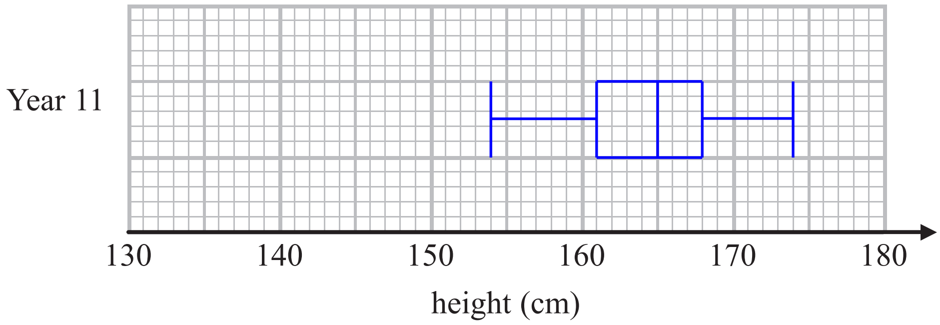
**12** The table shows information about the heights, in cm, of a group of Year 11 girls.

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

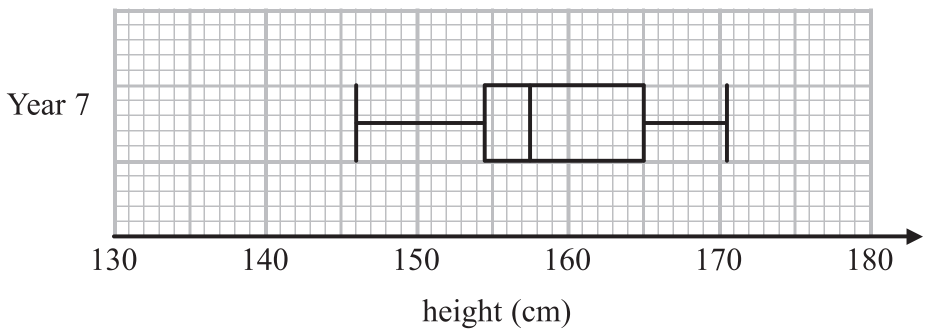
Upper quartile is 161 + 7 = 168.
Highest height is 154 + 20 = 174

(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

The median of Year 11 is 165 and for Year 7 it is 157.5.
The interquartile range is upper quartile subtract lower quartile. For Year 11 it is 7 and for Year 7 it is 10.5

**(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.

$\frac{4}{15} \times 450$

4 out the 15 pies in the sample are chicken so 4/15 of the pies made that day are 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. This can be converted into a conventional fraction by multiplying the numerator and denominator by 2 to eliminate the decimals

$\frac{11}{30}$

**(2)**

**(Total for Question 13 is 4 marks)**

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

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

$$\frac{y+x}{y-x} = k$$

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 be divided by the same amount. Both of the left sides of the ratios are equal to each other

$$y+x = k(y-x)$$

Multiply both sides by (y - x) to eliminate y being a denominator

$$= ky - kx$$

Expand out the brackets

$$x + kx = ky - y$$

Bring all the y terms to one side by subtracting y from both sides. Then move all the other terms to the other side by adding kx

$$y(k-1) = x(1+k)$$

Switch the equation around so that the x terms are now on the right and the y terms are on the left. Factorise both sides

$$y = \frac{x(k+1)}{k-1}$$

Divide 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 $\dfrac{24}{55}$

$$100x = 43.6\dot{3}\dot{6}$$

Multiply x by 100 so that the recurring part of the decimal is in the same decimal places as x

$$99x = 43.2$$

Subtracting x from 100x to get a terminating decimal

$$x = \frac{43.2}{99} = \frac{24}{55}$$

Dividing both sides by 99 to express x as a fraction. We know that the fraction simplifies to 24/55

**(Total for Question 15 is 3 marks)**





Turn over

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

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

Find the value of $y$ when $x = 64$

$y = k \times \sqrt[3]{x}$ ← The cube root of x can be multiplied by anything and still be directly proportional to y. Using this fact, we can make this equation

$k = \frac{1\frac{1}{6}}{\sqrt[3]{8}} = \frac{\left(\frac{7}{6}\right)}{2} = \frac{7}{12}$ ← Rearranging to make k the subject then substituting in the values of y and x

$y = \frac{7}{12} \times \sqrt[3]{64} = \frac{7}{12} \times 4$ ← Substituting k for 7/12 and x for 64 in the original equation

$\frac{7}{3}$ ..........................................

**(Total for Question 16 is 3 marks)**

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**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

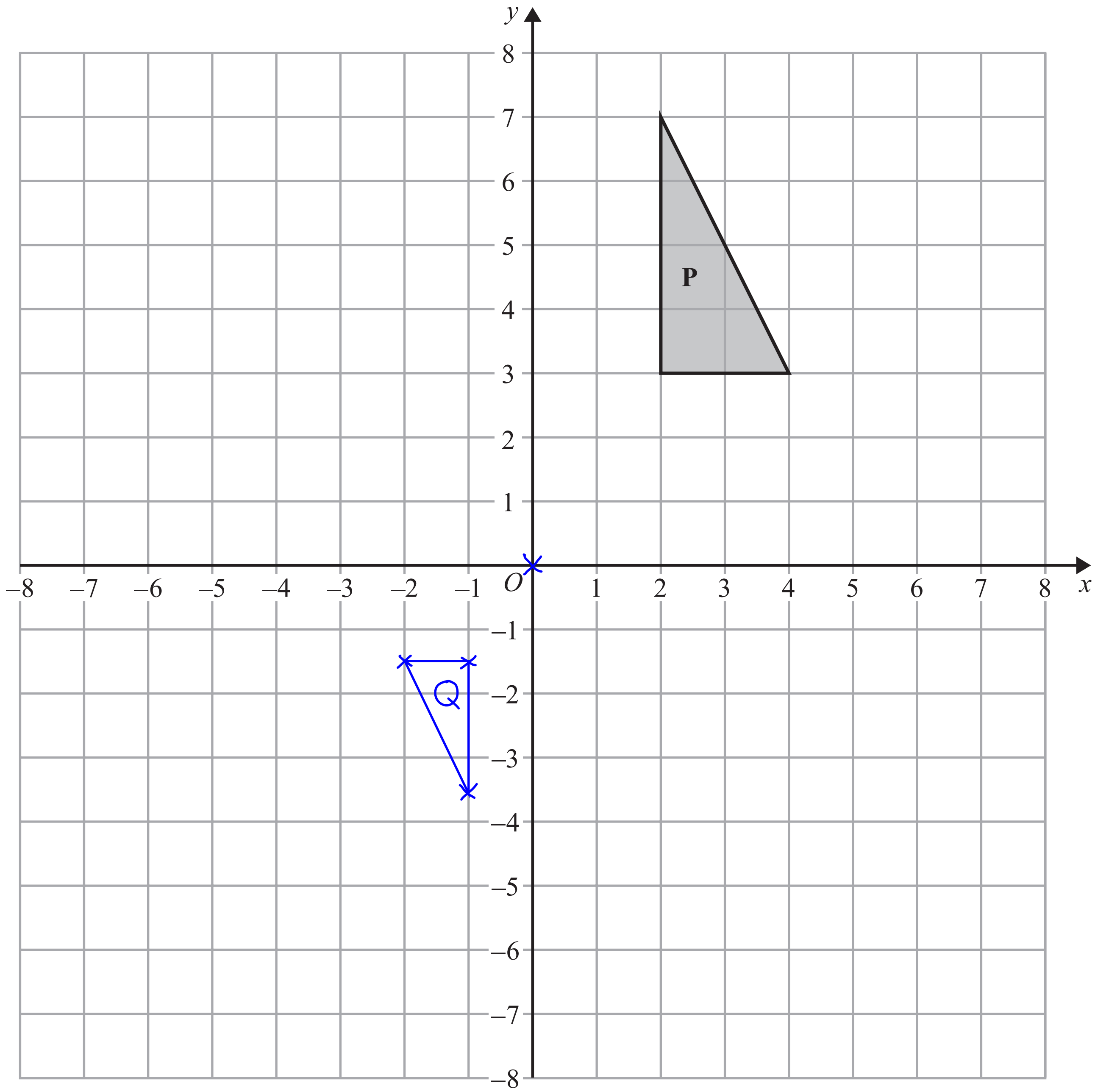
$\frac{1}{2}n^2 + \frac{1}{2}n + \frac{1}{2}n^2 + n + \frac{1}{2}n + 1$ ← Expanding the brackets

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

$(n+1)^2$ ← Factorising to express as something squared, therefore showing that it is a square number

**(Total for Question 17 is 2 marks)**

**18**

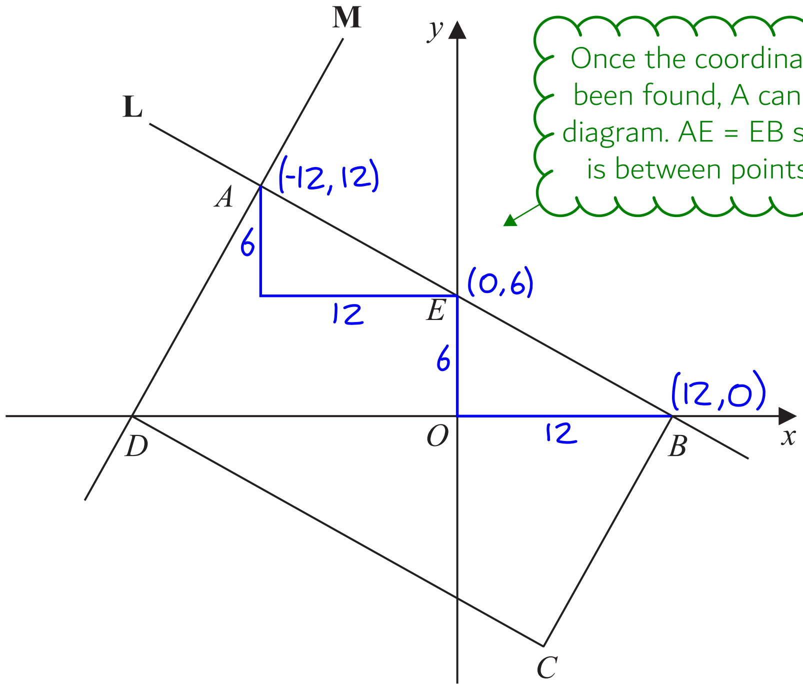



Enlarge shape **P** by scale factor $-\frac{1}{2}$ with centre of enlargement (0, 0).

Label your image **Q**.

**(Total for Question 18 is 2 marks)**

**19**




Once the coordinates of E and B have been found, A can be found using the diagram. AE = EB so the same distance is between points A and E, E and B.

*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**.

$x + 2(0) = 12$ , $x = 12$

At point B, y = 0. Substituting this into the equation gives that x = 12 at this point. Therefore the coordinates of B are (12 , 0)

$(0) + 2y = 12$ , $y = 6$

At point E, x = 0. Substituting this into the equation gives that y = 6 at this point. Therefore the coordinates of E are (0 , 6)

$\frac{-6}{12} = \frac{-1}{2}$

Gradient of L = change in y/change in x. Between E and B y has changed by -6 and x has changed by 12

$y = 2x + c$

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 of the gradient of L as they are perpendicular

$c = 12 - 2(-12) = 36$

Rearranging to find c and substituting in the values of x and y from the coordinates of A (which can be found using the diagram)

Substituting c back into the general equation

$y = 2x + 36$

**(Total for Question 19 is 4 marks)**

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**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 $x = 45$

$1 = a\cos 90 + b$

First substituting x for 90 as cos90 = 0 and this will eliminate the a so we can work out b

$b = 1$

$3 = a\cos 0 + 1$

cos0 = 1 so we get 3 = a + 1, which can be rearranged to find a

$a = 2$

$y = 2\cos 45 + 1$

Substituting in the values of a and b and x for 45 in the original equation

$= 2 \times \frac{\sqrt{2}}{2} + 1$

cos45 = (root 2)/2

$\sqrt{2}+1$

**(Total for Question 20 is 4 marks)**

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**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.

$\frac{6-\sqrt{8}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1}$

Rationalising the denominator to eliminate the surds from the denominator

$\frac{6\sqrt{2}+6-\sqrt{16}-\sqrt{8}}{2+\sqrt{2}-\sqrt{2}-1}$

Multiplying out the numerators and denominators in a similar way to expanding brackets

$\frac{6\sqrt{2}+6-4-2\sqrt{2}}{1}$

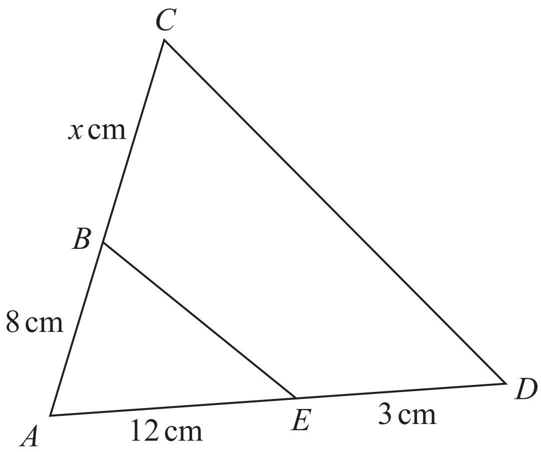
Square rooting 16 gives 4 and root 8 can be simplified by expressing is as root 4 x root 2 then root 4 is 2

$2+4\sqrt{2}$

Dividing by 1 has no effect so the denominator goes. Collecting like terms on the numerator

**(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

$12 \times r = 15$ r is the scale factor

$r = \frac{15}{12} = \frac{5}{4}$

$8 + x = 8 \times \frac{5}{4}$ These are two different ways of expressing side AC so they must be equal

$x = 10 - 8 = 2$

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

$8 \times q = 15$ q is the scale factor

$q = \frac{15}{8}$

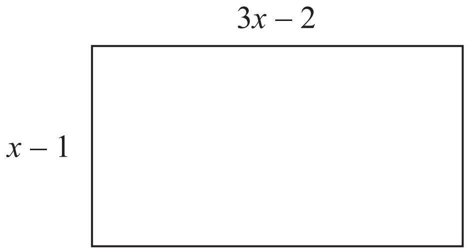
$8 + x = 12 \times \frac{15}{8}$ These are two different ways of expressing side AC so they must be equal

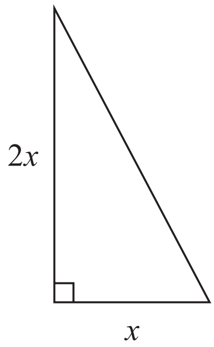
$x = 3 \times \frac{15}{2} - 8$

$= \frac{45}{2} - \frac{16}{2} = \frac{29}{2}$

**(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 x width
Area of triangle = 1/2 x base x height

$3x^2 - 3x - 2x + 2 > x^2$

Expanding the brackets and simplifying

$2x^2 - 5x + 2 > 0$

Bring all the terms to one side so it is in the quadratic form and can be solved with factorisation

$2x^2 - 4x - x + 2 > 0$

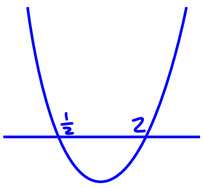
Multiply the coefficient of $x^2$ by the constant. 2 x 2 = 4. -4 and -1 add to get -5 (the coefficient of x) and multiply to get 4 so the middle term is split into these amounts of x

$2x(x-2) - 1(x-2) > 0$

The left two terms and right two terms are factorised separately

$(2x-1)(x-2) > 0$

Brought into the factorised form




The inequality is sketched. It is greater than 0 when x is less than 1/2 or x is greater than 2

x can't be less than 1/2 as x - 1 would be negative and this is one of the lengths

$x > 2$

**(Total for Question 23 is 5 marks)**

**TOTAL FOR PAPER IS 80 MARKS**