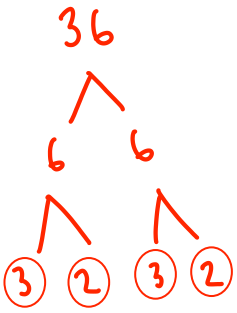
**1** Write 36 as a product of its prime factors.




$2^2 \times 3^2$

**(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.

J = $x$

K = $x + 7$

M = $2(x+7) = 2x + 14$

$x + x + 7 + 2x + 14 = 77$

$4x + 21 = 77$

$-21 \quad -21$

$4x = 56$

$\div 4 \quad \div 4$

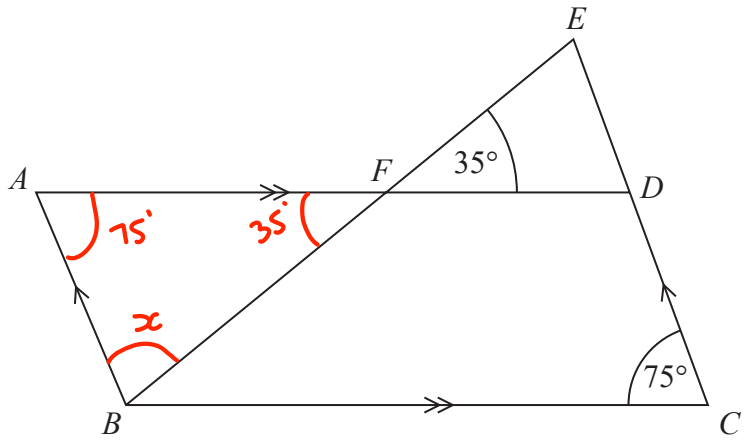
$x = 14$

$4 \overline{)56}$ = 14

14 : 21 : 42

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

**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.

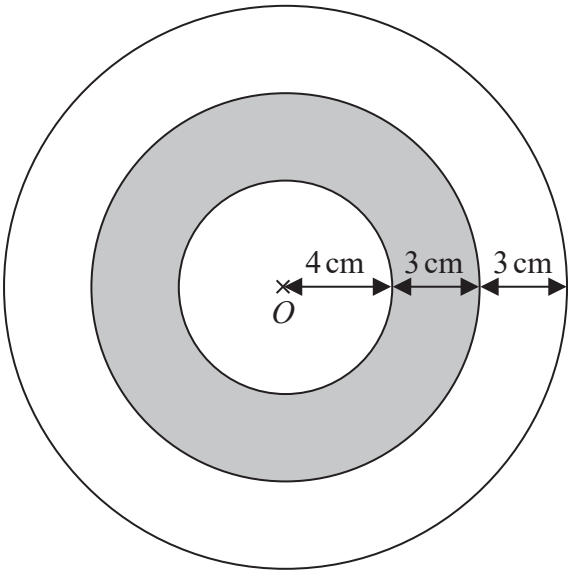
< AFB = 35° as vertically opposite angles are equal
< BAF = 75° as opposite angles in a parallelogram are equal

< ABF = 180 - 75 - 35 = 70° as angles in a triangle add to 180°

$$\begin{array}{r} 75 \\ +35 \\ \hline 110 \end{array} \qquad \begin{array}{r} 180 \\ -110 \\ \hline 70 \end{array}$$

**(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.

Total $= \pi \times 10^2 = 100\pi$

Shaded $= (\pi \times 7^2) - (\pi \times 4^2)$

$= 49\pi - 16\pi = 33\pi$

$\frac{33\pi}{100\pi} = \frac{33}{100} \neq \frac{1}{3}$

Daisy is wrong

**(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 |
|---|---|
| $150 < x \leqslant 250$ | 1 |
| $250 < x \leqslant 350$ | 11 |
| $350 < x \leqslant 450$ | 5 |
| $450 < x \leqslant 550$ | 0 |
| $550 < x \leqslant 650$ | 3 |

200 300 400 500 600 — 20

200 × 1 = 200
300 × 11 = 3300
400 × 5 = 2000
500 × 0 = 0
600 × 3 = 1800
7300

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

7300 ÷ 20 = 365

0365
20 | 7300

£ 365

**(3)**

Nadiya says,

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

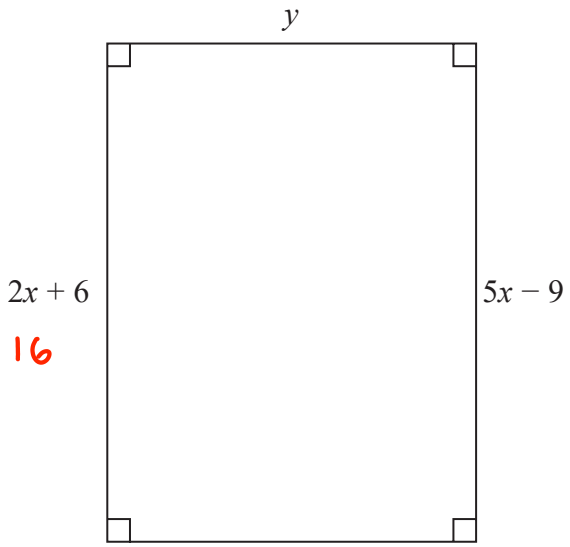
(b) Do you agree with Nadiya?
You must justify your answer.

Yes, the mean is affected by outliers. May be better to use the median or mode

**(1)**

**(Total for Question 5 is 4 marks)**

**6** Here is a rectangle.




16

All measurements are in centimetres.

The area of the rectangle is 48 cm$^2$.

Show that $y = 3$

$2x + 6 = 5x - 9$

$-2x \quad\quad -2x$

$6 = 3x - 9$

$+9 \quad\quad +9$

$15 = 3x$

$\div 3 \quad\quad \div 3$

$x = 5$

$2(5) + 6$

$= 10 + 6$

$= 16$

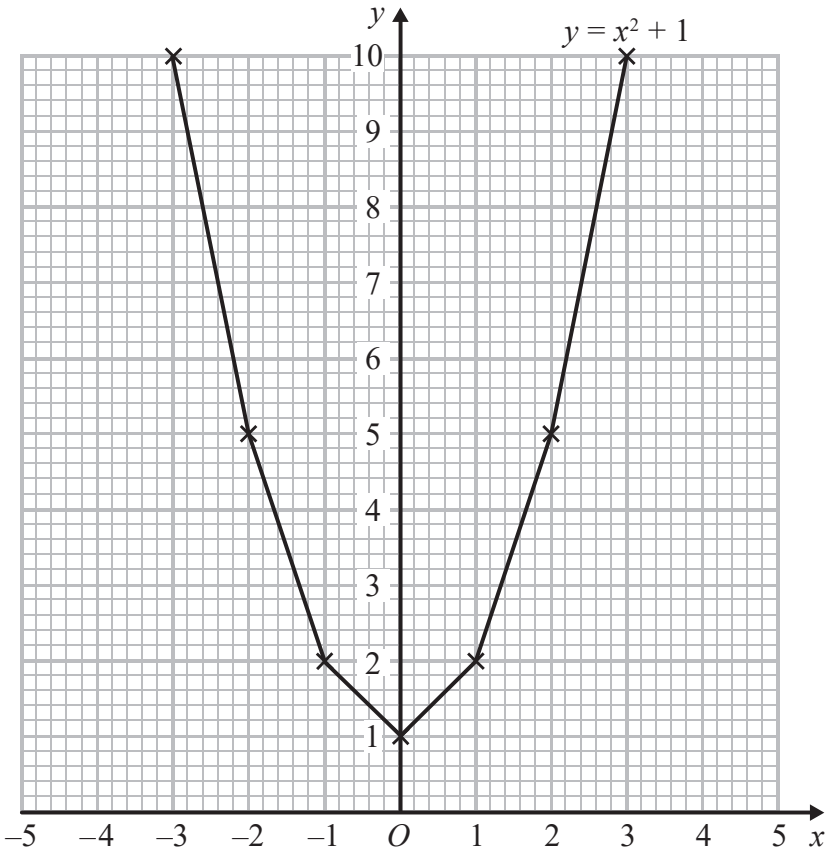
$16 \times y = 48$

$\therefore y = 3$

**(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.

The curve should have been drawm without a ruler

.....

.....

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

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

| $0.2\dot{4}\dot{6}$ | $0.24\dot{6}$ | $0.\dot{2}4\dot{6}$ | $0.246$ |
|---|---|---|---|
| 0.246464 | 0.246666 | 0.246246 | 0.246000 |

$0.246,\ 0.\dot{2}4\dot{6},\ 0.2\dot{4}\dot{6},\ 0.\dot{2}46$

**(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.


James
S = 20 kmh
D = 50 km
T = 2.5 hours

$S = \frac{50}{2.5} = \frac{500}{25} = 20$

$25 \overline{)500}$ 020

S = 20 km/h
D = 15 km
T =

$T = \frac{D}{S} = \frac{15}{20} = \frac{3}{4}$

= 45 mins

Peter
S =
D = 15 km
T = 40 mins = $\frac{2}{3}$ hour

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

$\frac{15}{1} \div \frac{2}{3} = \frac{15}{1} \times \frac{3}{2}$

$= \frac{45}{2}$

22.5 ..... km/h

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

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

$\sqrt{100} = 10$

10

**(1)**

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

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

$= 5^2 = 25$

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.

×2 ×2 ×2

$3t + 2c = 7.80$

$5t + 4c = 14.20$

$6t + 4c = 15.60$

$-\ 5t + 4c = 14.20$

$t = 1.40$

$3t + 2c = 7.80$

$3(1.40) + 2c = 7.80$

$4.20 + 2c = 7.80$

$-4.20 \quad -4.20$

$2c = 3.60$

$c = 1.80$

tea £ 1.40

coffee £ 1.80

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

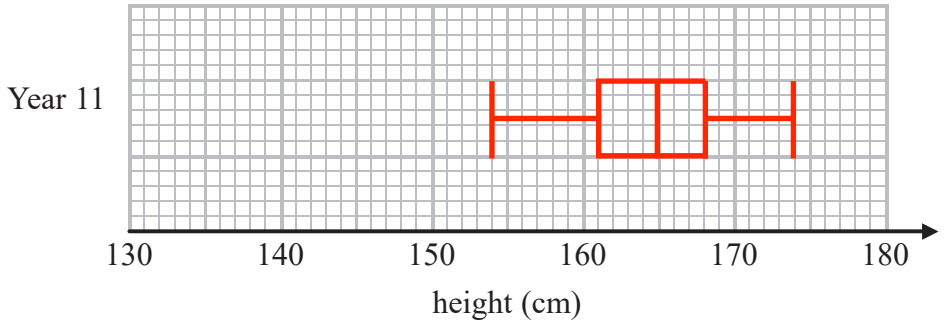
**12** The table shows information about the heights, in cm, of a group of Year 11 girls.

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

UQ = 161 + 7 = 168

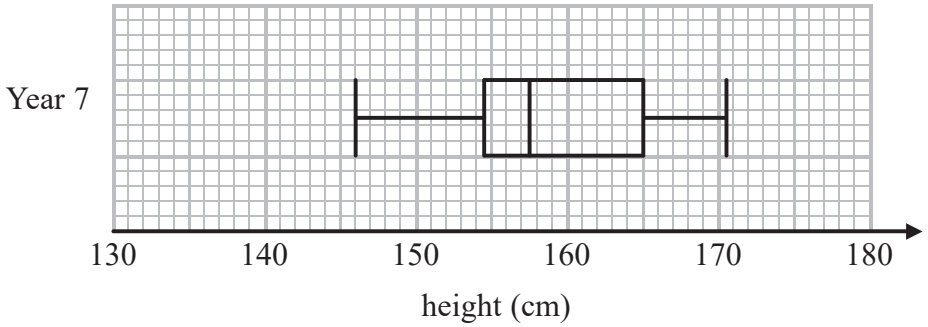
greatest = 154 + 20 = 174

(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 is higher for year 11, suggesting they are taller.

The IQR is larger for year 7, suggesting their heights vary more.

**(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.

$\frac{4}{15} = \frac{x}{450}$ ×30

030
15|4⁴50

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.

$\frac{5.5}{15} = \frac{x}{450}$ ×30

$\frac{165}{450}$

**(2)**

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

55
× 30
00
1650

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

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

Tip: You can write ratios as fractions!

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

When you have two fractions equal to eachother, you can cross multiply to solve!

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

$$\begin{array}{rcl} y+x & = & ky-kx \\ -y & & -y \\ x & = & ky-kx-y \\ +kx & & +kx \\ x+kx & = & ky-y \end{array}$$

$$\begin{array}{rcl} \dfrac{x+kx}{k-1} & = & \dfrac{y(k-1)}{k-1} \\ \dfrac{kx+x}{k-1} & = & y \\ \dfrac{x(k+1)}{k-1} & = & y \end{array}$$

**(Total for Question 14 is 3 marks)**

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

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

$100x = 43.6\dot{4}\dot{3}\dot{6}\ldots$

$-\quad x = 0.4\dot{3}\dot{6}\ldots$

$99x = 43.2$

$x = \frac{43.2}{99} = \frac{432}{990} = \frac{48}{110} = \frac{24}{55}$

$\div 9$ $\div 2$

$9\overline{)432}$ $= 48$

**(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 $x = 64$

$y \propto \sqrt[3]{x}$

$y = k\sqrt[3]{x}$

$1\frac{1}{6} = k\sqrt[3]{8}$

$\frac{7}{6} = k \times 2$

$\div 2 \quad \div 2$

$\frac{7}{12} = k$

$y = \frac{7}{12}\sqrt[3]{x}$

$y = \frac{7}{12}\sqrt[3]{64}$

$= \frac{7}{12} \times \frac{4}{1}$

$= \frac{28}{12}$

$\frac{28}{12}$

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

$\frac{7}{6} \div \frac{2}{1} = \frac{7}{6} \times \frac{1}{2} = \frac{7}{12}$

**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.

$\frac{1}{2}n(n+1) + \frac{1}{2}(n^2+3n+2)$

$= \frac{1}{2}n^2 + \frac{1}{2}n + \frac{1}{2}n^2 + \frac{3}{2}n + 1$

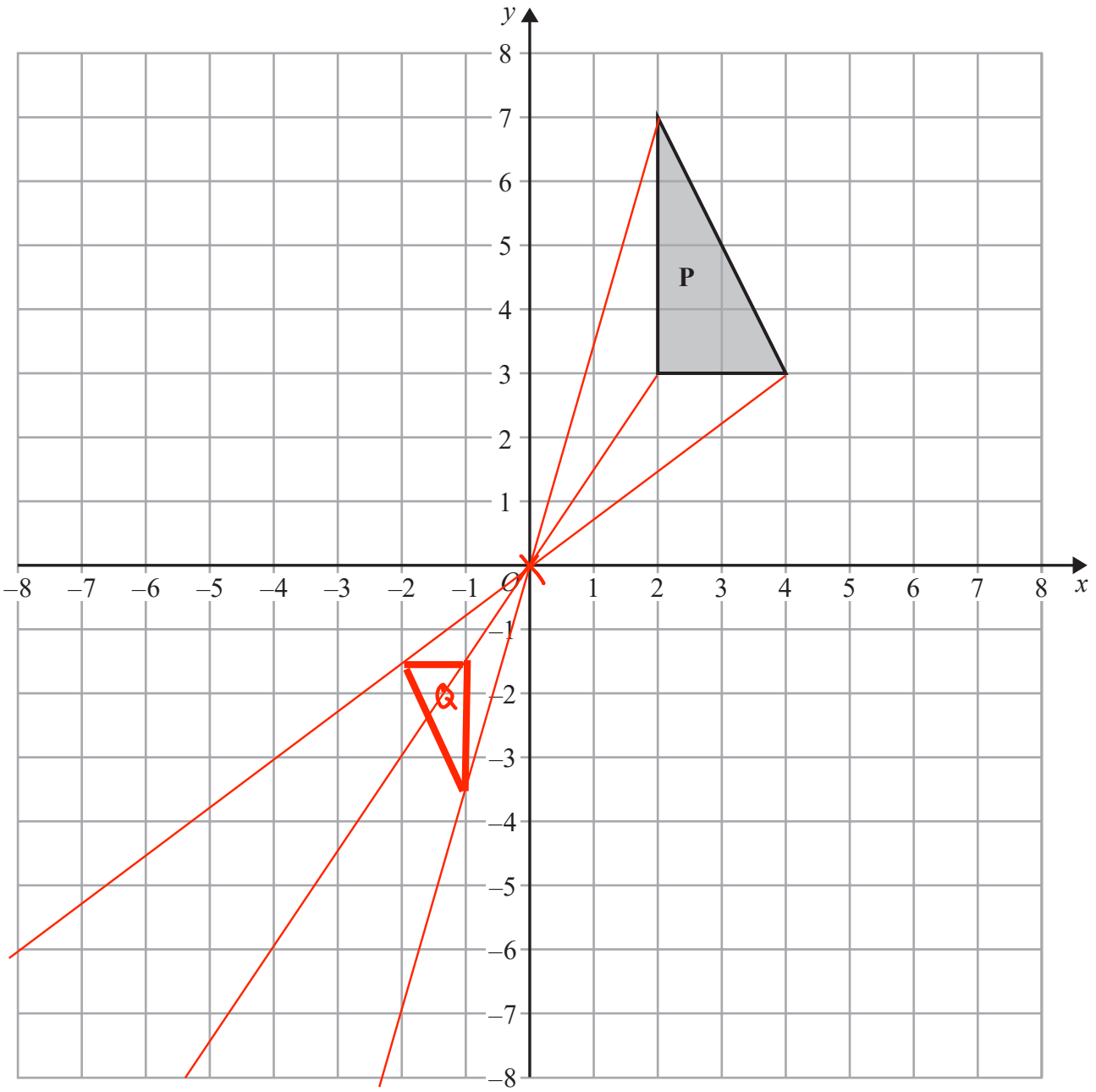
$= n^2 + 2n + 1$

$= (n+1)(n+1) = (n+1)^2$

$\therefore$ the sum will be a square number for all values of n

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

**18**

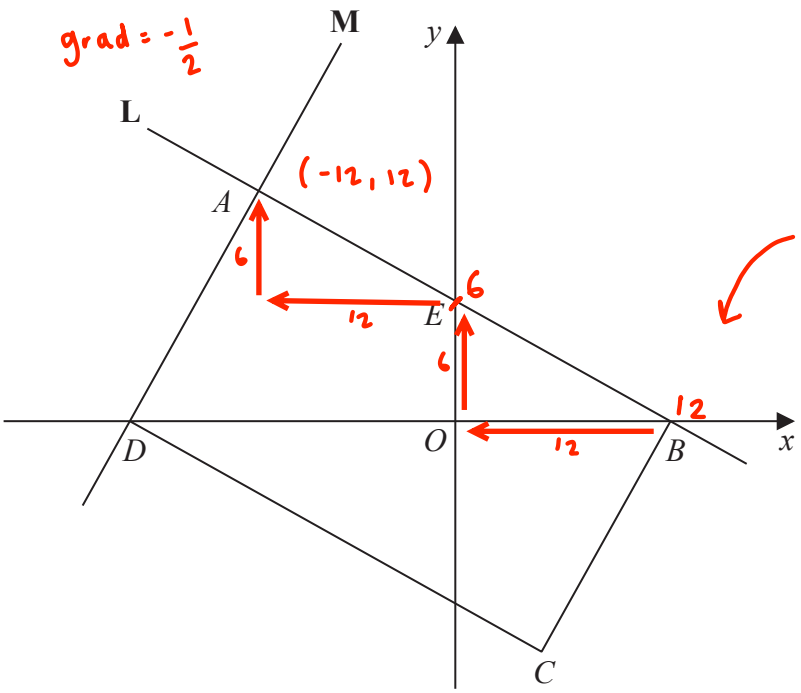



Enlarge shape **P** by scale factor $-\frac{1}{2}$ with centre of enlargement (0, 0).
Label your image **Q**.

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

**19**

Grad = 2




$y = -\frac{1}{2}x + 6$

$0 = -\frac{1}{2}x + 6$

$\frac{1}{2}x = 6$

$x = 12$

*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**.

$2y = -x + 12$

$y = -\frac{1}{2}x + 6$

Gradient $= -\frac{1}{2}$

*AE* = *EB*

Find an equation for **M**.

Line L : Gradient = 2

$y = 2x + c$

passing through (-12, 12)

$12 = 2(-12) + c$

$12 = -24 + c$

$+24 \quad +24$

$36 = c$

$y = 2x + 36$

$y = 2x + 36$

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

**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 $x = 45$

$y = \cos x$

| $x$ | 0 | 30 | 45 | 60 | 90 |
|---|---|---|---|---|---|
| $y$ | 1 | $\frac{\sqrt{3}}{2}$ | $\frac{\sqrt{2}}{2}$ | $\frac{1}{2}$ | 0 |

$1 = a\cos(90) + b$

$1 = 0 + b \quad \therefore b = 1$

$3 = a\cos(0) + b$

$3 = a + b$

$3 = a + 1$

$2 = a$

$y = 2\cos x + 1$

when $x = 45$

$y = 2\cos(45) + 1$

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

$= \sqrt{2} + 1$

$\sqrt{2} + 1$

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

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

$\sqrt{8} = \sqrt{4} \times \sqrt{2} = 2\sqrt{2}$

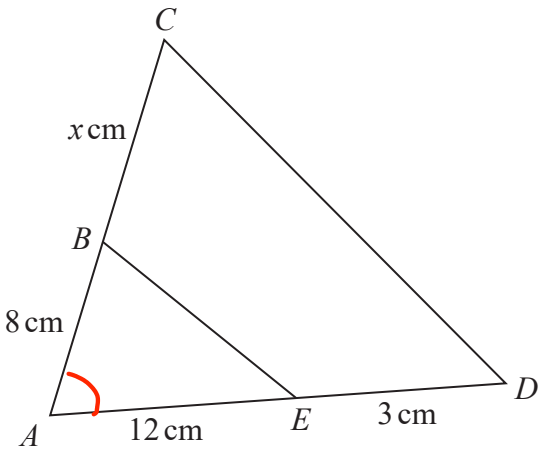
$$\frac{6-2\sqrt{2}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} = \frac{6\sqrt{2}+6-2(2)-2\sqrt{2}}{2+\sqrt{2}-\sqrt{2}-1}$$

$$= 4\sqrt{2} + 2$$

OR $2 + 4\sqrt{2}$

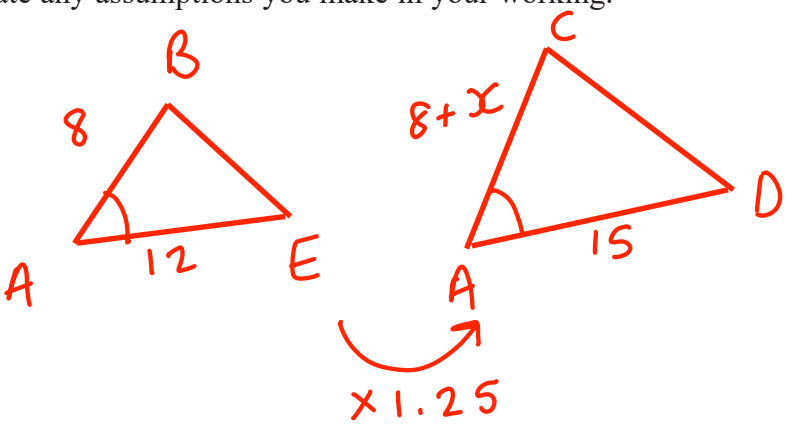
**(Total for Question 21 is 3 marks)**

**22** The two triangles in the diagram are similar.




There are two possible values of $x$.

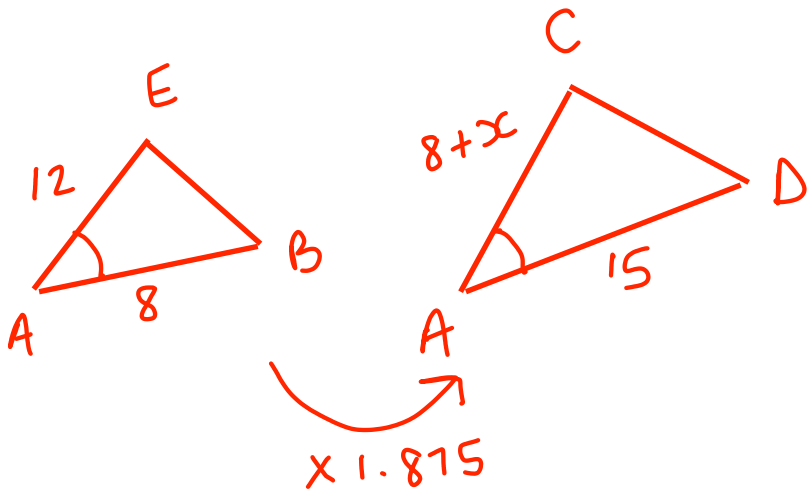
Work out each of these values.
State any assumptions you make in your working.




$8 \times 1.25 = 8 + x$
$10 = 8 + x$
$2 = x$

(AB x SF = AC)

OR



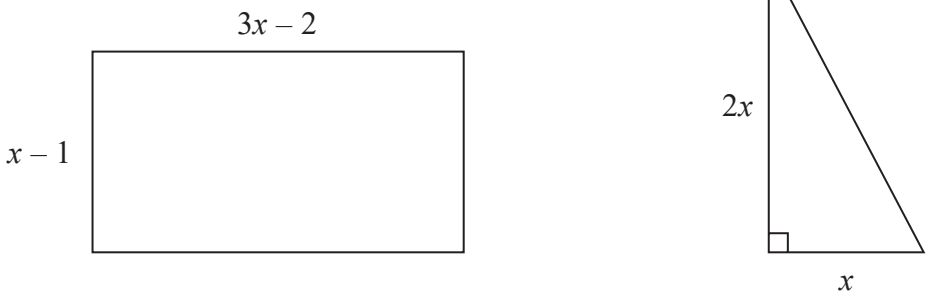

$12 \times 1.875 = 8 + x$
$22.5 = 8 + x$
$14.5 = x$

(AE x SF = AC)

$x = 2$ or $14.5$

**(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 $x$.

$(3x - 2)(x-1) > \frac{1}{2} \times x \times 2x$

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

$3x^2 - 5x + 2 > x^2$

$-x^2 \quad -x^2$

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

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

$+-5 \quad \times 4$

$2x^2 - 5x + 2$

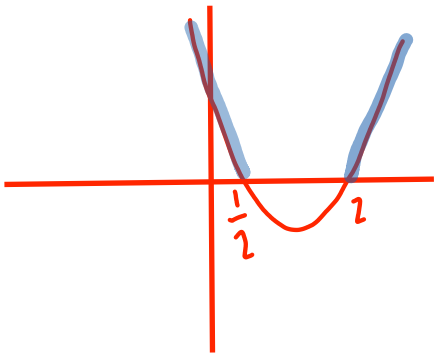
$-4, -1$

$2x^2 - 4x - x + 2$

$2x(x-2) - 1(x-2)$

$(2x-1)(x-2)$

$x = \frac{1}{2}$ or $2$




$x < \frac{1}{2}, \quad x > 2$

If $x < \frac{1}{2}$ $(x-1)$ is negative

$x > 2$

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

**TOTAL FOR PAPER IS 80 MARKS**