Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

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

Centre Number | Candidate Number

# Tuesday 6 November 2018

Morning (Time: 1 hour 30 minutes) | Paper Reference **1MA1/1H**

# Mathematics

## Paper 1 (Non-Calculator)
## Higher Tier

**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* ▶



6/7/7/7/7/7/1/C2/



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 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

**.CG Maths.**

**Answer ALL questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

**1** Work out the value of $\frac{3^7 \times 3^{-2}}{3^3}$ $= \frac{3^5}{3^3} = 3^2$

$a^x \times a^y = a^{x+y}$
$a^x \div a^y = a^{x-y}$
First add the indices
7 + -2 = 5
Next subtract the indices
5 - 3 = 2
$3^2$ = 3 x 3 = 9

9

**(Total for Question 1 is 2 marks)**

---

**2** $v^2 = u^2 + 2as$

$u = 12 \quad a = -3 \quad s = 18$

$144 - 108 = 36 \qquad 18 \times 6 = 108$

(a) Work out a value of $v$.

$v = \sqrt{12^2 + 2 \times (-3) \times 18}$

$= \sqrt{144 - 108}$

$= \sqrt{36}$

Square rooting both sides makes v the subject. Substitute in the values for u, a and s. Follow BIDMAS when evaluating the value

6 or -6

**(2)**

(b) Make $s$ the subject of $v^2 = u^2 + 2as$

$v^2 - u^2 = 2as$

s wants to stay where it is. Everything else needs to go. Follow BIDMAS backward to decide what to eliminate first

$s = \frac{v^2 - u^2}{2a}$

**(2)**

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

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**3** A bonus of £2100 is shared by 10 people who work for a company.
40% of the bonus is shared equally between 3 managers.
The rest of the bonus is shared equally between 7 salesmen.

One of the salesmen says,

"If the bonus is shared equally between all 10 people I will get 25% more money."

Is the salesman correct?
You must show how you get your answer.

10% is £210

Divide £2100 by 10 (remove a 0) to work out 10% of the bonus

$$\begin{array}{r} 210 \\ \times \quad 6 \\ \hline 1260 \end{array}$$

60% is £1260

If 40% goes to the managers, 60% goes to the salesmen. 60% is 6 x 10%

$$\begin{array}{r|l} & 1\,8\,0 \\ \hline 7 & 1\,2\,{}^{5}6\,0 \end{array}$$

Each salesman gets £180

$2100 \div 10 = 210$

Each salesman would get £210 if it was shared equally by all 10. Remove a 0 to divide by 10

$$\begin{array}{r|l} & 4\,5 \\ \hline 4 & 1\,8\,{}^{2}0 \end{array}$$

25% is 1/4 so dividing £180 by 4 works out 25% of £180

$$\begin{array}{r} 180 \\ +\ 45 \\ \hline 225 \end{array}$$

Adding the 25% to £180 works out how much 25% more than £180 is

NO

£225 is 25% more and this isn't equal to the £210 they would get

**(Total for Question 3 is 5 marks)**

**4** It would take 120 minutes to fill a swimming pool using water from 5 taps.

(a) How many minutes will it take to fill the pool if only 3 of the taps are used?

$$\begin{array}{r} 120 \\ \times \quad 5 \\ \hline 600 \end{array}$$

This works out the total amount of minutes of work have been done by all 5 taps

$$3 \overline{)600} = 200$$

Then share the total amount of work by the 3 taps

200 minutes

**(2)**

(b) State one assumption you made in working out your answer to part (a).

Each of the taps work at the same rate

If they didn't, it would be impossible to calculate the previous question

**(1)**

**(Total for Question 4 is 3 marks)**

**5** A plane travels at a speed of 213 miles per hour.

(a) Work out an estimate for the number of seconds the plane takes to travel 1 mile.

$$\frac{d}{s \mid t} \qquad t = \frac{d}{s}$$

Using the formula triangle (cover what you are trying to find), time = distance/speed

$$\frac{1}{200} \times 60 \times 60$$

Divide the distance of 1 mile by 200 (the speed is roughly 200 miles per hour). Convert into minutes by multiplying by 60 then multiply by 60 again to convert into seconds

$$\frac{3600}{200} = \frac{36}{2}$$

6 x 6 = 36 so 60 x 60 = 3600
Simplify the fraction

$$2 \overline{)3{}^{1}6} = 18$$

18 seconds

**(3)**

(b) Is your answer to part (a) an underestimate or an overestimate?
Give a reason for your answer.

Overestimate as we rounded down the speed

Dividing by less gives a larger answer

**(1)**

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

**6** Solve the simultaneous equations

$$5x + y = 21$$
$$x - 3y = 9$$

$5x - 15y = 45$

Multiply the second equation by 5 to get the same number of x as the top equation

$16y = -24$

Subtract the new equation from the top equation to eliminate the x terms

$y = \frac{-24 \div 8}{16 \div 8} = \frac{-3}{2}$

$x - 3\left(\frac{-3}{2}\right) = 9$

$x + \frac{9}{2} = 9$

$x = \frac{18}{2} - \frac{9}{2} = \frac{9}{2}$

Substitute the value of y into the second equation and rearrange to find x

$x =$ $\frac{9}{2}$

$y =$ $\frac{-3}{2}$

**(Total for Question 6 is 3 marks)**

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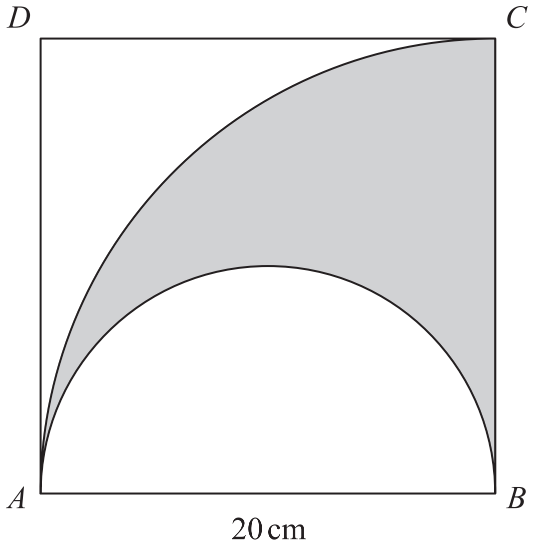
.CG Maths.

**7** The diagram shows a square *ABCD* with sides of length 20 cm.
It also shows a semicircle and an arc of a circle.




*AB* is the diameter of the semicircle.
*AC* is an arc of a circle with centre *B*.

Show that $\dfrac{\text{area of shaded region}}{\text{area of square}} = \dfrac{\pi}{8}$

$\pi r^2$ = area of a circle

Area of the quarter circle ABC

Area of the semicircle. Subtracting this from the area of the quarter circle gives the area of the shaded region

$$\frac{\boxed{\frac{1}{4}\pi \times 20^2} - \boxed{\frac{1}{2}\pi \times 10^2}}{\boxed{20^2}}$$

Length squared gives the area of the square

$$\frac{50\pi}{400}$$

$20^2 = 20 \times 20 = 400$
$1/4 \times 400 = 100$
So the area of the quarter circle is $100\pi$.
$10^2 = 10 \times 10 = 100$
$1/2 \times 100 = 50$
So the area of the semicircle is $50\pi$.
Subtracting these gives the area of the shaded region which is $50\pi$.
The area of the square is 400

The fraction simplifies by dividing the numerator and denominator by 50

$$\frac{\pi}{8}$$

**(Total for Question 7 is 4 marks)**

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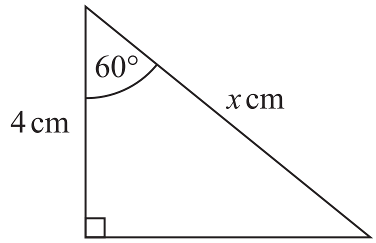
**8** (a) Write down the exact value of tan 45°

The trig values of 0, 30, 45, 60 and 90 need to be remembered. Sin(45)/cos(45) = tan(45)

1

**(1)**

Here is a right-angled triangle.




cos 60° = 0.5

(b) Work out the value of $x$.

SOH CAH TOA

$\frac{A}{C \mid H}$

$x = \frac{4 \times 10}{0.5 \times 10} = \frac{40}{5}$

We have the adjacent and hypotenuse so we tick A and H. 2 ticks on CAH tells us we can use this formula triangle. Covering what we are trying to find (H for hypotenuse) tells us that it is equal to adjacent/cos of the angle

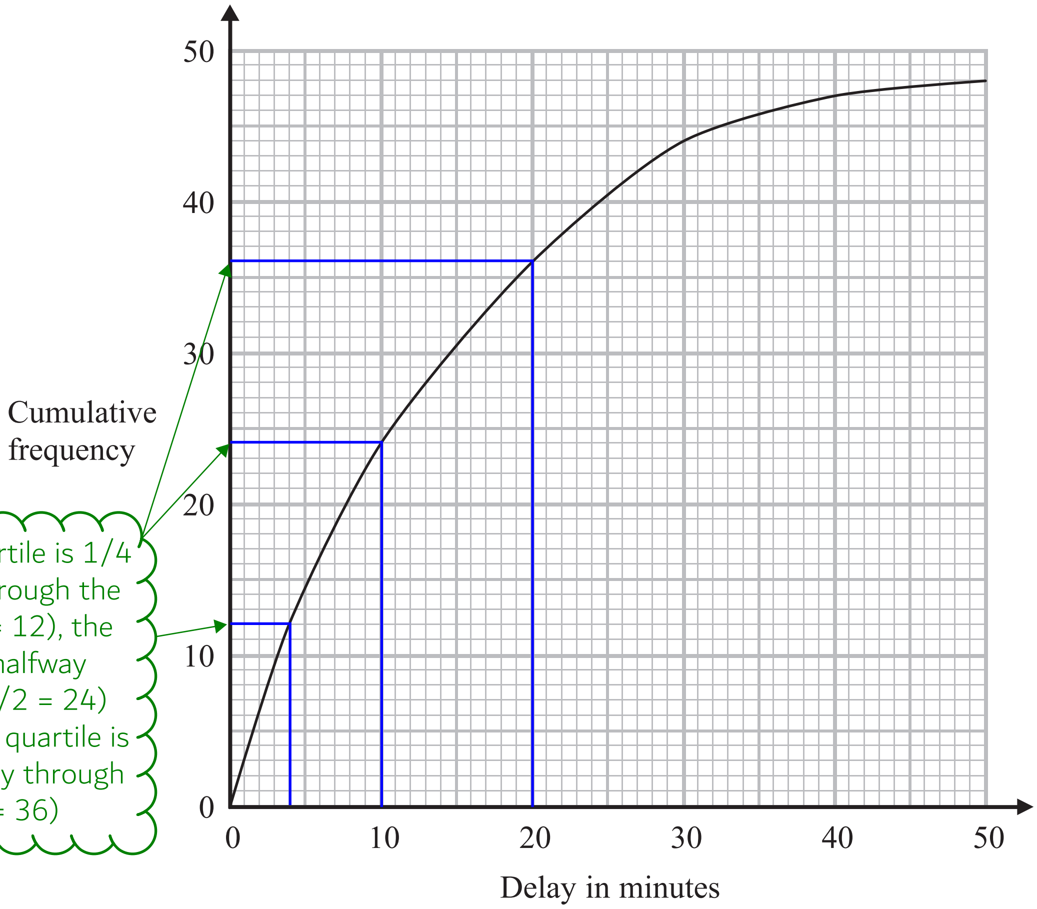
8

**(2)**

**(Total for Question 8 is 3 marks)**

**9** The times that 48 trains left a station on Monday were recorded.

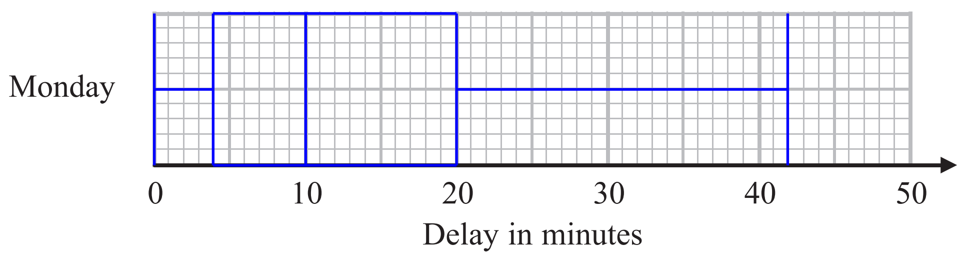
The cumulative frequency graph gives information about the numbers of minutes the trains were delayed, correct to the nearest minute.




The lower quartile is 1/4 of the way through the data (48/4 = 12), the median is halfway through (48/2 = 24) and the upper quartile is 3/4 of the way through (3 x 12 = 36)

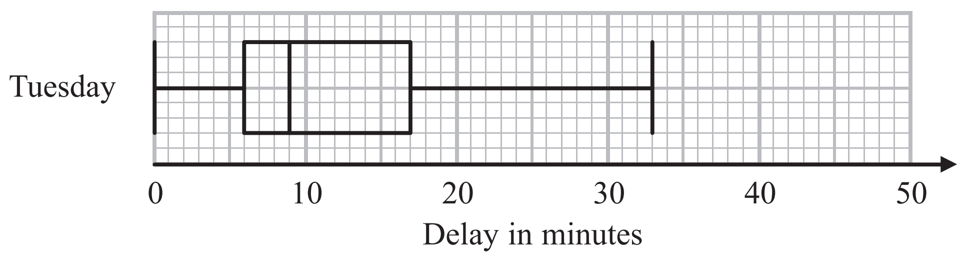
The shortest delay was 0 minutes.
The longest delay was 42 minutes.

(a) On the grid below, draw a box plot for the information about the delays on Monday.




**(3)**

48 trains left the station on Tuesday.
The box plot below gives information about the delays on Tuesday.



(b) Compare the distribution of the delays on Monday with the distribution of the delays on Tuesday.

On average the trains were later on Monday and the trains were less consistent on Monday

Later on average as the median was higher and less consistent as the range and interquartile range was greater

**(2)**

Mary says,

"The longest delay on Tuesday was 33 minutes.
This means that there must be some delays of between 25 minutes and 30 minutes."

(c) Is Mary right?
You must give a reason for your answer.

No, as the next longest delay could be less than 25 minutes.

As the upper quartile is 17 it could be anything above this

**(1)**

**(Total for Question 9 is 6 marks)**

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**10** (a) Simplify $\dfrac{x-1}{5(x-1)^2}$

The x - 1 on the numerator cancels out with one of the x - 1 on the denominator

$\dfrac{1}{5(x-1)}$

**(1)**

(b) Factorise fully $50 - 2y^2$

$2(25-y^2)$

Bring out 2 as a common factor then factorise further by using the difference of two squares

$2(5+y)(5-y)$

**(2)**

**(Total for Question 10 is 3 marks)**

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**11** Jack and Sadia work for a company that sells boxes of breakfast cereal.

The company wants to have a special offer.

Here is Jack's idea for the special offer.

| |
|---|
| Put 25% more cereal into each box and do **not** change the price. |

Here is Sadia's idea.

| |
|---|
| Reduce the price and do **not** change the amount of cereal in each box. |

Sadia wants her idea to give the same value for money as Jack's idea.

By what percentage does she need to reduce the price?

$x = 1.25y$

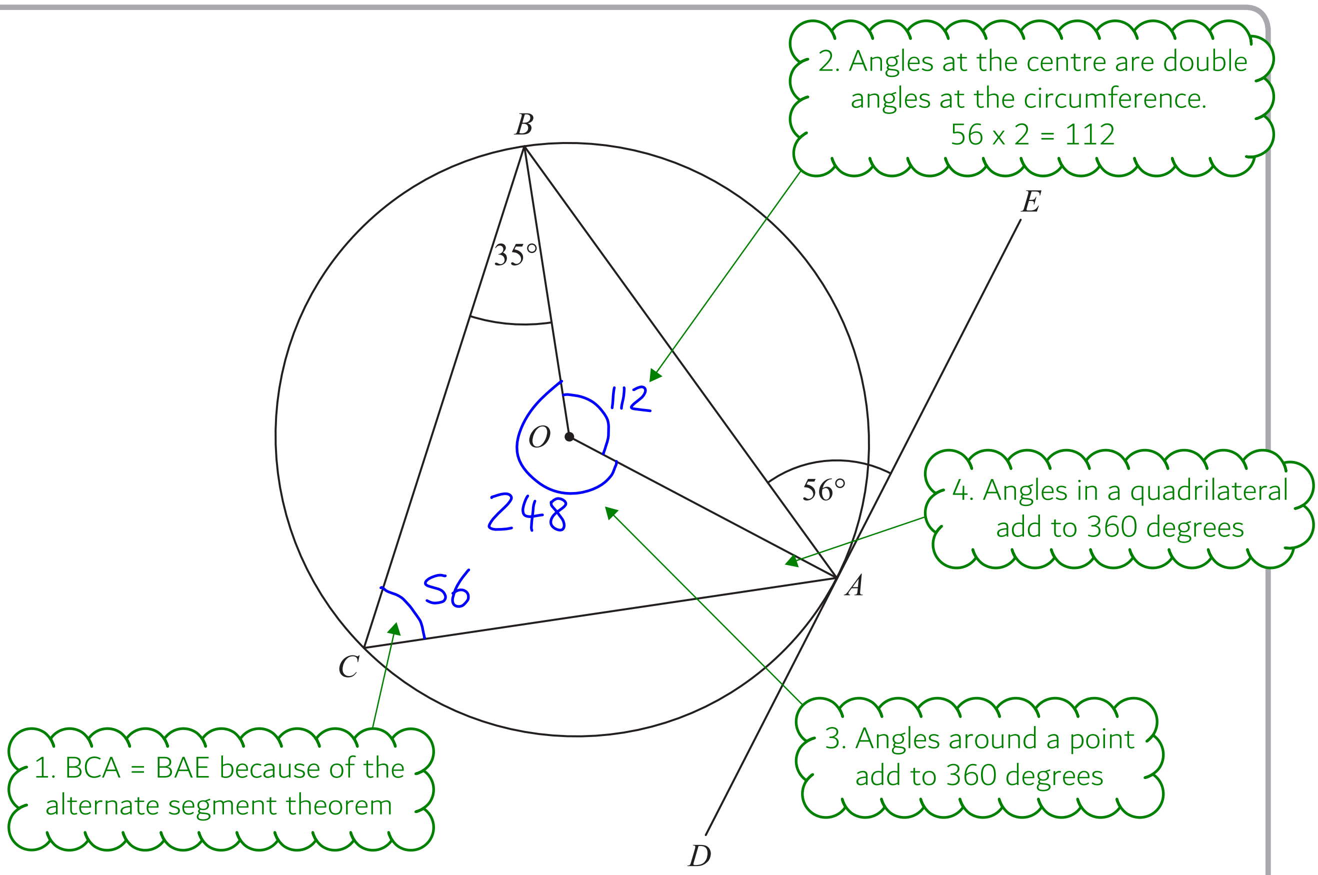
$y = \frac{x^{\times 4}}{1.25_{\times 4}} = \frac{4x}{5} = 0.8x$

Let x be the price and y be the amount of cereal. To increase the amount of cereal by 25%, multiply it by 1.25. For x you get 1.25y. Rearranging to work out x when there is one y works out the proportion of the cost which gives the same value as Jack's offer. 0.8 = 80%. This is a 20% reduction

20 %

**(Total for Question 11 is 3 marks)**

**12**




$A$, $B$ and $C$ are points on the circumference of a circle, centre $O$.
$DAE$ is the tangent to the circle at $A$.

Angle $BAE = 56°$
Angle $CBO = 35°$

Work out the size of angle $CAO$.
You must show all your working.

56 × 2 = 112

360 − 112 = 248

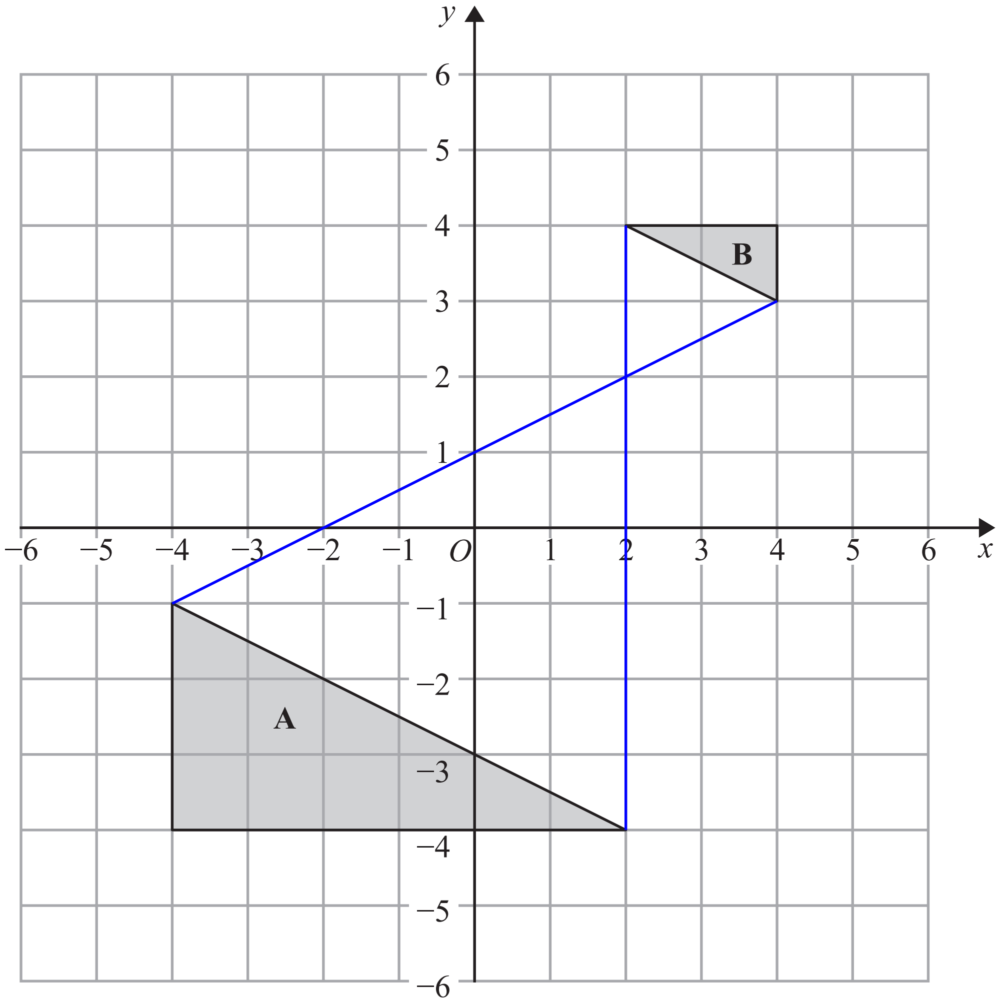
248 + 56 + 35 = 339

360 − 339 = 21

21 °

**(Total for Question 12 is 3 marks)**

**13**




Describe fully the single transformation that maps triangle **A** onto triangle **B**.

Enlargement by scale factor -1/3 from the point (2 , 2)

**(Total for Question 13 is 2 marks)**

It is an enlargement as it changes size. The scale factor is -1/3 as the sides have divided by 3 and B is on the other side of the point it is enlarging from. The point it is enlarging from can be found by drawing straight lines from two of the corners to the same corners on the other shape (where the lines meet is where it is enlarging from)

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**14** (a) Work out the value of $\left(\frac{16}{81}\right)^{\frac{3}{4}} = \left(\frac{2}{3}\right)^{3}$

The power means to find the fourth root then cube. The power can apply to the numerator and denominator separately. Fourth root can be found by square rooting twice and the cube can be found by multiplying by itself twice

$\frac{8}{27}$

**(2)**

$3^a = \frac{1}{9}$ $\qquad$ $3^b = 9\sqrt{3}$ $\qquad$ $3^c = \frac{1}{\sqrt{3}}$

(b) Work out the value of $\quad a + b + c$

$-2 + 2\frac{1}{2} + \left(-\frac{1}{2}\right)$

*a* must be -2 as $1/9 = 1/3^2$ (negative power takes the reciprocal). *b* must be $2^1/_2$ as $9 = 3^2$ and root $3 = 3^{1/2}$, multiplying these together adds the indices. *c* must be -1/2 as root $3 = 3^{1/2}$ and it is the reciprocal of this

0

**(2)**

**(Total for Question 14 is 4 marks)**

**15** Three solid shapes **A**, **B** and **C** are similar.

The surface area of shape **A** is 4 cm$^2$
The surface area of shape **B** is 25 cm$^2$

The ratio of the volume of shape **B** to the volume of shape **C** is 27 : 64

Work out the ratio of the height of shape **A** to the height of shape **C**.
Give your answer in its simplest form.

A : B    B : C
2 : 5    3 : 4

The ratio between the surface areas of A and B is 4:25. As area is a squared dimension, we can square root both sides of the ratio to find the ratio of the lengths of A and B. We can cube root both sides of the ratio of the volumes of B and C to work out the ratio of the lengths of B and C

A : B : C
6 : 15 : 20

The ratios can be combined by making the same number of parts for B. The ratio A:B is multiplied by 3 and B:C is multiplied by 5 to get 15 parts for B

The ratio A:C is 6:20 and this can be simplified by dividing it by 2

3 : 10

**(Total for Question 15 is 4 marks)**

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**16** Prove algebraically that $0.2\dot{5}\dot{6}$ can be written as $\dfrac{127}{495}$

$x = 0.2\dot{5}\dot{6}$

$100x = 25.6\dot{5}\dot{6}$

$99x = 25.4$

$x = \dfrac{25.4}{99} = \dfrac{254}{990} = \dfrac{127}{495}$

Multiplying by 100 aligns the recurring decimal places so that when x is subtracted from 100x they are eliminated

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

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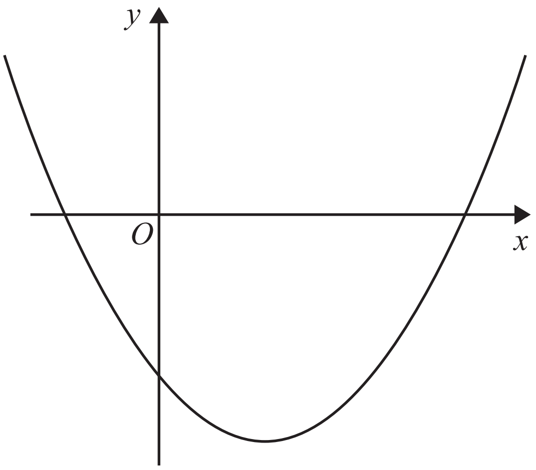
**17** Here is a sketch of a curve.




The equation of the curve is $y = x^2 + ax + b$ where $a$ and $b$ are integers.

The points $(0, -5)$ and $(5, 0)$ lie on the curve.

Find the coordinates of the turning point of the curve.

$-5 = (0)^2 + a(0) + b$

The first point (0 , -5) tells us that where x = 0, y = -5. Substitute these values into the equation

$b = -5$

Rearrange to find b

$0 = (5)^2 + a(5) - 5$

The second point (5 , 0) tells us that where x = 5, y = 0. Substitute these values into the equation

$0 = 20 + 5a$

$a = -4$

Rearrange to find a

$y = x^2 - 4x - 5$

We now have the equation

$y = (x-2)^2 - 9$

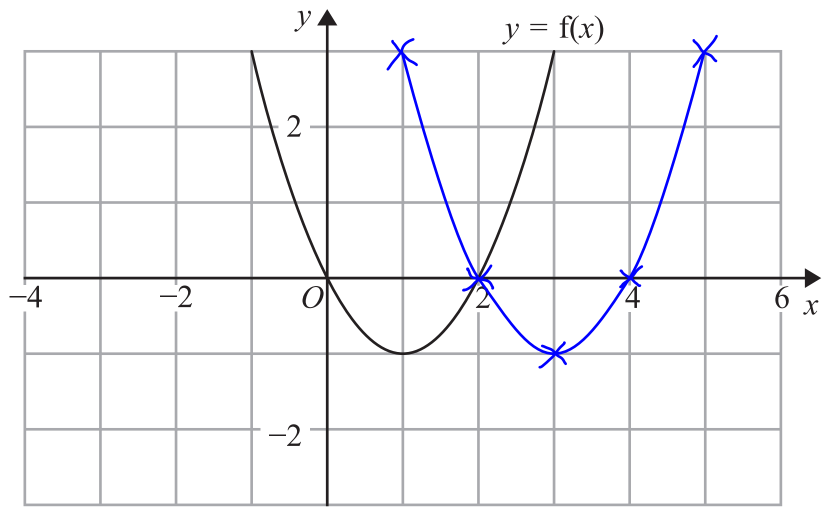
Completing the square to find the minimum point

The minimum point occurs when the bracket is equal to 0. x = 2 for this to happen. y = -9 when the bracket is 0

( 2 , -9 )

**(Total for Question 17 is 4 marks)**

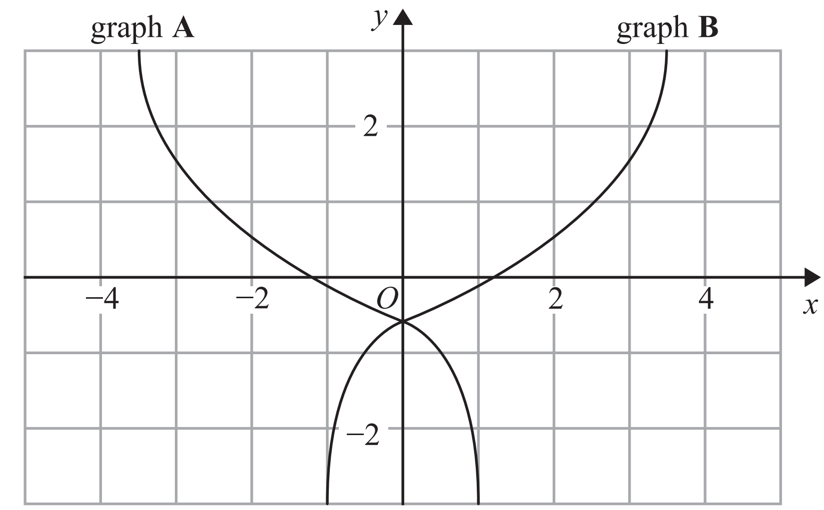
**18** The graph of $y = \mathrm{f}(x)$ is shown on the grid below.




(a) On the grid above, sketch the graph of $y = \mathrm{f}(x - 2)$

Translates the graph 2 to the right

**(1)**




On the grid, graph **A** has been reflected to give graph **B**.

The equation of graph **A** is $y = \mathrm{g}(x)$

(b) Write down the equation of graph **B**.

The value for -2 becomes the value for 2.
The value for -3 becomes the value for 3.
It is a reflection in the y axis

$y = g(-x)$

**(1)**

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

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**19** For all values of $x$

$$f(x) = (x + 1)^2 \quad \text{and} \quad g(x) = 2(x - 1)$$

(a) Show that $gf(x) = 2x(x + 2)$

$$gf(x) = 2((x+1)^2 - 1)$$

Substitute f(x) for x in g(x)

$$= 2(x^2 + 2x)$$

Expand $(x + 1)^2$ (square the first term, double the product of the two terms, square the last term) to get $x^2 + 2x + 1$. The +1 and -1 cancel out

$$= 2x(x + 2)$$

Bring out x as a factor

**(2)**

(b) Find $g^{-1}(7)$

$$x = 2(y - 1)$$

$$y = \frac{x}{2} + 1 = g^{-1}(x)$$

Switch g(x) for x and x for y then rearrange to make y the subject. This finds $g^{-1}(x)$

$$g^{-1}(7) = \frac{7}{2} + 1 = \frac{7}{2} + \frac{2}{2}$$

Substitute 7 for x

$\frac{9}{2}$

**(2)**

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



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**20** Show that $\dfrac{(\sqrt{18}+\sqrt{2})^2}{\sqrt{8}-2}$ can be written in the form $a(b+\sqrt{2})$ where $a$ and $b$ are integers.

$$\frac{18+2\sqrt{36}+2}{\sqrt{8}-2} \times \frac{\sqrt{8}+2}{\sqrt{8}+2}$$

Expand out the square bracket and rationalise the denominator

$\sqrt{a} \times \sqrt{a} = a$

$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

$$\begin{array}{r} 36 \\ \times\ 8 \\ \hline 288 \end{array}$$

$$\frac{18\sqrt{8}+36+2\sqrt{288}+4\sqrt{36}+2\sqrt{8}+4}{8+2\sqrt{8}-2\sqrt{8}-4}$$

$$\frac{20\sqrt{8}+2\sqrt{288}+64}{4}$$

Collect the like terms and simplify. Root 36 is 6. 4 x 6 = 24

36 + 24 + 4 = 64

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

$\sqrt{288}=\sqrt{144}\times\sqrt{2}=12\sqrt{2}$

Simplify the surds so they are in terms of root 2

$$\frac{40\sqrt{2}+24\sqrt{2}+64}{4}$$

Substitute the simplified surds back into the expression

$4\overline{)6^{2}4}$ = 16

$40\sqrt{2} + 24\sqrt{2} = 64\sqrt{2}$.

Dividing both terms by 4

$16\sqrt{2}+16$

$16(1+\sqrt{2})$

Bringing out 16 as a factor to get into the desired form

**(Total for Question 20 is 3 marks)**

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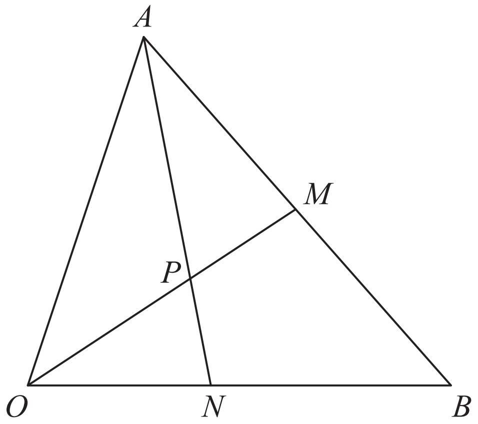
**21**




*OAB* is a triangle.
*OPM* and *APN* are straight lines.
*M* is the midpoint of *AB*.

$\overrightarrow{OA} = \mathbf{a}$ $\quad \overrightarrow{OB} = \mathbf{b}$

$OP : PM = 3 : 2$

Work out the ratio $ON : NB$

$\overrightarrow{ON} = x(\overrightarrow{OB}) = xb$

$= \overrightarrow{OA} + \overrightarrow{AN} = a + \overrightarrow{AN}$

$\overrightarrow{AN} = y\overrightarrow{AP}$

$\overrightarrow{AP} = \overrightarrow{AO} + \overrightarrow{OP} = -a + \overrightarrow{OP}$

$\overrightarrow{OP} = \frac{3}{5} \times \overrightarrow{OM}$

$\overrightarrow{OM} = \overrightarrow{OA} + \overrightarrow{AM} = a + \overrightarrow{AM}$

$\overrightarrow{AM} = \frac{1}{2} \times \overrightarrow{AB}$

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB} = -a + b$

$\overrightarrow{AM} = \frac{1}{2}(-a + b) = -\frac{1}{2}a + b$

$\overrightarrow{OM} = \frac{1}{2}a + \frac{1}{2}b$

$\overrightarrow{OP} = \frac{3}{10}a + \frac{3}{10}b$

$\overrightarrow{AP} = \frac{-7}{10}a + \frac{3}{10}b$

$\overrightarrow{AN} = y\left(\frac{-7}{10}a + \frac{3}{10}b\right)$

$xb = a + \frac{-7y}{10}a + \frac{3y}{10}b$

$a + \frac{-7y}{10}a = 0$

$\frac{7y}{10}a = a \quad \frac{7y}{10} = 1 \quad y = \frac{10}{7}$

$x = \frac{3(\frac{10}{7})}{10} = \frac{30}{70} = \frac{3}{7}$

$\overrightarrow{ON} = \frac{3}{7}b \quad \overrightarrow{NB} = \frac{4}{7}b$

$ON : NB = \frac{3}{7} : \frac{4}{7}$

Generally starting with what we are trying to find then working backward until we finally get vector AB in terms of a and b. At the end, equating the coefficients of a and b by setting the two ways of expressing ON equal to each other

3 : 4

**(Total for Question 21 is 5 marks)**

**22** There are only green pens and blue pens in a box.

There are three more blue pens than green pens in the box.
There are more than 12 pens in the box.

Simon is going to take at random two pens from the box.

The probability that Simon will take two pens of the same colour is $\frac{27}{55}$

Work out the number of green pens in the box.

G is the number of green pens and B is the number of blue pens

$$\frac{27}{55} = \frac{G}{G+B} \times \frac{G-1}{(G-1)+B} + \frac{B}{G+B} \times \frac{B-1}{G+(B-1)}$$

$$B = G+3$$

$$\frac{27}{55} = \frac{G}{G+(G+3)} \times \frac{G-1}{(G-1)+(G+3)} + \frac{(G+3)}{G+(G+3)} \times \frac{(G+3)-1}{G+((G+3)-1)}$$

$$= \frac{G}{2G+3} \times \frac{G-1}{2G+2} + \frac{G+3}{2G+3} \times \frac{G+2}{2G+2}$$

$$= \frac{G^2-G}{4G^2+4G+6G+6} + \frac{G^2+2G+3G+6}{4G^2+4G+6G+6}$$

$$= \frac{2G^2+4G+6}{4G^2+10G+6}$$

$$27(4G^2+10G+6) = 55(2G^2+4G+6)$$

$$108G^2+270G+162 = 110G^2+220G+330$$

$$2G^2-50G+168=0$$

$$G^2-25G+84=0$$

$$(G-21)(G-4)=0$$

G can't be 4 as there would be 7 blue pens and there are more than 12 pens

21

**(Total for Question 22 is 6 marks)**

**TOTAL FOR PAPER IS 80 MARKS**