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 |
|---|---|
| | |

# Monday 12 November 2018

Morning (Time: 1 hour 30 minutes) | Paper Reference **1MA1/3H**

# Mathematics
## Paper 3 (Calculator)
## Higher Tier

**You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. 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 be used**.
- If your calculator does not have a $\pi$ button, take the value of $\pi$ to be 3.142 unless the question instructs otherwise.

## 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* ▶

P55598A

6/7/7/7/1/

**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** (a) Write 7357 correct to 3 significant figures.

Only the first three figures are quoted. All other figures become 0. The 5 rounds to a 6 as there is a 7 in the next place

7360

**(1)**

(b) Work out $\dfrac{\sqrt{17 + 4^2}}{7.3^2}$

Write down all the figures on your calculator display.

Type into the calculator

0.1077981356

**(2)**

**(Total for Question 1 is 3 marks)**

---

**2** Last year Jo paid £245 for her car insurance.
This year she has to pay £883 for her car insurance.

Work out the percentage increase in the cost of her car insurance.

883 - 245 ← Subtracting the £245 from the £883 works out that the increase is £638

$\frac{638}{245} \times 100$ ← Putting the increase over the original expresses the increase as a fraction. Multiplying by 100 converts this to a percentage

260.4 %

**(Total for Question 2 is 3 marks)**

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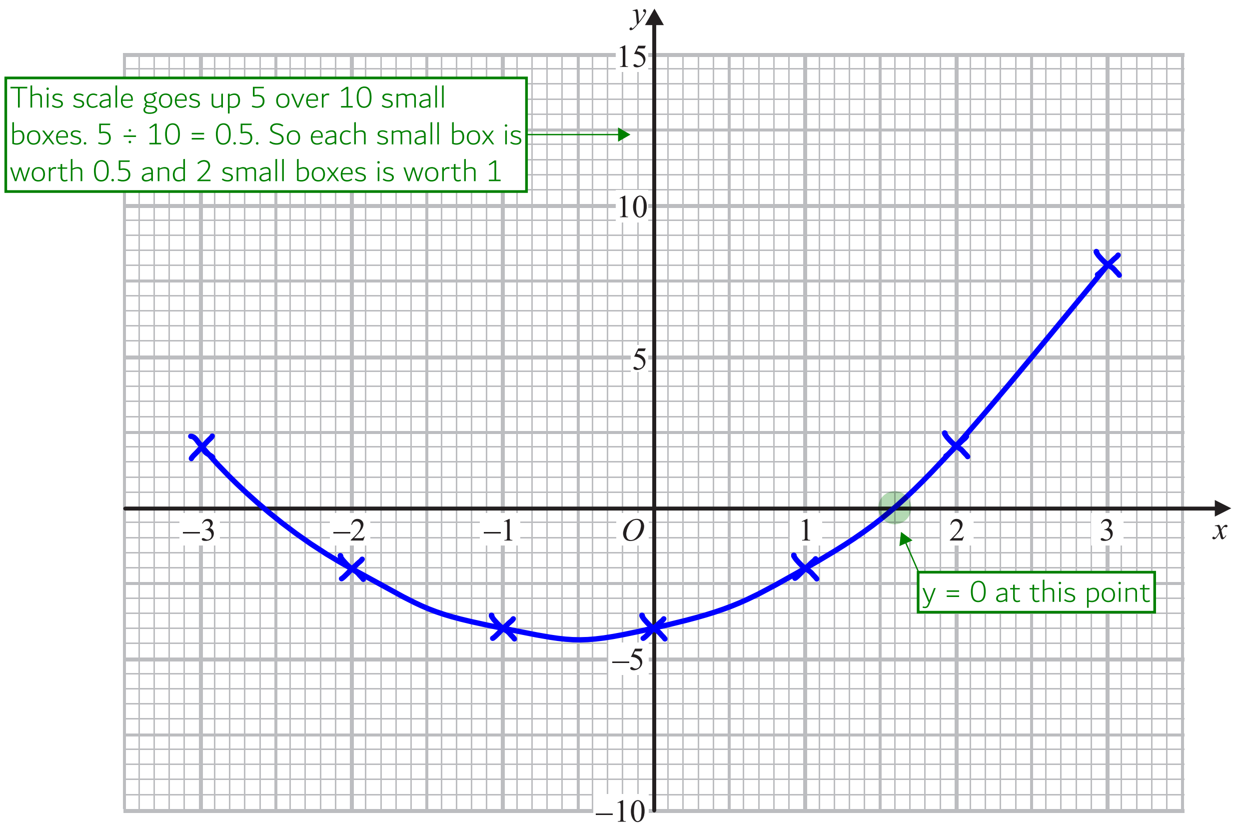
**3** (a) Complete this table of values for $y = x^2 + x - 4$

| $x$ | $-3$ | $-2$ | $-1$ | $0$ | $1$ | $2$ | $3$ |
|---|---|---|---|---|---|---|---|
| $y$ | 2 | $-2$ | $-4$ | -4 | $-2$ | 2 | 8 |

Using table mode on the calculator. Define f(x) = $x^2 + x - 4$.
Start: -3. End: 3. Step: 1. This completes the table of values

**(2)**

(b) On the grid, draw the graph of $y = x^2 + x - 4$ for values of $x$ from $-3$ to $3$




Plotting the points from the table of values then joining up with a curve

**(2)**

(c) Use the graph to estimate a solution to $x^2 + x - 4 = 0$

y has been replaced with 0. So it is asking for a value of x when y = 0

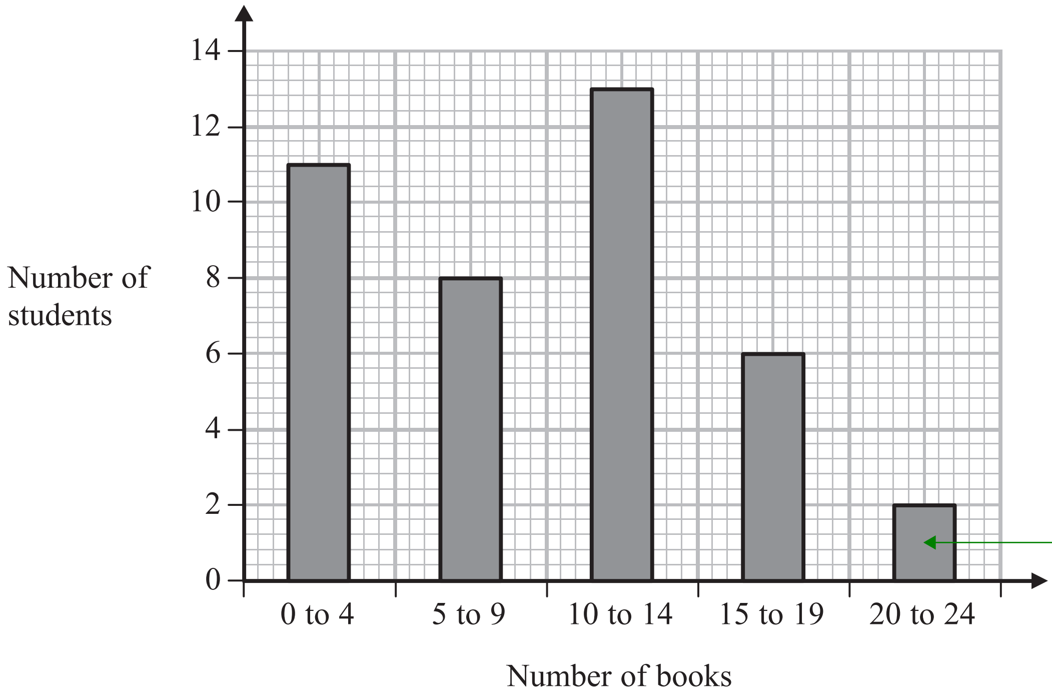
1.6

**(1)**

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

**4** Fran asks each of 40 students how many books they bought last year.

The chart below shows information about the number of books bought by each of the 40 students.




2 students bought more than 20 books

(a) Work out the percentage of these students who bought 20 or more books.

$\frac{2}{40} \times 100$

Expressing the 2 students who bought 20 or more books as a fraction of the 40 students. Multiplying this by 100 converts it to a percentage

5 %

**(2)**

(b) Show that an estimate for the mean number of books bought is 9.5
You must show all your working.

$2 \times 11 = 22$

$7 \times 8 = 56$

$12 \times 13 = 156$

$17 \times 6 = 102$

$22 \times 2 = 44$

Multiplying the midpoints of the number of books for each category by the number of students for each category works out an estimate of the total number of books bought by all the students in each category

$22 + 56 + 156 + 102 + 44$

Adding all the estimated totals gives an estimated overall total of 380 books bought by all the students

$380 \div 40 = 9.5$

Dividing the estimated overall total number of books bought by all the students by the 40 students estimates the mean to be 9.5

**(4)**

**(Total for Question 4 is 6 marks)**

**5** Lara is a skier.

She completed a ski race in 1 minute 54 seconds.
The race was 475 m in length.

Lara assumes that her average speed is the same for each race.

(a) Using this assumption, work out how long Lara should take to complete a 700 m race.
Give your answer in minutes and seconds.

700 ÷ 475

Dividing the 700 m by the 475 m works out that the 700 m is 1.4... times the distance of the 475 m

0°1°54° × 1.4...

Multiplying the 1 minute 54 seconds by the 1.4... times the distance works out the time it should take for the 700 m as the average speed is the same. Entering 0 hours 1 minute 54 seconds as a sexagesimal on the calculator and using the exact answer for 1.4...

0°2'48" can be read as 2 minutes 48 seconds

2 minutes 48 seconds

**(3)**

Lara's average speed actually increases the further she goes.

(b) How does this affect your answer to part (a)?

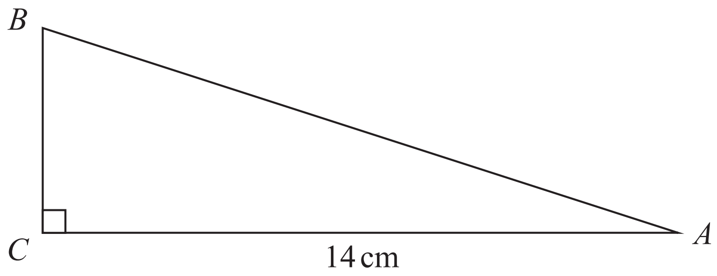
It would take less time

700m is further than 475m so the average speed would be higher

**(1)**

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

**6** $ABC$ is a right-angled triangle.




$AC = 14$ cm.
Angle $C = 90°$

size of angle $B$ : size of angle $A = 3 : 2$

Work out the length of $AB$.
Give your answer correct to 3 significant figures.

180 - 90 — There are 180° in a triangle. Subtracting angle C from 180° works out that the total of angle A and angle B is 90°

90 ÷ 5 — 3 + 2 = 5 parts in total in the ratio which represent the 90° total of angle A and angle B. So dividing the 90° by 5 works out that 1 part of the ratio is worth 18°

18 × 3 = 54 — Multiplying the value of 1 part of the ratio by the 3 parts which represent angle B works out that angle B is 54°

$\frac{O}{S\ H}$ $\frac{A}{C\ H}$ $\frac{O}{T\ A}$ — Using right-angled trigonometry. Ticking O as the 14 cm is the opposite to angle B. Ticking H as AB is the hypotenuse. There are two ticks on the SOH formula triangle so this one can be used

14 ÷ sin54 — Covering H in the SOH formula triangle finds that hypotenuse = opposite ÷ sin of the angle

17.30... is rounded to 3 significant figures

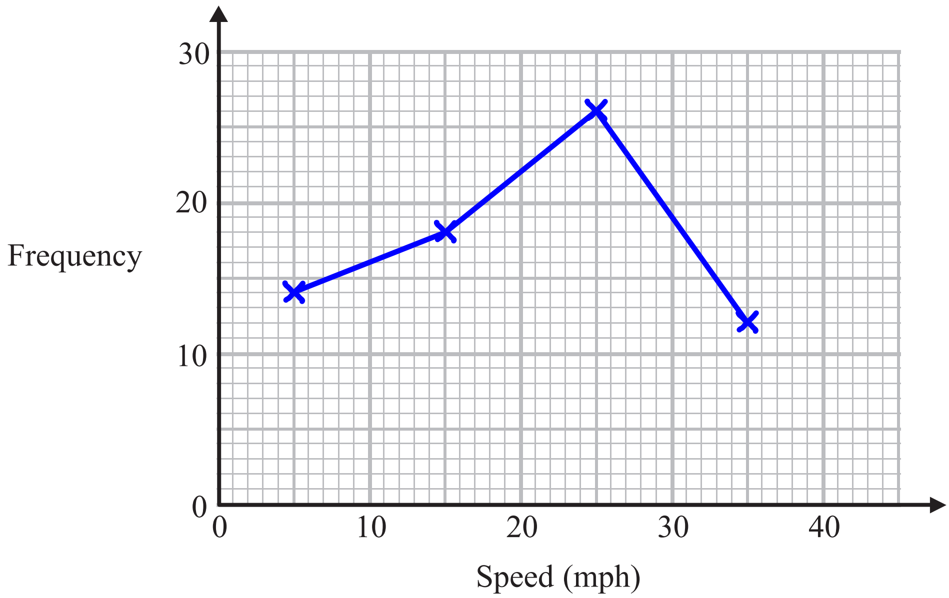
........................17.3........................ cm

**(Total for Question 6 is 4 marks)**

**7** The table gives information about the speeds of 70 cars.

| Speed ($s$ mph) | Frequency |
|---|---|
| $0 < s \leqslant 10$ | 14 |
| $10 < s \leqslant 20$ | 18 |
| $20 < s \leqslant 30$ | 26 |
| $30 < s \leqslant 40$ | 12 |

Draw a frequency polygon for this information.




The frequencies are plotted at the midpoints of each category then joined up with straight lines

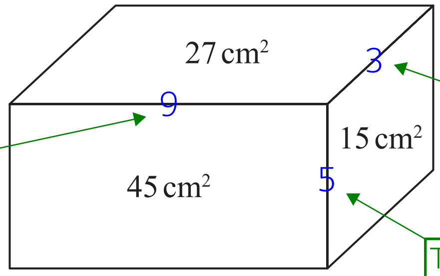
**(Total for Question 7 is 2 marks)**

**8** The diagram shows a solid metal cuboid.

The areas of three of the faces are marked on the diagram. ← Area of rectangle = length × width

The lengths, in cm, of the edges of the cuboid are whole numbers.

This length must be 9 cm as it is a common factor of 27 and 45 and works with the other lengths




This length must be 3 cm as it is a common factor of 27 and 15 and works with the other lengths

This length must be 5 cm as it is a common factor of 45 and 15 and works with the other lengths

The metal cuboid is melted and made into cubes.
Each of the cubes has sides of length 2.5 cm.

Work out the greatest number of these cubes that can be made.

$9 \times 3 \times 5 = 135$ ← Volume of cuboid = length × width × height. So the volume of the cuboid is 135 cm$^3$

$2.5^3$ ← Volume of cube = length$^3$. So the volume of each cube is 15.625 cm$^3$

$135 \div 15.625$ ← Dividing the volume of the cuboid by the volume of each cube works out how many cubes can be made

8.64 is rounded down to 8 as it needs to be a whole number of cubes and 9 is too many

8 ..............................

**(Total for Question 8 is 5 marks)**

**9** (a) Expand and simplify $(x-2)(2x+3)(x+1)$

$2x^2+3x-4x-6$ ← Expanding the first pair of brackets

$(2x^2-x-6)(x+1)$ ← Collecting like terms and writing the 3rd bracket

$2x^3+2x^2-x^2-x-6x-6$ ← Expanding with the 3rd bracket

Collecting like terms → $2x^3+x^2-7x-6$

**(3)**

$$\frac{y^4 \times y^n}{y^2} = y^{-3}$$

(b) Find the value of $n$.

$\frac{y^{4+n}}{y^2}$ ← $a^x \times a^w = a^{x+w}$. So adding the indices on the numerator

$y^{2+n} = y^{-3}$ ← $a^x \div a^w = a^{x-w}$. So subtracting the index on the denominator. This must be equal to the $y^{-3}$

$2+n=-3$ ← The power on the left must be equal to the power on the right

Subtracting 2 from both sides gets n = - 5 → -5

**(2)**

(c) Solve $5x^2-4x-3=0$

Give your solutions correct to 3 significant figures.

$$x=\frac{-(-4)\pm\sqrt{(-4)^2-4(5)(-3)}}{2(5)}$$ ← $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ ← Using the quadratic formula as it is in the quadratic form $ax^2+bx+c=0$

1.271... and -0.4717... are rounded to 3 significant figures → 1.27 and -0.472

**(3)**

**(Total for Question 9 is 8 marks)**

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**10** $f(x) = 4\sin x°$

(a) Find f(23)
Give your answer correct to 3 significant figures.

4sin23 ← Substituting 23 for x in f(x)

1.562... is rounded to 3 significant figures

1.56

**(1)**

$g(x) = 2x - 3$

(b) Find fg(34)
Give your answer correct to 3 significant figures.

2(34) - 3 ← Substituting 34 for x in g(x) finds that g(34) = 65

4sin65 ← Substituting 65 for x in f(x) finds f(65), which is the value of the composite function fg(34)

3.635... is rounded to 3 significant figures

3.63

**(2)**

$h(x) = (x + 4)^2$

Ivan needs to solve the following equation $h(x) = 25$

He writes

$(x + 4)^2 = 25$
$x + 4 = 5$ ← This is correct but also x + 4 = -5
$x = 1$

This is not fully correct.

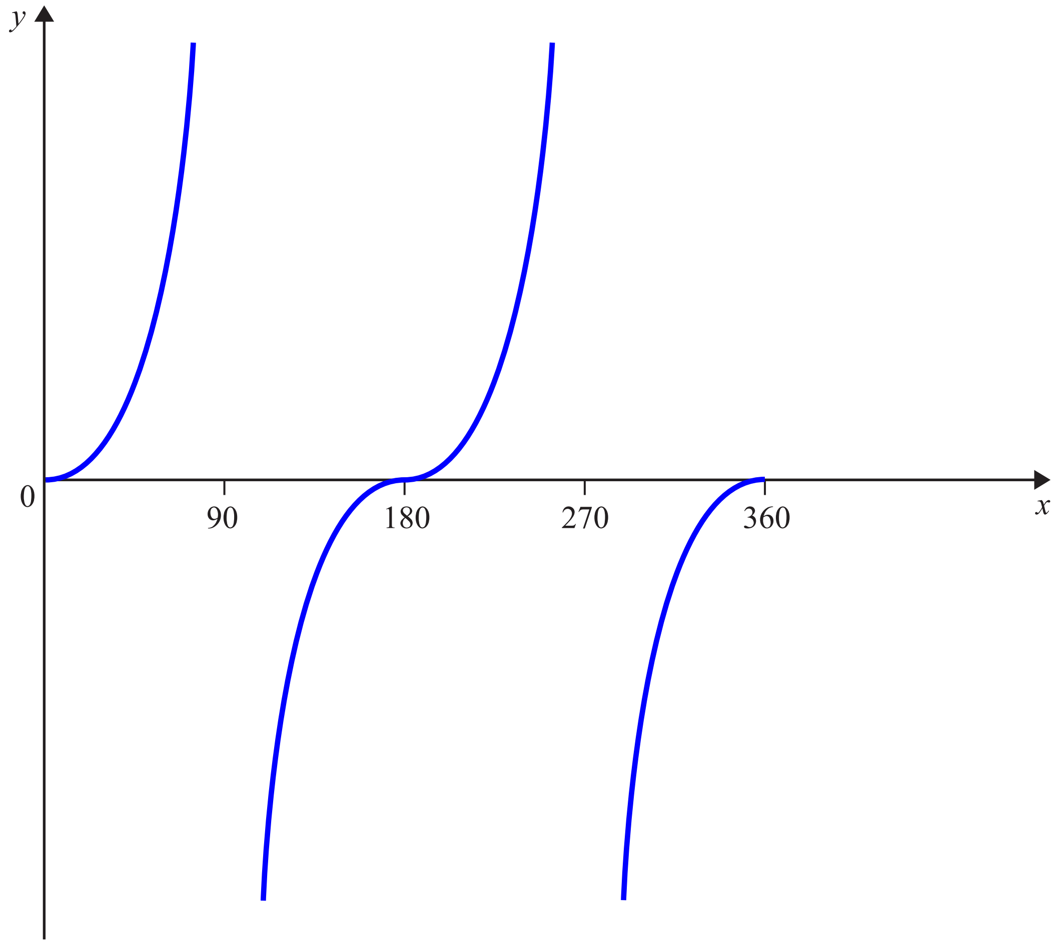
(c) Explain why.

Should do the positive and negative square root

**(1)**

**(Total for Question 10 is 4 marks)**

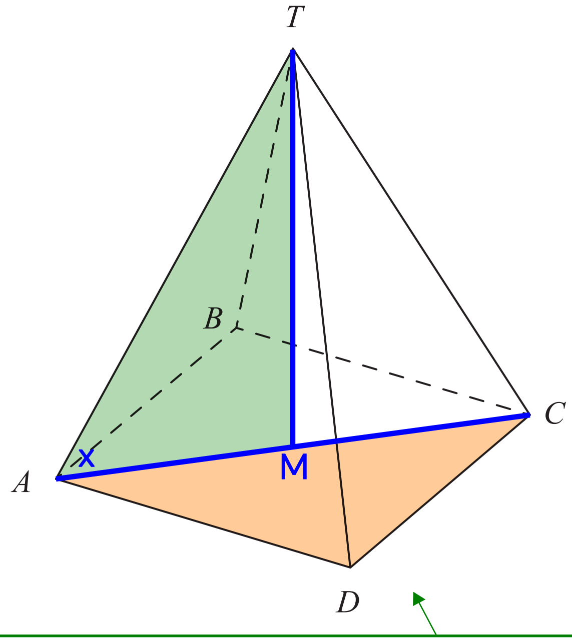
**11** Sketch the graph of $y = \tan x°$ for $0 \leqslant x \leqslant 360$




**(Total for Question 11 is 2 marks)**

Using table mode on the calculator. Define f(x) = tanx. Start: 0. End: 360. Step: 15.
This gives a table of values which can be used to visualise what it looks like

**12** Here is a pyramid with a square base *ABCD*.




Drawing AC to draw the angle TAC, which forms the orange right angled triangle. Then drawing on the vertical 12 m from T to the midpoint of AC, which is labelled as M

$AB = 5\,\text{m}$

The vertex $T$ is 12 m vertically above the midpoint of $AC$.

Calculate the size of angle $TAC$.

$AC^2 = 5^2 + 5^2$ — Using Pythagoras' Theorem in the orange right-angled triangle. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side. Both AD and DC are 5 m as the base is a square and all its side lengths are the same

$AC = \sqrt{50}$ — Square rooting both sides finds that AC = 7.0... m

$7.0... \div 2$ — Dividing AC by 2 works out that AM is 3.5... m

$\frac{O}{S\ H}\quad\frac{A}{C\ H}\quad\frac{O}{T\ A}$ — Using right-angled trigonometry in the green right-angled triangle. Ticking O as the 12 m is the opposite. Ticking A as AM is the adjacent. There are two ticks on the TOA formula triangle so this one can be used

$\tan x = \frac{12}{3.5...}$ — Covering T in the TOA formula triangle finds that tan of the angle = opposite/adjacent

Doing the inverse tan of both sides gets x on its own

73.6 °

**(Total for Question 12 is 4 marks)**

**13** The number of animals in a population at the start of year $t$ is $P_t$
The number of animals at the start of year 1 is 400

Given that

$$P_{t+1} = 1.01P_t$$

$P_{t+1}$ is the number of animals next year. $P_t$ is the number of animals in the current year

work out the number of animals at the start of year 3

$P_2 = 1.01 \times 400$

Substituting the 400 animals at the start of year 1 for $P_t$ gives 404 animals at the start of year 2

$P_3 = 1.01 \times 404$

Substituting the 404 animals at the start of year 2 for $P_t$ gives 408.04 animals at the start of year 3

408.04 is rounded to the nearest whole number

408

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

---

**14** $y$ is inversely proportional to $x^3$

$y = 44$ when $x = a$

Show that $y = 5.5$ when $x = 2a$

$y = \frac{k}{x^3}$

Writing the proportion as an equation by multiplying the right side by k, which is a constant to be found

$k = 44a^3$

Multiplying both sides by $x^3$ then substituting 44 for y and a for x finds k

$y = \frac{44a^3}{(2a)^3}$

Substituting the value of k into the equation. Substituting 2a for x

$= \frac{44a^3}{8a^3}$

$(2a)^3 = 2^3a^3 = 8a^3$

$= 5.5$

Dividing both the numerator and denominator by $a^3$ cancels it out. $44/8 = 5.5$

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

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**15** Prove algebraically that the difference between the squares of any two consecutive odd numbers is always a multiple of 8

$(2n+3)^2 - (2n+1)^2$

Let n be an integer. Multiplying it by 2 gives 2n, which is an even number. Adding 1 gives 2n + 1, which is an odd number. Adding 2 to this gives 2n + 3, which is the next odd number. Squaring 2n + 3 and 2n + 1. Difference is largest subtract smallest

$4n^2 + 12n + 9 - 4n^2 - 4n - 1$

Expanding the square brackets by squaring the first term, doubling the product of the two terms and squaring the last term. The second bracket is negative so flipping the signs of each of the terms when expanding

$8n + 8$

Collecting like terms

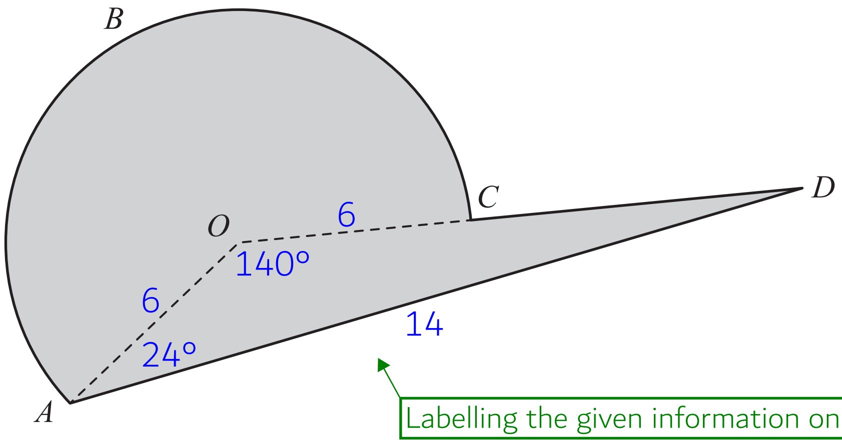
$8(n+1)$

Multiples of 8 are divisible by 8 so bringing out 8 as a factor shows that it is always a multiple of 8

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

.CG Maths.

**16** Here is a shaded shape *ABCD*.




Labelling the given information on the diagram

The shape is made from a triangle and a sector of a circle, centre *O* and radius 6 cm.
*OCD* is a straight line.

*AD* = 14 cm
Angle *AOD* = 140°
Angle *OAD* = 24°

Calculate the perimeter of the shape.
Give your answer correct to 3 significant figures.

360 - 140

There are 360° around a point. So subtracting angle AOD from 360° finds that reflex angle AOD = 220°

$\frac{220}{360} \times \pi \times 12 = 23.0...$ A

There are 360° around the centre of a circle. The sector is 220° out of these 360°. So the arc ABC is 220/360 of the circumference. Circumference = π × diameter. The diameter is double the radius so is 12 cm. Storing the exact length of arc ABC as A on the calculator

$\frac{OD}{\sin 24} = \frac{14}{\sin 140}$

There are two opposite pairs of sides and angles in triangle AOD so the sine rule can be used. a/sinA = b/sinB, where angle A is opposite side a and angle B is opposite side b

OD = 8.8...

Multiplying both sides by sin24 finds that OD is 8.8... cm

8.8... - 6

Subtracting radius OC from OD finds that CD is 2.8... cm

14 + 23.0... + 2.8...

Perimeter is all the outside sides added together. Adding AD, arc ABC (which was stored as A) and CD

39.89... is rounded to 3 significant figures

39.9 cm

**(Total for Question 16 is 5 marks)**

**17** The table shows information about the distances 570 students travelled to a university open day.

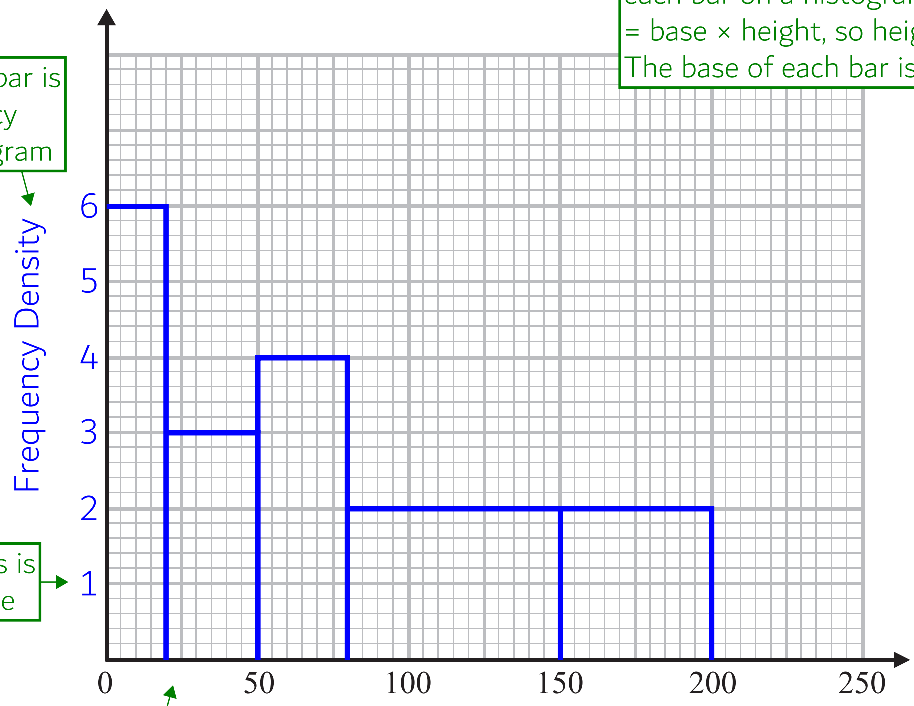
| Distance ($d$ miles) | Frequency | |
|---|---|---|
| $0 < d \leqslant 20$ | 120 | $\div 20 = 6$ |
| $20 < d \leqslant 50$ | 90 | $\div 30 = 3$ |
| $50 < d \leqslant 80$ | 120 | $\div 30 = 4$ |
| $80 < d \leqslant 150$ | 140 | $\div 70 = 2$ |
| $150 < d \leqslant 200$ | 100 | $\div 50 = 2$ |

This interval has a class width of 30 as 50 - 20 = 30

Frequency is represented by the area of each bar on a histogram. Area of rectangle = base × height, so height = area ÷ base. The base of each bar is the class width

(a) Draw a histogram for the information in the table.

The height of the bar is called the frequency density on a histogram




Going up in 1s is a suitable scale

This scale goes up 50 over 10 small boxes. 50 ÷ 10 = 5. So each small box is worth 5

istance (miles)

**(3)**

(b) Estimate the median distance.

The method is on the next page

68.75 miles

**(2)**

**(Total for Question 17 is 5 marks)**

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| | |
|---|---|
| $570 \div 2$ | The median is roughly halfway through the 570 students so can be estimated to be the 285th student |
| $285 - 120$ | Counting the first 120 students in the 1st interval works out that there is another 165 to count to get to the estimated median |
| $165 - 90$ | Counting the next 90 students in the 2nd interval works out that there is another 75 to count to get to the estimated median |
| $\frac{75}{120} \times 30$ | Another 120 students cannot be counted so the estimated median must be 75 into the 3rd interval. It can be estimated that the median is 75/120 of the way along the 3rd interval, which has a width of 30 |
| $50 + 18.75$ | The estimated median is 18.75 miles after the start of the 3rd interval |

**18** A high speed train travels a distance of 487 km in 3 hours.

The distance is measured correct to the nearest kilometre.
The time is measured correct to the nearest minute.

By considering bounds, work out the average speed, in km/minute, of the train to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

$3 \times 60$

1 hour = 60 minutes. So multiplying the 3 hours by 60 converts it to 180 minutes

$\left(487 + \frac{1}{2}\right) \div \left(180 - \frac{1}{2}\right) = 2.715877437$

$\left(487 - \frac{1}{2}\right) \div \left(180 + \frac{1}{2}\right) = 2.695290859$

km/minute means to divide the distance in km by the time in minutes. Using the upper bound for the distance and the lower bound for the time works out the upper bound for the average speed. Using the lower bound for the distance and the upper bound for the time works out the lower bound for the average speed. Adding half of the resolution expresses the upper bound and subtracting half of the resolution expresses the lower bound. The resolution is 1 for both the distance and time as the distance is to the nearest kilometre and the time is to the nearest minute

2.7, as both the upper and lower bound round to this to 1 decimal place

1 decimal place is a suitable degree of accuracy as it cannot be more accurate without getting different results for the upper and lower bound

.......................................................km/minute

**(Total for Question 18 is 5 marks)**

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**19** Solve algebraically the simultaneous equations

$$2x^2 - y^2 = 17$$ 1st equation

$$x + 2y = 1$$ 2nd equation

$x = 1 - 2y$ Rearranging the 2nd equation to make x the subject by subtracting 2y from both sides

$(1 - 2y)(1 - 2y)$ Squaring 1 - 2y to express $x^2$ in terms of y

$1 - 2y - 2y + 4y^2$ Expanding the brackets

$2(1 - 4y + 4y^2)$ Collecting like terms and substituting the expression of $x^2$ in terms of y into $2x^2$

$2 - 8y + 8y^2 - y^2 = 17$ Expanding the brackets and substituting into the 1st equation

$7y^2 - 8y - 15 = 0$ Bringing into the quadratic form by subtracting 17 from both sides and collecting like terms

$$y = \frac{--8 \pm \sqrt{(-8)^2 - 4 \times 7 \times -15}}{2 \times 7}$$ Solving using the quadratic formula

$x = 1 - 2\left(\frac{15}{7}\right)$

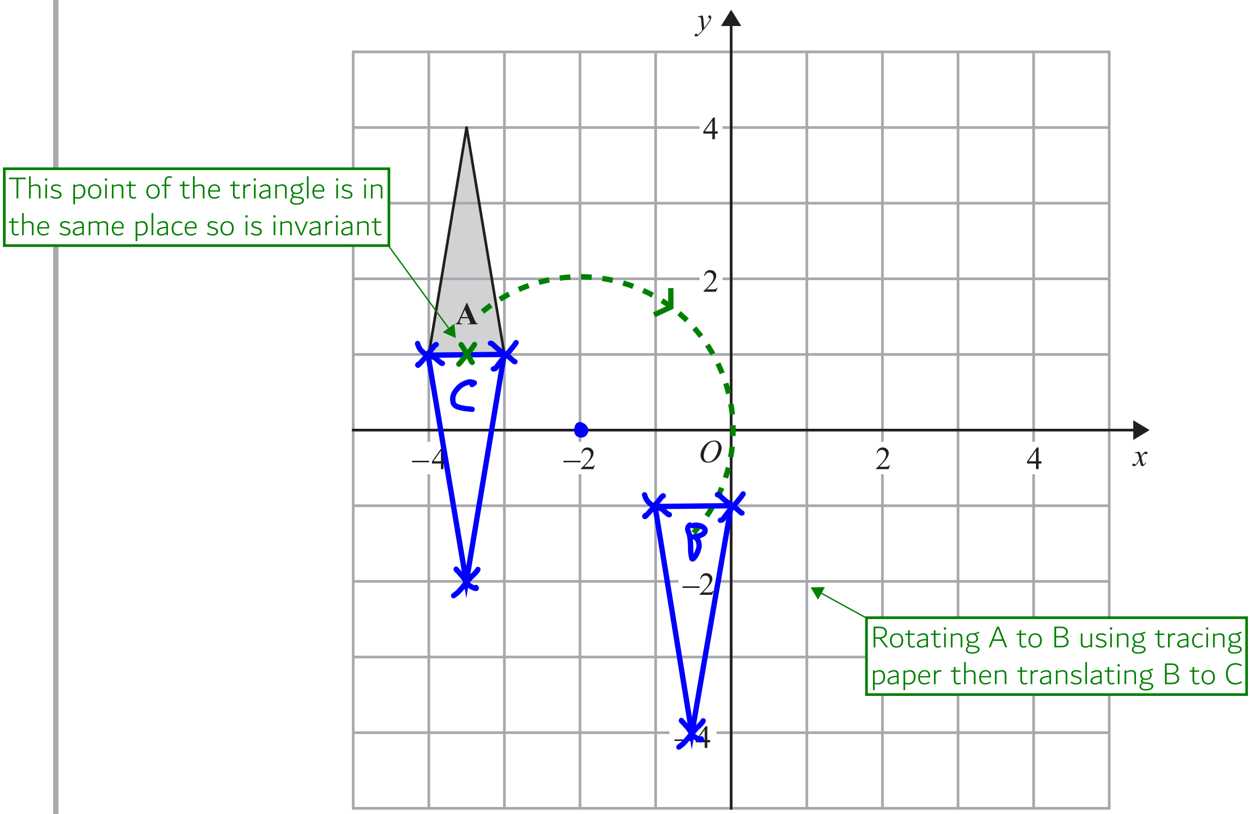
$x = 1 - 2(-1)$

Substituting the values of y into x = 1 - 2y to find the values of x

$y = \frac{15}{7}$, $x = -\frac{23}{7}$ or $y = -1$, $x = 3$

**(Total for Question 19 is 5 marks)**

**20**




Triangle **A** is transformed by the combined transformation of a rotation of 180° about the point (−2, 0) followed by a translation with vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

One point on triangle **A** is invariant under the combined transformation.

Find the coordinates of this point.

( -3.5 , 1 )

**(Total for Question 20 is 2 marks)**

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**TOTAL FOR PAPER IS 80 MARKS**

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