Write your name here

Surname	Other names

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

Centre Number	Candidate Number

Mathematics

Paper 3 (Calculator)

Higher Tier

Tuesday 13 June 2017 – Morning
Time: 1 hour 30 minutes

Paper Reference
1MA1/3H

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 π button, take the value of π 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 ▶

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

.CG Maths.

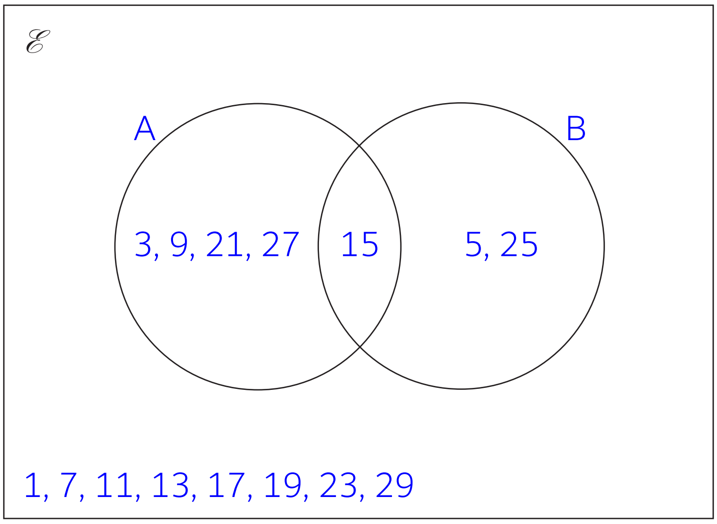
Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 $\mathscr{E}$ = {odd numbers less than 30}
A = {3, 9, 15, 21, 27}
B = {5, 15, 25}

(a) Complete the Venn diagram to represent this information.



(4)

A number is chosen at random from the universal set, $\mathscr{E}$.

(b) What is the probability that the number is in the set $A \cup B$?

$\boxed{\text{7 out of the 15 numbers are in the union of A and B (A or B or both)}} \longrightarrow \frac{7}{15}$

(2)

(Total for Question 1 is 6 marks)

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2 Solve the simultaneous equations

$$3x + y = -4$$ 1st equation
$$3x - 4y = 6$$ 2nd equation

$5y = -10$ Subtracting the 2nd equation from the 1st equation cancels out the x term. 3x - 3x = 0 and y - -4y = 5y and -4 - 6 = -10. Then dividing both sides by 5 finds that y = -2

$3x - 2 = -4$ Substituting -2 for y in the 1st equation

$3x = -2$ Adding 2 to both sides gets the x term on its own

Dividing both sides by 3 gets x on its own

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

$y = -2$

(Total for Question 2 is 3 marks)

3 The table shows some information about the dress sizes of 25 women.

Dress size	Number of women
8	2
10	9
12	8
14	6

(a) Find the median dress size.

$\frac{25 + 1}{2}$ Using the formula (n + 1)/2, where n is the number of women, works out that the 13th women is in the middle

13 - 2 Counting the first 2 women with a dress size of 8 finds that another 11 needs to be counted to get to the 13th

11 - 9 Counting the next 9 women with a dress size of 10 finds that another 2 needs to be counted to get to the 13th

The 8 women with dress size 12 is more than the 2 which still needs to be counted to get to the 13th. So the median must be in this category, which is dress size 12

12

(1)

3 of the 25 women have a shoe size of 7

Zoe says that if you choose at random one of the 25 women, the probability that she has either a shoe size of 7 or a dress size of 14 is $\frac{9}{25}$ because

$$\frac{3}{25} + \frac{6}{25} = \frac{9}{25}$$

(b) Is Zoe correct?
You must give a reason for your answer.

No, as some women may have both shoe size of 7 and a dress size of 14

The number of women who have both shoe size of 7 and a dress size of 14 would subtract from the 9 when working out the number of women with either a shoe size of 7 or a dress size of 14

(1)

(Total for Question 3 is 2 marks)

4 Daniel bakes 420 cakes.
He bakes only vanilla cakes, banana cakes, lemon cakes and chocolate cakes.

$\frac{2}{7}$ of the cakes are vanilla cakes.

35% of the cakes are banana cakes.
The ratio of the number of lemon cakes to the number of chocolate cakes is 4 : 5

Work out the number of lemon cakes Daniel bakes.

$\frac{2}{7} \times 420 = 120$ ← This works out that 2/7 of the 420 cakes is 120 vanilla cakes

$\frac{35}{100} \times 420 = 147$ ← This works out that 35% of the 420 cakes is 147 banana cakes. Putting the 35% over 100 converts it into a fraction

$420 - 120 - 147$ ← Subtracting the 120 vanilla cakes and the 147 banana cakes from the 420 cakes works out that there are 153 lemon and chocolate cakes in total

$153 \div 9$ ← 4 + 5 = 9 parts in total in the ratio which represent the 153 lemon and chocolate cakes. Dividing the 153 total by 9 works out that 1 part of the ratio is worth 17 cakes

17×4 ← Multiplying the value of 1 part of the ratio by the 4 parts which represent the lemon cakes works out that there are 68 lemon cakes

68

(Total for Question 4 is 5 marks)

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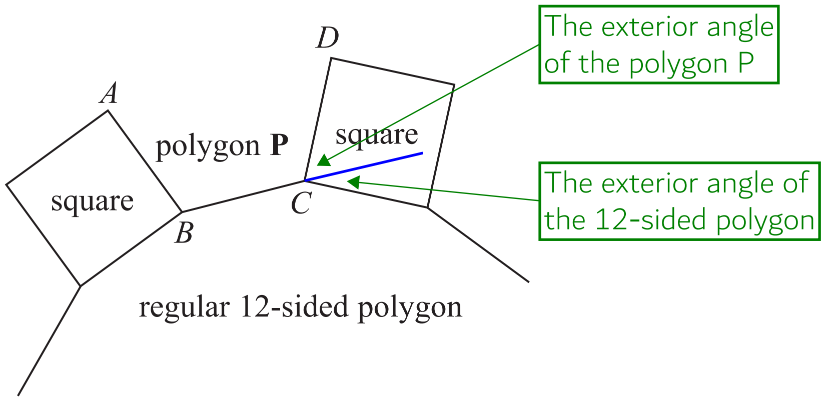
5 In the diagram, *AB*, *BC* and *CD* are three sides of a regular polygon **P**.



Show that polygon **P** is a hexagon.
You must show your working.

$360 \div 12$ ← The exterior angles of any polygon add up to 360°. So dividing 360° by the 12 exterior angles of the 12-sided polygon works out that each exterior angle is 30°

$90 - 30$ ← The interior angle of a square is 90°. Subtracting the exterior angle of the 12-sided polygon from this 90° works out that each exterior angle of the polygon P is 60°

$360 \div 60 = 6$ ← The exterior angles of any polygon add up to 360°. So dividing 360° by the size of each exterior angle of the polygon P works out that there must be 6 of them, which means it is a 6-sided polygon, which is a hexagon

(Total for Question 5 is 4 marks)

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6 The density of apple juice is 1.05 grams per cm^3.

The density of fruit syrup is 1.4 grams per cm^3.

The density of carbonated water is 0.99 grams per cm^3.

25 cm^3 of apple juice are mixed with 15 cm^3 of fruit syrup and
280 cm^3 of carbonated water to make a drink with a volume of 320 cm^3.

Work out the density of the drink.
Give your answer correct to 2 decimal places.

$d\,{}^{m}\,v$ ← Writing the formula triangle for density, mass, volume. Covering m in the formula triangle finds that mass = density × volume

$1.05 \times 25 = 26.25$ ← Multiplying the density of the apple juice by the volume of the apple juice works out that the mass of the apple juice is 26.25 grams

$1.4 \times 15 = 21$ ← Multiplying the density of the fruit syrup by the volume of the fruit syrup works out that the mass of the fruit syrup is 21 grams

$0.99 \times 280 = 277.2$ ← Multiplying the density of the carbonated water by the volume of the carbonated water works out that the mass of the carbonated water is 277.2 grams

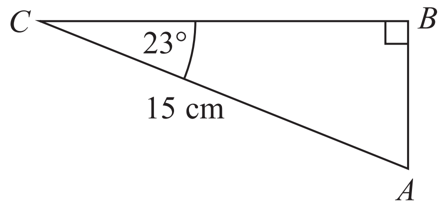
$26.25 + 21 + 277.2$ ← Adding the masses of the apple juice, the fruit syrup and the carbonated water works out that the mass of the drink is 324.45 grams

$324.45 \div 320$ ← Covering d in the formula triangle finds that density = mass ÷ volume

1.013... is rounded to 2 decimal places → 1.01 .... g/cm^3

(Total for Question 6 is 4 marks)

7 *ABC* is a right-angled triangle.



Calculate the length of *AB*.
Give your answer correct to 3 significant figures.

O✓ A✓ O✓
S H✓ C H T A

Using right-angled trigonometry. Ticking H as the 15 cm is the hypotenuse. Ticking O as AB is the opposite. There are two ticks on the SOH formula triangle so this one can be used

$\sin 23 \times 15$

Covering O finds that opposite = sin of the angle × hypotenuse

5.860... is rounded to 3 significant figures → 5.86 cm

(Total for Question 7 is 2 marks)

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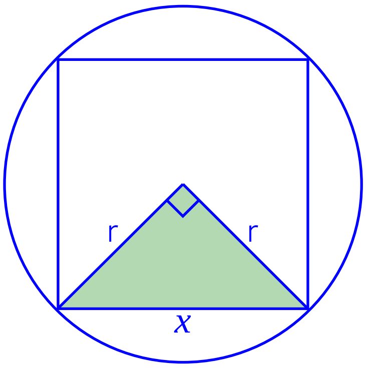
8 A square, with sides of length x cm, is inside a circle.
Each vertex of the square is on the circumference of the circle.

The area of the circle is 49 cm^2.

Work out the value of x.
Give your answer correct to 3 significant figures.



Drawing a square with each vertex on the circumference of a circle. Labelling the side length of the square as x. Drawing on two radii forms a right-angled triangle

$\pi r^2 = 49$ ← Area of circle = π × radius^2

$r^2 = 15.5...$ ← Dividing both sides by π

$r = 3.9...$ ← Square rooting both sides finds the radius

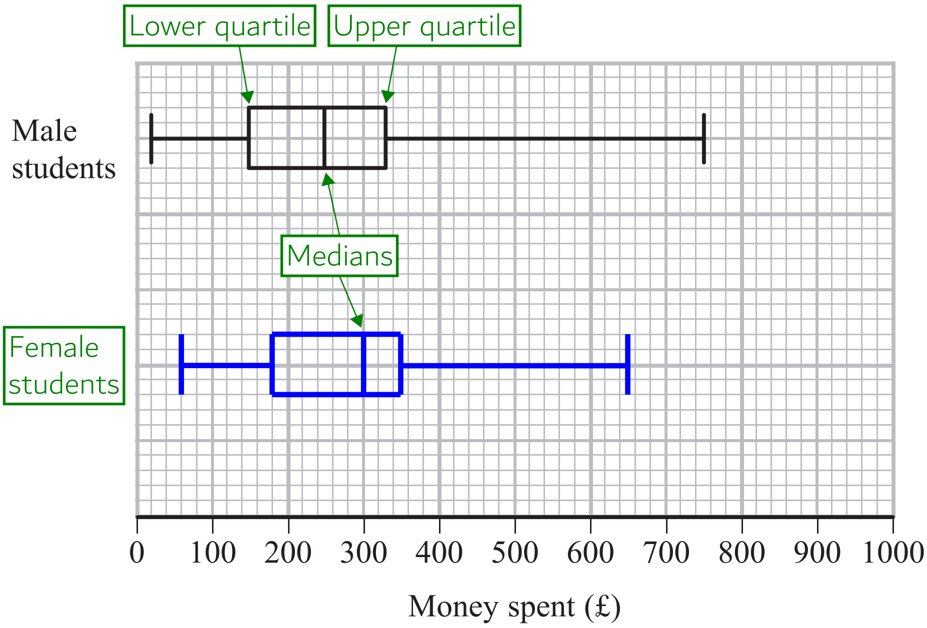
$3.9...^2 + 3.9...^2 = x^2$ ← Using Pythagoras' Theorem. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side

$x = \sqrt{31.1...}$ ← Square rooting both sides finds x

5.585... is rounded to 3 significant figures → 5.59

(Total for Question 8 is 4 marks)

9 The box plot shows information about the distribution of the amounts of money spent by some male students on their holidays.



(a) Work out the interquartile range for the amounts of money spent by these male students.

330 - 150 ← Interquartile range = upper quartile - lower quartile

£ 180

(2)

The table below shows information about the distribution of the amounts of money spent by some female students on their holidays.

	Smallest	Lower quartile	Median	Upper quartile	Largest
Money spent (£)	60	180	300	350	650

(b) On the grid above, draw a box plot for the information in the table.

(2)

Drawing vertical lines for each of these values then joining them up into a box plot

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Chris says,

"The box plots show that the female students spent more money than the male students."

(c) Is Chris correct?
Give a reason for your answer.

Yes, as median was greater for females

So females spent more on average

(1)

(Total for Question 9 is 5 marks)

10 Naoby invests £6000 for 5 years.
The investment gets compound interest of x% per annum.

At the end of 5 years the investment is worth £8029.35

Work out the value of x.

$$6000\left(\frac{100+x}{100}\right)^5 = 8029.35$$

Adding x% to 100% expresses the percentage it increases to each year. Putting this over converts it to a fraction, which when multiplied by increases by x%. Raising the fraction to the power of 5 as the £6000 needs to be increased by x% 5 times. This will give the value of the investment after 5 years

$$\left(\frac{100+x}{100}\right)^5 = 1.3...$$

Dividing both sides by 6000

$$\frac{100+x}{100} = 1.0...$$

Doing the 5th root of both sides

Multiplying both sides by 100 then subtracting 100 from both sides to get x on its own. 5.99... is rounded to 6

6

(Total for Question 10 is 3 marks)

11 Jeff is choosing a shrub and a rose tree for his garden.
At the garden centre there are 17 different types of shrubs and some rose trees.

Jeff says,

"There are 215 different ways to choose one shrub and one rose tree."

Could Jeff be correct?
You must show how you get your answer.

$215 \div 17 = 12.6...$

Using the product rule for counting: number of shrubs × number of rose trees = 215. So dividing the 215 by the 17 shrubs works out that there would be 12.6... rose trees

No

There needs to be a whole number of rose trees

(Total for Question 11 is 2 marks)

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12 The points *A*, *B*, *C* and *D* lie in order on a straight line.

$$AB : BD = 1 : 5$$
$$AC : CD = 7 : 11$$

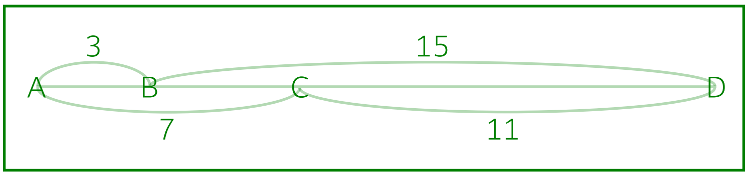
Work out $AB : BC : CD$

3 : 15

Both ratios describe the whole line from A to D. So having the same amount of parts in total makes them compatible so that 1 part is worth the same in both ratios. 7 + 11 = 18 parts in total in the 2nd ratio. 1 + 5 = 6 parts in total in the 1st ratio. Multiplying both sides of the 1st ratio by 3 will give 18 parts in total

7 - 3

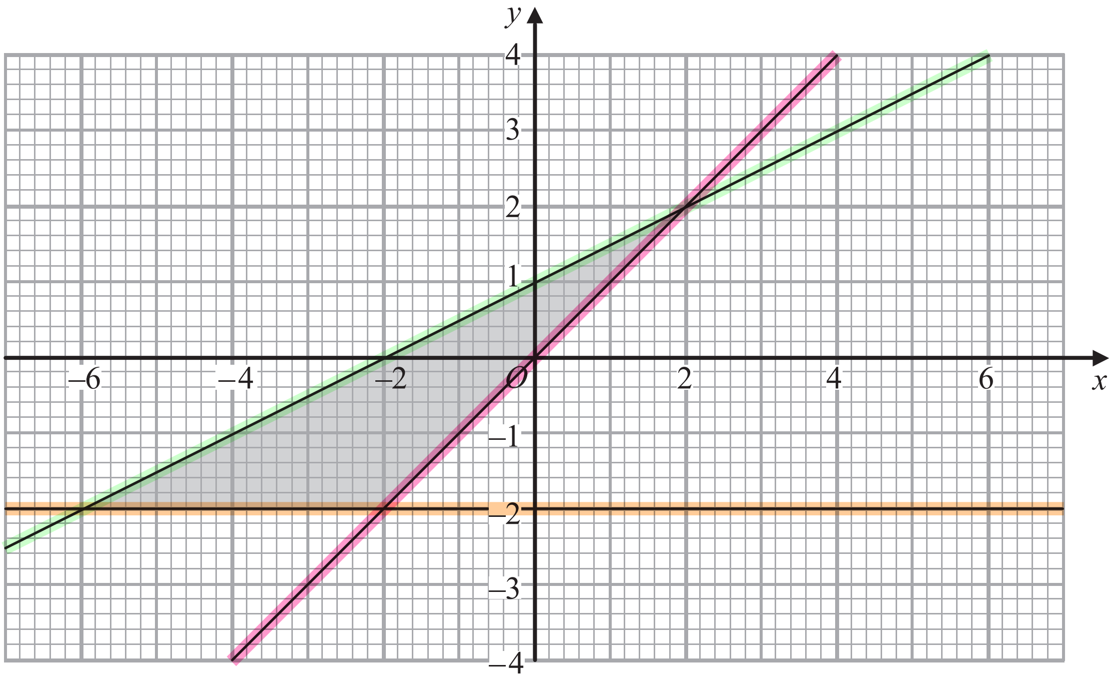
Subtracting AB from AC leaves BC



3 : 4 : 11

(Total for Question 12 is 3 marks)

13



Write down the three inequalities that define the shaded region.

The equation of the orange line is y = -2 as all the y-coordinates are -2. y is greater as the region is above this line.

The equation of the pink line is y = x as all the x-coordinates are the same as the y-coordinates. y is greater as the region is above this line.

The general equation of a straight line is y = mx + c, where m is the gradient and c is the y-intercept. The equation of the green line is y = 0.5x + 1 as its gradient is 0.5 (it goes up 0.5 every 1 it goes to the right) and its y-intercept is 1. y is less as the region is below this line.

All of the lines are solid (not dashed) so y can also be equal for all of the inequalities

$y \geq -2$

$y \geq x$

$y \leq 0.5x + 1$

(Total for Question 13 is 4 marks)

14 (a) Simplify $\dfrac{x^2 - 16}{2x^2 - 5x - 12}$

$(x + 4)(x - 4)$ ← Factorising the numerator using difference of two squares. $A^2 - B^2 = (A + B)(A - B)$. $A^2 = x^2$ so A is x and $B^2 = 16$ so B is 4

$2x^2 - 8x + 3x - 12$ ← The denominator is in the form $ax^2 + bx + c$. a is 2, b is -5 and c is -12. Multiplying a by c gives -24. Two numbers which multiply to this -24 and which add to b are -8 and 3. Splitting the middle x term into these numbers of x

$2x(x - 4) + 3(x - 4)$ ← Factorising the left two terms and the right two terms separately

$(2x + 3)(x - 4)$ ← Writing the denominator in factorised form by bringing the 2x and +3 together and writing the x - 4 once

(x - 4) is a common factor to the numerator and denominator so can be cancelled out → $\dfrac{x + 4}{2x + 3}$

(3)

(b) Make v the subject of the formula $w = \dfrac{15(t - 2v)}{v}$

$wv = 15t - 30v$ ← Multiplying both sides by v eliminates v as the denominator on the right. Expanding the bracket on the right

$wv + 30v = 15t$ ← Adding 30v to both sides to get all of the terms involving v on the same side

$v(w + 30) = 15t$ ← Bringing v out as a factor on the left side

Dividing both sides by w + 30 to get v on its own → $v = \dfrac{15t}{w + 30}$

(3)

(Total for Question 14 is 6 marks)

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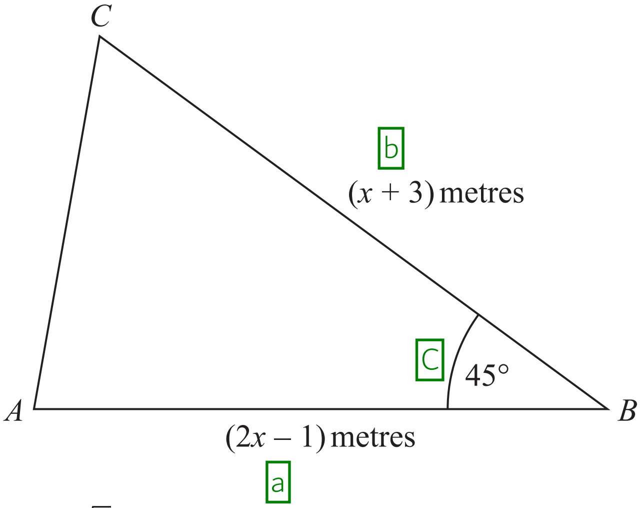
15



The area of triangle ABC is $6\sqrt{2}$ m^2.

Calculate the value of x.
Give your answer correct to 3 significant figures.

$\frac{1}{2}(2x - 1)(x + 3)\sin 45 = 6\sqrt{2}$ ← Area of triangle = 1/2 absinC, where a and b are two sides and C is the angle between them. Expressing the area in terms of x then setting equal to the value of the area

$(2x - 1)(x + 3) = 24$ ← Dividing both sides by 1/2 and sin45

$2x^2 + 6x - x - 3 - 24 = 0$ ← Expanding the brackets and subtracting 24 from both sides

$2x^2 + 5x - 27 = 0$ ← Collecting like terms

$\frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times -27}}{2 \times 2}$ ← $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ← It is in the form $ax^2 + bx + c = 0$ so can be solved using the quadratic formula

2.631... is rounded to 3 significant figures. The other solution of -5.13 is ignored as this would give negative lengths on the triangle → 2.63

(Total for Question 15 is 5 marks)

16 Using $x_{n+1} = -2 - \frac{4}{x_n^2}$

with $x_0 = -2.5$

(a) find the values of x_1, x_2 and x_3

Enter -2.5 into the calculator and press =/exe. Enter -2 - 4/ans^2 and press =/exe to get x_1. Press =/exe again to get x_2. Press =/exe again to get x_3.

This substitutes x_0 for x_n in the formula to get x_1. Then substitutes x_1 for xn in the formula to get x_2. Then substitutes x_2 for xn in the formula to get x_3

$x_1 =$ -2.64

$x_2 =$ -2.57

$x_3 =$ -2.60

(3)

(b) Explain the relationship between the values of x_1, x_2 and x_3 and the equation $x^3 + 2x^2 + 4 = 0$

They are estimates of the solutions to the equation. The iterative form is a rearrangement of the equation

(2)

(Total for Question 16 is 5 marks)

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17 A train travelled along a track in 110 minutes, correct to the nearest 5 minutes.

Jake finds out that the track is 270 km long.
He assumes that the track has been measured correct to the nearest 10 km.

(a) Could the average speed of the train have been greater than 160 km/h?
You must show how you get your answer.

$110 - \frac{5}{2} = 107.5$

Subtracting half of the resolution of the measurement from the 110 minutes works out that the lower bound of the time taken is 107.5 minutes. The resolution is 5 minutes as it is to the nearest 5 minutes

$270 + \frac{10}{2} = 275$

Adding half of the resolution of the measurement to the 270 km works out that the upper bound of the distance travelled is 275 km. The resolution is 10 km as it is to the nearest 10 km

$275 \div \frac{107.5}{60} = 153.4...$

km/h means to divide the distance travelled in km by the time taken in hours. Dividing the upper bound of the distance by the lower bound of the time (as dividing by less makes it more) works out the upper bound of the average speed. There are 60 minutes in an hour so putting the 107.5 minutes over 60 converts it to hours

No

The upper bound of the average speed is less than 160 km/h so it could not have been greater than 160 km/h

(4)

Jake's assumption was wrong.
The track was measured correct to the nearest 5 km.

(b) Explain how this could affect your decision in part (a).

No affect as the speed would be less

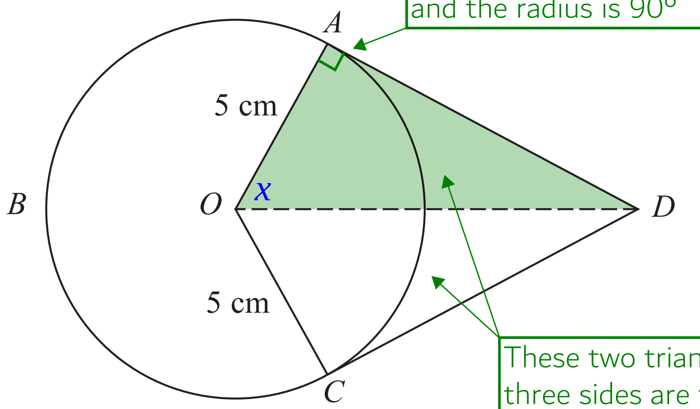
The upper bound of the distance would be less than 275. Dividing a smaller amount by the lower bound of the time taken will result in a lower speed. So it still would not be greater than 160 km/h

(1)

(Total for Question 17 is 5 marks)

18

The angle between a tangent and the radius is 90°



These two triangles are congruent as all three sides are the same in both. Tangents meeting at the same point are equal in length

A, *B* and *C* are points on a circle of radius 5 cm, centre *O*.
DA and *DC* are tangents to the circle.
DO = 9 cm

Work out the length of arc *ABC*.
Give your answer correct to 3 significant figures.

S $\overset{O}{\text{H}}$ C $\overset{A}{\text{H}}$ T $\overset{O}{\text{A}}$

Using right-angled trigonometry in the green triangle to find the angle x. Ticking H as the 9 cm is the hypotenuse. Ticking A as the 5 cm is the adjacent. There are two ticks on the CAH formula triangle so this one can be used

$\cos x = \frac{5}{9}$

Covering C in the CAH formula triangle finds that cos of the angle = adjacent/hypotenuse. Then doing the inverse cos of both sides finds that x = 56.2...°

56.2... × 2

As the triangles are congruent, angle x is equal to angle COD. So multiplying x by 2 works out angle AOC

360 - 112.5...

There are 360° around a point. So subtracting angle AOC from 360° works out that the reflex angle AOC is 247.4...°

$\frac{247.4...}{360} \times 2 \times \pi \times 5$

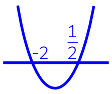
Putting reflex angle AOC over 360° expresses the fraction of the circle which the sector ABC is. The arc ABC is this fraction of the circumference. Circumference = 2 × π × radius

21.59... is rounded to 3 significant figures → 21.6 .... cm

(Total for Question 18 is 5 marks)

19 Solve $2x^2 + 3x - 2 > 0$

$\dfrac{-3 \pm \sqrt{3^2 - 4 \times 2 \times -2}}{2 \times 2}$ ← $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ← Solving where the left side is equal to 0 using the quadratic formula. a = 2, b = 3, c = -2



← Sketching the graph. It is positive x^2 so is u-shaped

It is greater than 0 in the y-direction to the left from -2 and to the right from 1/2 → $x < -2 \quad x > \dfrac{1}{2}$

(Total for Question 19 is 3 marks)

20 The equation of a curve is $y = a^x$
A is the point where the curve intersects the y-axis.

(a) State the coordinates of A.

The x-coordinate is 0 where it is intersecting the y-axis.
Anything to the power of 0 is 1 so the y-coordinate must be 1

(......0......, ...1......)

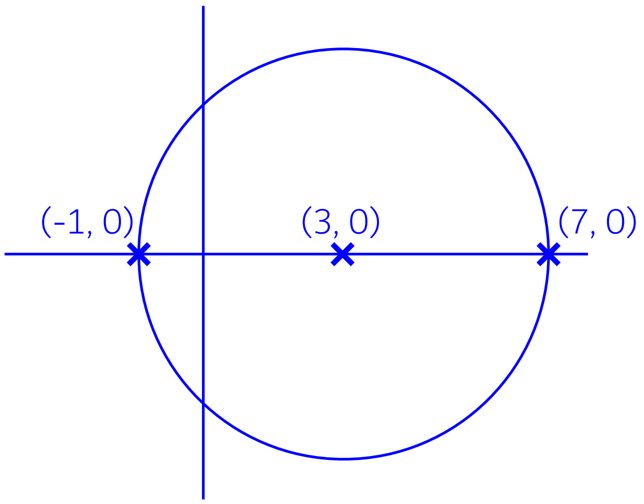
(1)

The equation of circle **C** is $x^2 + y^2 = 16$

The circle **C** is translated by the vector $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ to give circle **B**.

(b) Draw a sketch of circle **B**.

Label with coordinates
the centre of circle **B**
and any points of intersection with the x-axis.



The general equation of a circle with its centre at the origin is $x^2 + y^2 = \text{radius}^2$. Moving it 3 to the right means that the centre will be at (3, 0). $\text{Radius}^2 = 16$ so radius = 4. So the circle will intersect the x-axis 4 to the left and 4 to the right from the centre

(3)

(Total for Question 20 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS