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 ▶

6/6/6/6/6/7/4/

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

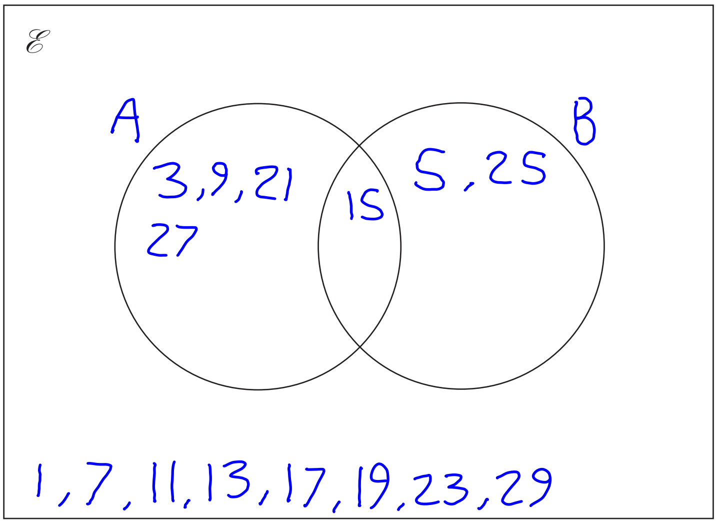
Answer ALL questions.

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 $A \cup B$?

7 out of 15 numbers are in A or B or both.

$\frac{7}{15}$

(2)

(Total for Question 1 is 6 marks)

2 Solve the simultaneous equations

$$3x + y = -4$$
$$3x - 4y = 6$$

Eliminated the x terms by subtracting the second equation from the first equation.

$5y = -10$

$y = -2$

$x = \frac{-4 - (-2)}{3}$

Rearranged the first equation to make x the subject then substituted in -2 for y to solve x.

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

$y = -2$

(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.

$\frac{25+1}{2} = 13$

So the 13th value is the median, which is in 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, the events aren't mutually exclusive.

Some of the women might have both shoe size of 7 and dress size of 14.

(1)

(Total for Question 3 is 2 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

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 calculates how many vanilla cakes there are.

$0.35 \times 420 = 147$

This calculates how many bannana cakes there are.

$420 - 120 - 147 = 153$

This calculates how many lemon and chocolate cakes there are.

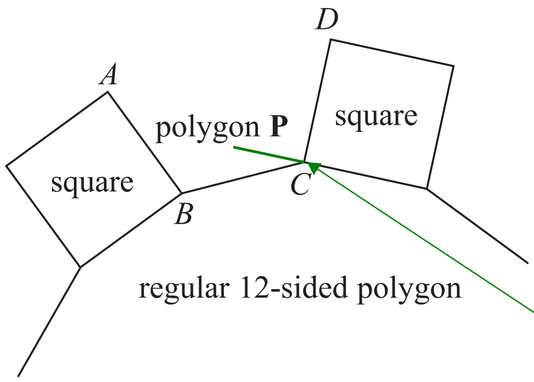
$\frac{153}{9} \times 4$

Dividing by 9 calculates 1 part of the ratio then multiplying by 4 calculates 4 parts, which represents the lemon cakes.

68

(Total for Question 4 is 5 marks)

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.

$$\frac{360}{12} = 30$$

The exterior angle of the 12-sided polygon using the formula 360/number of sides = exterior angle.

$$90 + 30 = 120$$

The exterior angle of the square is 90° and this is added to the exterior angle of the 12-sided polygon to get the interior angle of polygon P.

$$\frac{(6-2) \times 180}{6} = 120$$

The interior angle of a hexagon, which has 6 sides, is 120. Degrees in a polygon = (n - 2) x 180, where n is the number of sides. Dividing the total number of degrees by the number of angles gives one of the angles.

(Total for Question 5 is 4 marks)

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.

$d = \frac{m}{V}$

$m = dV$

To work out the density, ***d***, we need to work out the total mass, ***m***, and divide this by the total volume, ***v***. To work out the total mass, we need to add the mass of each of the liquids together.

$$\frac{1.05 \times 25 + 1.4 \times 15 + 0.99 \times 280}{320}$$

Multiplying the density by the volume for each liquid then adding them together. Dividing by the total volume, 320 cm^3.

1.01 g/cm^3

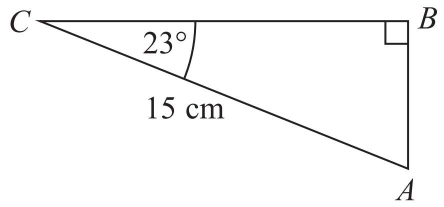
(Total for Question 6 is 4 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

7 *ABC* is a right-angled triangle.



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

S O H C A H T O A

Listing SOH CAH TOA as formula triangles and ticking what we have and what we are trying to find. AB is the opposite (O) and AC is the hypotenuse (H).

Sin 23 x 15

There are two ticks on SOH so that formula triangle can be used. Covering O (as we are trying to find the opposite) tells us that opposite = (sin of the angle) x hypotenuse

5.86 cm

(Total for Question 7 is 2 marks)

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.

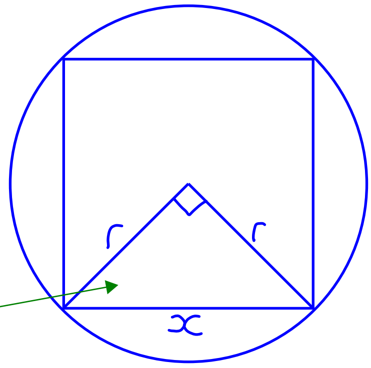
The area of the circle is 49 cm^2.

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

$\pi r^2 = 49$

$r = \sqrt{\frac{49}{\pi}} = \frac{7}{\sqrt{\pi}}$

πr^2 = area of circle
This can be rearranged to find r



$x^2 = r^2 + r^2$

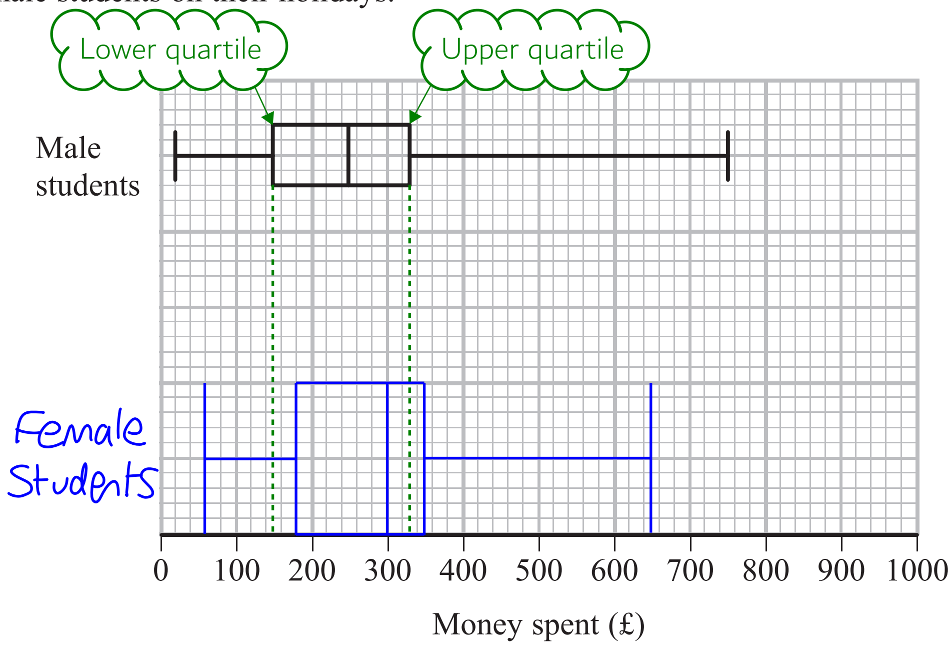
$x = \sqrt{\left(\frac{7}{\sqrt{\pi}}\right)^2 + \left(\frac{7}{\sqrt{\pi}}\right)^2}$

Side *x* and two radii make a right angled triangle so Pythagoras' Theorem can be used.

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.

Interquartile range = upper quartile - lower quartile

330-150

£ 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)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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, the median was higher for the females.

(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.

$$6000\left(1+\frac{x}{100}\right)^5 = 8029.35$$

Using the formula for compound interest.

$$x = \left(\sqrt[5]{\frac{8029.35}{6000}} - 1\right) \times 100$$

Rearrange the formula so x is the subject.

6

(Total for Question 10 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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.

$$\frac{215}{17} = 12.6\ldots$$

Using the product rule for counting:
number of shrubs x number of rose trees = 215
Rearranging to find the number of rose trees gets this.
The result is not a whole number and this is impossible.

No

(Total for Question 11 is 2 marks)

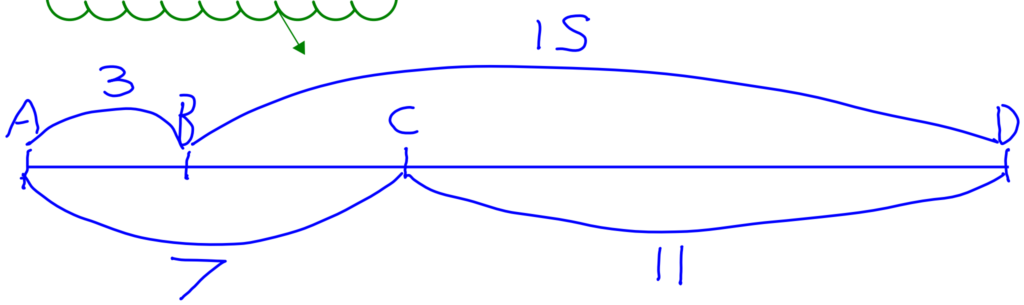
12 The points A, B, C and D lie in order on a straight line.

$AB:BD = 1:5$ $= 3:15$
$AC:CD = 7:11$

Converted so that both ratios have
18 parts in total from A to D.

Work out $AB:BC:CD$

A rough sketch of the
information we are given.

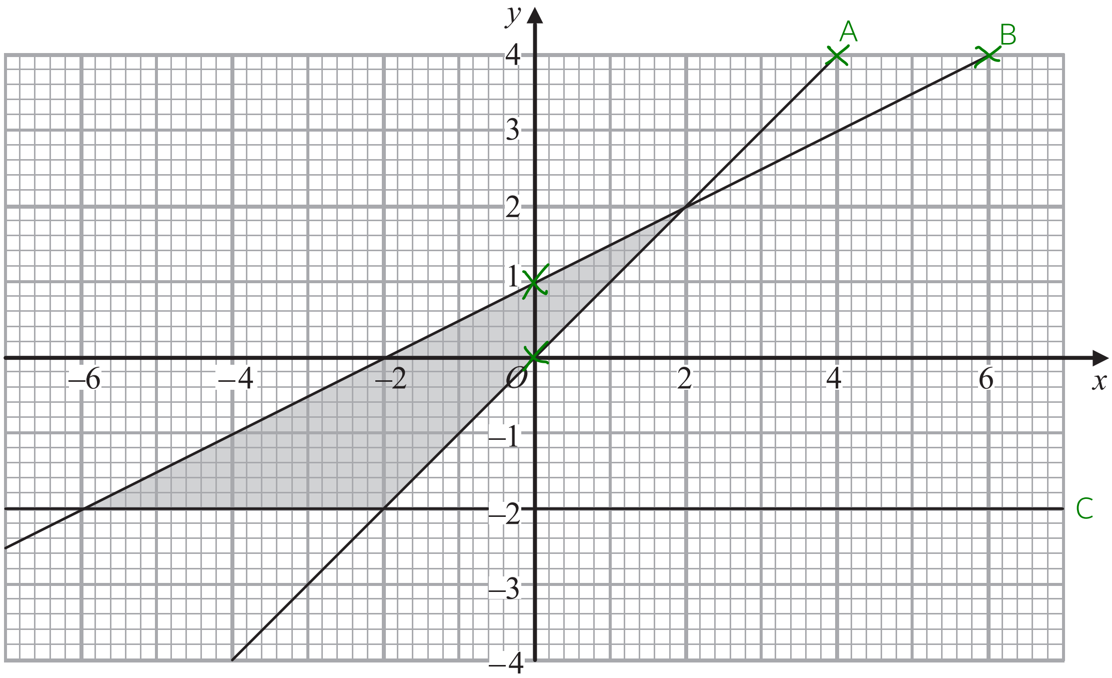


If AC is 7 parts and AB is 3
parts, BC must be 4 parts.

3 : 4 : 11

(Total for Question 12 is 3 marks)

13



Write down the three inequalities that define the shaded region.

Work out the equation of the lines then convert them into inequalities. They are all in the form $y = mx + c$ where m is the gradient and c is the y-intercept. Gradient = (change in y)/(change in x).

Line A: y changes from 0 to 4, so the change in y is 4. x changes from 0 to 4 so the change in x is 4. 4/4 = 1 so the gradient is 1. The y-intercept is 0. Therefore the equation is $y = x$. The region is above the line so y is more and the line is solid so it can also be equal.

Line B: y changes from 1 to 4, so the change in y is 3. x changes from 0 to 6 so the change in x is 6. 3/6 = 1/2 so the gradient is 1/2. The y-intercept is 1. Therefore the equation is $y = 1/2\,x + 1$. The region is below the line so y is less and the line is solid so it can also be equal.

Line C: The equation of the line is y = -2 as y doesn't change and is always -2. The region is above the line so y is more and the line is solid so it can also be equal.

$y \geq x$

$y \leq \frac{1}{2}x + 1$

$y \geq -2$

(Total for Question 13 is 4 marks)

.CG Maths.

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

$(x+4)(x-4)$ ← Factorising the numerator by using difference of two squares.

$2x^2 - 8x + 3x - 12$

$2x(x-4) + 3(x-4)$

$(2x+3)(x-4)$

Factorising the denominator. Multiplying a by c (2 x -12) to get -24. Splitting the middle term into two numbers which multiply to -24 and add to -5. Factorising the first two terms and the last two terms then bringing together the $2x$ and +3 into a single bracket.

Cancelled out the common factor of (x - 4) from the numerator and denominator.

$\dfrac{x+4}{2x+3}$

(3)

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

$wv = 15t - 30v$ Multiply both sides by v to eliminate it as the denominator. Expand the bracket.

$wv + 30v = 15t$ Move all the terms involving v onto the same side.

$v(w+30) = 15t$ Bring v out as a factor.

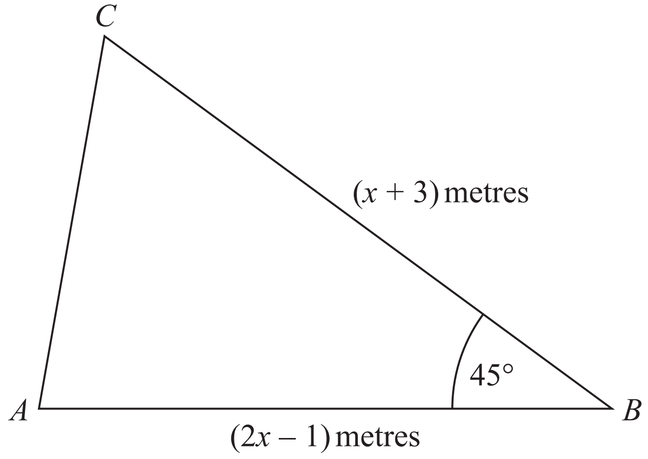
Divide both sides by (w + 30) to make v the subject.

$v = \dfrac{15t}{w+30}$

(3)

(Total for Question 14 is 6 marks)

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.

$$\frac{1}{2}(x+3)(2x-1)\sin 45 = 6\sqrt{2}$$

1/2 x ***ab**sinC* = area of triangle

$$(2x^2 - x + 6x - 3) \times \frac{1}{2} \times \frac{\sqrt{2}}{2} - 6\sqrt{2} = 0$$

$$(2x^2 + 5x - 3) \times \frac{\sqrt{2}}{4} - 6\sqrt{2} = 0$$

Expand the brackets and simplify. Bring everything onto one side so if can be solved.

$$2x^2 + 5x - 27 = 0$$

Divide both sides by $\sqrt{2}/4$

$$x = \frac{-5 \pm \sqrt{5^2 - 4 \times 2 \times -27}}{2 \times 2}$$

Using the quadratic formula, which can be put into the calculator.

There is also a solution of -5.13 but this is disregarded as there cannot be a negative length.

2.63

(Total for Question 15 is 5 marks)

.CG Maths.

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

with $x_0 = -2.5$

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

$$x_1 = -2 - \frac{4}{(-2.5)^2}$$

Substitute x_0 for x_n in the formula.

$$x_2 = -2 - \frac{4}{(-2.64)^2}$$

Substitute x_1 for x_n in the formula.

$$x_3 = -2 - \frac{4}{\left(-\frac{2803}{1089}\right)^2}$$

Substitute x_2 for x_n in the formula.

$x_1 =$ -2.64

$x_2 =$ $-\frac{2803}{1089}$

$x_3 =$ -2.603767255

(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 equation is a rearrangement of the equation

(2)

(Total for Question 16 is 5 marks)

DO NOT WRITE IN THIS AREA

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.

$$s = \frac{d}{t} = \frac{275}{\left(\frac{107.5}{60}\right)} = 153.5$$

To get the fastest possible speed, we need the greatest distance in the shortest amount of time. Therefore the upper bound of 275 for the distance has been used. The lower bound of 107.5 has been used for the time.

To find the bounds, add and subtract half of the resolution.

Dividing the time by 60 converts the minutes into hours.

No

The maximum possible speed was less 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).

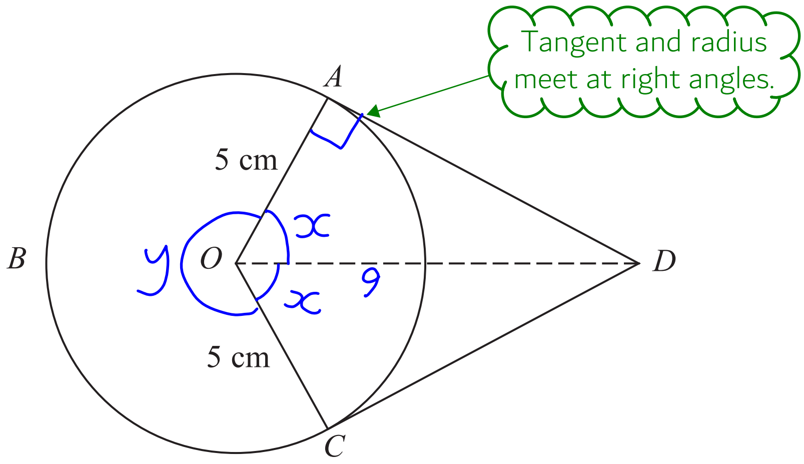
It would still be no as the speed would be less.

The distance would be less.

(1)

(Total for Question 17 is 5 marks)

18



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.

SOHCAHTOA

$\cos x = \frac{\text{Adj}}{\text{Hyp}}$

$x = \cos^{-1}\left(\frac{5}{9}\right)$

$\pi \times 10 \times \frac{360 - 2\cos^{-1}\left(\frac{5}{9}\right)}{360}$

10 is the diameter, which is double the radius of 5

Arc ABC is a fraction of the circumference, which can be found with π x diameter. The diameter is double the radius.

To find the fraction of the circumference, we need to find angle y and to find this we need angle x, which is in a right angled triangle and can be found using trigonometry.

There are 360° around the inside of a circle. Angle y/360 works out the fraction of the circle and therefore the fraction of the circumference the arc is. Angle y is found by 360 - 2x.

21.6 cm

(Total for Question 18 is 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

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

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

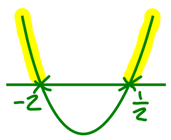
$2x(x+2) - 1(x+2)$

$(2x-1)(x+2) = 0$

Factorising the left side then setting it equal to 0 so it can be solved. Multiplying a by c (2 x -2) to get -4. Splitting the middle term into two numbers which multiply to -4 and add to 3. Factorising the first two terms and the last two terms then bringing together the 2*x* and -1 into a single bracket.

either $2x - 1 = 0$ or $x + 2 = 0$

$x = \frac{1}{2}$ $\quad$ $x = -2$



The quadratic looks something like the sketch on the left. The highlighted parts are greater than 0.

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

(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 at the y-axis.
Substituting x for 0 gives $y = a^0$.
Anything to the power of 0 is 1.

(0 , 1)

(1)

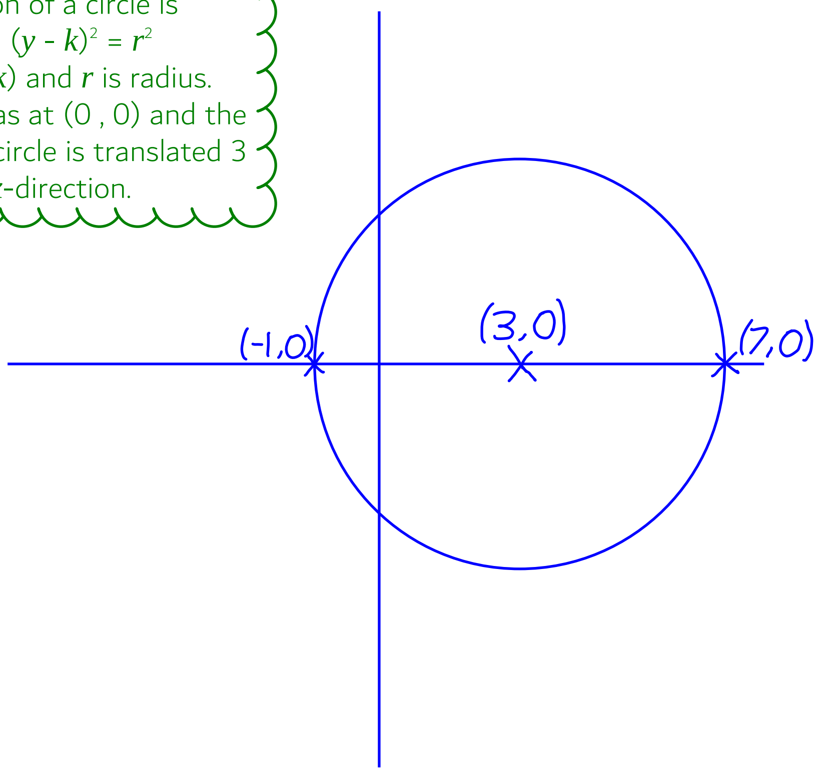
The equation of circle **C** is $x^2 + y^2 = 16$

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 equation of a circle is
$(x - h)^2 + (y - k)^2 = r^2$
centre is (h , k) and r is radius.
So the centre was at (0 , 0) and the radius is 4. The circle is translated 3 in the x-direction.



(3)

(Total for Question 20 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS