

Thursday 4 November 2021 – Morning**GCSE (9–1) Mathematics****J560/05 Paper 5 (Higher Tier)****Time allowed: 1 hour 30 minutes****You can use:**

- geometrical instruments
- tracing paper

Do not use:

- a calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

First name(s)

Last name

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- This document has **20** pages.

ADVICE

- Read each question carefully before you start your answer.

Please note that these worked solutions have neither been provided nor approved by OCR 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** the questions.

1 Work out.

$$3\frac{4}{7} \times \frac{7}{10}$$

Give your answer as a mixed number in its simplest form.

Convert the mixed fraction into an improper fraction by multiplying the whole number by the denominator and adding the result to the numerator. Fractions can be multiplied by multiplying the numerators together and the denominators together. To simplify a fraction, divide both the numerator and denominator by the same amount. To convert an improper fraction into a mixed number, divide the numerator by the denominator to get the whole number and leave the remainder in the fraction

..... [3]

2 (a) Azmi is given this question.

Write 40 as a product of prime factors.
Give your answer in index form.

This means that the answer should be given using indices if possible

Azmi's answer is $2 \times 2 \times 2 \times 5$.

Is Azmi correct?

Explain your answer.

Product means the result of multiplying numbers together. Prime means numbers which only have two factors: themselves and 1. Factors means whole numbers a certain value can be divided by without resulting in a decimal or fraction

..... [1]

(b) Find the value of x .

$$\frac{1}{16} = 2^x$$

Express 16 as a power of 2. A negative power means '1 over'

(b) $x =$ [1]

- 3 A car mechanic has a tin containing 5 litres of engine oil.
Each week they use 450 millilitres of this oil for their vehicles.

The car mechanic says

After 9 weeks I will have used over 80% of the oil in this tin.

Are they correct?

Show how you decide.

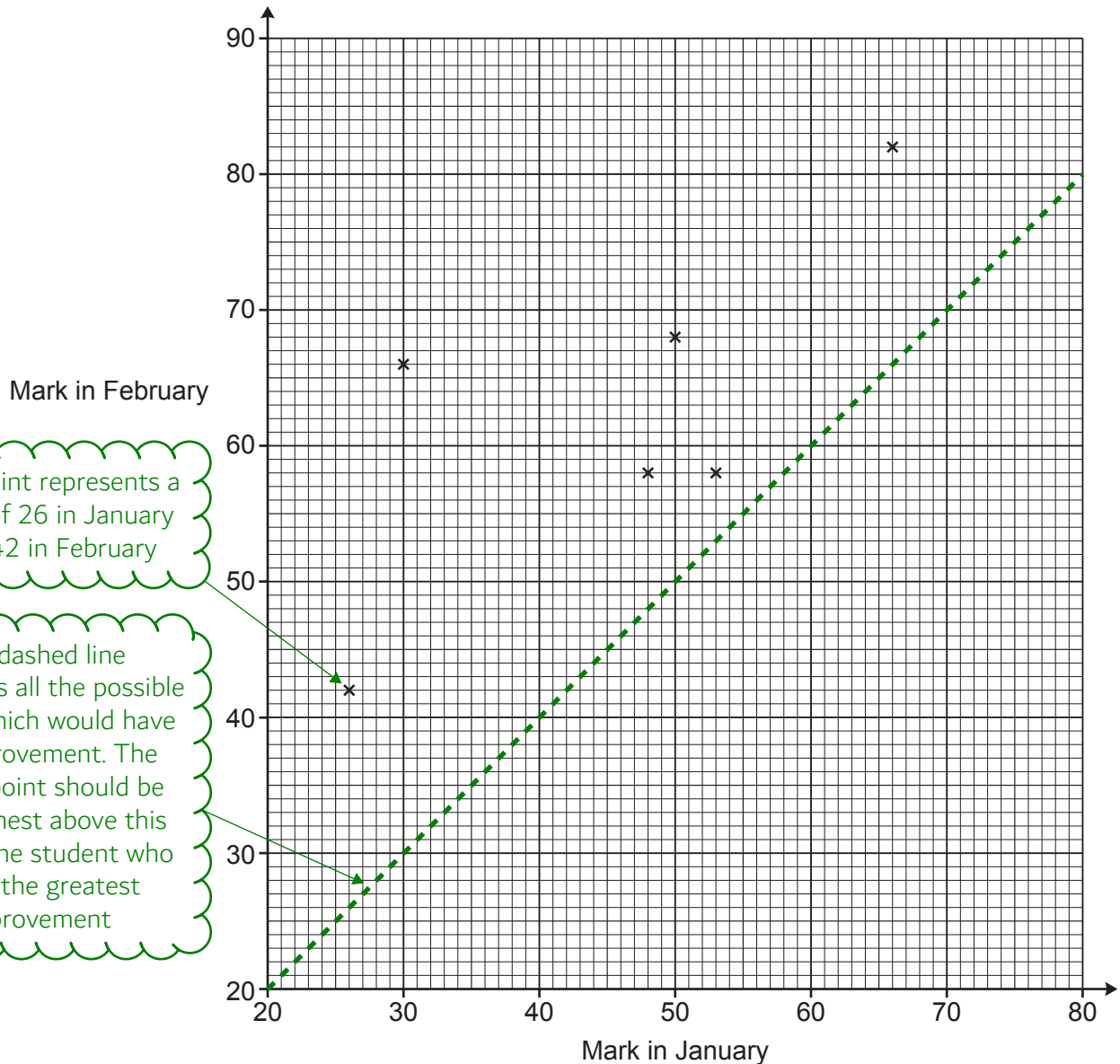
Multiplying the 450 millilitres used each week by the 9 weeks works out how many millilitres are used after 9 weeks. There are 1000 millilitres in 1 litre. Use this conversion to convert the 5 litres into millilitres. Work out 10% of this amount of millilitres then multiply the result by 8 to work out 80% of the tin. If the number of millilitres used is more than the number of millilitres in 80% of the tin, they are correct

.....
..... [5]

- 4 The table shows the marks obtained by 10 students in spelling tests in January and February.

Mark in January	26	53	50	48	30	66	70	44	37	38
Mark in February	42	58	68	58	66	82	86	60	48	50

The marks for the first six students are plotted on the scatter diagram.



- (a) Plot the marks for the remaining four students. [2]
- (b) Describe the type of correlation shown in the completed scatter diagram. [1]

..... Positive: both variables increase together. Negative: one variable increases as the other decreases. None: there is no link between the variables [1]

- (c) (i) On the scatter diagram, **circle** the student that made the greatest improvement in their marks from January to February. [1]
- (ii) Work out the percentage change in this student's marks from January to February.

Percentage change = $(\text{new} - \text{original}) / \text{original} \times 100$. The new is the mark in February. The original is the mark in January

(c)(ii) % [3]

- (d) Another student, Kai, scored 79 marks in the test in January but was absent for the test in February.

Kai says

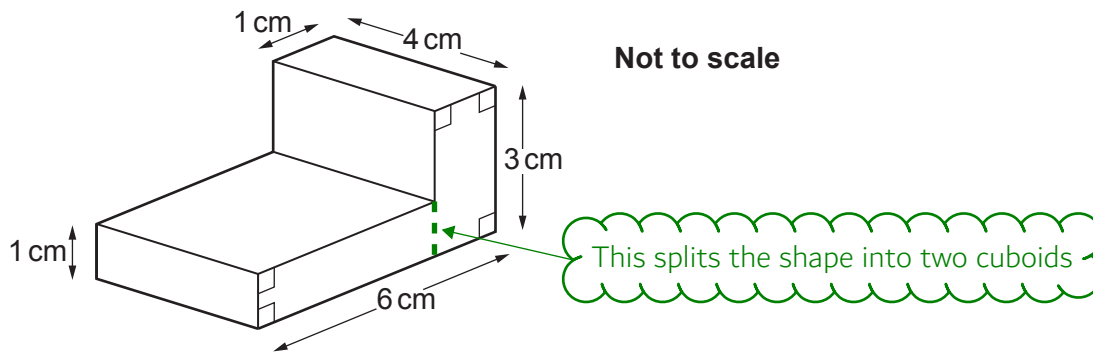
I could use a line of best fit on the scatter diagram to estimate the marks I may have achieved in the test in February.

Is Kai's method reliable?
Give a reason for your answer.

No,

.....
..... [1]

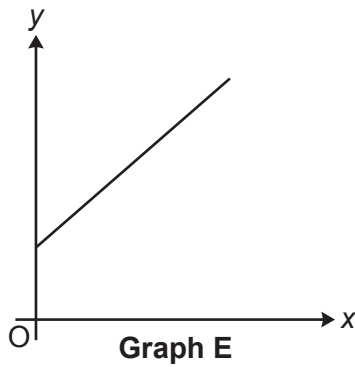
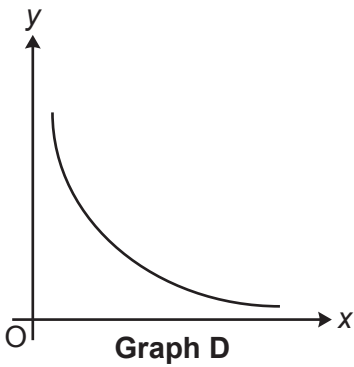
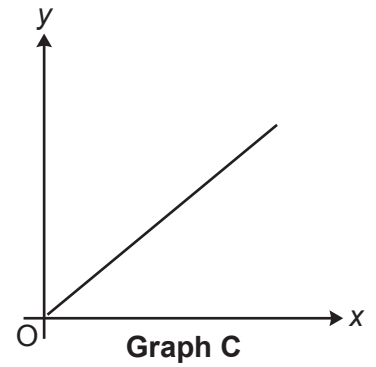
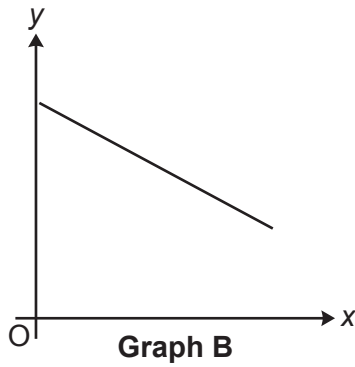
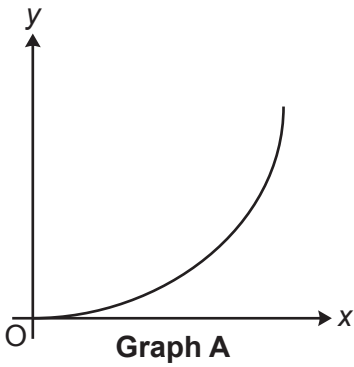
5 Work out the volume of this prism.



Volume of cuboid = length \times width \times height

..... cm³ [4]

6 Here are sketches of five graphs.



Write the letter of the graph that represents the following relationships.

(a) y is directly proportional to x .

Doubling x doubles y →

(a) [1]

(b) y is inversely proportional to x .

Doubling x halves y →

(b) [1]

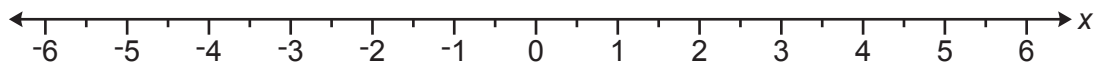
- 7 (a) Solve the inequality.

$$4(x - 3) < x$$

Expanding the brackets. Get all the x on the side with the most. Follow BIDMAS backward and do the opposite operations to both sides to get x on its own

(a) [3]

- (b) Show your answer to **part (a)** on the number line.



A hollow circle above a certain value indicates that it cannot be equal to that value. A shaded in circle above a certain value indicates that it can be equal to that value. An arrow should be drawn from the circle to indicate all the values included in the inequality

[2]

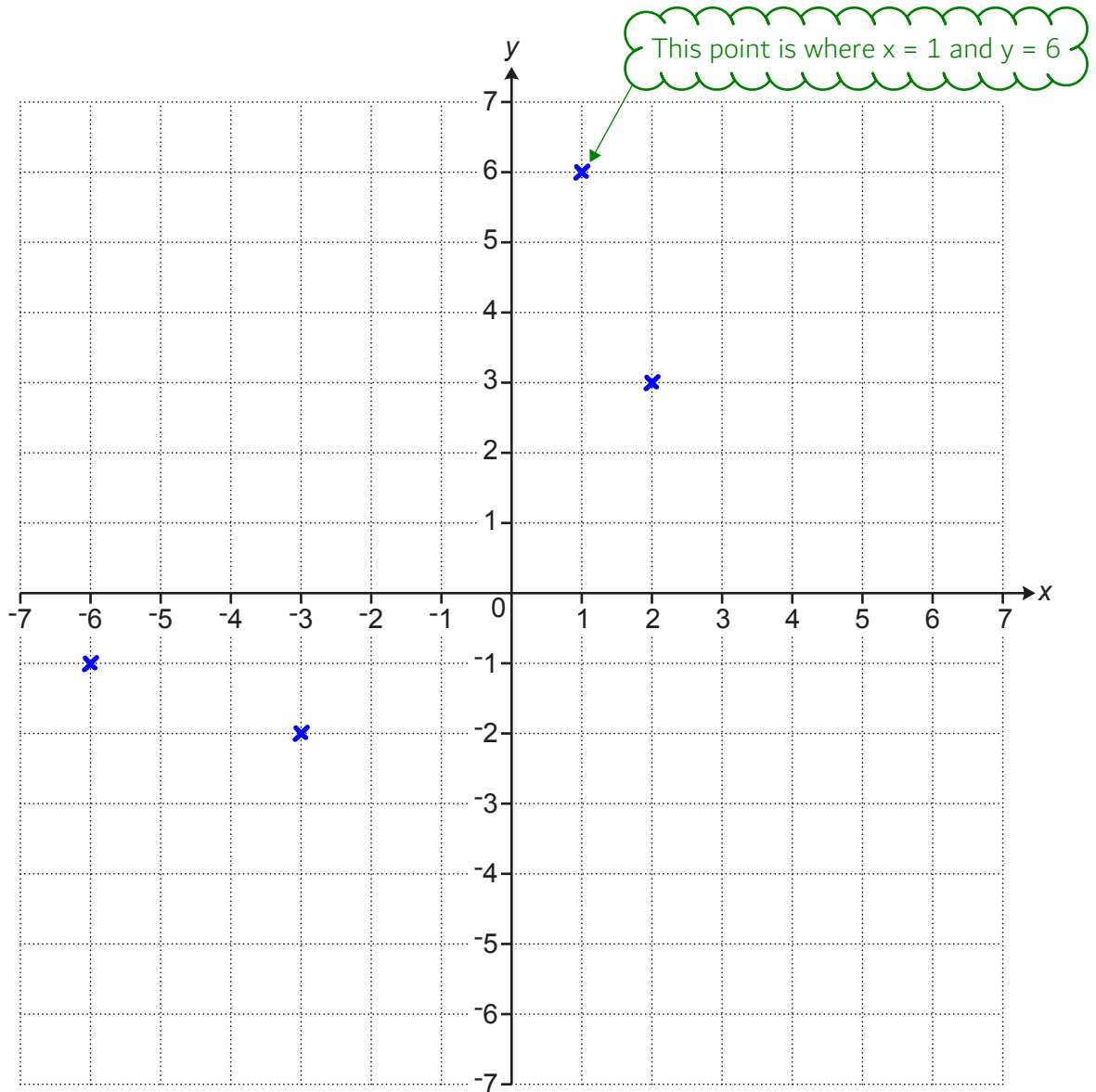
- 8 (a) Complete the table for $y = \frac{6}{x}$.

x	-6	-3	-2	-1	1	2	3	6
y	-1	-2		-6	6	3	2	1

$6/-2 = \dots$

[1]

- (b) Draw the graph of $y = \frac{6}{x}$ for $-6 \leq x \leq 6$, $x \neq 0$.



[3]

- 9 A worker received a 10% pay increase in 2017 and a further 10% pay increase in 2018. The worker says

Over these two years, my pay increased by $10\% + 10\% = 20\%$.

The worker is incorrect.

Work out the correct percentage increase.
You must show your working.

100% + 10% increases to 110%. Dividing this by 100 converts it into a decimal multiplier. Multiplying the decimal multiplier by itself represents an increase of 10% then another increase of 10%. Convert the resulting decimal into a percentage by multiplying it by 100 then work out the percentage increase by considering how much it has increased from 100%

..... [5]

- 10 Force is measured in newtons (N).
A force of 198.5 N is applied to a rectangular surface of length 4.9 cm and width 4.1 cm.

Work out an **estimate** of the pressure, in N/cm^2 , applied to this rectangular surface.

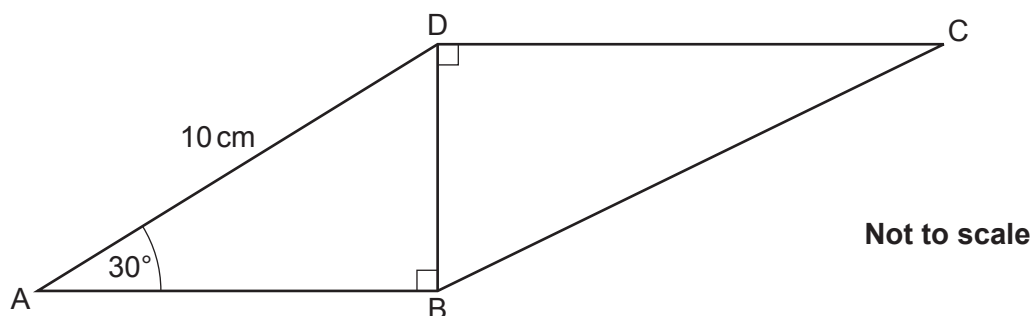
[The formula for pressure is: $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$]

Round all values to 1 significant figure. Area of rectangle = length x width.
Substitute the force and area into the formula to find pressure

..... N/cm^2 [4]

11 The diagram shows a quadrilateral ABCD.

$AD = 10\text{ cm}$, angle $BAD = 30^\circ$ and angle $ABD = \text{angle } BDC = 90^\circ$.



The ratio of length BD to length DC is 1 : 2.4 .

Work out length BC.

You must show your working.

SOHCAHTOA

Right-angled trigonometry can be used to work out the length BD in triangle ABD. Writing out SOH CAH TOA as formula triangles. Tick what we have and what we are trying to find. Two ticks on one of the formula triangles means that one can be used. Cover over what we are trying to find in the formula triangle and it will tell us how to find it.

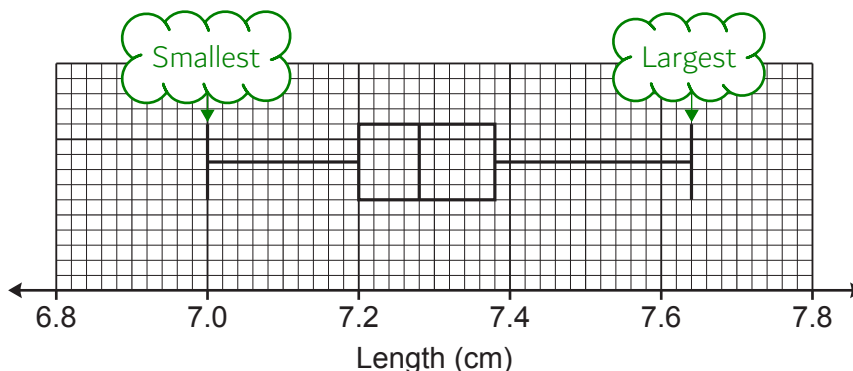
0 30 45 60 90

The angles we need to remember the trig values for are 0, 30, 45, 60 and 90. Writing these out and writing 0, 1, 2, 3, 4 under these for the sin values and 4, 3, 2, 1, 0 for the cos values. Square rooting and putting them over 2 works out the sin and cos values. Dividing the sin value by the cos value works out the tan values

From the ratio, side DC is 2.4 times the length of BD. Once BD and DC are worked out, Pythagoras' Theorem can be used to work out side BC as it is the missing side in right-angled triangle BCD. $a^2 + b^2 = c^2$, where a and b are the two shorter sides and c is the longest side.

..... cm [7]

- 12 The box plot shows the distribution of the lengths, in cm, of 60 full-grown mice owned by a pet shop.



- (a) Find the range.

Range = largest - smallest

(a)cm [2]

- (b) Work out the number of these mice that have a length of at least 7.2 cm.

The lower quartile is 7.2. So 3/4 of the mice have a length of at least 7.2cm

(b) [2]

- (c) Sam owns 5 full-grown mice.
Sam picks the third longest mouse and measures its length.
Sam then looks at the box plot.

Sam says

This mouse is 7.35cm long.

Therefore, the mice I own are longer than the full-grown mice owned by the pet shop.

- (i) Give a mathematical reason to support Sam's conclusion.

.....
 The third longest mouse will be the median of Sam's mice
 [1]

- (ii) Give a mathematical reason why Sam's conclusion may be unreliable.

.....
 The third longest mouse will be the median of Sam's mice
 [1]

- 13 (a) Write $\frac{3}{11}$ as a recurring decimal.

Dividing the numerator by the denominator converts the fraction into a decimal

(a) [2]

- (b) Write $0.4\dot{8}$ as a fraction in its simplest form.

$$x = 0.4\dot{8}$$

Let x be the recurring decimal

Multiplying both sides by 10 once as there is 1 recurring digit allows the recurring digit to be written in the same decimal place. Subtracting x from $10x$ cancels out the recurring digit. Dividing both sides by 9 expresses x as a fraction, but there will be a decimal in the fraction. Multiplying the numerator and denominator by 10 eliminates the decimal from the fraction. The fraction can be simplified by dividing both the numerator and denominator by the same amount until they cannot be divided any further without getting decimals

(b) [3]

- 14 Two solid ornaments are mathematically similar.
The larger ornament is twice as tall as the smaller ornament.

The smaller ornament has a volume of 50 cm^3 .

Work out the volume of the larger ornament.

The scale factor of the lengths is 2 so the scale factor of the volume is 2^3

..... cm^3 [2]

- 15 Write $\sqrt{20} + \sqrt{45}$ in the form $k\sqrt{5}$.

Use the rule $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ to split $\sqrt{20}$ and $\sqrt{45}$ into two surds, one of which is the square root of a square number

The square number can then be square rooted to give a whole number. Both should now be involving $\sqrt{5}$, which behaves like x when two terms involving $\sqrt{5}$ are added

..... [3]

16 In a group of 60 students, 40 own a smartphone, 27 own a tablet and 8 own neither.

A student is chosen at random from those that own a tablet.

Find the probability that they also own a smartphone.

You must show your working.

Subtracting the 8 who have neither from the 60 students finds how many students either have a smartphone or a tablet or have both. Assuming that no student owns both, adding the 40 who own a smartphone and the 27 who own a tablet works out how many students would either have a smartphone or a tablet. This should be more than the number of students who either have a smartphone or a tablet or have both. Every one student who owns both takes one off the total

..... [5]

17 Simplify fully.

$$\frac{2x^2 - 50}{x^2 + 7x + 10}$$

To simplify a fraction, cancel out common factors to the numerator and denominator.

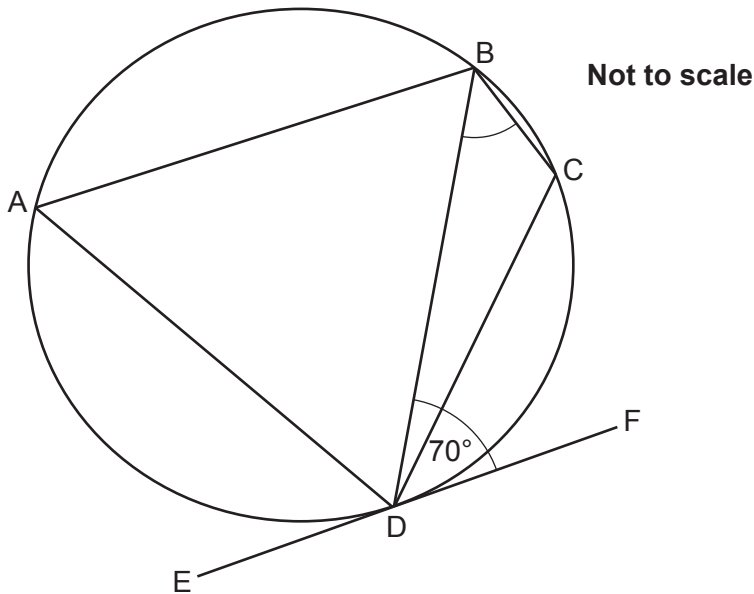
Factorise both the numerator and denominator to see the common factors. To factorise the numerator: find a common factor of both terms, bring this out as a factor and divide both terms by the factor leaving the result in a bracket. Then use difference of two squares. $A^2 - B^2 = (A + B)(A - B)$. To factorise the denominator: find two integers which multiply to the 10 and add to the 7 and put these in brackets with x

..... [5]

18 A, B, C and D are points on the circumference of a circle.

EF is the tangent to the circle at D.

Angle BDF = 70° .



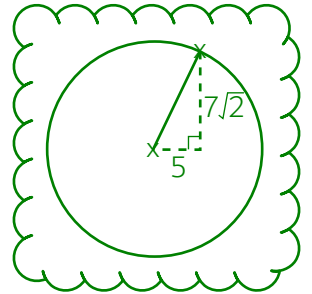
The ratio angle BCD : angle CBD is 5 : 2.

Work out angle CBD.

You must show your working.

The alternate segment theorem can be used: the angle between a tangent and a chord is equal to the interior opposite angle. Opposite angles in a cyclic quadrilateral add up to 180° . Angle BCD is represented by 5 parts of the ratio so dividing it by 5 works out the value of 1 part. Multiplying this by 2 works out the value of the 2 parts representing angle CBD

..... $^\circ$ [5]



- 19 The point $(5, 7\sqrt{2})$ lies on the circumference of a circle, centre $(0, 0)$.

Find the equation of the circle.

The radius of the circle goes from the centre to the point given. The distance of 5 from the centre to the point in the x-direction and the distance of $7\sqrt{2}$ from the centre to the point in the y-direction forms a right-angled triangle. So Pythagoras' Theorem can be used to work it out. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side. Substituting 5 for a and $7\sqrt{2}$ for b expresses c^2 , which is the radius²

The general equation of a circle with its centre at the origin is $x^2 + y^2 = r^2$, where r is the radius

..... [4]

- 20 $x^2 - 2y = 5$ and $4y + z = 7$.

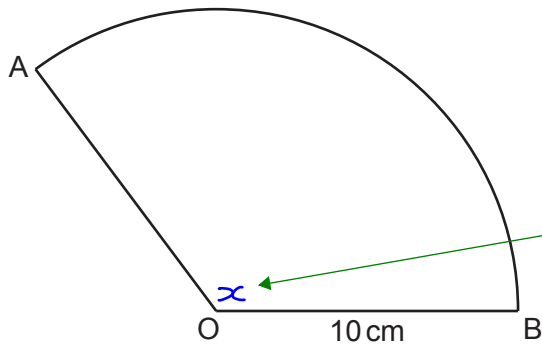
Write z in terms of x.

Give your answer in its simplest form.

Write z in terms of y by rearranging the second equation to make z the subject. Write y in terms of x by rearranging the first equation to make y the subject. Substitute y in terms of x for y in z in terms of y to get z in terms of x

..... [4]

21 AOB is a sector of a circle, centre O and radius 10 cm.



Not to scale

Let x be the angle of the sector

The area of the sector is $40\pi \text{ cm}^2$.

Work out the perimeter of the sector.

Give your answer in the form $a + b\pi$, where a and b are integers.

You must show your working.

Area of circle = $\pi \times \text{radius}^2$. There are 360° around the centre of a circle so $x/360$ is the fraction of the circle the sector is. Doing this fraction of the area of the circle must give the area of the sector. Form an equation in terms of x then rearrange to find x . We now have the angle of the sector. Express the perimeter of the sector by adding two lots of the radius and the arc length. The arc length is $x/360$ of the circumference. Circumference = $\pi \times \text{diameter}$. Diameter = $2 \times \text{radius}$

..... cm [6]

Turn over for Question 22

22 n is a positive integer.

Prove that $(2n + 1)(n - 3)(n + 2) + 3n(n + 7)$ is always even.

Expand out the first two brackets. Collect like terms then write it multiplied by the third bracket. Expand out these two brackets and also expand out the $3n(n + 7)$ at the end. Collect like terms. Bringing out 2 as a factor shows that it must be even

..... [6]

END OF QUESTION PAPER

OCR

Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.