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

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, Formulae Sheet (enclosed). 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.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ▶

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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 Solve $7x - 27 < 8$

$7x < 35$ ← Adding 27 to both sides eliminates the -27 on the left and gets the x term on its own

Dividing both sides by 7 eliminates the 7 on the left →

$x < 5$

(Total for Question 1 is 2 marks)

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2 Write 124 as a product of its prime factors.

124 → 2, 62
62 → 2, 31

← Doing a factor tree by splitting each number into factors and stopping at the prime numbers

Writing the primes multiplied together gives 2 x 2 x 31 →

$2^2 \times 31$

(Total for Question 2 is 2 marks)

---

3 A delivery company has a total of 160 cars and vans.

the number of cars : the number of vans = 3 : 7

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.
25% of the cars use diesel.
The rest of the cars use petrol.

Work out the number of cars that use petrol.
You must show all your working.

$160 \div 10$

There are 10 parts in total in the ratio as 3 + 7 = 10. These parts represent the total of 160 so dividing by 10 works out that 1 part is worth 16

$16 \times 3 = 48$
$48 - 6 - 12 = 30$

Multiplying the worth of 1 part by 3 works out that the 3 parts representing the cars is worth 48. 1/8 of 48 is 6 so there are 6 electric cars. 25% of 48 is 12 so there are 12 diesel cars. Subtracting these away from the 48 total cars leaves the number which must be petrol

30

(Total for Question 3 is 5 marks)

4 (a) Write 1.63×10^{-3} as an ordinary number.

1.63

$\times 10^{-3}$ basically means to divide by 10 3 times.
The decimal point moves 3 places to the left

0.00163
(1)

(b) Write 438000 in standard form.

438000 must be divided by 10 5 times to get a number between 1 and 10. It must be multiplied by 10^5, which is basically multiplying by 10 5 times, to keep it equal

4.38×10^5
(1)

(c) Work out $(4 \times 10^3) \times (6 \times 10^{-5})$
Give your answer in standard form.

24×10^{-2}

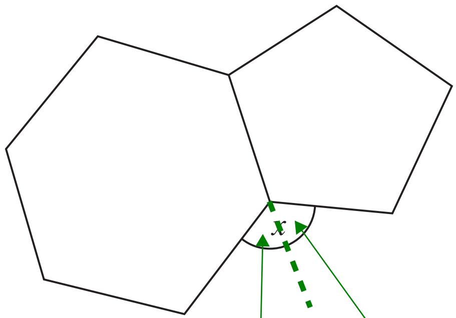
The multiplication can be done in any order so multiplying the 4 and 6 together to get 24 and the 10^3 and 10^{-5} to get 10^{-2}

Dividing 24 by 10 once to get 2.4 then multiplying the power of 10 by 10 once to keep it equal. This adds 1 to the power

2.4×10^{-1}
(2)

(Total for Question 4 is 4 marks)

5 Here is a regular hexagon and a regular pentagon.



The exterior angle of the hexagon

The exterior angle of the pentagon

Work out the size of the angle marked x.
You must show all your working.

$6\overline{)360}$ = 60 — This works out that the exterior angle of the hexagon is 60°

$5\overline{)360}$ = 72 — This works out that the exterior angle of the pentagon is 72°

The exterior angles of any polygon add up to 360. So dividing 360 by the number of exterior angles, which is the same as the number of sides, works out each exterior angle

60 + 72 = 132 — Adding the two exterior angles give x

132 °

(Total for Question 5 is 3 marks)

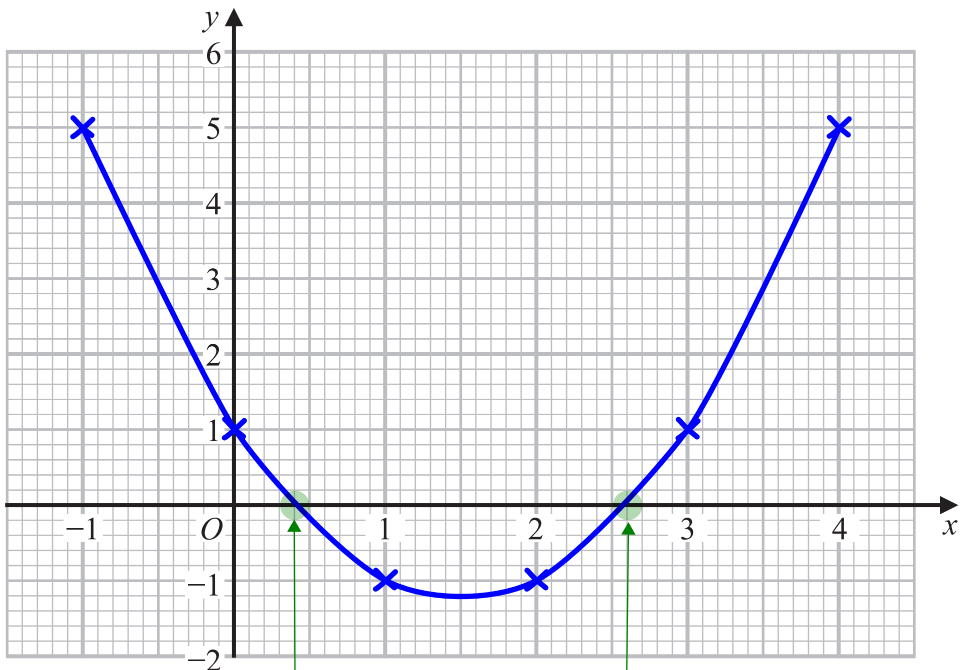
6 (a) Complete the table of values for $y = x^2 - 3x + 1$

x	-1	0	1	2	3	4
y	5	1	-1	-1	1	5

Substituting each value of x into the equation to find y
$(-1)^2 - 3(-1) + 1 = 1 + 3 + 1 = 5$
$2^2 - 3(2) + 1 = 4 - 6 + 1 = -1$
$3^2 - 3(3) + 1 = 9 - 9 + 1 = 1$
$4^2 - 3(4) + 1 = 16 - 12 + 1 = 5$

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$ for values of x from -1 to 4



y = 0 at both of these points

(2)

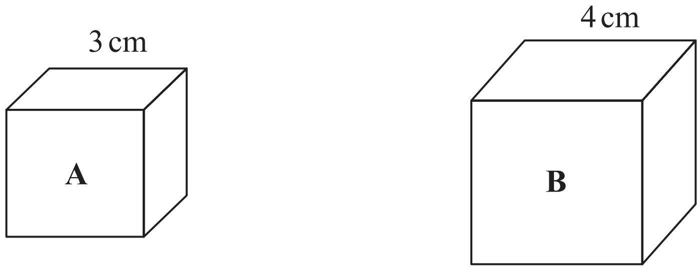
(c) Using your graph, find estimates for the solutions of the equation $x^2 - 3x + 1 = 0$

0.4, 2.6

(2)

(Total for Question 6 is 6 marks)

7 Here are two cubes, **A** and **B**.



Cube **A** has a mass of 81 g.

Cube **B** has a mass of 128 g.

Work out

the density of cube **A** : the density of cube **B**

Give your answer in the form *a* : *b*, where *a* and *b* are integers.

d m v

This is a density, mass, volume problem so writing the formula triangle

$27\overline{)81}$ = 3
27, 54, 81

This works out that the density of A is $3g/cm^3$. From the formula triangle, density = mass/volume. Volume of cube = $length^3$. $3^3 = 3 \times 3 \times 3 = 27$

$64\overline{)128}$ = 2
64, 128

This works out that the density of B is $2g/cm^3$. From the formula triangle, density = mass/volume. Volume of cube = $length^3$. $4^3 = 4 \times 4 \times 4 = 64$

3:2

(Total for Question 7 is 3 marks)

8 The table shows the amount of snow, in cm, that fell each day for 30 days.

Amount of snow (s cm)	Frequency	
$0 \leqslant s < 10$	5 × 8 =	40
$10 \leqslant s < 20$	15 × 10 =	150
$20 \leqslant s < 30$	25 × 7 =	175
$30 \leqslant s < 40$	35 × 2 =	70
$40 \leqslant s < 50$	45 × 3 =	135
		570

The range of each category is 10. 10/2 = 5. Adding 5 to the lower bound of each category works out the midpoint

Multiplying the midpoint of each category by the frequency estimates the total for each category

Work out an estimate for the mean amount of snow per day.

Adding up the totals of each category works out the overall estimated total

$30 \overline{)570} = 019$

Mean = total/number, where total is the estimated total amount of snow and number is the number of days

19 cm

(Total for Question 8 is 3 marks)

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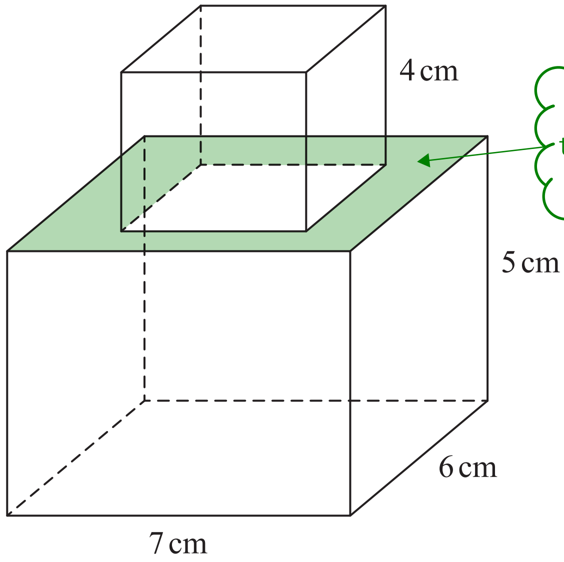
9 A cube is placed on top of a cuboid, as shown in the diagram, to form a solid.



Subtracting the area of 1 face of the cube from the area of the top of the cuboid leaves the shaded area

The cube has edges of length 4 cm.
The cuboid has dimensions 7 cm by 6 cm by 5 cm.

Work out the total surface area of the solid.

16 × 5 = 80 — The area of the 5 square faces on the surface of the cube. Each face has an area of $16cm^2$ as area of square = $length^2$ = 4^2

42 × 2 = 84, 84 − 16 = 68 — The area of the top and bottom of the cuboid then subtracting the area of 1 face of the cube. Area of rectangle = length x width = 7 x 6 = 42

35 × 2 = 70 — The area of the front and back of the cuboid. Area of rectangle = length x width = 7 x 5 = 35

30 × 2 = 60 — The area of the left and right of the cuboid. Area of rectangle = length x width = 6 x 5 = 30

80 + 68 + 70 + 60 = 278 — Adding all of the areas together works out the total surface area

278 cm^2

(Total for Question 9 is 3 marks)

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Turn over

10 The table shows some information about the profit made each day at a cricket club on 100 days.

Profit (£x)	**Frequency**
$0 \leqslant x < 50$	10
$50 \leqslant x < 100$	15
$100 \leqslant x < 150$	25
$150 \leqslant x < 200$	30
$200 \leqslant x < 250$	5
$250 \leqslant x < 300$	15

(a) Complete the cumulative frequency table.

Profit (£x)	**Cumulative frequency**
$0 \leqslant x < 50$	10
$0 \leqslant x < 100$	25 ← 10 + 15
$0 \leqslant x < 150$	50 ← 25 + 25
$0 \leqslant x < 200$	80 ← 50 + 30
$0 \leqslant x < 250$	85 ← 80 + 5
$0 \leqslant x < 300$	100 ← 80 + 15

(1)

The frequencies are added up as they go

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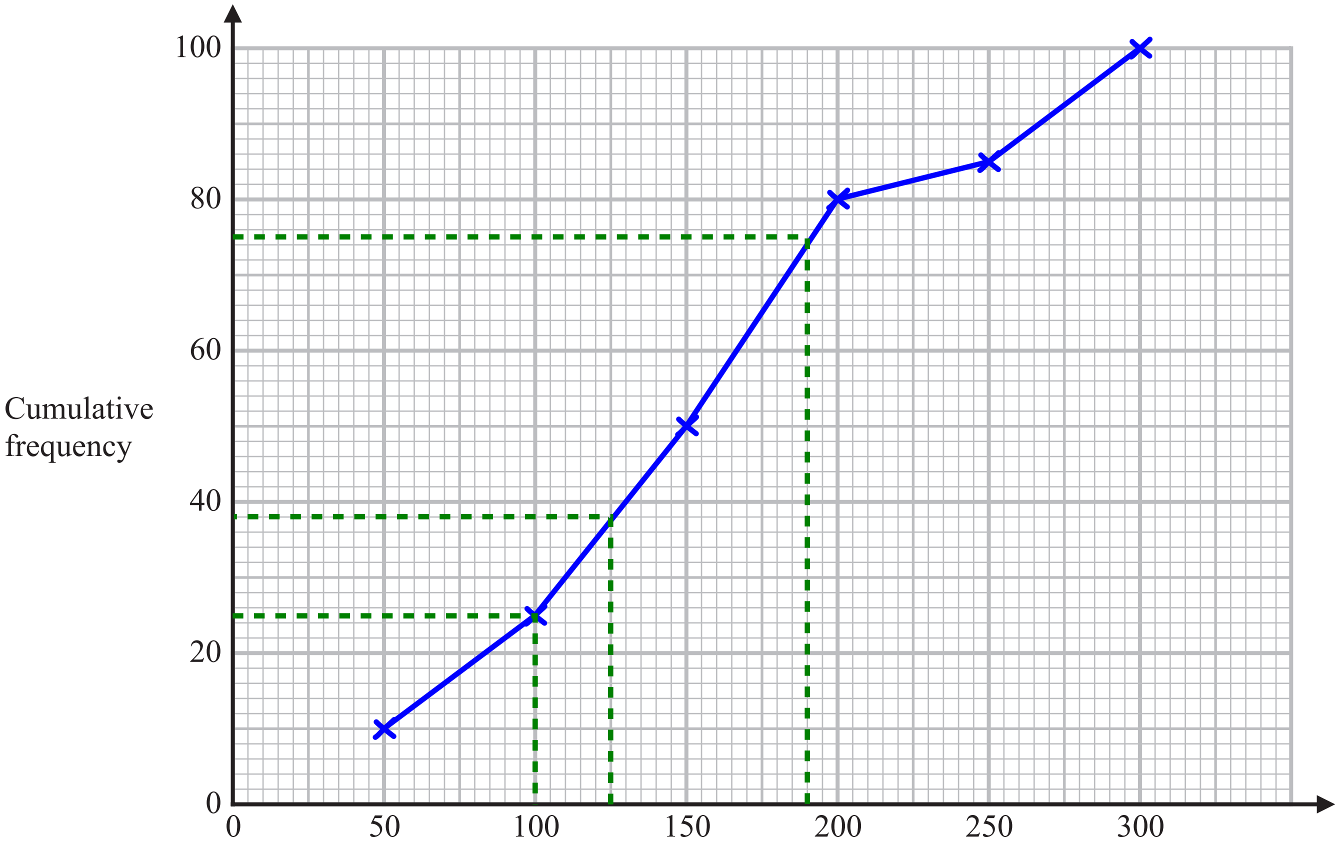
(b) On the grid, draw a cumulative frequency graph for this information.



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

(2)

(c) Use your graph to find an estimate for the number of days on which the profit was less than £125

Drawing up from £125 to the line then across works out an estimate of the number of days profit was less than £125

38 days

(1)

(d) Use your graph to find an estimate for the interquartile range.

190 − 100

Interquartile range = upper quartile - lower quartile. The lower quartile is 1/4 of the way through the data so is the 25th frequency. Drawing a line across from 25 to the line then down estimates that the lower quartile is £100. The upper quartile is 3/4 of the way through the data so is the 75th frequency. Drawing a line across from 75 to the line then down estimates that the upper quartile is £190

£ 90

(2)

(Total for Question 10 is 6 marks)

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Turn over

11 Cormac has some sweets in a bag.
The sweets are lime flavoured or strawberry flavoured or orange flavoured.

In the bag

number of lime flavoured sweets : number of strawberry flavoured sweets : number of orange flavoured sweets $= 9 : 4 : x$

Cormac is going to take at random a sweet from the bag.

The probability that he takes a lime flavoured sweet is $\frac{3}{7}$

Work out the value of x.

$\frac{3}{7}t = 9$ ← 3/7 of the total number of sweets are lime. Therefore 3/7 of the total number of parts in the ratio are for lime. Let t be the total number of parts in the ratio

$t = 9 \times \frac{7}{3}$ ← Dividing both sides by 3/7 to find t. To divide by a fraction, keep the first part, change the sign to multiply and flip the second fraction

$= 21$ ← To multiply an integer by a fraction, divide it by the denominator then multiply the result by the numerator. 9/3 = 3. 3 x 7 = 21

$21 - 9 - 4$ ← There are 21 parts in total in the ratio. Subtracting the parts for lime and strawberry leaves the number for orange, which is x

$x =$ ....8..........

(Total for Question 11 is 3 marks)

12 Express $0.1\dot{1}\dot{7}$ as a fraction.
You must show all your working.

$x = 0.1\dot{1}\dot{7}$ ← Let x be the recurring decimal

$100x = 11.7\dot{1}\dot{7}$ ← There are 2 recurring digits so multiplying by 10 twice lines up the recurring digits in the same decimal places

$99x = 11.6$ ← Subtracting x from 100x cancels out the recurring digits

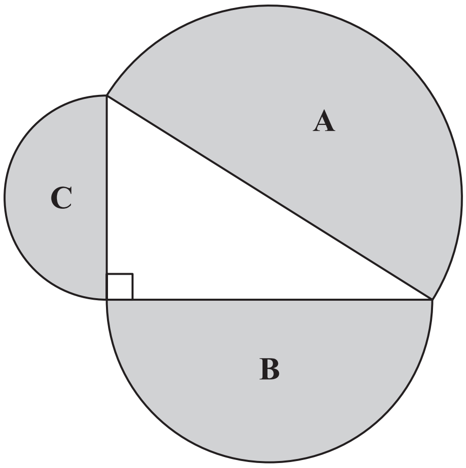
$x = \frac{11.6}{99}$ ← Rearranging to express x as a fraction

Multiplying both the numerator and denominator by 10 to eliminate the decimal from the fraction →

$\frac{116}{990}$

(Total for Question 12 is 3 marks)

13 A right-angled triangle is formed by the diameters of three semicircular regions, **A**, **B** and **C** as shown in the diagram.



Show that

area of region **A** = area of region **B** + area of region **C**

Let A be the diameter of region A, B be the diameter of region B and C be the diameter of region C

$$\frac{\pi \times \left(\frac{1}{2}B\right)^2}{2} + \frac{\pi \times \left(\frac{1}{2}C\right)^2}{2}$$

Area of circle = π x radius². The radius of region B is half of diameter B. The radius of region C is half of diameter C. Halving the areas of both gives the area of the semicircles. Adding these together to express the area of region B + area of region C

$$\frac{1}{8}B^2\pi + \frac{1}{8}C^2\pi$$

Simplifying the expression

$$A^2 = B^2 + C^2$$

$$A = \sqrt{B^2 + C^2}$$

Using Pythagoras' Theorem to express diameter A in terms of diameters B and C

$$\frac{\pi \times \left(\frac{1}{2}\sqrt{B^2 + C^2}\right)^2}{2}$$

Area of circle = π x radius². The radius of region A is half of diameter A, which is expressed in terms of B and C. Halving the area gives the area of the region A

$$\frac{1}{8}(B^2 + C^2)\pi$$

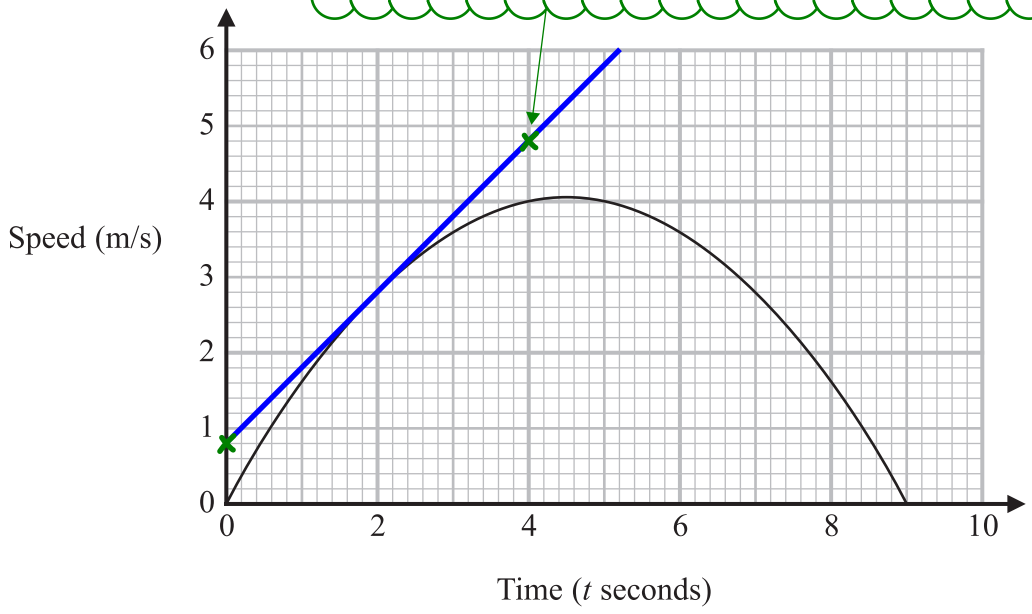
$$\frac{1}{8}B^2\pi + \frac{1}{8}C^2\pi$$

Simplifying the expression and expanding the bracket to show that the area of region A is the same as the expression for the area of region B + area of region C. Therefore they must be equal

(Total for Question 13 is 3 marks)

14 Here is a speed-time graph.

Drawing a tangent to the curve where t = 2 then picking two points on the line. Picking points on grid-lines and where the change in x will be a whole number to make any division easier



(a) Work out an estimate of the gradient of the graph at $t = 2$

$\frac{4.8-0.8}{4-0}$

Gradient = (change in y)/(change in x). Change in y is found by subtracting the first y coordinate from the second. Change in x is found by subtracting the first x coordinate from the second x coordinate

Both changes are 4 and 4/4 = 1

.... 1

(3)

(b) What does the area under the graph represent?

Distance ....

....

(1)

(Total for Question 14 is 4 marks)

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15 A, B and C are three points such that

$\overrightarrow{AB} = 3\mathbf{a} + 4\mathbf{b}$

$\overrightarrow{AC} = 15\mathbf{a} + 20\mathbf{b}$

(a) Prove that A, B and C lie on a straight line.

$\overrightarrow{AC} = 5(3a + 4b)$

$\overrightarrow{AC}$ is a multiple of $\overrightarrow{AB}$ and both start at A

This means that they both go in the same direction and as they both start from A the vectors going through points A, B and C are on the same straight line

(2)

D, E and F are three points on a straight line such that

$\overrightarrow{DE} = 3\mathbf{e} + 6\mathbf{f}$

$\overrightarrow{EF} = -10.5\mathbf{e} - 21\mathbf{f}$

(b) Find the ratio

length of DF : length of DE

$3e + 6f - 10.5e - 21f$ ← $\overrightarrow{DF} = \overrightarrow{DE} + \overrightarrow{EF}$

$-7.5e - 15f$ ← Collecting like terms to simplify

$3\overline{)7.5}$ = 2.5 ← All the points are on a straight line so $\overrightarrow{DF}$ must be a multiple of $\overrightarrow{DE}$. Ignoring the negative sign as length cannot be negative and working out how many times greater $\overrightarrow{DF}$ must be than $\overrightarrow{DE}$

Length DF must be 2.5 times greater than DE

2.5 : 1

(3)

(Total for Question 15 is 5 marks)

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16 A first aid test has two parts, a theory test and a practical test.
The probability of passing the theory test is 0.75
The probability of passing only one of the two parts is 0.36

The two events are independent.

Work out the probability of passing the practical test.

Let x be the probability of passing the practical test

$0.75(1-x)+0.25x$

Expressing the probability of passing only one of the two parts. Pass theory AND fail practical OR fail theory AND pass practical. AND means to multiply and OR means to add. As the probability of passing the practical test is x, the probability of failing the practical test is 1 - x. As the probability of passing the theory test is 0.75, the probability of failing the theory test is 1 - 0.75 = 0.25

$0.75-0.5x=0.36$

Simplifying the expression by expanding the brackets and collecting like terms. Setting it equal to the probability of passing only one of the two parts

$x=\frac{0.36-0.75}{-0.5}$

Rearranged to make x the subject by subtracting 0.75 from both sides then dividing both sides by -0.5

$$\begin{array}{r} 0.75 \\ -0.36 \\ \hline 0.39 \\ \times \quad 2 \\ \hline 0.78 \end{array}$$

0.36 - 0.75 is the same as -0.75 + 0.36, which is the same as -(0.75 - 0.36). The answer to this is -0.39, but as it is divided by a negative the negative on the denominator cancels out with the negative on the numerator. 0.5 = 1/2. Dividing by 1/2 is the same as multiplying by 2

.............................0.78.............................

(Total for Question 16 is 4 marks)

17 y is directly proportional to the square root of t.
$y = 15$ when $t = 9$

t is inversely proportional to the cube of x.
$t = 8$ when $x = 2$

Find a formula for y in terms of x.
Give your answer in its simplest form.

$y = k\sqrt{t}$ ← The right side of the first proportion can be multiplied by anything and still be directly proportional. Using k to represent what it is multiplied by and converting it into an equation

$k = \frac{15}{\sqrt{9}} = 5$ ← Rearranging to make k the subject by dividing both sides by $\sqrt{t}$. Then substituting 15 for y and 9 for t. k is 5

$y = 5\sqrt{t}$ ← Substituting 5 for k in the original equation

$t = \frac{c}{x^3}$ ← The right side of the second proportion can be multiplied by anything and still be directly proportional. Using c to represent what it is multiplied by and converting it into an equation

$c = 8 \times 2^3 = 64$ ← Rearranging to make c the subject by multiplying both sides by x^3. Then substituting 8 for t and 2 for x. c is 64

$t = \frac{64}{x^3}$ ← Substituting 64 for c in the original equation

$y = 5\sqrt{\frac{64}{x^3}}$ ← Substituting $64/x^3$ for t in the first equation

$= 5 \times \frac{8}{\sqrt{x^3}}$ ← Square rooting the numerator and denominator separately

$y = \frac{40}{\sqrt{x^3}}$

(Total for Question 17 is 4 marks)

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18 Work out the value of $\dfrac{\left(5\frac{4}{9}\right)^{-\frac{1}{2}} \times \left(4\frac{2}{3}\right)}{2^{-3}}$

You must show all your working.

$\left(\frac{49}{9}\right)^{-\frac{1}{2}}$ ← Converting the first mixed number into an improper fraction by multiplying the whole number by the denominator and adding the result to the numerator

$\frac{3}{7} \times \frac{14}{3}$ ← The power of 1/2 means to do the positive square root. Square rooting both the numerator and denominator gives 7/3. The negative power means to do the reciprocal and this gives 3/7. Converting the second mixed number into an improper fraction by multiplying the whole number by the denominator and adding the result to the numerator

$2 \div \frac{1}{8}$ ← The 3 from the numerator on the first fraction cancels out with the 3 on the denominator on the second fraction. This will leave 1/7 x 14, which is 2. The power of 3 in 2^{-3} means to cube. $2^3 = 2 \times 2 \times 2 = 8$. The negative power means to do the reciprocal so it becomes 1/8

To divide by a fraction, multiply by the reciprocal. It becomes 2 x 8 which is 16

16

(Total for Question 18 is 4 marks)

19 Solve $\dfrac{1}{2x-1} + \dfrac{3}{x-1} = 1$

Give your answer in the form $\dfrac{p \pm \sqrt{q}}{2}$ where p and q are integers.

$x-1+3(2x-1)=(2x-1)(x-1)$ ← Multiplying all terms on both sides by the denominators to eliminate them

$x-1+6x-3=2x^2-2x-x+1$ ← Expanding all brackets

$0=2x^2-10x+5$ ← Rearranging into the quadratic form

$x=\dfrac{-(-10)\pm\sqrt{(-10)^2-4\times2\times5}}{2\times2}$ ← Solving using the quadratic formula

$=\dfrac{10\pm\sqrt{60}}{4}$

$=\dfrac{10\pm2\sqrt{15}}{4}$ ← Simplifying $\sqrt{60}$ by splitting it into $\sqrt{4} \times \sqrt{15}$ then $\sqrt{4} = 2$

Dividing all terms on the numerator and denominator by 2 to simplify into the desired form →

$\dfrac{5\pm\sqrt{15}}{2}$

(Total for Question 19 is 4 marks)

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20 The centre of a circle is the point with coordinates (−1, 3)

The point A with coordinates (6, 8) lies on the circle.

Find an equation of the tangent to the circle at A.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

$\frac{8-3}{6--1} = \frac{5}{7}$ ← Finding the gradient of the radius, from the centre of the circle to point A. Gradient = (change in y)/(change in x). Change in y is found by subtracting the first y coordinate from the second y coordinate. Change in x is found by subtracting the first x coordinate from the second x coordinate

$y = -\frac{7}{5}x + c$ ← The gradient of the tangent is the negative reciprocal of the gradient of the radius as the tangent is perpendicular to the radius. So the gradient of the tangent is -7/5. Substituting this into the general equation of a straight line y = mx + c, where m is the gradient and c is the y intercept

$c = 8 + \frac{7}{5}(6)$ ← Rearranged to make c the subject and substituted in the x and y coordinate of point A as this lies on the tangent

$5y = -7x + 40 + 42$ ← Substituted c back into the general equation and multiplied all terms by 5 on both sides to eliminate the fractions. 7 x 6 = 42

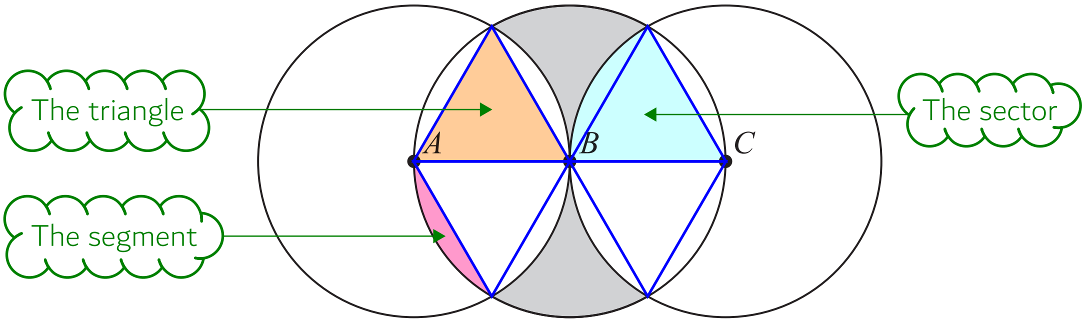
Rearranged into the desired form →

$7x + 5y - 82 = 0$

(Total for Question 20 is 4 marks)

21 The diagram shows three circles, each of radius 4 cm.

The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 4$ cm.



Work out the total area of the two shaded regions.
Give your answer in terms of π

The triangle is equilateral as all three of its sides are radii so are 4cm and are all equal in length. The angle in the triangle is therefore 60° as there are 180° in a triangle, all the angles are the same and 180/3 = 60

0	30	45	60	90
0	1	2	3	4

Listing out the angles which need to be remembered for the trig values. Writing 0, 1, 2, 3, 4 under these for the sin values. Square rooting the 3 then putting it over 2 gives the value of sin60

$$\pi \times 16 - 4\left(\frac{1}{2} \times 4 \times 4 \times \frac{\sqrt{3}}{2}\right) - 8\left(\frac{60}{360} \times \pi \times 16 - \frac{1}{2} \times 4 \times 4 \times \frac{\sqrt{3}}{2}\right) \text{ cm}^2$$

Area of the middle circle. Area of circle = π x radius^2. The radius is 4cm

8 lots of the segment. The area of the triangle is subtracted from the area of the sector to express the area of the segment. Area of sector = y/360 x π x radius^2, where y is the angle of the sector. The angle of the sector is 60° as it is the same as the angle in the triangle. Area of triangle = 1/2 absinC, where a and b are two sides and C is the angle between them. a and b are both 4 as they are both sides of the triangle

4 lots of the triangle. Area of triangle = 1/2 absinC, where a and b are two sides and C is the angle between them. a and b are both 4 as they are both sides of the triangle

Subtracting the area of 4 of the triangle and 8 of the segment from the area of the middle circle leaves the shaded region. The answer does not need to be simplified so can be left as shown

.... cm^2

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS