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

Tuesday 5 November 2019

Morning (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.
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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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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

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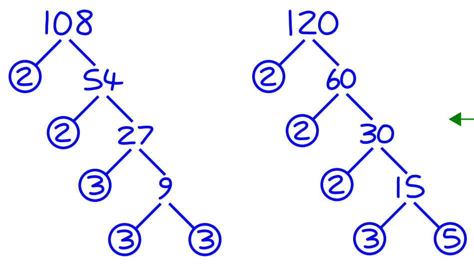
Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Find the Lowest Common Multiple (LCM) of 108 and 120



Doing factor trees for both 108 and 120 to express them as product of prime factors. $108 = 2^2 \times 3^3$. $120 = 2^3 \times 3 \times 5$

$2^3 \times 3^3 \times 5$

The Lowest Common Multiple is the highest power of each prime multiplied together

$27 \times 8 = 216$

$216 \times 5 = 1080$

$2^3 = 2 \times 2 \times 2 = 8$. $3^3 = 3 \times 3 \times 3 = 27$. Multiplying these together then multiplying by the 5

1080

(Total for Question 1 is 3 marks)

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2 There are 60 people in a choir.
Half of the people in the choir are women.

The number of women in the choir is 3 times the number of men in the choir.
The rest of the people in the choir are children.

the number of children in the choir : the number of men in the choir = $n : 1$

Work out the value of n.
You must show how you get your answer.

30 ← Half of 60 is 30 so there are 30 women

10 ← The 30 women is 3 times the number of men so there are 10 men as 10 x 3 = 30

20:10 ← There are 20 children as 60 - 30 - 10 = 20. Writing the number of children to the number of men as a ratio

2:1 ← Simplifying the ratio by dividing both sides by 10 gives 2 : 1 so n is 2

n = 2

(Total for Question 2 is 4 marks)

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3 Work out $1\frac{3}{4} \times 1\frac{1}{3}$

Give your answer as a mixed number.

$\frac{7}{4} \times \frac{4}{3}$ ← Converting the mixed numbers into improper fractions by multiplying the whole numbers by the denominators then adding the results to the numerators. This makes it easier to multiply

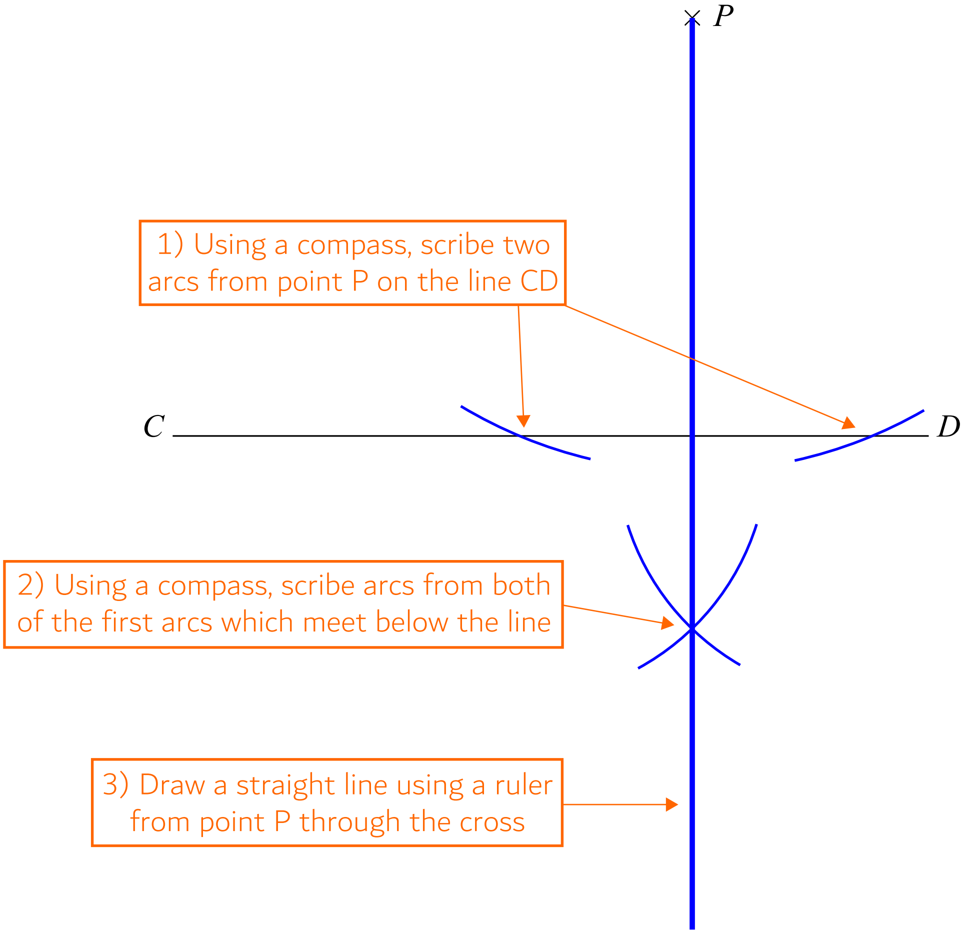
$\frac{28}{12}$ ← Multiplied the fractions by multiplying the numerators and denominators

Converted into a mixed number by considering that 12 goes into 28 2 times with a remainer of 4. The 2 is the whole number and the remainder of 4 is left in the fraction

$2\frac{4}{12}$

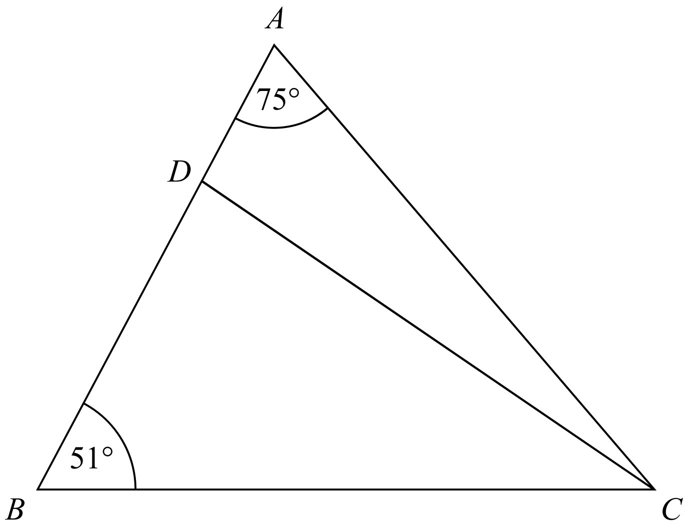
(Total for Question 3 is 3 marks)

4 Use a ruler and compasses to construct the line from the point P perpendicular to the line CD.
You must show **all** construction lines.



(Total for Question 4 is 2 marks)

5 The diagram shows triangle *ABC*.



ADB is a straight line.

the size of angle *DCB* : the size of angle *ACD* = 2 : 1

Work out the size of angle *BDC*.

180 − 75 − 51 = 54

Angles in a triangle add up to 180°. So subtracting the other angles in triangle ABC leaves angle ACB

54 ÷ 3 = 18

Angle ACB is the total of angles DCB and ACD. This is represented by 3 parts in the ratio as 2 + 1 = 3 so dividing it by 3 works out the value of 1 part

18 × 2 = 36

Angle DCB is worth 2 parts in the ratio so multiplying the value of 1 part by 2 works out the angle DCB

180 − 36 − 51 = 93

Angles in a triangle add up to 180°. So subtracting the other angles in triangle DBC leaves angle BDC

.......................93.......................°

(Total for Question 5 is 4 marks)

6 4 red bricks have a mean weight of 5 kg.
5 blue bricks have a mean weight of 9 kg.
1 green brick has a weight of 6 kg.

Donna says,

"The mean weight of the 10 bricks is less than 7 kg."

Is Donna correct?
You must show how you get your answer.

$m \, t \, n$ ← Mean = total/number, where total is the total weight and number is the number of bricks. Writing this as a formula triangle

4×5
5×9 ← From the formula triangle, total = mean x number. This works out the total weight of the red bricks and the total weight of the blue bricks

$20 + 45 + 6 = 71$
$71 \div 10 = 7.1$ ← Adding together the total weight of all of the bricks works out that the total weight of all of the bricks is 71kg. There are 10 bricks so dividing this by 10 works out the mean weight of the 10 bricks

No ← The mean is 7.1kg, which is not less than 7kg

(Total for Question 6 is 3 marks)

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7 (a) Simplify $(p^2)^5$

$(a^x)^y = a^{xy}$

p^{10}

(1)

(b) Simplify $12x^7y^3 \div 6x^3y$

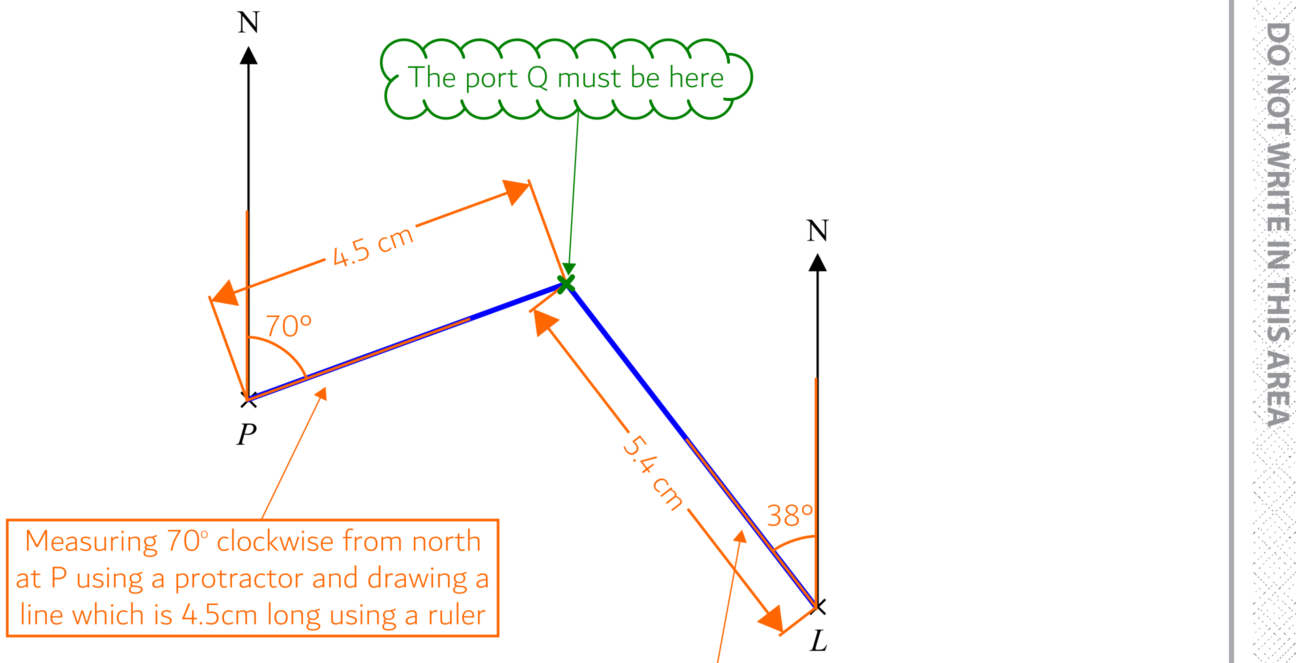
$12/6 = 2.\ x^7/x^3 = x^4.\ y^3/y = y^2$

$2x^4y^2$

(2)

(Total for Question 7 is 3 marks)

8 The accurate scale drawing shows the positions of port P and a lighthouse L.



Scale: 1 cm represents 4 km.

Aleena sails her boat from port P on a bearing of 070°

She sails for $1\frac{1}{2}$ hours at an average speed of 12 km/h to a port Q.

Find

(i) the distance, in km, of port Q from lighthouse L,

(ii) the bearing of port Q from lighthouse L.

$s\,d\,t$ ← Writing the formula triangle for distance, speed and time

$12 \times 1\frac{1}{2}$ ← From the formula triangle, distance = speed x time. Working out the distance she sailed to port Q. 1 x 12 = 12. 1/2 x 12 = 6. 12 + 6 = 18

$18.0 \div 4 = 04.5$ ← Every 4km is represented by 1cm so dividing the distance by 4 works out how many centimetres represent it

$5.4 \times 4 = 21.6$ ← Every 1cm represents 4km so multiplying the measured distance by 4 works out the actual distance in kilometres

$360 - 38 = 322$ ← Subtracting the anticlockwise angle from north at L from 360 works out the bearing

distance QL = ...21.6........ km

bearing of Q from L = ...322........ °

(Total for Question 8 is 5 marks)

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9 A car travels for 18 minutes at an average speed of 72 km/h.

(a) How far will the car travel in these 18 minutes?

s d t ← Writing the formula triangle for distance, speed, time

$\frac{18}{60}$ ← There are 60 minutes in an hour so dividing the 18 by 60 converts it into hours. This needs to be done as the speed is in terms of hours

$72 \times \frac{3}{10}$ ← From the formula triangle, distance = speed x time. Simplifying the fraction of an hour by dividing the numerator and denominator by 6

$7.2 \times 3 = 21.6$ ← To multiply by a fraction, divide by the denominator then multiply by the numerator. 72/10 = 7.2

21.6 km

(2)

David says,

"72 kilometres per hour is faster than 20 metres per second."

(b) Is David correct?
You must show how you get your answer.

72×1000 ← Converting the kilometres per hour into metres per hour. There are 1000 metres in a kilometre

$72000 \div 60 = 01200$ ← Converting the metres per hour into metres per minute. There are 60 minutes in an hour

$1200 \div 60 = 0020$ ← Converting the metres per minute into metres per second. There are 60 seconds in a minute

72 Km/h = 20 m/s

No ← 72 kilometres per hour is not faster than 20 metres per second as they are the same

(2)

(Total for Question 9 is 4 marks)

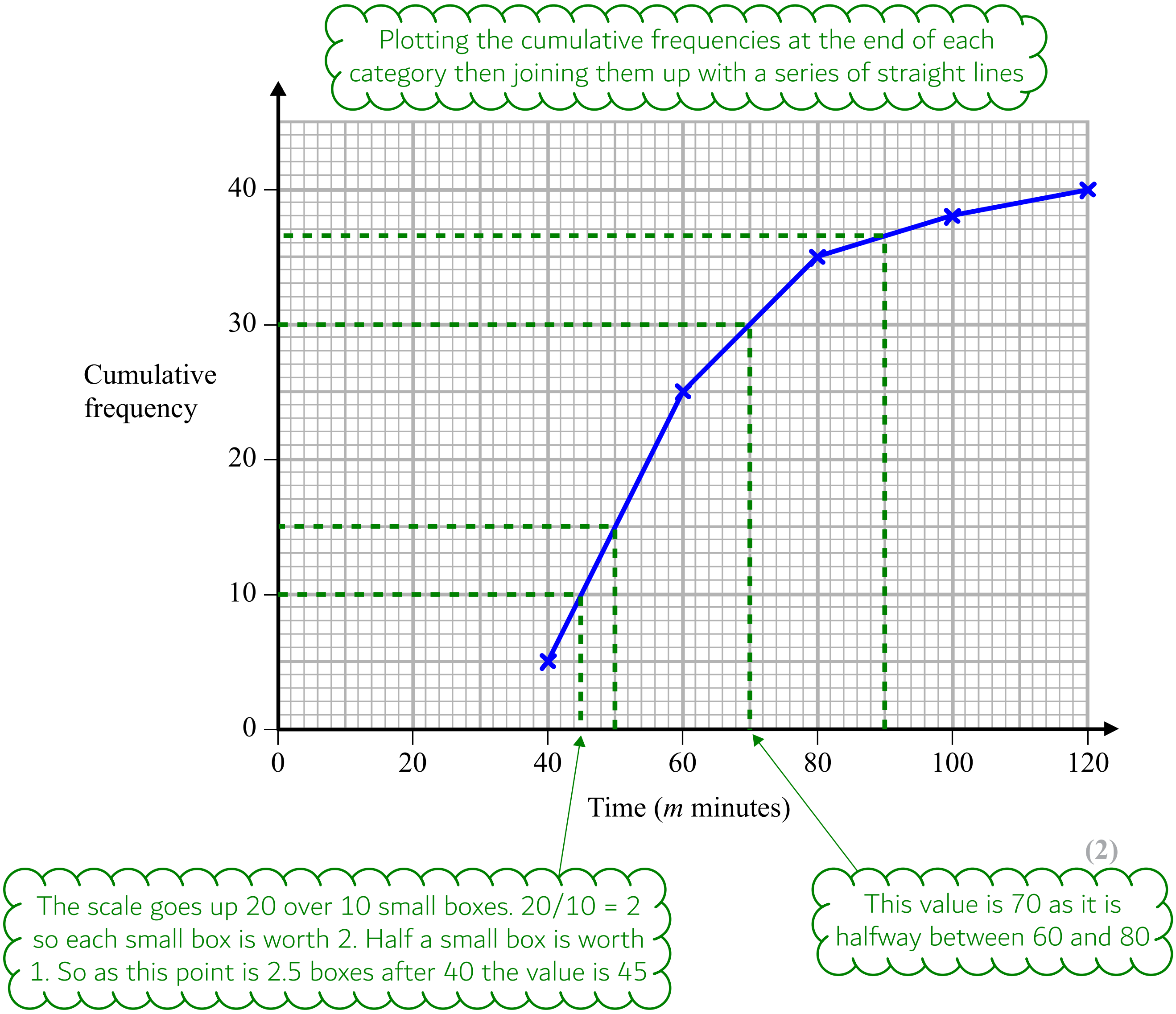
.CG Maths.

Turn over

10 The cumulative frequency table shows information about the times, in minutes, taken by 40 people to complete a puzzle.

Time (m minutes)	**Cumulative frequency**
$20 < m \leqslant 40$	5
$20 < m \leqslant 60$	25
$20 < m \leqslant 80$	35
$20 < m \leqslant 100$	38
$20 < m \leqslant 120$	40

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



(2)

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

70
−45
25

Interquartile range = upper quartile - lower quartile. The lower quartile is roughly 1/4 of the way through the data and 1/4 of 40 is 10 so reading across from 10 on the cumulative frequency to the line then down works out that the lower quartile is 45. The upper quartile is roughly 3/4 of the way through the data and 3/4 of 40 is 30 so reading across from 30 on the cumulative frequency to the line then down works out that the upper quartile is 70

25 minutes

(2)

One of the 40 people is chosen at random.

(c) Use your graph to find an estimate for the probability that this person took between 50 minutes and 90 minutes to complete the puzzle.

36
−15
21

Reading up from 50 to the line then across estimates that 15 people took 50 minutes or less. Reading up from 90 to the line then across estimates that 36 people (it is at 36.5 but there needs to be a whole number of people and the 37th person took longer than 90 minutes) took 90 minutes or less. Subtracting the 15 from the 36 works out an estimate of how many people took between 50 minutes and 90 minutes

21 out of the 40 people took between 50 minutes and 90 minutes

$\frac{21}{40}$

(2)

(Total for Question 10 is 6 marks)

11 There are p counters in a bag.
12 of the counters are yellow.

Shafiq takes at random 30 counters from the bag.
5 of these 30 counters are yellow.

Work out an estimate for the value of p.

$\frac{1}{6}p = 12$

We can estimate that 5/30 of the counters are yellow. This simplifies to 1/6. This fraction of p is estimated to be 12

Multiplying both sides by 6 eliminates the 1/6 and makes p the subject. p = 12 x 6 = 72

72

(Total for Question 11 is 2 marks)

12 $T = \frac{q}{2} + 5$

Here is Spencer's method to make q the subject of the formula.

$2 \times T = q + 5$

$q = 2T - 5$

What mistake did Spencer make in the first line of his method?

The 5 wasn't multiplied by 2

When multiplying by 2 all terms on both sides of the equation need to be multiplied by 2

(Total for Question 12 is 1 mark)

13 (a) Write $\dfrac{5}{x+1} + \dfrac{2}{3x}$ as a single fraction in its simplest form.

$\dfrac{5(3x)}{3x(x+1)} + \dfrac{2(x+1)}{3x(x+1)}$ ← Making a common denominator by multiplying the denominators together. The numerators need to be multiplied by the same as what its denominator was multiplied by

$15x + 2x + 2$ ← Expanding the brackets on the numerators and adding them together

Collecting like terms to simplify the numerator. The brackets do not need to be expanded on the denominator as this does not make it simpler

$\dfrac{17x+2}{3x(x+1)}$

(2)

(b) Factorise $(x + y)^2 + 3(x + y)$

(x + y) is a common factor to both terms so this can be brought out as a factor. Dividing the first term by (x + y) leaves x + y and dividing the second term by (x + y) leaves 3

$(x+y)(x+y+3)$

(1)

(Total for Question 13 is 3 marks)

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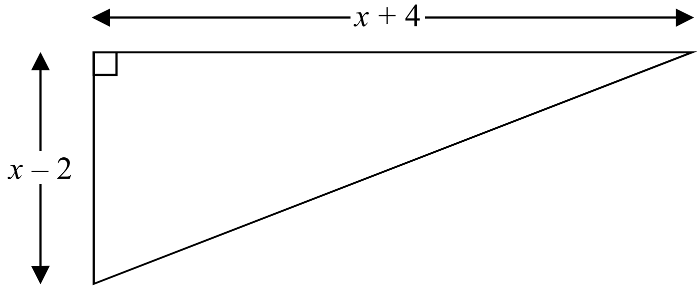
14 The diagram shows a right-angled triangle.



All the measurements are in centimetres.

The area of the triangle is 27.5 cm^2

Work out the length of the shortest side of the triangle.
You must show all your working.

$\frac{1}{2}(x+4)(x-2)=27.5$ ← Area of triangle = 1/2 x base x height. x + 4 is the base and x - 2 is the height. Expressing the area in terms of x and setting this equal to the actual area of 27.5

$27.5 \times 2 = 55.0$ ← Multiplying both sides of the equation by 2 eliminates the 1/2. Working out what will be on the right

$x^2-2x+4x-8=55$ ← Expanding the brackets on the left

$x^2+2x-63=0$ ← Bringing into the quadratic form so that it can be solved

1,63
3,21
7,9 ← Listing out the factor pairs of 63 until they add to 2 when one of them is negative

$(x+9)(x-7)=0$ ← Factorising the left side of the equation. 9 and -7 multiply to -63 and add to 2 so these will work when put in brackets with x

$x=-9$
$x=7$ ← There are two brackets multiplied together to get 0 so one of the brackets must equal to 0. When x + 9 = 0, x = -9. When x - 7 = 0, x = 7

$7-2$ ← x cannot be -9 as this would create negative lengths and length must be positive. Therefore x is 7. This works out the shortest length

........5........ cm

(Total for Question 14 is 4 marks)

15 Express $0.4\dot{1}\dot{8}$ as a fraction.
You must show all your working.

$x = 0.4\dot{1}\dot{8}$ ← Let x be the recurring decimal

$100x = 41.8\dot{1}\dot{8}$ ← Multiplying by 10 twice as there are two recurring digits. Writing the recurring digits in the same decimal place as in x

$99x = 41.4$ ← Subtracting x from 100x cancels out the recurring digits

$x = \frac{41.4}{99}$ ← Rearranging to express x as a fraction

The fraction must not have decimals in it to be accepted as a final answer. So multiplying the numerator and denominator by 10 to eliminate the decimals → $\frac{414}{990}$

(Total for Question 15 is 3 marks)

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16 (a) Rationalise the denominator of $\frac{22}{\sqrt{11}}$

Give your answer in its simplest form.

$\frac{22\sqrt{11}}{11}$ ← Multiplying the numerator and denominator by $\sqrt{11}$ rationalises the denominator

The fraction is simplified by dividing both the numerator and denominator by 11 → $2\sqrt{11}$

(2)

(b) Show that $\frac{\sqrt{3}}{2\sqrt{3}-1}$ can be written in the form $\frac{a+\sqrt{3}}{b}$ where a and b are integers.

$\frac{\sqrt{3}(2\sqrt{3}+1)}{(2\sqrt{3}-1)(2\sqrt{3}+1)}$ ← Flipping the sign to a plus on the denominator and multiplying the numerator and denominator by this rationalises the denominator

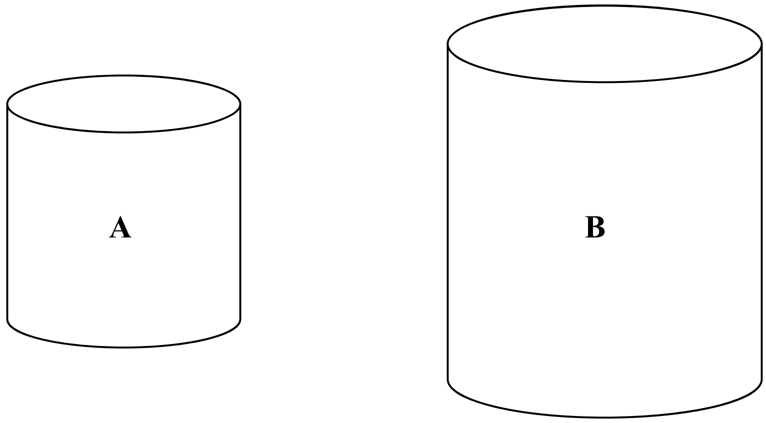
$\frac{6+\sqrt{3}}{12+2\sqrt{3}-2\sqrt{3}-1}$ ← Expanding the brackets. $\sqrt{3} \times \sqrt{3} = 3$

$\frac{6+\sqrt{3}}{11}$ ← Simplifying the denominator by collecting like terms. The $\sqrt{3}$ terms cancel out

(3)

(Total for Question 16 is 5 marks)

17 **A** and **B** are two similar cylindrical containers.



the surface area of container **A** : the surface area of container **B** = 4 : 9

Tyler fills container **A** with water.
She then pours all the water into container **B**.
Tyler repeats this and stops when container **B** is full of water.

Work out the number of times that Tyler fills container **A** with water.
You must show all your working.

2 : 3 ← Square rooting both sides of the ratio of the areas gives the ratio of the lengths

8 : 27 ← Cubing both sides of the ratio of the lengths gives the ratio of the volumes

27 ÷ 8 ← Working out how many lots of the smaller container A goes into the larger container B

8 goes into 27 3 times with a remainder. So container A will need to be filled 4 times as 3 times is not enough

4

(Total for Question 17 is 4 marks)

18 The function f is given by

$$f(x) = 2x^3 - 4$$

(a) Show that $f^{-1}(50) = 3$

$x = 2y^3 - 4$ ← Finding the inverse function by switching f(x) with x and x with y then rearranging to find y

$\sqrt[3]{\frac{x+4}{2}} = y$

$f^{-1}(50) = \sqrt[3]{\frac{50+4}{2}}$ ← Substituting 50 for x in the inverse function

$= 3$ ← The answer must be 3 as it is a show that question

(2)

The functions g and h are given by

$$g(x) = x + 2 \quad \text{and} \quad h(x) = x^2$$

(b) Find the values of x for which

$$hg(x) = 3x^2 + x - 1$$

$(x+2)^2$ ← Substituting g(x) for x in h(x) works out the composite function hg(x)

$x^2 + 4x + 4 = 3x^2 + x - 1$ ← Expanding out the square bracket using square the first term, double the product of the two terms, square the last term. Setting this equal to the $3x^2 + x - 1$

$0 = 2x^2 - 3x - 5$ ← Bringing into the quadratic form $ax^2 + bx + c = 0$ so it can be solved

1, 10
2, 5 ← Multiplying the 2 by the -5 to give -10. Listing out the factor pairs of 10 until a pair will multiply to -10 and add to -3 when one of the pair is negative

$0 = 2x^2 + 2x - 5x - 5$ ← 2 and -5 multiply to -10 and add to -3. Splitting the middle term into these amounts of x

$= 2x(x+1) - 5(x+1)$ ← Factorising the first two terms and the last two terms separately

$= (2x-5)(x+1)$ ← Bringing it into the factorised form

Both brackets multiplied together gives 0. So one of the two brackets must equal to 0. When 2x - 5 = 0, x = 5/2. When x + 1 = 0, x = -1 → $x = \frac{5}{2}$, $x = -1$

(4)

(Total for Question 18 is 6 marks)

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19 Given that $9^{-\frac{1}{2}} = 27^{\frac{1}{4}} \div 3^{x+1}$

find the exact value of x.

$(3^2)^{-\frac{1}{2}} = (3^3)^{\frac{1}{4}} \div 3^{x+1}$ ← Expressing 9 and 27 as a power of 3 so that they are all powers of 3

$3^{-1} = 3^{\frac{3}{4}-x-1}$ ← $(a^x)^y = a^{xy}$. $a^x/a^y = a^{x-y}$

$-1 = \frac{3}{4} - x - 1$ ← The power on the left must be equal to the power on the right

$-\frac{3}{4} = -x$ ← Adding 1 and subtracting 3/4 from both sides gets the x term on its own

Dividing both sides by -1 →

$x =$ $\frac{3}{4}$

(Total for Question 19 is 3 marks)

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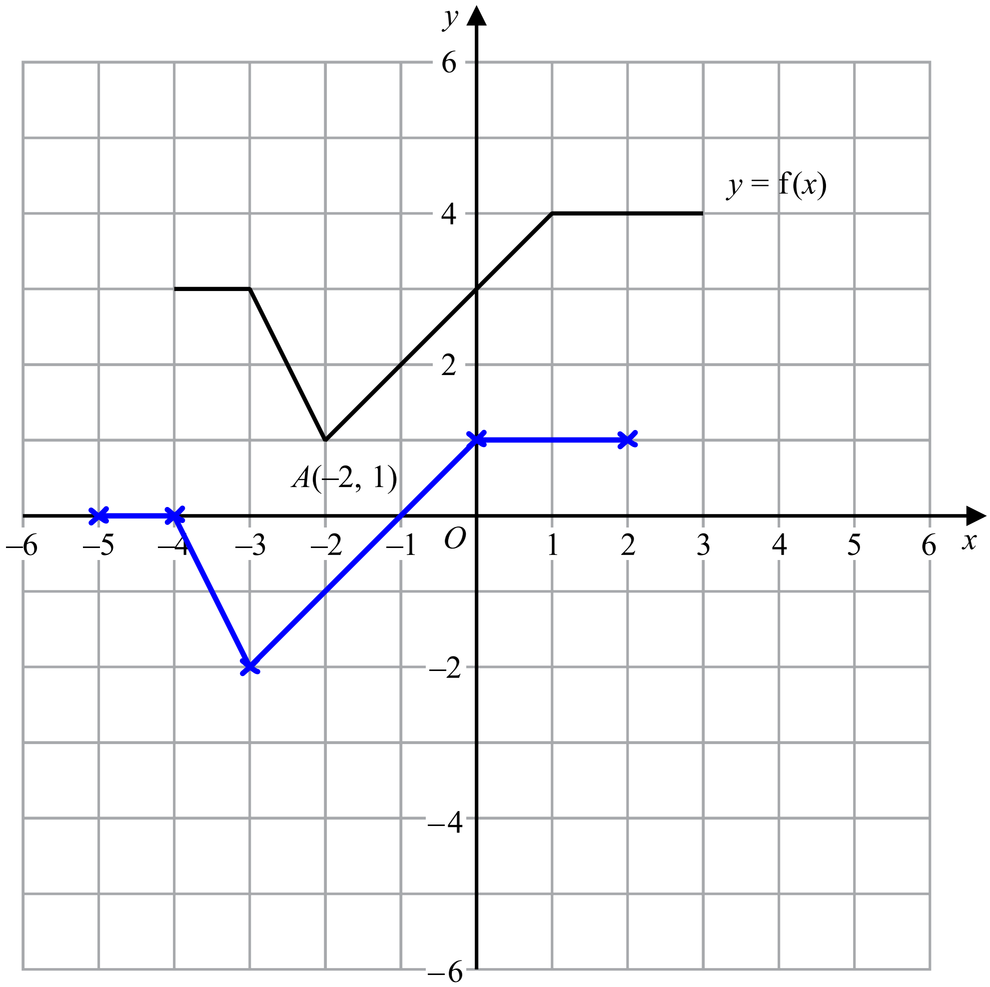
20 The graph of $y = \text{f}(x)$ is shown on the grid.



(a) On the grid, draw the graph with equation $y = \text{f}(x + 1) - 3$

It moves 1 to the left and 3 down

(2)

Point $A(-2, 1)$ lies on the graph of $y = \text{f}(x)$.

When the graph of $y = \text{f}(x)$ is transformed to the graph with equation $y = \text{f}(-x)$, point A is mapped to point B.

(b) Write down the coordinates of point B.

All the x coordinates are multiplied by -1. It reflects in the y axis

(......2...... , ...1......)

(1)

(Total for Question 20 is 3 marks)

21 Sketch the graph of

$$y = 2x^2 - 8x - 5$$

showing the coordinates of the turning point and the exact coordinates of any intercepts with the coordinate axes.

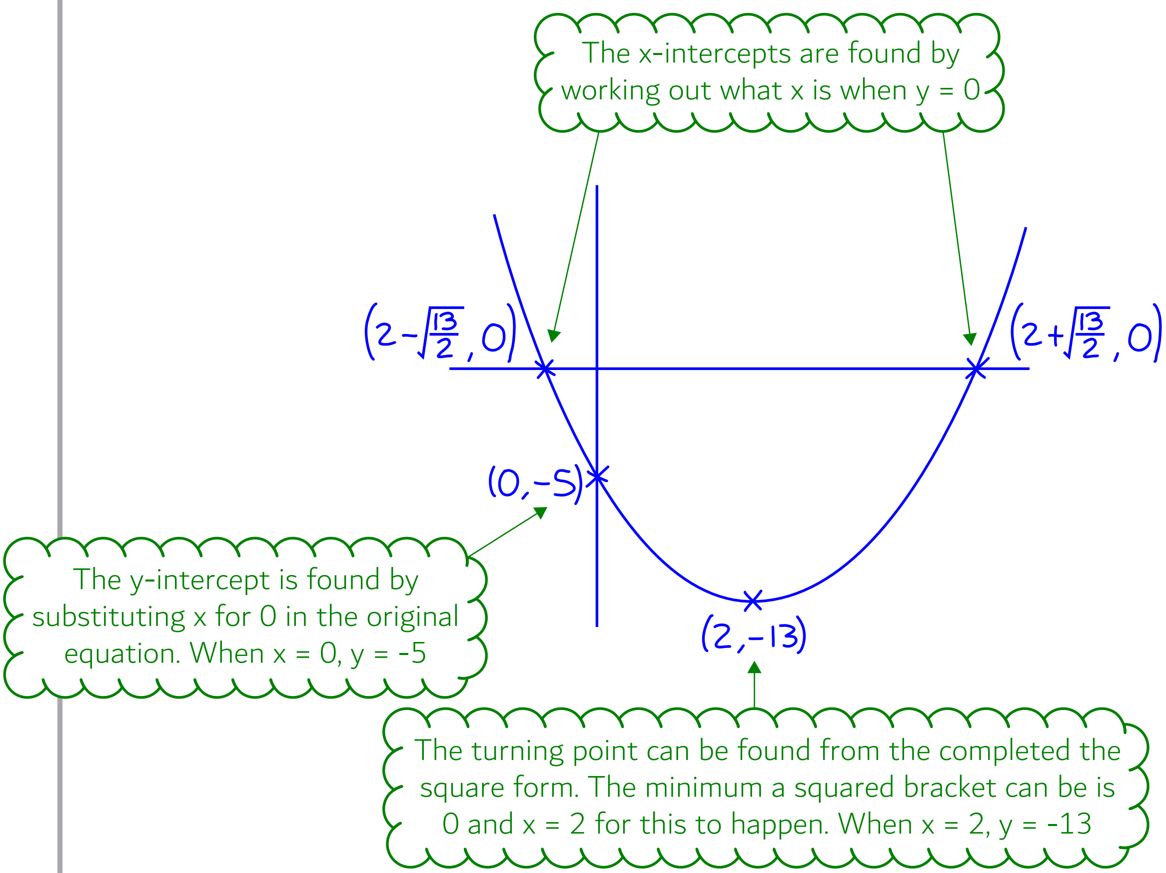
$y = 2(x^2 - 4x) - 5$ ← Bringing out 2 as a factor for the first two terms so that it is in a form where it is possible to complete the square

$= 2(x-2)^2 - 5 - 8$ ← Completing the square

$2(x-2)^2 - 13 = 0$ ← Setting it equal to 0 to work out the x-intercepts

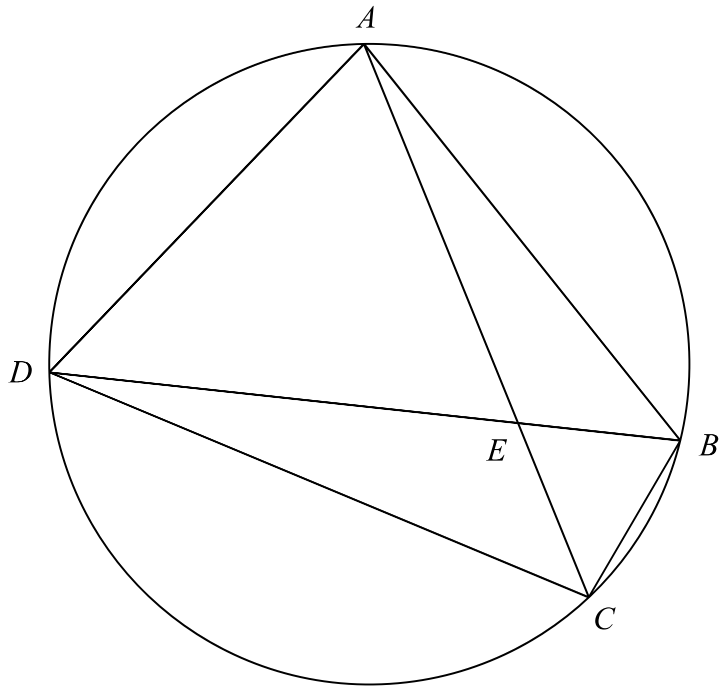
$(x-2)^2 = \frac{13}{2}$ ← Starting to rearrange to make x the subject by adding 13 to both sides then dividing by 2

$x = 2 \pm \sqrt{\frac{13}{2}}$ ← Making x the subject by square rooting both sides then adding 2 to both sides



(Total for Question 21 is 5 marks)

22 *A*, *B*, *C* and *D* are four points on a circle.



AEC and *DEB* are straight lines.

Triangle *AED* is an equilateral triangle.

Prove that triangle *ABC* is congruent to triangle *DCB*.

BC is shared

180/3 = 60 so angles ADE, DEA and EAD are 60° as angles in an equilateral triangle are equal

Angles EAD = DBC and ADE = ACB as angles in the same segment from the same chord are equal

Angles ABC = DBC + ABD = ACB + ACD = DCB as angles in the same segment from the same chord are equal

ASA

(Total for Question 22 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS