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 19 May 2020

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

.CG Maths.

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The first five terms of an arithmetic sequence are

1 4 7 10 13

Write down an expression, in terms of n, for the nth term of this sequence.

The sequence increases by 3 each term so it must involve 3n. The 0th term, the one before the first term, would be -2 so it must be 3n - 2

3n-2

(Total for Question 1 is 2 marks)

2 Show that $2\frac{1}{3} \times 3\frac{3}{4} = 8\frac{3}{4}$

$\frac{7}{3} \times \frac{15}{4} = \frac{35}{4} = 8\frac{3}{4}$

Converting the mixed numbers into improper fractions by multiplying the whole number by the denominator then adding the result to the numerator. 2 x 3 = 6. 1 + 6 = 7. 3 x 4 = 12. 3 + 12 = 15.

Cancelling out a factor of 3 from the numerators and denominators makes the multiplication of the fractions easier. 3/3 = 1 and 15/3 = 5 so it becomes 7/1 x 5/4. The fractions can be multiplied by multiplying the numerators and denominators. 7 x 5 = 35. 1 x 4 = 4.

8 lots of 4 go into 35 with a remainder of 3 so it becomes $8^3/_4$ as a mixed number

(Total for Question 2 is 3 marks)

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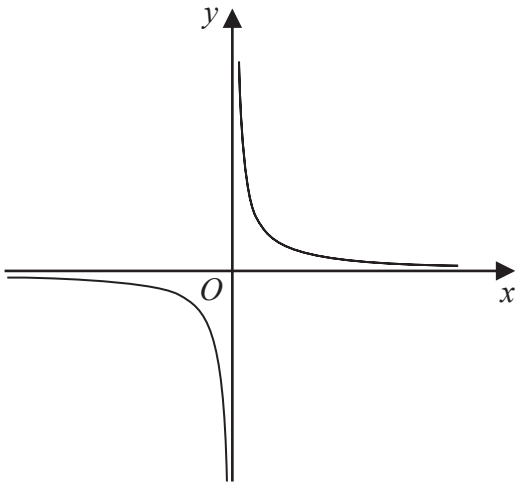
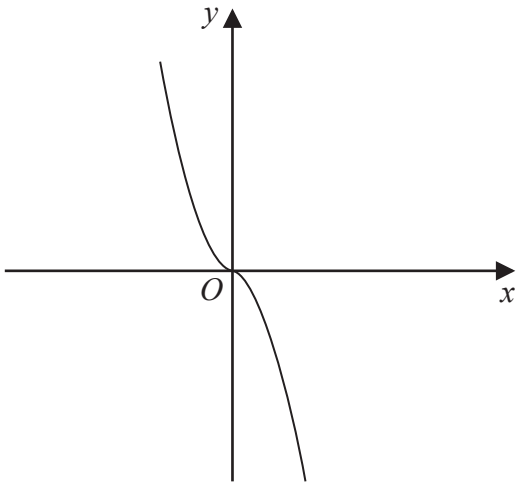
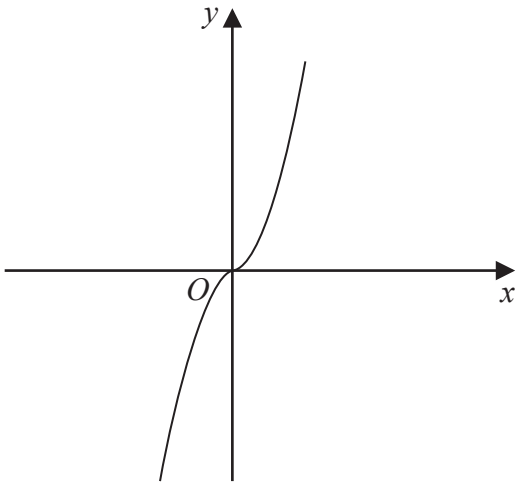
3 The diagram shows four graphs.



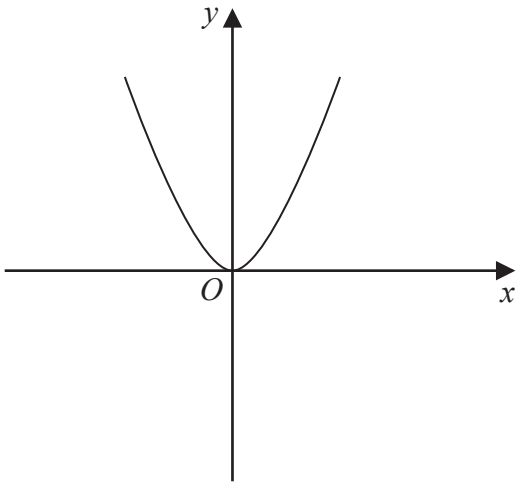
Graph **A**



Graph **B**



Graph **C**



Graph **D**

Each of the equations in the table is the equation of one of the graphs.

Complete the table.

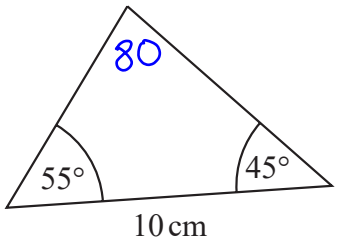
x	-2	-1	0	1	2
y	8	1	0	-1	-8
y	-8	-1	0	1	8
y	4	1	0	1	4
y	$\frac{-1}{2}$	-1	-	1	$\frac{1}{2}$

Equation	Letter of graph
$y = -x^3$	B
$y = x^3$	C
$y = x^2$	D
$y = \frac{1}{x}$	A

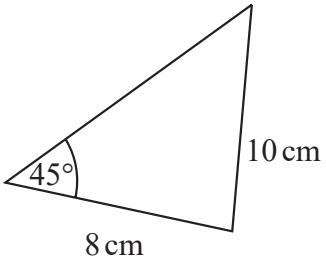
Doing a table of values for x values from -2 to 2 can work out which graph is which equation

(Total for Question 3 is 2 marks)

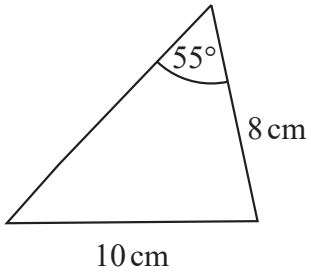
4 The diagram shows four triangles.



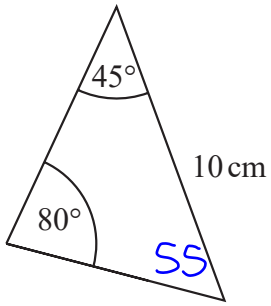
Triangle **A**



Triangle **B**



Triangle **C**



Triangle **D**

Two of these triangles are congruent. ← All the sides and angles are the same

Write down the letters of these two triangles.

It can't be B or C as the 10cm is opposite a different angle to the others

A and D

(Total for Question 4 is 1 mark)

5 Sean pays £10 for 24 chocolate bars.

He sells all 24 chocolate bars for 50p each.

Work out Sean's percentage profit.

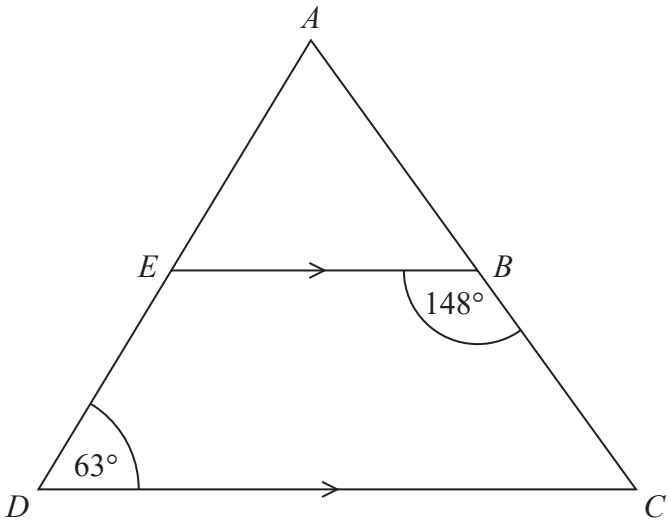
$$\frac{12 - 10}{10} \times 100$$

Percentage profit = percentage change = (new - old)/old x 100. The new value is the amount of income he gets. 50p is half of £1 so halving the 24 works out the income in pounds. The old value is the amount he paid

20 %

(Total for Question 5 is 3 marks)

6 *ADC* is a triangle.



AED and *ABC* are straight lines.
EB is parallel to *DC*.

Angle *EBC* = 148°
Angle *ADC* = 63°

Work out the size of angle *EAB*.
You must give a reason for each stage of your working.

180 - 148 = 32

Angle BCD is 32° as co-interior angles sum to 180 ← EBC is co-interior to BCD

180 - 63 - 32 = 85 ← Subtracting angles EDC and BCD from the 180° in triangle ADC

Angle EAB is 85° as angles in a triangle sum to 180

(Total for Question 6 is 5 marks)

7 The table shows information about the heights, in cm, of a group of Year 9 girls.

least height	150 cm
median	165 cm
greatest height	170 cm

This stem and leaf diagram shows information about the heights, in cm, of a group of 15 Year 9 boys.

15	8 9 9
16	4 5 7 7 8
17	0 3 4 4 7
18	0 2

Key: 15 | 8 represents 158 cm

Compare the distribution of the heights of the girls with the distribution of the heights of the boys.

The median for the boys is 168, which is higher than the median for the girls, which was 165.

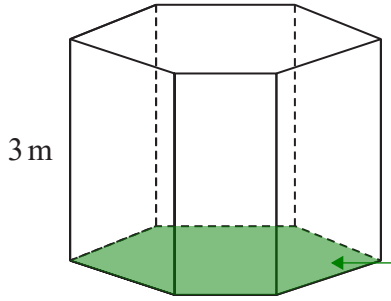
(15 + 1)/2 = 8 so the 8th value is the median for the boys. They are arranged in order in the stem and leaf diagram so we can count to the 8th value from the top left to the bottom right

The range for the boys is 24, which is higher than the range for the girls, which was 20.

The greatest value for the boys was 182 and the least was 158. The range is 182 - 158 which is 24. 170 - 150 is 20 so this is the range for the girls

(Total for Question 7 is 3 marks)

8 The diagram shows a prism placed on a horizontal floor.



$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

This is the cross sectional area, the area in contact with the floor

The prism has height 3 m
The volume of the prism is 18 m^3

The pressure on the floor due to the prism is 75 newtons/m^2

Work out the force exerted by the prism on the floor.

$F = PA$ ← Rearranged to make the force the subject of the formula by multiplying both sides by the area

$18 \div 3 = 6$ ← Volume of prism = cross sectional area x length
Cross sectional area = volume of prism/length
Cross sectional area = 18/3

$$\begin{array}{r} 75 \\ \times\ 6 \\ \hline 450 \\ {\scriptstyle 3} \end{array}$$
← Multiplying the pressure by the cross sectional area, which is the area in contact with the floor, to calculate the force

450 newtons

(Total for Question 8 is 3 marks)

9 Write these numbers in order of size.
Start with the smallest number.

6.72×10^5 67.2×10^{-4} 672×10^4 0.000 672

672000 0.00672 6720000

$x10^n$ means to multiply by 10 n times
$x10^{-n}$ means to divide by 10 n times

0.000672 67.2×10^{-4} 6.72×10^5 672×10^4

(Total for Question 9 is 2 marks)

10 Given that $\frac{a}{b} = \frac{2}{5}$ and $\frac{b}{c} = \frac{3}{4}$

find $a : b : c$

a	b	c
2	5	
	3	4

a could be 2 while b could be 5. b could be 3 while c could be 4. Writing these as ratios in columns to see what is in common to both ratios

b is in common to both ratios and a common multiple of 5 and 3 is 15. Multiplying both sides of the first ratio by 3 and both sides of the second ratio by 5 makes it so that the ratios can be combined

6 : 15 : 20

(Total for Question 10 is 3 marks)

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11 (a) Find the value of $\sqrt[4]{81 \times 10^8}$

This can be split into $\sqrt[4]{81} \times \sqrt[4]{10^8}$. The fourth root is the square root of the square root. $\sqrt{81} = 9$. $\sqrt{9} = 3$. The fourth root is the same as raising to the power of 1/4 and $(a^x)^y = a^{xy}$ so $(10^8)^{1/4} = 10^2$

The final answer can be left in standard form rather than converting into an ordinary number

3×10^2

(2)

(b) Find the value of $64^{-\frac{1}{2}}$

To the power of 1/2 means the positive square root. The negative means reciprocal. $\sqrt{64} = 8$ then reciprocal means 1 over

$\frac{1}{8}$

(2)

(c) Write $\frac{3^n}{9^{n-1}}$ as a power of 3

$(3^2)^{n-1}$ ← Writing the denominator as a power of 3. $9 = 3^2$

$\frac{3^n}{3^{2n-2}}$ ← $(3^2)^{n-1} = 3^{2n-2}$ as $(a^x)^y = a^{xy}$. $2(n-1) = 2n-2$

$n-(2n-2)$ ← $a^x/a^y = a^{x-y}$ so the powers of 3 can be subtracted

3^{2-n}

(2)

(Total for Question 11 is 6 marks)

12 The table gives information about the weekly wages of 80 people.

Wage (£w)	Frequency
$200 < w \leqslant 250$	5
$250 < w \leqslant 300$	10
$300 < w \leqslant 350$	20
$350 < w \leqslant 400$	20
$400 < w \leqslant 450$	15
$450 < w \leqslant 500$	10

(a) Complete the cumulative frequency table.

Wage (£w)	Cumulative frequency
$200 < w \leqslant 250$	5
$200 < w \leqslant 300$	15
$200 < w \leqslant 350$	35
$200 < w \leqslant 400$	55
$200 < w \leqslant 450$	70
$200 < w \leqslant 500$	80

The frequencies are added up as they go

5 + 10

15 + 20

35 + 20

55 + 15

70 + 10

(1)

(b) On the grid opposite, draw a cumulative frequency graph for your completed table.

(2)

Juan says

"60% of this group of people have a weekly wage of £360 or less."

(c) Is Juan correct?
You must show how you get your answer.

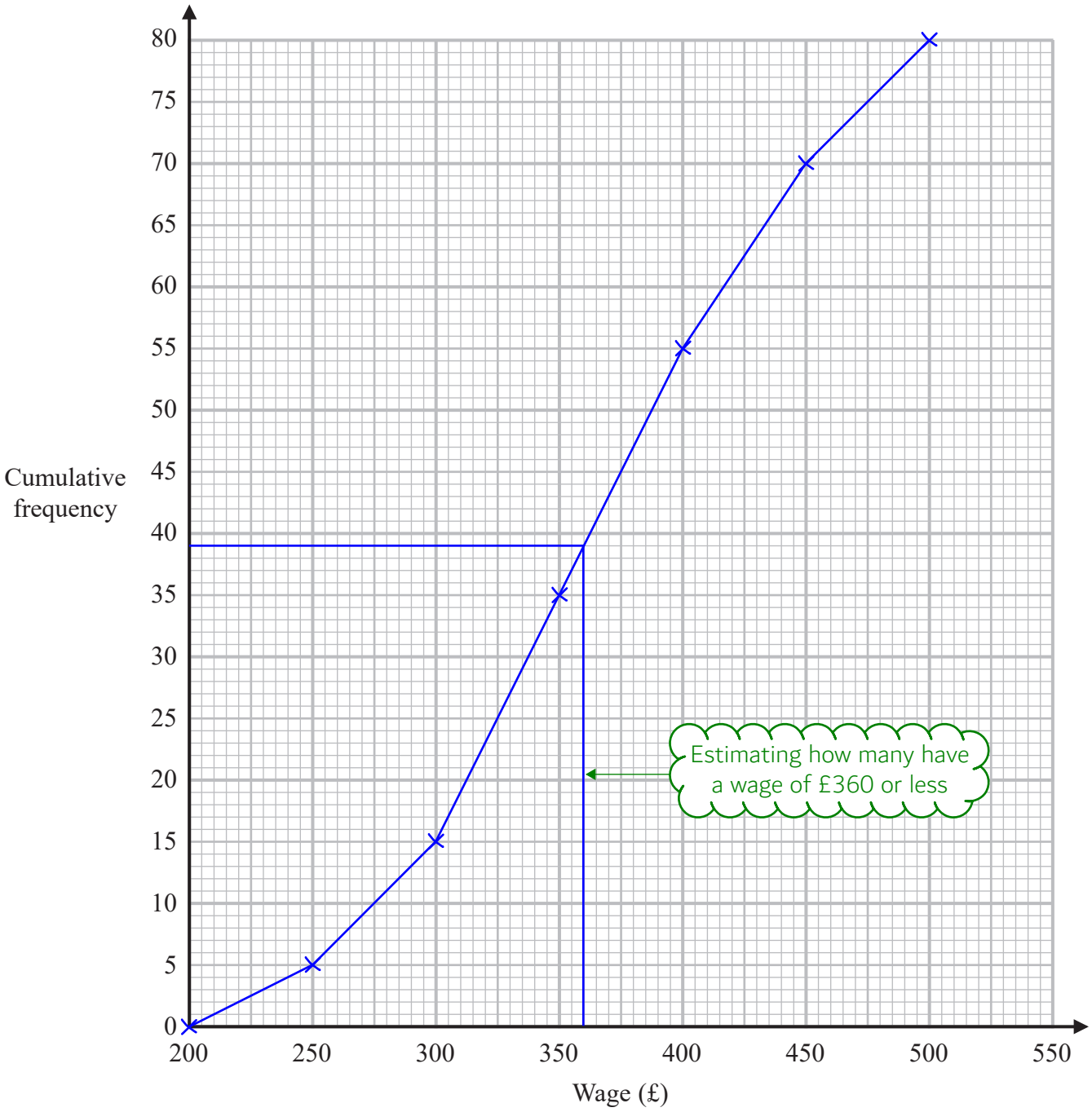
$\frac{80}{10} \times 6 = 48$

Dividing by 10 works out 10% of 80.
Multiplying by 6 works out that 60% is 48

No

From the cumulative frequency graph and assuming that the wages are evenly distributed through the $350 < w \leq 400$ category, we estimate that there were about 39 with a wage of £360 or less. This is less than 48

(3)



(Total for Question 12 is 6 marks)

The cumulative frequencies are plotted at the end of each category. There were no wages below £200 so 0 is plotted at £200. The points are joined up with a series of straight lines, which is easier than trying to do a smooth curve freehand

13 Liquid **A** and liquid **B** are mixed to make liquid **C**.

Liquid **A** has a density of 70 kg/m^3
Liquid **A** has a mass of 1400 kg

Liquid **B** has a density of 280 kg/m^3
Liquid **B** has a volume of 30 m^3

Work out the density of liquid **C**.

d m V

Writing out the formula triangle for density

1400 + 280 × 30
1400 / 70 + 30

density of C = mass of C/volume of C
mass of C = mass of A + mass of B
mass of B = density of B x volume of B = 280 x 30
volume of C = volume of A + volume of B
volume of A = mass of A/density of A = 1400/70

280
× 30
8400

Mass of B: 280 x 30 = 8400kg

+1400
9800

Mass of C: 8400 + 1400 = 9800kg

0196
50 | 9848030

196 kg/m^3

(Total for Question 13 is 3 marks)

Volume of A: 1400/70 = 140/7 = 20m^3
Volume of C: 20 + 30 = 50m^3

density of C = mass of C/volume of C

14 Sally plays two games against Martin.
In each game, Sally could win, draw or lose.

In each game they play,
the probability that Sally will win against Martin is 0.3
the probability that Sally will draw against Martin is 0.1

Work out the probability that Sally will win **exactly** one of the two games against Martin.

It is certain to either win or not win so the probabilities must sum to 1. 1 - 0.3 = 0.7 so this is the probability of not winning

$0.3 \times 0.7 + 0.7 \times 0.3$ ← Win AND not win OR not win AND win. AND means to multiply, OR means to add

$\frac{3}{10} \times \frac{7}{10} = \frac{21}{100}$ ← Converted 0.3 and 0.7 into decimals so they are easier to multiply

0.3 x 0.7 is the same as 0.7 x 0.3. 21/100 + 21/100 = 42/100

$\frac{42}{100}$

(Total for Question 14 is 3 marks)

15 The straight line L_1 has equation $y = 3x - 4$
The straight line L_2 is perpendicular to L_1 and passes through the point (9, 5)

Find an equation of line L_2

$y = \frac{-1}{3}x + c$ ← The general equation of a straight line is y = mx + c, where m is the gradient and c is the y-intercept. The gradient of L_2 must be the negative reciprocal of the gradient of L_1 as they are perpendicular. The negative reciprocal of 3 is -1/3

$c = 5 + \frac{1}{3}(9) = 8$ ← Rearranged to make c the subject and substituted in the coordinates (9 , 5). c = y + 1/3 x and x = 9, y = 5

$y = \frac{-1}{3}x + 8$

(Total for Question 15 is 3 marks)

16 Shirley wants to find an estimate for the number of bees in her hive.

On Monday she catches 90 of the bees.
She puts a mark on each bee and returns them to her hive.

On Tuesday she catches 120 of the bees.
She finds that 20 of these bees have been marked.

(a) Work out an estimate for the total number of bees in her hive.

$\frac{20}{90}x = 120$ ← Let x be the total number of bees. We can estimate that she has caught 20/90 of the total number of bees and this is 120

$120 \times \frac{90}{20}$ ← x = 120 ÷ 20/90 = 120 x 90/20

120/20 = 12/2 = 6
6 x 9 = 54 so 6 x 90 = 540 → 540

(3)

Shirley assumes that none of the marks had rubbed off between Monday and Tuesday.

(b) If Shirley's assumption is wrong, explain what effect this would have on your answer to part (a).

It will decrease

If some of the marks have rubbed off, there will likely be more than 20 caught on Tuesday which are of the original 90 caught on Monday. This would mean that the total number of bees would be 120 x 90/(something greater than 20), which would be less than 540

(1)

(Total for Question 16 is 4 marks)

17 Make f the subject of the formula $d = \dfrac{3(1-f)}{f-4}$

$df - 4d = 3 - 3f$ ← Multiply both sides by f - 4 and expand the brackets

$df + 3f = 3 + 4d$ ← Add 3f to both sides to get the f terms on the same side then add 4d to get them on their own

$f(d+3)$ ← Factorise the left side to get f out of both of the terms involving f

Divide both sides by d + 3 to get f on its own

$f = \dfrac{3+4d}{d+3}$

(Total for Question 17 is 4 marks)

18 x is proportional to $\sqrt{y}$ where $y > 0$

y is increased by 44%

Work out the percentage increase in x.

$\sqrt{\dfrac{144}{100}} = \dfrac{12}{10} = \dfrac{120}{100}$ ← Expressing the multiplier for x as a fraction out of 100 to work out what percentage it has increased to

Expressing the percentage increase as a multiplier: 144/100. The square root of the multiplier will happen to x as y is square rooted

x has increased to 120% so has increased by 20%

20 %

(Total for Question 18 is 3 marks)

19 f and g are functions such that

$$f(x) = \frac{12}{\sqrt{x}} \quad \text{and} \quad g(x) = 3(2x + 1)$$

(a) Find g(5)

$3(2(5)+1)$ ← Substituting x for 5 in g(x)

2(5) = 10
10 + 1 = 11
3(11) = 33 → 33

(1)

(b) Find gf(9)

$3\left(2\left(\frac{12}{\sqrt{9}}\right)+1\right)$ ← Substituting 9 for x in f(x). Then substituting the result for x in g(x)

12/√9 = 12/3 = 4
2(4) = 8
8 + 1 = 9
3(9) = 27 → 27

(2)

(c) Find $g^{-1}(6)$

$x = 3(2y + 1)$ ← Switching g(x) with x and x with y as inverse functions basically switch the x and y variables

$= 6y + 3$ ← Expanding the bracket

$y = \frac{x-3}{6}$ ← Rearranging to make y the subject. So $g^{-1}(x) = (x - 3)/6$

Substituting 6 for x in $g^{-1}(x)$ gives (6 - 3)/6. 6 - 3 = 3 → $\frac{3}{6}$

(2)

(Total for Question 19 is 5 marks)

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20 Show that $\frac{\sqrt{180} - 2\sqrt{5}}{5\sqrt{5} - 5}$ can be written in the form $a + \frac{\sqrt{5}}{b}$ where a and b are integers.

$5\overline{)11'80}$ 036

$\sqrt{180} = \sqrt{36} \times \sqrt{5} = 6\sqrt{5}$

$\sqrt{180}$ must simplify to something $\sqrt{5}$ as the answer has $\sqrt{5}$ as the only surd. $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$ so this works out what surd multiplies by $\sqrt{5}$ to get $\sqrt{180}$

$\frac{4\sqrt{5}}{5\sqrt{5}-5} \times \frac{5\sqrt{5}+5}{5\sqrt{5}+5}$

$6\sqrt{5} - 2\sqrt{5} = 4\sqrt{5}$. Rationalising the denominator by switching the sign from - to + on the denominator and multiplying by the result/the result. This will cancel out the surds on the denominator

$\frac{20\sqrt{25} + 20\sqrt{5}}{25\sqrt{25} + 25\sqrt{5} - 25\sqrt{5} - 25}$

$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

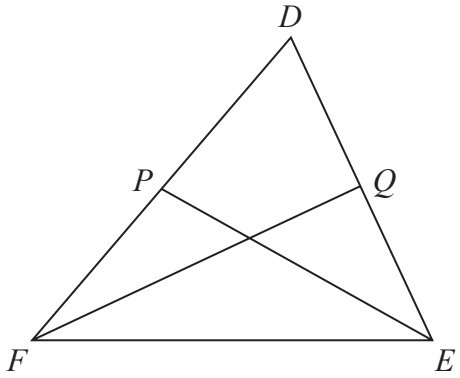
$\frac{100 + 20\sqrt{5}}{100}$

$1 + \frac{\sqrt{5}}{5}$

Putting both terms over 100 separately give $100/100 + 20\sqrt{5}/100$

(Total for Question 20 is 4 marks)

21 *DEF* is a triangle.



P is the midpoint of *FD*.
Q is the midpoint of *DE*.

$\overrightarrow{FD} = \mathbf{a}$ and $\overrightarrow{FE} = \mathbf{b}$

Use a vector method to prove that *PQ* is parallel to *FE*.

$\overrightarrow{PQ} = \overrightarrow{PD} + \overrightarrow{DQ}$

$= \frac{1}{2}a + \frac{1}{2}(-a + b)$

$= \frac{1}{2}b$

$\overrightarrow{PD} = 1/2\ a$ as P is the midpoint of FD and $\overrightarrow{FD} = a$.
$\overrightarrow{DQ} = 1/2\ \overrightarrow{DE}$ as Q is the midpoint of DE.
$\overrightarrow{DE} = \overrightarrow{DF} + \overrightarrow{FE} = -a + b$

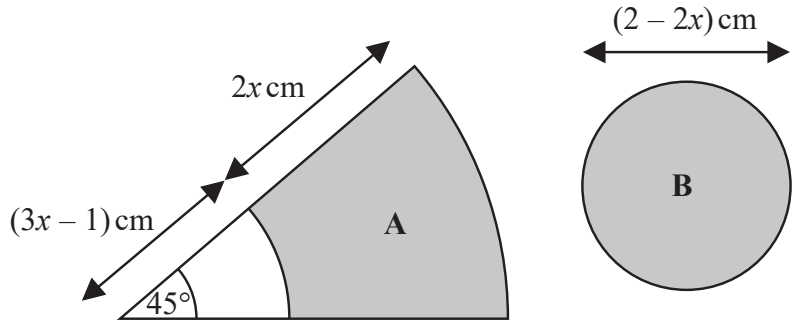
They both only in terms of b

So they must be parallel as $\overrightarrow{PQ}$ and $\overrightarrow{FE}$ are in the same direction

(Total for Question 21 is 4 marks)

22 The diagram shows two shaded shapes, **A** and **B**.

Shape **A** is formed by removing a sector of a circle with radius $(3x - 1)$ cm from a sector of the circle with radius $(5x - 1)$ cm.
Shape **B** is a circle of diameter $(2 - 2x)$ cm.



The area of shape **A** is equal to the area of shape **B**.

Find the value of x.
You must show all your working.

$\frac{45}{360}\pi(5x-1)^2 - \frac{45}{360}\pi(3x-1)^2 = \pi(1-x)^2$

$\frac{1}{8}(25x^2-10x+1-(9x^2-6x+1)) = x^2-2x+1$

$16x^2-4x = 8x^2-16x+8$

$8x^2+12x-8=0$

$2x^2+3x-2=0$

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

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

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

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

Area of sector = y/360 x πr², where y is the angle of the sector and r is the radius. Area of circle = πr². The radius of B is half of its diameter

45/360 simplifies to 1/8. Expanding the square brackets: square the first term, double the product of both terms, square the last term

Simplifying and multiplying both sides by 8 to eliminate the 1/8

Collecting all terms to the left so it is in the quadratic form and can be solved

Dividing all terms by the highest common factor, 4, to make it simpler

a x c = 2 x -2 = -4. Splitting the middle x term into two numbers which multiply to -4 and add to b, 3. Factorising the left two terms and the right two terms separately then bringing the 2x and -1 together as one bracket. The quadratic is now factorised

Either 2x - 1 = 0 or x + 2 = 0. Rearranging these solves for x

x can't be -2 as length has to be positive → $\frac{1}{2}$

(Total for Question 22 is 5 marks)

23 There are four types of cards in a game.

Each card has a black circle or a white circle or a black triangle or a white triangle.

number of cards with a black shape	:	number of cards with a white shape	=	3 : 5
number of cards with a circle	:	number of cards with a triangle	=	2 : 7

Express the total number of cards with a black shape as a fraction of the total number of cards with a triangle.

$\frac{3}{8} \div \frac{7}{9}$ ← 3 out of the 8 parts in the ratio of the colours are black shapes. 7 out of the 9 parts in the ratio of the shapes are triangles. The fraction of the cards with a black shape, 3/8, as a fraction of the fraction of the cards with a triangle, 7/9

$\frac{3}{8} \times \frac{9}{7}$ ← Divide the fractions: keep, change, flip

Multiply the fractions by multiplying the numerators and the denominators → $\frac{27}{56}$

(Total for Question 23 is 3 marks)

TOTAL FOR PAPER IS 80 MARKS