

Langley Park School for Girls  
Year 11 Trial Exam March 2021

Higher Tier

PAPER 1H

NON-CALCULATOR



Time: 1 hour 30 minutes

Name

LTH WS

Maths Teacher

Instructions

- Use black ink or ball-point pen.
- Answer all questions.
- Answer the questions in the spaces provided.
- Calculators must not be used.

Information

- There are 23 questions on this paper
- 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.
- Show all of your working out.
- Check your answers if you have time at the end.

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

$+3$   $+3$   $+3$   $+3$

-2

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

$3n-2$

$3n-2$

(Total for Question 1 is 2 marks)

2

Show that

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

$$2\frac{1}{3} = \frac{2 \times 3 + 1}{3} = \frac{7}{3}$$

$$3\frac{3}{4} = \frac{3 \times 4 + 3}{4} = \frac{15}{4}$$

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

$$= \frac{105}{12} \div 3$$

$$= \frac{35}{4} = 8\frac{3}{4}$$

4 goes into 35  
8 times remainder 3

both numbers are  
divisible by 3  
 $105 \div 3 = 35$   
 $12 \div 3 = 4$   
 $1+0+5=6$   
 $1+2=3$

(Total for Question 2 is 3 marks)

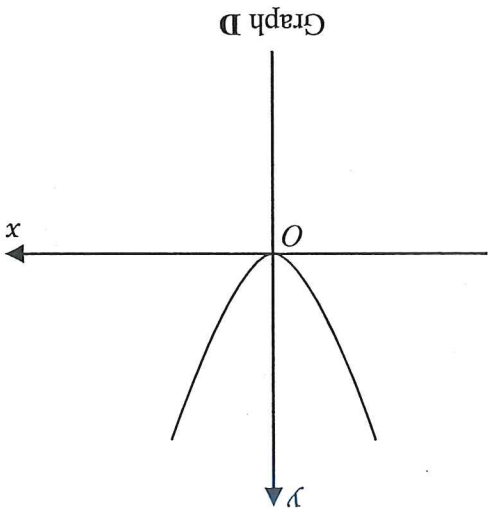
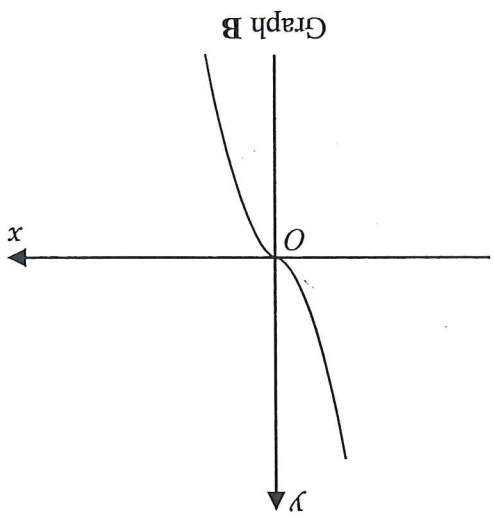
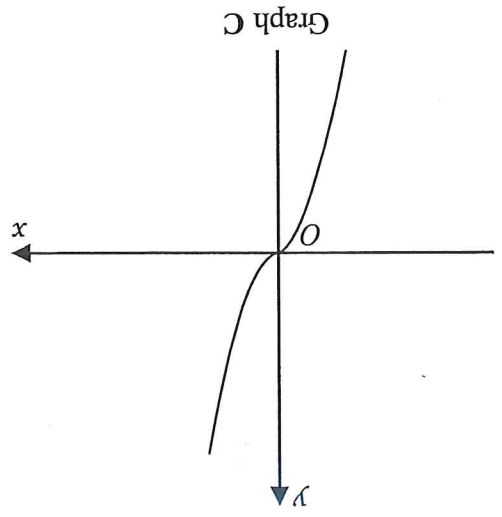
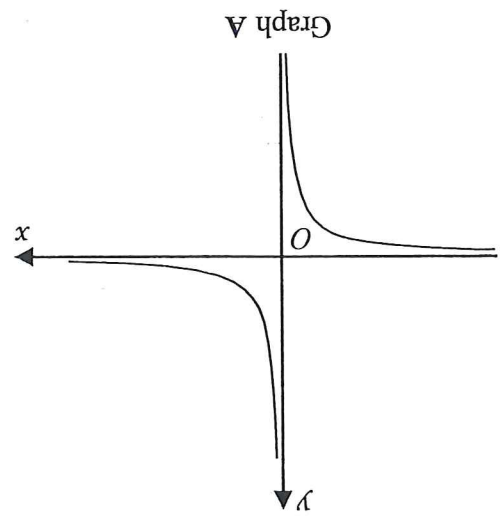


DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

3 The diagram shows four graphs.



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

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

(Total for Question 3 is 2 marks)



P 6 2 2 7 7 R A 0 3 2 0



(Total for Question 5 is 3 marks)

20 %

$$\begin{aligned} 24 \times 50p &= £12 \\ \text{profit} &= £2 \\ \% \text{ profit} &= \frac{2}{12} \times 100 \\ &= 0.2 \times 100 \\ &= 20 \% \end{aligned}$$

Work out Sean's percentage profit.

He sells all 24 chocolate bars for 50p each.

5 Sean pays £10 for 24 chocolate bars.

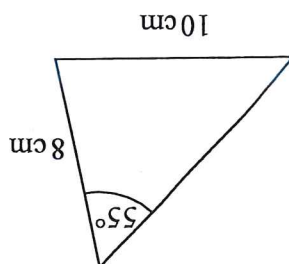
(Total for Question 4 is 1 mark)

Angle-Side-Angle

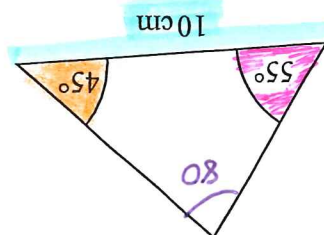
Write down the letters of these two triangles.

Two of these triangles are congruent.

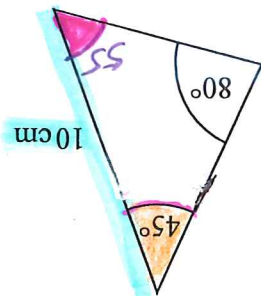
Triangle C



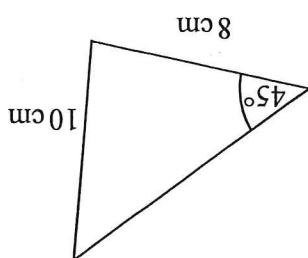
Triangle A



Triangle D



Triangle B



4 The diagram shows four triangles.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

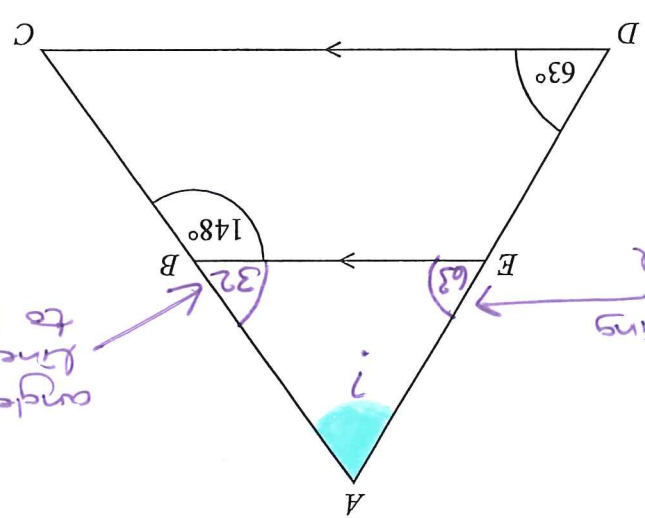


DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

6  $ADC$  is a triangle.



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

Angle  $EBC = 148^\circ$   
Angle  $ADC = 63^\circ$

Work out the size of angle  $EAB$ .

You must give a reason for each stage of your working.

angle  $EAB = 180 - (63 + 32)$   
 $= 180 - 95$   
 $= 85^\circ$   
angles in a triangle add up to  $180^\circ$

63  
+ 32  
95  
171  
- 95  
85

(Total for Question 6 is 5 marks)



P 6 2 2 7 7 R A 0 5 2 0

Turn over



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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 |

Girls  
Range = 170 - 150  
= 20 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       |

Boys

Median = 168 cm  
Range = 182 - 158  
= 24 cm

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 height of boys, 168 cm, is greater than the median height of girls, 165 cm. This tells us that on average Y9 boys are taller than Y9 girls.  
The range of heights of boys, 24 cm, is greater than the range of heights of girls, 20 cm. This tells us that there is a greater variation of heights for Y9 boys compared to Y9 girls.

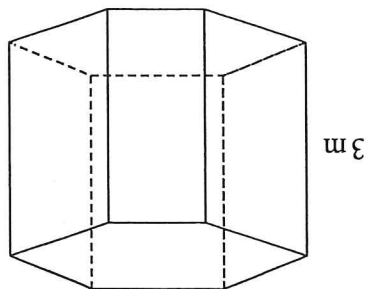
(Total for Question 7 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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



The prism has height 3 m  
The volume of the prism is 18 m<sup>3</sup>

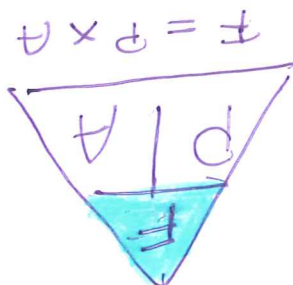
The pressure on the floor due to the prism is 75 newtons/m<sup>2</sup>

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

$$\begin{aligned} \text{Volume of prism} &= \text{Area base} \times \text{height} \\ 18 \text{ m}^3 &= \text{Area base} \times 3 \text{ m} \\ 6 \text{ m}^2 &= \text{Area base} \end{aligned}$$

$$\begin{aligned} \text{Force} &= \text{Pressure} \times \text{Area} \\ &= 75 \times 6 \\ &= 450 \end{aligned}$$

$$\begin{array}{r} 75 \\ \times 6 \\ \hline 450 \end{array}$$



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

newtons

450

(Total for Question 8 is 3 marks)

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

$$\begin{aligned} 6.72 \times 10^5 &= 672000 \\ 67.2 \times 10^{-4} &= 0.00672 \\ 672 \times 10^4 &= 6720000 \\ 0.000672 &= 0.000672 \end{aligned}$$

$$0.000672, 67.2 \times 10^{-4}, 6.72 \times 10^5, 672 \times 10^4$$

(Total for Question 9 is 2 marks)



P 6 2 2 7 7 R A 0 7 2 0

Turn over





DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 10 is 3 marks)

$$6:15:20$$

$$a:b:c \\ 6:15:20$$

$$a:b \\ 2:5 \\ \times 3 \quad \times 3 \quad \times 5 \\ 6:15:20$$

Find  $a:b:c$ 

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

$$a:b = 2:5 \quad b:c = 3:4$$



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

$$\begin{aligned}
 &= \sqrt[4]{81} \times \sqrt[4]{10^8} \\
 &= 3 \times (10^8)^{1/4} \\
 &= 3 \times 10^2 \\
 &= 3 \times 100 \\
 &= 300
 \end{aligned}$$

300

(2)

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

$$\begin{aligned}
 &= \frac{1}{64^{1/2}} \\
 &= \frac{1}{\sqrt{64}}
 \end{aligned}$$

 $\frac{1}{8}$ 

(2)

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

$$\frac{3^n}{3^{2(n-1)}} = \frac{3^n}{3^{2n-2}}$$

$$= \frac{3^n}{3^{2n-2}}$$

$$= 3^{n-(2n-2)}$$

$$= 3^{n-2n+2}$$

$$= 3^{-n+2}$$

 $3^{2-n}$ 

(2)

(Total for Question 11 is 6 marks)



P 6 2 2 7 7 R A 0 9 2 0

Turn over

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

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

(a) Complete the cumulative frequency table.

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

(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.

$$\frac{39 \text{ people}}{80 \text{ people}} \approx 50\%$$

Juan is not correct. Less than 60% of people have a weekly wage of £360 or less

(3)

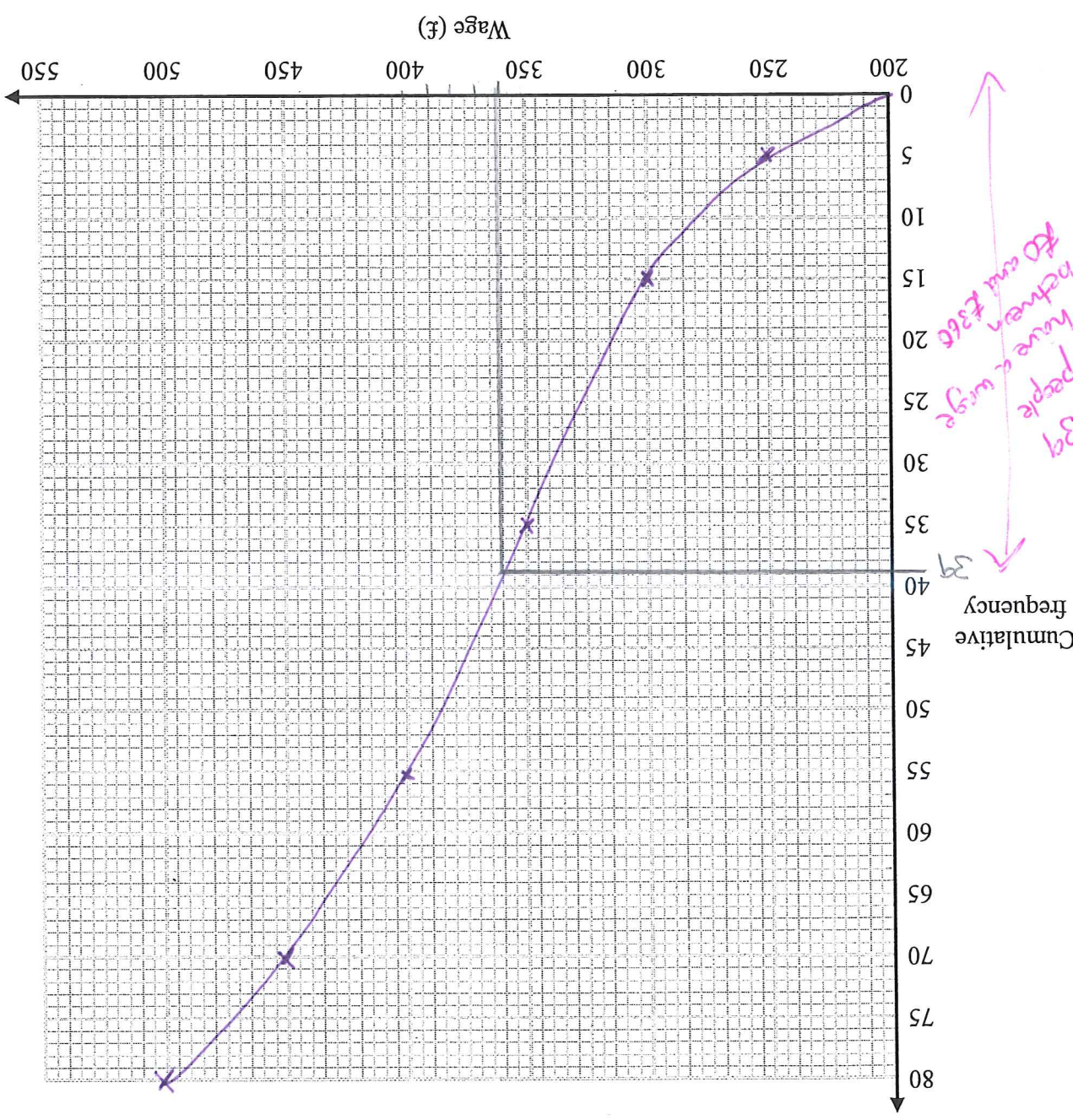




DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(Total for Question 12 is 6 marks)



Turn over



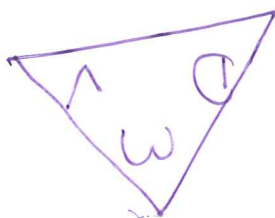
13 Liquid A and liquid B are mixed to make liquid C.

Liquid A has a density of  $70 \text{ kg/m}^3$   
Liquid A has a mass of  $1400 \text{ kg}$

Liquid B has a density of  $280 \text{ kg/m}^3$   
Liquid B has a volume of  $30 \text{ m}^3$

Work out the density of liquid C.

|          | Density | Mass | Volume |
|----------|---------|------|--------|
| Liquid A | 70      | 1400 | 20     |
| Liquid B | 280     | 8400 | 30     |
| Liquid C |         | 9800 | 50     |



$$\text{Volume Liquid A} = \frac{M}{D} = \frac{1400}{70} = 20$$

$$= 20 \text{ m}^3$$

$$\begin{aligned} \text{Mass Liquid B} &= D \times V \\ &= 280 \times 30 \\ &= 8400 \text{ kg} \end{aligned}$$

Remember we cannot add densities as density is a compound measure

$$\begin{aligned} \text{Mass Liquid C} &= \text{mass Liquid A} + \text{mass Liquid B} \\ &= 1400 + 8400 \\ &= 9800 \text{ kg} \end{aligned}$$

$$\begin{aligned} \text{Volume Liquid C} &= \text{Volume Liquid A} + \text{Volume Liquid B} \\ &= 20 + 30 \\ &= 50 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} \text{Density Liquid C} &= \frac{\text{Mass}}{\text{Volume}} \\ &= \frac{9800}{50} \\ &= 196 \text{ kg/m}^3 \end{aligned}$$

$$\begin{array}{r} 1400 \\ + 8400 \\ \hline 9800 \\ \div 50 \\ \hline 196 \end{array}$$

$$\begin{array}{r} 28 \\ \times 30 \\ \hline 840 \end{array}$$

(Total for Question 13 is 3 marks)

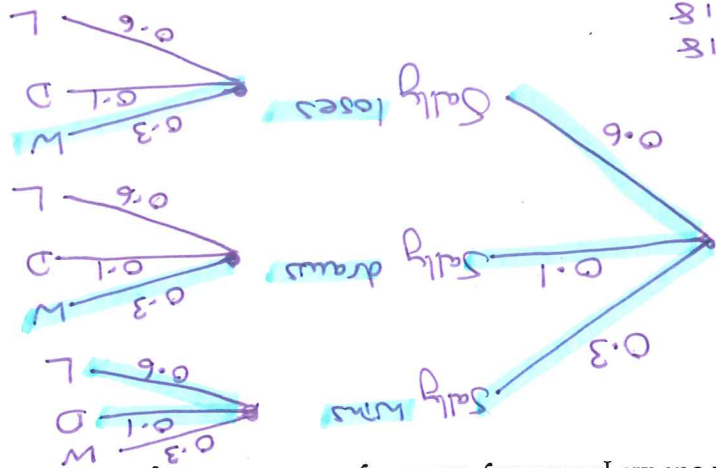
$$196 \text{ kg/m}^3$$



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.



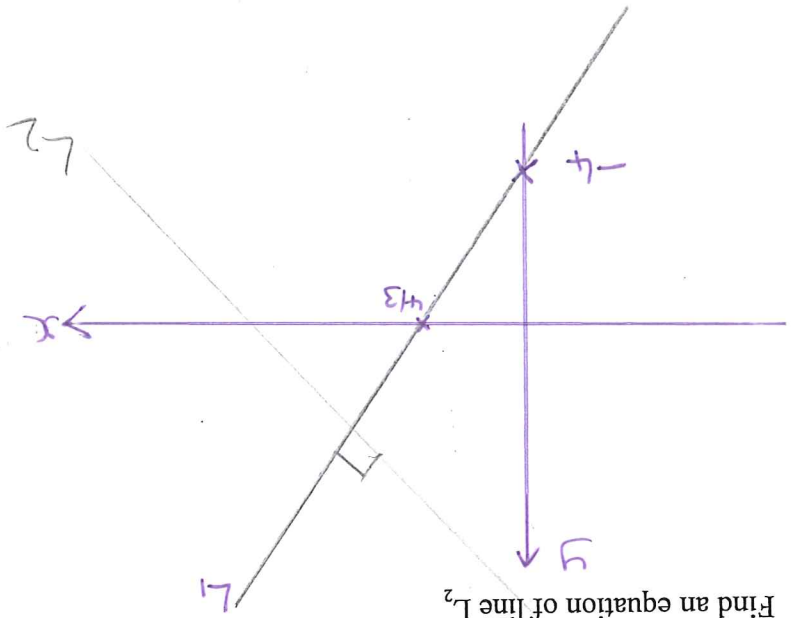
$$\begin{array}{r}
 0.18 \\
 + 0.03 \\
 + 0.03 \\
 + 0.03 \\
 \hline
 0.42
 \end{array}$$

(Total for Question 14 is 3 marks)

$$\begin{array}{l}
 P(WD) = 0.3 \times 0.1 = 0.03 \\
 P(WL) = 0.3 \times 0.6 = 0.18 \\
 P(DW) = 0.1 \times 0.3 = 0.03 \\
 P(DL) = 0.1 \times 0.6 = 0.06 \\
 P(LW) = 0.6 \times 0.3 = 0.18 \\
 P(LL) = 0.6 \times 0.6 = 0.36
 \end{array}$$

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  $L_2$



$$\begin{array}{l}
 L_2 \text{ has gradient } m = -\frac{1}{3} \\
 \text{equation } L_2 \\
 y = -\frac{1}{3}x + c \\
 \text{when } x = 9, y = 5 \\
 5 = -\frac{1}{3}(9) + c \\
 5 = -3 + c \\
 8 = c
 \end{array}$$

(Total for Question 15 is 3 marks)

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



Turn over





DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

Population = 90  
Sample = 120

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.

Tuesday

$$\frac{20}{120} = \frac{90}{N}$$

$$\frac{120}{20} = \frac{90}{N}$$

$$6 = \frac{90}{N}$$

$$540 = N$$

$$540$$

(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).

If some of the marks had rubbed off then  
Shirley will have over-estimated the number  
of bees

(1)

(Total for Question 16 is 4 marks)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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

$$[ \times (f-4) ]$$

[ expand

$$[ +3f ]$$

$$[ +4d ]$$

[ factorise

$$[ \div d+3 ]$$

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

$$f(d+3) = 3+4d$$

$$df + 3f = 3+4d$$

$$df - 4d + 3f = 3$$

$$df - 4d = 3 - 3f$$

$$d(f-4) = 3(1-f)$$

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

$y$  is increased by 44%

Work out the percentage increase in  $x$ .

$$x \propto \sqrt{y}$$

$$x = k\sqrt{y}$$

If  $y$  increases by 44% then

$$x = k\sqrt{1.44}$$

$$x = k \times 1.2$$

$$x = 1.2k$$

1.2 is an increase of 20%

that ...  
 $\sqrt{1.44} = 1.2$   
 and so  
 $\sqrt{1.44} = 1.2$

(Total for Question 18 is 3 marks)

20 %



19 f and g are functions such that

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

(a) Find  $g(5)$

$$\begin{aligned} &= 3(2 \times 5 + 1) \\ &= 3(10 + 1) \\ &= 3(11) \\ &= 33 \end{aligned}$$

(b) Find  $gf(9)$

$$\begin{aligned} f(9) &= \frac{12}{\sqrt{9}} \\ &= \frac{12}{3} \\ &= 4 \end{aligned}$$

$$\begin{aligned} g(4) &= 3(2 \times 4 + 1) \\ &= 3(8 + 1) \\ &= 3(9) \\ &= 27 \end{aligned}$$

(1)

33

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

$$g(x) = 3(2x+1)$$

$$\begin{array}{c} x \\ \downarrow \times 2 \\ x \\ \downarrow +1 \\ x \\ \downarrow \times 3 \\ g(x) \end{array} \quad \begin{array}{c} x \\ \downarrow \div 3 \\ \frac{x}{3} \\ \downarrow -1 \\ \frac{x}{3} - 1 \\ \downarrow \div 2 \\ \frac{\frac{x}{3} - 1}{2} \\ \downarrow - \\ \frac{\frac{x}{3} - 1}{2} - 1 \\ \downarrow \times 3 \\ g^{-1}(x) \end{array}$$

$$g^{-1}(x) = \frac{\frac{x}{3} - 1}{2}$$

$$\begin{aligned} g^{-1}(6) &= \frac{\frac{6}{3} - 1}{2} \\ &= \frac{2 - 1}{2} \\ &= \frac{1}{2} \end{aligned}$$

(2)

(Total for Question 19 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

DO NOT WRITE IN THIS AREA

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.

Simplify first

$$\frac{\sqrt{36 \times 5} - 2\sqrt{5}}{5(\sqrt{5} - 1)}$$

$$= \frac{6\sqrt{5} - 2\sqrt{5}}{5(\sqrt{5} - 1)}$$

$$= \frac{4\sqrt{5}}{5(\sqrt{5} - 1)}$$

now rationalise the denominator

$$= \frac{4\sqrt{5} \times (\sqrt{5} + 1)}{5(\sqrt{5} - 1)(\sqrt{5} + 1)}$$

$$= \frac{4\sqrt{5}(\sqrt{5} + 1)}{5(5 + \sqrt{5} - \sqrt{5} - 1)}$$

$$= \frac{5(4)}{20 + 4\sqrt{5}}$$

$$= \frac{20}{20 + 4\sqrt{5}}$$

$$= \frac{20}{4(5 + \sqrt{5})}$$

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

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

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

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

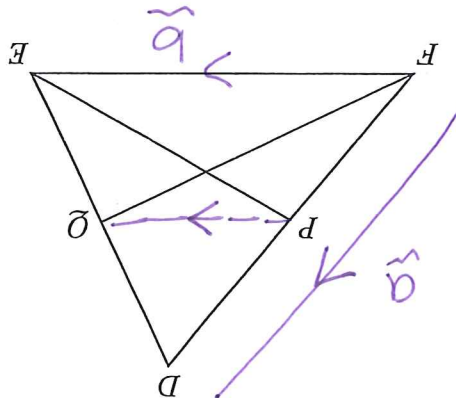
(Total for Question 20 is 4 marks)



P 6 2 2 7 7 R A 0 1 7 2 0



21 DEF is a triangle.



$P$  is the midpoint of  $FD$ .  
 $Q$  is the midpoint of  $DE$ .  
 $\vec{FD} = \vec{a}$  and  $\vec{FE} = \vec{b}$

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

$$\vec{FD} = \vec{a} \quad \vec{PD} = \frac{1}{2} \vec{a}$$

$$\vec{DE} = -\vec{a} + \vec{b} \quad \vec{DQ} = \frac{1}{2} (-\vec{a} + \vec{b})$$

$$\vec{PQ} = \vec{PD} + \vec{DQ} = \frac{1}{2} \vec{a} + \frac{1}{2} (-\vec{a} + \vec{b}) = \frac{1}{2} \vec{a} - \frac{1}{2} \vec{a} + \frac{1}{2} \vec{b} = \frac{1}{2} \vec{b}$$

$\vec{PQ}$  is a scalar multiple of  $\vec{FE}$  and is therefore parallel to  $\vec{FE}$

(Total for Question 21 is 4 marks)



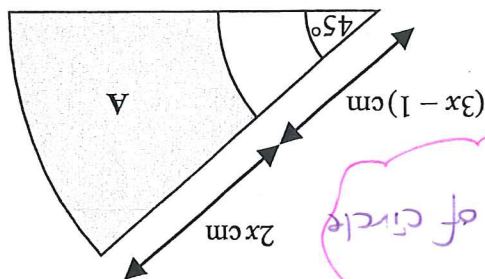
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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.



$$\frac{45}{360} = \frac{1}{8} \text{ of circle}$$

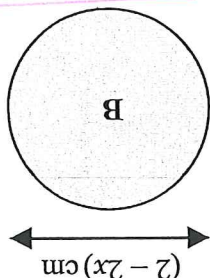
The area of shape A is equal to the area of shape B.

Find the value of  $x$ .

You must show all your working.

$$\begin{aligned} \text{Area A} &= \frac{\pi}{8} (5x-1)^2 - \frac{\pi}{8} (3x-1)^2 \\ &= \frac{\pi}{8} (25x^2 - 10x + 1) - \frac{\pi}{8} (9x^2 - 6x + 1) \\ &= \frac{\pi}{8} (16x^2 - 4x) \end{aligned}$$

$$\begin{aligned} \text{Area B} &= \pi (1-x)^2 \\ &= \pi (1-x)(1-x) \\ &= \pi (1-2x+x^2) \end{aligned}$$



$$\begin{aligned} d &= 2-2x \\ r &= 1-x \end{aligned}$$

$$\begin{aligned} \text{Area A} &= \text{Area B} \\ \frac{\pi}{8} (16x^2 - 4x) &= \pi (1-2x+x^2) \\ 2x^2 - \frac{1}{2}x &= 1-2x+x^2 \\ x^2 - \frac{1}{2}x &= 1-2x \\ x^2 + \frac{2}{3}x &= 1 \\ x^2 + \frac{2}{3}x - 1 &= 0 \end{aligned}$$

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

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

$$2x-1=0 \text{ or } x+2=0$$

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

$x$  is a length and must therefore be positive

$$x = \frac{1}{2} \text{ cm}$$

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

$$\begin{aligned} &[\div \pi] \\ &[-x^2] \\ &[+2x] \\ &[-1] \\ &[\times 2] \end{aligned}$$

(Total for Question 22 is 5 marks)





TOTAL FOR PAPER IS 80 MARKS

(Total for Question 23 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

23 There are four types of cards in a game.

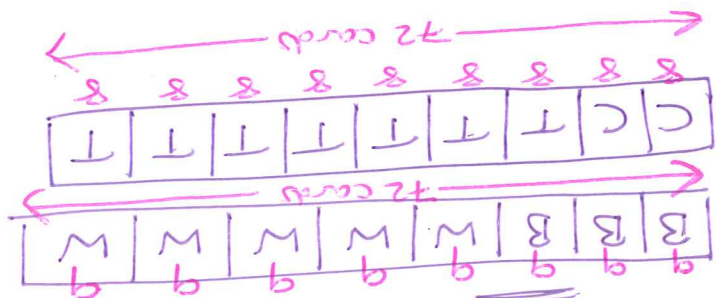
Each card has a black circle or a white circle or a black triangle or a white triangle.



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.



27 Black shape, 45 white shape  
16 Circle, 56 Triangle

$$\frac{27}{56}$$

Let there be 72 cards (LCM of 8 and 9 is 72)