

Langley Park School for Girls
Year 11 Maths Trial Exam March 2021



Higher Tier
PAPER 2H
CALCULATOR

Time: 1 hour 30 minutes

Name _____

Maths Teacher _____

Instructions

- Use black ink or ball-point pen.
- Answer **all** questions.
- Answer the questions in the spaces provided
- Calculators may be used.

Information

- There are 22 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.

LTH WS

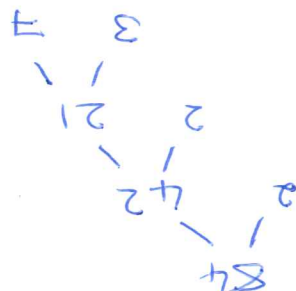
LTH WS

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Write 84 as a product of its prime factors.



* On Calculator
84 =
Shift FFACT *

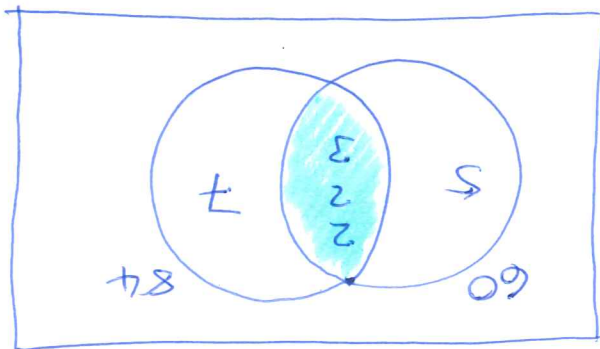
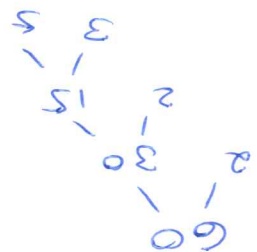
$$2^2 \times 3 \times 7$$

(2)

(b) Find the lowest common multiple (LCM) of 60 and 84

$$84 = 2 \times 2 \times 3 \times 7$$

$$60 = 2 \times 2 \times 3 \times 5$$



$$LCM = 2 \times 2 \times 3 \times 5 \times 7 = 420$$

$$420$$

(2)

(Total for Question 1 is 4 marks)

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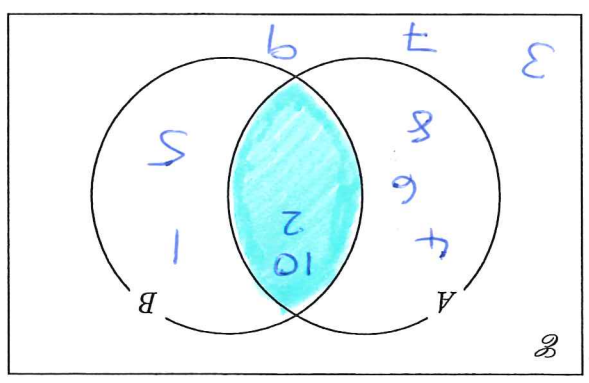
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2

$\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
 $A = \{\text{even numbers}\} = \{2, 4, 6, 8, 10\}$
 $B = \{\text{factors of } 10\} = \{1, 2, 5, 10\}$

(a) Complete the Venn diagram for this information.



(3)

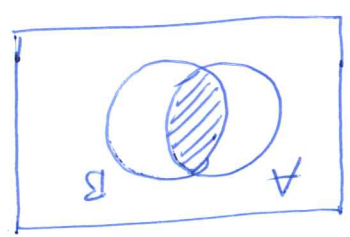
A number is chosen at random from the universal set, $\mathcal{E}$

(b) Find the probability that this number is in the set $A \cap B$

two numbers in here and ten numbers in total

$$P(A \cap B) = \frac{10}{20} \text{ or } \frac{1}{2}$$

(2)



$A \cap B$

(Total for Question 2 is 5 marks)



P 6 2 2 7 8 R A 0 3 2 4



(Total for Question 3 is 5 marks)

Carlo is not correct as 31% of the boxes filled with tins are large boxes

$$\begin{aligned} &= 31\% \\ &= \frac{31.0344 \dots}{100} \times 100 \\ &= \frac{96}{290} \times 100 \end{aligned}$$

$$\begin{aligned} &= 68.9655 \dots \\ &\approx 69\% \end{aligned}$$

$$\text{Small boxes } \frac{200}{290} \times 100$$

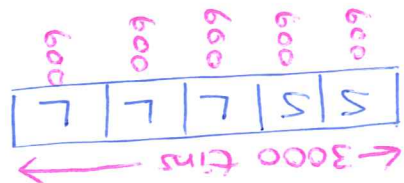
$$\text{total boxes} = 200 + 90 = 290 \text{ boxes}$$

$$\text{number of large boxes needed} = \frac{1800}{20} = 90 \text{ large boxes (each with 20 tins in)}$$

$$\text{number of small boxes needed} = \frac{1200}{6} = 200 \text{ small boxes (each with 6 tins in)}$$

$$\text{number of tins in large boxes} = 3 \times 600 = 1800$$

$$\text{number of tins in small boxes} = 2 \times 600 = 1200$$



$$3000 \div 5 = 600$$

Is Carlo correct?
You must show all your working.

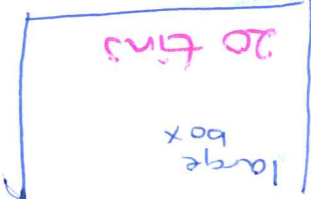
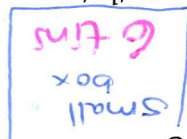
Carlo says that less than 30% of the boxes filled with tins are large boxes.

number of tins in small boxes : number of tins in large boxes = 2 : 3

Carlo puts a total of 3000 tins into the boxes so that

He puts 6 tins into each small box.
He puts 20 tins into each large box.

3 Carlo puts tins into small boxes and into large boxes.



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4 (a) Complete the table of values for $y = 5 - x^3$

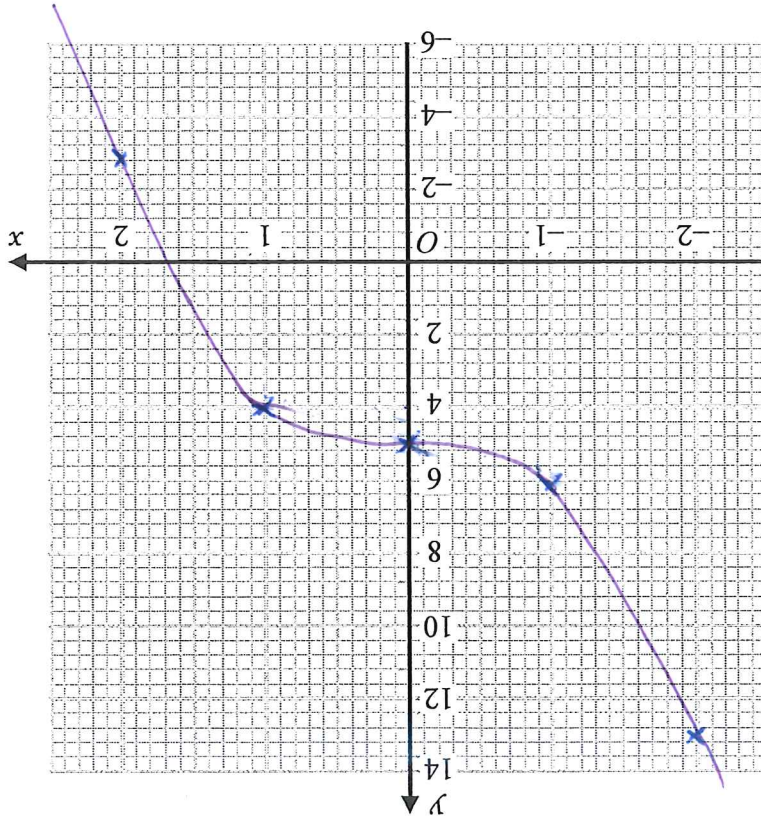
on calc
option 1
 $x = -2, y = 5 - (-2)^3 =$
use brackets
around -2

option 2
 $\frac{-2}{5 - \text{ANS}^3}$

option 3
mode 3: TABLE
 $f(x) = 5 - x^3$
use ALPHA X
stat -2
end 2
step 1

x	-2	-1	0	1	2
y	13	6	5	4	-3

(2)

(b) On the grid below, draw the graph of $y = 5 - x^3$ for values of x from -2 to 2

(2)

(Total for Question 4 is 4 marks)



P 6 2 2 7 8 R A 0 5 2 4

(Total for Question 6 is 2 marks)

$$\begin{pmatrix} -9 \\ 14 \end{pmatrix}$$

$$\begin{aligned} &= \begin{pmatrix} -9 \\ 14 \end{pmatrix} \\ &= \begin{pmatrix} 6-15 \\ 8-6 \end{pmatrix} \\ &= \begin{pmatrix} 6 \\ 8 \end{pmatrix} - \begin{pmatrix} 15 \\ 6 \end{pmatrix} \\ &= 2 \begin{pmatrix} 3 \\ 4 \end{pmatrix} - 3 \begin{pmatrix} 5 \\ -2 \end{pmatrix} \end{aligned}$$

Find $2a - 3b$ as a column vector.

$$6 \quad a = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \quad b = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$$

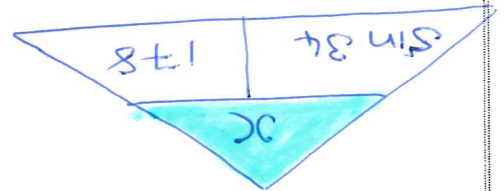
(Total for Question 5 is 2 marks)

99.5 mm

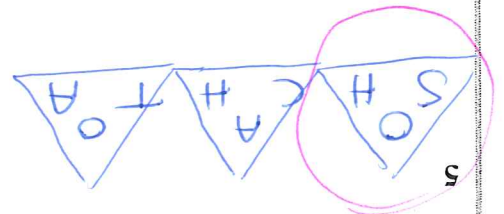
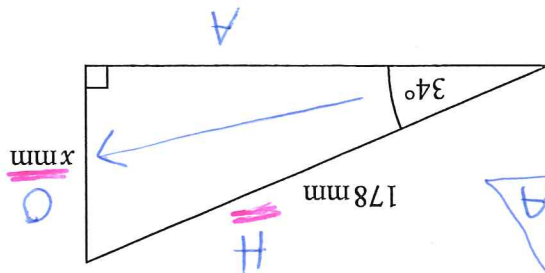
↑

units

$$\begin{aligned} x &= \sin(34^\circ) \times 178 \\ &= 99.53633 \dots \\ &= 99.5 \text{ mm (1dp)} \end{aligned}$$



Work out the value of x .
Give your answer correct to 1 decimal place.



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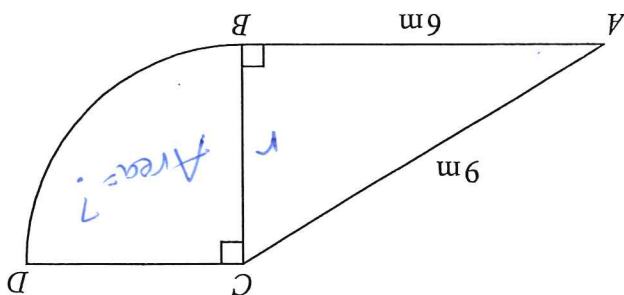
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7 The diagram shows a right-angled triangle and a quarter circle.



The right-angled triangle ABC has angle $ABC = 90^\circ$.
The quarter circle has centre C and radius CB .

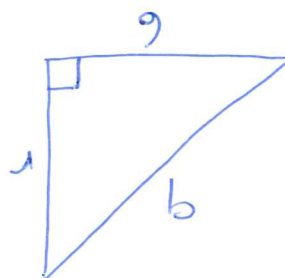
Work out the area of the quarter circle.

Give your answer correct to 3 significant figures.

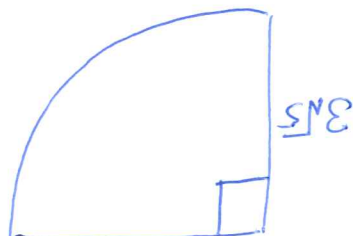
You must show all your working.

Use Pythagoras' theorem to find the radius.

Area quarter circle $= \frac{\pi r^2}{4}$



$$\begin{aligned} r^2 + 6^2 &= 9^2 \\ r^2 &= 9^2 - 6^2 \\ r^2 &= 45 \\ r &= \sqrt{45} \\ r &= 3\sqrt{5} \end{aligned}$$



$$\begin{aligned} \text{Area} &= \frac{\pi (3\sqrt{5})^2}{4} \\ &= 35.34291 \dots \\ &= 35.3 \text{ (3sf)} \end{aligned}$$

35.3 m²

(Total for Question 7 is 4 marks)



P 6 2 2 7 8 R A 0 7 2 4

Turn over



(Total for Question 8 is 5 marks)

(3)

£ 6354.67

on your calc you could also do
 $6000 \times 102.4\% \times (102.7\%)^2$
 using the % button

$= £6354.67$ (to nearest penny)

$= £6354.6716...$

$$£6000 \times 1.024 \times (1.017)^2$$

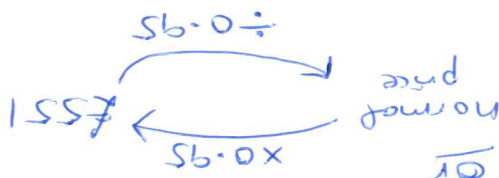
(b) Work out the value of Joan's investment at the end of 3 years.

2.4% for the first year $100\% + 2.4\% = 102.4\%$ multiplier 1.024
 1.7% for each extra year. $100\% + 1.7\% = 101.7\%$ multiplier 1.017

Joan invests £6000 in a savings account.
 The savings account pays compound interest at a rate of

(2)

£ 580



$$\begin{aligned} 95\% &= £551 \\ \div 95 & \\ 1\% &= £5.80 \\ \times 100 & \\ 100\% &= £580 \end{aligned}$$

(a) Work out the normal price of the laptop.

He gets a discount of 5% off the normal price.
 Tariq pays £551 for the laptop.

8 Tariq buys a laptop.

$$100\% - 5\% = 95\%$$

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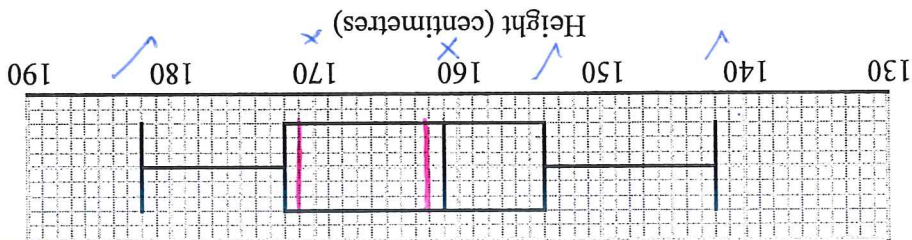
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- 9 Aisha recorded the heights, in centimetres, of some girls. She used her results to work out the information in this table.

Least height	142 cm
Lower quartile	154 cm
Interquartile range	17 cm
Median	162 cm
Range	40 cm

Aisha drew this box plot for the information in the table.

The box plot is not fully correct.



Write down the two things Aisha should do to make the box plot fully correct.

- 1 move the median line to 162 as marked on diagram as it is currently at 161 cm

- 2 move the upper quartile line to 171 cm as marked on diagram as it is currently at 172 cm

(Total for Question 9 is 2 marks)



P 6 2 2 7 8 R A 0 9 2 4



(Total for Question 11 is 2 marks)

number of ways
 = number starters $\times$ number mains $\times$ number desserts
 = 5 $\times$ 8 $\times$ 3
 = 400
 could 400 = 240 ? $[\div 40]$
 $x = 6$
 Yes, Jack could be correct if there were 6 desserts to choose from.

You must show how you get your answer.

Could Jack be correct?

He says there are 240 ways that he can choose his starter, his main course and his dessert.

Jack is going to choose one starter, one main course and one dessert.

There are 5 starters, 8 main courses and some 3 desserts on the menu.

11 Jack is in a restaurant.

(Total for Question 10 is 4 marks)

(2)

$$27n^{12}w^6$$

$$= 3^3(n^4)^3(w^2)^3$$

(c) Simplify $(3n^4w^2)^3$

(1)

$$\frac{x-4}{8}$$

$$= \frac{8(x-4)(x-4)}{(x-4)(x-4)}$$

(b) Simplify $\frac{8(x-4)}{(x-4)^2}$

(1)

anything to the power of
 zero is one

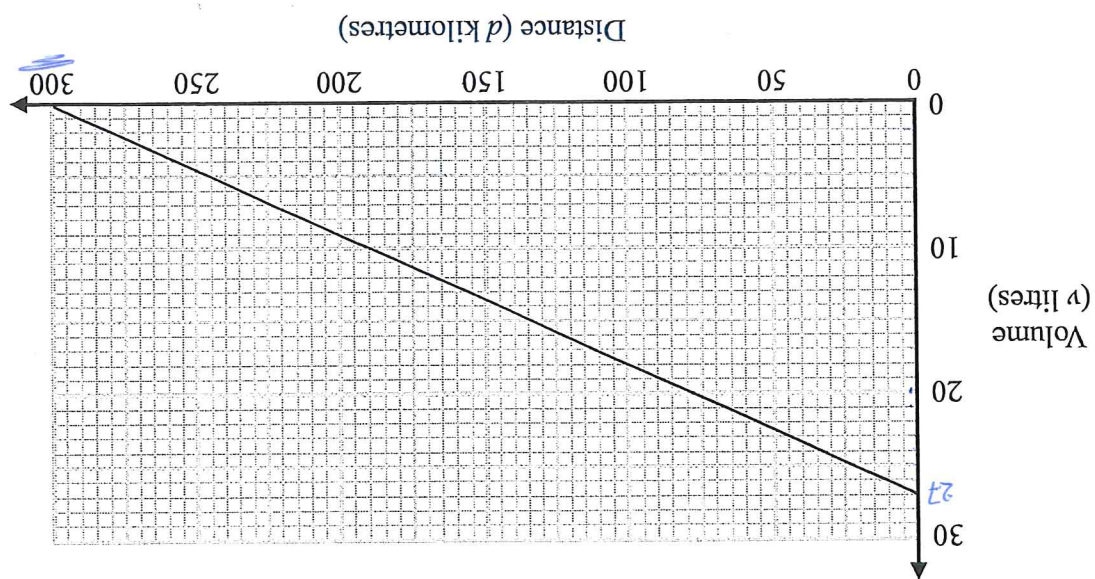
10 (a) Simplify $\left(\frac{1}{m^2}\right)^0$

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12 The graph gives information about the volume, v litres, of petrol in the tank of Jim's car after it has travelled a distance of d kilometres.



(a) Find the gradient of the graph.

$$\text{gradient} = \frac{\text{rise}}{\text{run}}$$

$$= -\frac{27}{300}$$

$$= -\frac{9}{100}$$

(b) Interpret what the gradient of the graph represents.

for every 1 km travelled, Jim's car uses 0.09 litres of petrol

(1)

(Total for Question 12 is 3 marks)



Turn over

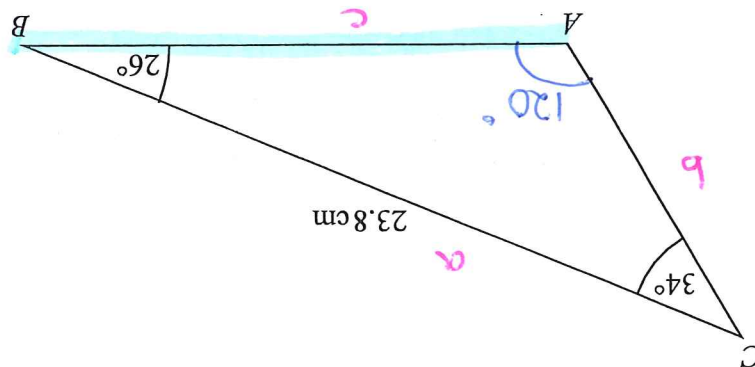


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13 Here is triangle ABC.



Work out the length of AB.

Give your answer correct to 1 decimal place.

Sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{23.8}{\sin A} = \frac{AB}{\sin 26}$$

need more information. Find angle at A

$$\frac{23.8}{\sin 120} = \frac{AB}{\sin 34} \quad [\times \sin 34]$$

$$23.8 \times \frac{\sin 34}{\sin 120} = AB$$

$$AB = 15.36766 \dots = 15.4 \text{ cm (1dp)}$$

15.4 cm

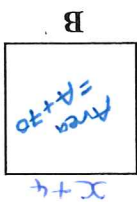
(Total for Question 13 is 3 marks)

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14 Here are two squares, A and B.



The length of each side of square B is 4 cm greater than the length of each side of square A.
The area of square B is 70 cm² greater than the area of square A.

Find the area of square B.

Give your answer correct to 3 significant figures.
You must show all your working.

$$\text{Area A} = x^2$$

$$\text{Area B} = (x+4)^2$$

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

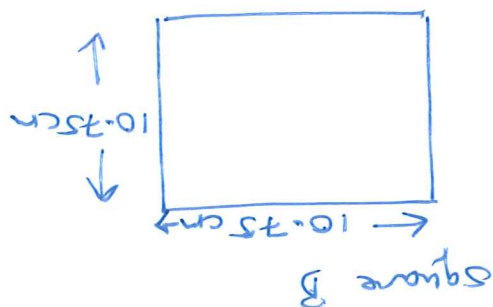
$$x^2 + 70 = x^2 + 8x + 16$$

$$70 =$$

$$8x + 16$$

$$54 = 8x$$

$$6.75 = x$$



$$\begin{aligned} \text{Area} &= 10.75 \times 10.75 \\ &= 115.5625 \\ &= 116 \text{ cm}^2 \text{ (3sf)} \end{aligned}$$

116 cm²

(Total for Question 14 is 4 marks)





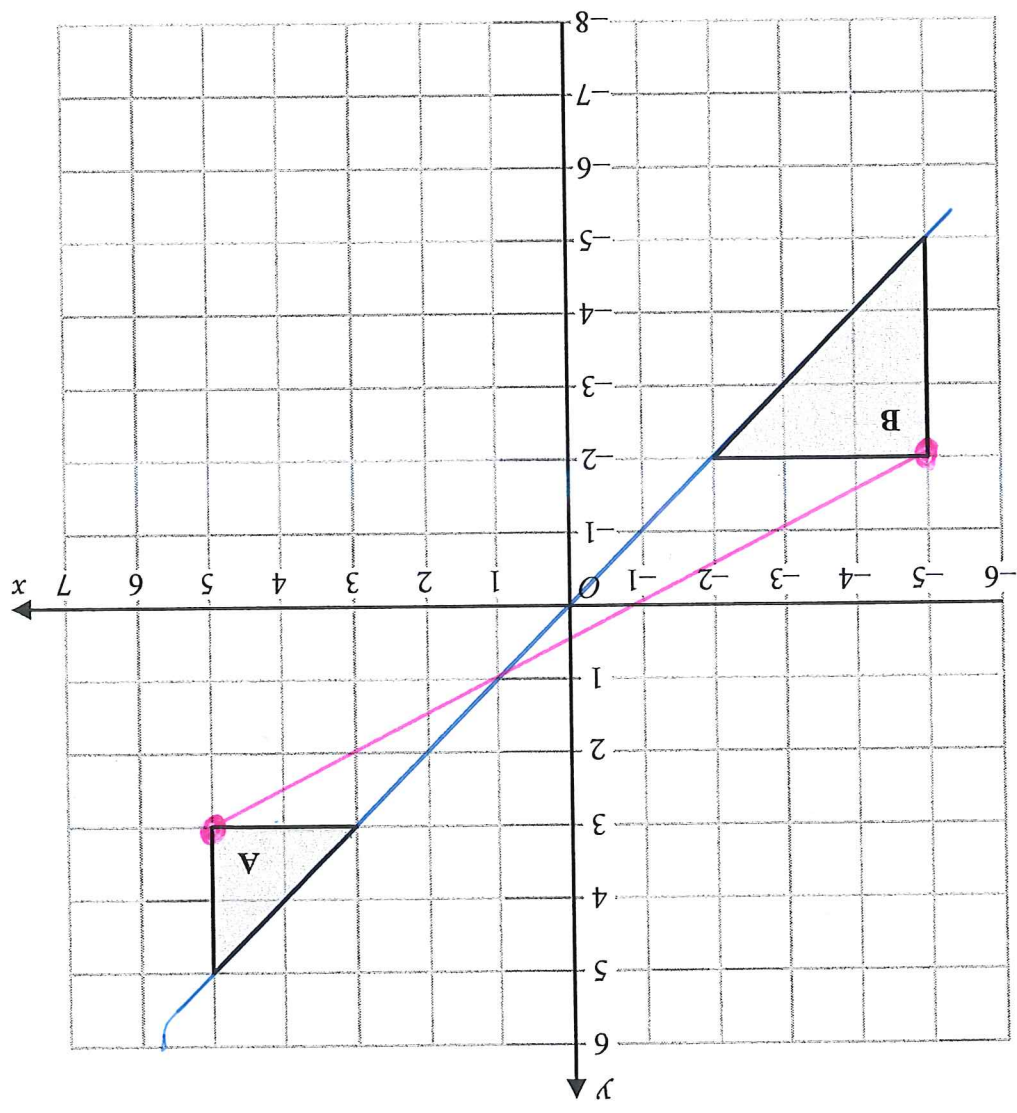
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(Total for Question 15 is 2 marks)

Describe fully the single transformation that maps triangle A onto triangle B.
Enlargement, scale factor -1.5, centre (1,1)



16 Here are the first five terms of a quadratic sequence.

5	4	3	2	1	0
90	61	38	21	10	

Find an expression, in terms of n , for the n th term of this sequence.

10	21	38	61	90
	11	17	23	29
	6	6	6	6

2nd difference constant $\therefore$ quadratic
 $\therefore$ 2nd difference = 6 $\therefore a = \frac{6}{2} = 3$

n^2	1	4	9	16	25
$3n^2$	3	12	27	48	75
	+7	+9	+11	+13	+15
Sequence	10	21	38	61	90
					$3n^2 + 2n + 5$

OR if you have learnt the MW method (clip 213)

$2a = 6$
 $a = 3$
 $3a + b = 11$
 $9 + b = 11$
 $b = 2$
 $a + b + c = 10$
 $3 + 2 + c = 10$
 $c = 5$

 $an^2 + bn + c$

(5) 7, 9, 11, 13, 15, ...
 $2n+5$

(Total for Question 16 is 3 marks)

17 Write down the coordinates of the turning point on the graph of $y = (x + 12)^2 - 7$

left 12, down 7

(-12, -7)

(Total for Question 17 is 1 mark)



P 6 2 2 7 8 R A 0 1 5 2 4

(Total for Question 18 is 4 marks)

160π cm²

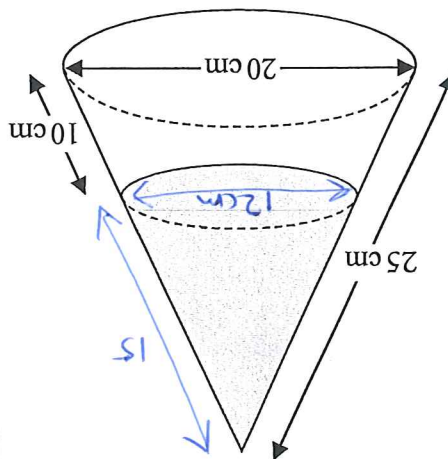
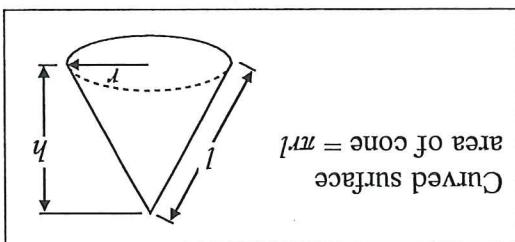
curved SA of whole cone — curved SA of small cone
 curved SA not painted grey
 $= 250\pi - 90\pi$
 $= 160\pi$

Curved SA of whole cone
 $= \pi r l$
 $= \pi \times 10 \times 25$
 $= 250\pi$
 Curved SA of small cone
 $= \pi r l$
 $= \pi \times 6 \times 15$
 $= 90\pi$

The small and large cone are mathematically similar
 Scale factor $= \frac{15}{25} = 0.6$
 Slant height large $\times 0.6$ = slant height small
 diameter large $\times 0.6$ = diameter small

need to find the curved surface area of the frustum

The cone has a base diameter of 20 cm and a slant height of 25 cm.
 A circle is drawn around the surface of the cone at a slant height of 10 cm above the base.
 The curved surface of the cone above the circle is painted grey.
 Work out the area of the curved surface of the cone that is **not** painted grey.
 Give your answer as a multiple of π
 You must show all your working.



Large
 $d = 20$
 $r = 10$
 Small
 $d = 12$
 $r = 6$

18 The diagram represents a solid cone.

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19 A hot air balloon is descending.

The height of the balloon n minutes after it starts to descend is h_n metres.The height of the balloon $(n+1)$ minutes after it starts to descend, h_{n+1} metres, is given by

$$h_{n+1} = K \times h_n + 20 \quad \text{where } K \text{ is a constant.}$$

The balloon starts to descend from a height of 1200 metres at 09 15
 At 09 16 the height of the balloon is 1040 metres. $h_1 = 1040$

Work out the height of the balloon at 09 18

$$0915 \quad n=0 \quad h_0 = 1200$$

$$0916 \quad n=1 \quad h_1 = K \times h_0 + 20$$

$$1040 = 1200K + 20$$

$$1020 = 1200K$$

$$0.85 = K$$

$$0917 \quad n=2 \quad h_2 = 0.85h_1 + 20$$

$$= 0.85(1040) + 20$$

$$= 904 \text{ m}$$

$$0918 \quad n=3 \quad h_3 = 0.85h_2 + 20$$

$$= 0.85(904) + 20$$

$$= 788.4 \text{ m}$$

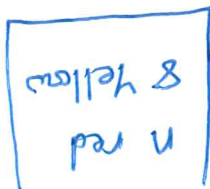
$$788.4 \text{ m}$$

(Total for Question 19 is 4 marks)



20 There are only red sweets and yellow sweets in a bag.

There are n red sweets in the bag.
There are 8 yellow sweets in the bag.



Sajid is going to take at random a sweet from the bag and eat it.

He says that the probability that the sweet will be red is $\frac{7}{10}$

(a) Show why the probability cannot be $\frac{7}{10}$

total sweets in bag = $n+8$

$$P(\text{red}) = \frac{n}{n+8}$$

if $\frac{n}{n+8} = \frac{7}{10}$

$$10n = 7(n+8)$$

$$10n = 7n + 56$$

$$3n = 56$$

$$n = 18\frac{2}{3}$$

n sweets must be a whole number and so $P(\text{red})$ cannot be $\frac{7}{10}$

After Sajid has taken the first sweet from the bag and eaten it, he is going to take at random a second sweet from the bag.

Given that the probability that both the sweets he takes will be red is $\frac{3}{5}$

(b) work out the number of red sweets in the bag.
You must show all your working.

$$P(\text{first sweet red}) = \frac{n}{n+8}$$

$$P(\text{second sweet red if first sweet was red}) = \frac{n-1}{(n-1)+8}$$

$$= \frac{n-1}{n+7}$$

$$P(\text{first red AND second red}) = \frac{3}{5}$$

$$\frac{n}{n+8} \times \frac{n-1}{n+7} = \frac{3}{5}$$

$$\frac{n(n-1)}{(n+8)(n+7)} = \frac{3}{5}$$

$$5n(n-1) = 3(n+8)(n+7)$$

$$5n^2 - 5n = 3(n^2 + 15n + 56)$$

$$5n^2 - 5n = 3n^2 + 45n + 168$$

$$2n^2 - 5n = 168$$

$$2n^2 - 5n - 168 = 0$$

$$[3n^2]$$

$$[-45n]$$

$$[-168]$$

$$n^2 - 25n - 84 = 0$$

$$(n-28)(n+3) = 0$$

$$n-28=0 \quad n+3=0$$

$$n=28 \quad n=-3$$

must be a whole number of sweets

$$2n^2 - 50n - 168 = 0 \quad \div 2$$

$n=28$
12 red sweets



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(Total for Question 20 is 8 marks)

(5)

28

oops, I didn't see all this lovely space!



(Total for Question 21 is 4 marks)

(2)

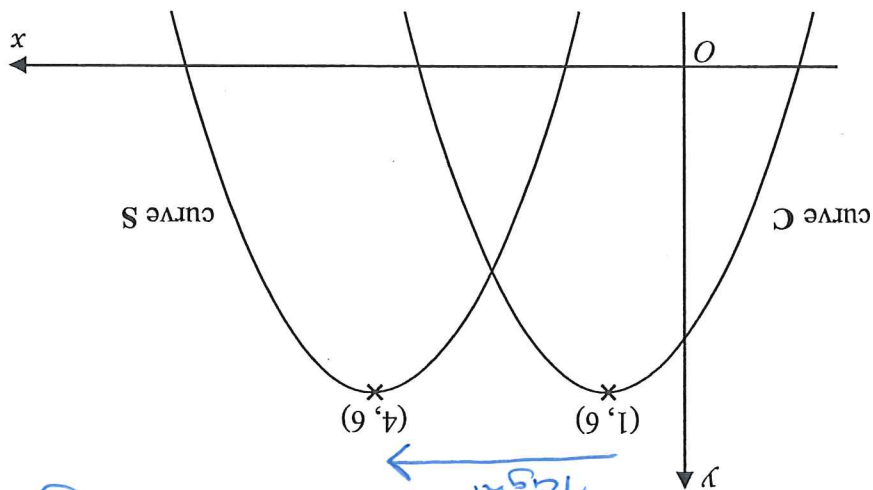
$$y = 5 + 2(x-3) - (x-3)^2$$

$$y = 5 + 2(x-3) - (x-3)^2$$

translation right 3

(b) Find an equation for S.

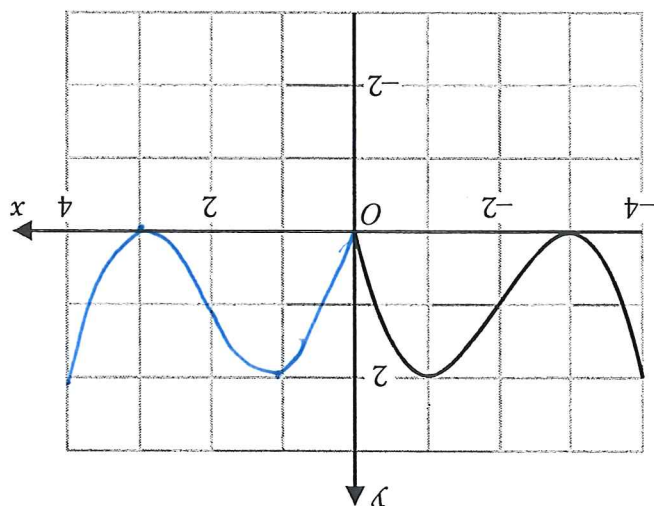
The curve C with equation $y = 5 + 2x - x^2$ is transformed by a translation to give the curve S such that the point (1, 6) on C is mapped to the point (4, 6) on S.



reflect in the y-axis

(2)

(a) On the grid above, sketch the graph of the curve with equation $y = f(-x)$



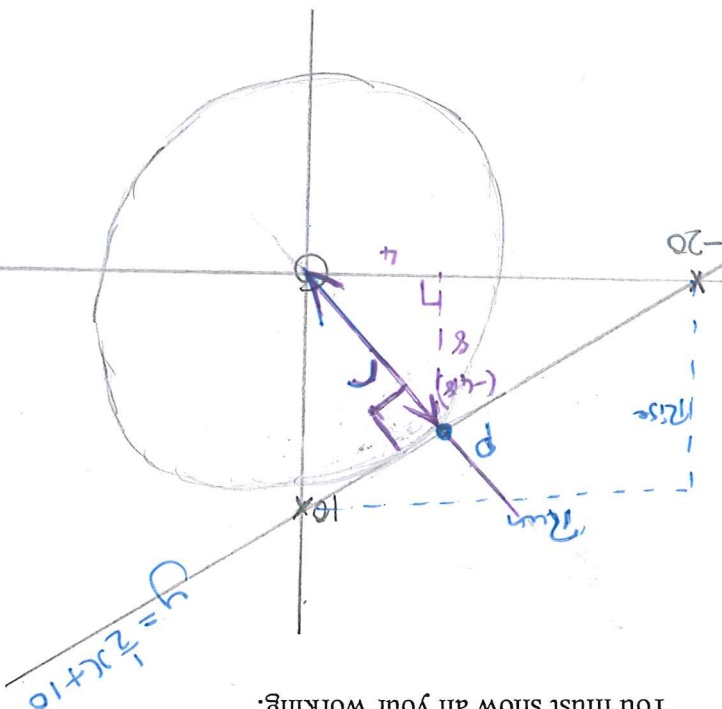
21 The graph of the curve with equation $y = f(x)$ is shown on the grid below.

22 C is a circle with centre the origin.

A tangent to C passes through the points $(-20, 0)$ and $(0, 10)$

Work out an equation of C.

You must show all your working.



equation of tangent
 $y = mx + c$
 gradient $m = \frac{10}{-20} = -\frac{1}{2}$
 when $x = 0, y = 10$
 $10 = -\frac{1}{2}(0) + c$
 $10 = c$

$\therefore$ equation of tangent is
 $y = -\frac{1}{2}x + 10$

equation of line perpendicular to tangent has gradient 2 and passes through origin.
 equation of perpendicular line
 $y = 2x$

to find radius we need distance from O to P

$\frac{1}{2}x + 10 = -2x$ [$+2x$]
 $2\frac{1}{2}x + 10 = 0$ [-10]
 $2\frac{1}{2}x = -10$
 $x = -4$
 $y = -2x$
 $y = -2(-4)$
 $y = 8$
 point P is at $(-4, 8)$

Distance from origin to P
 $(0, 0) \rightarrow (-4, 8)$
 will be the radius
 $r^2 = 8^2 + 4^2$
 $r^2 = 80$

$x^2 + y^2 = 80$

(Total for Question 22 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS



