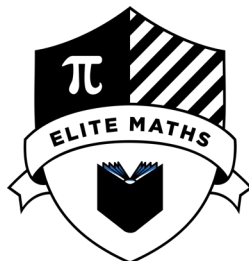


9 1 0 2 7



Level 1 Mathematics and Statistics CAT, 2021 v1

91027 Apply algebraic procedures in solving problems

Wednesday 15 September 2021

Credits: Four

You should attempt ALL the questions in this booklet.

Calculators may NOT be used.

Show ALL working.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

You are required to show algebraic working in this paper. 'Guess and check' and 'correct answer only' methods do not demonstrate relational thinking and will limit the grade for that part of the question to a maximum of Achievement. Guess and check and correct answer only may only be used a maximum of one time in the paper and will not be used as evidence of solving a problem.

A candidate cannot gain Achievement in this standard without solving at least one problem.

Answers must be given in their simplest algebraic form.

Where a question is given in words you will be expected to write an equation.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement Criteria

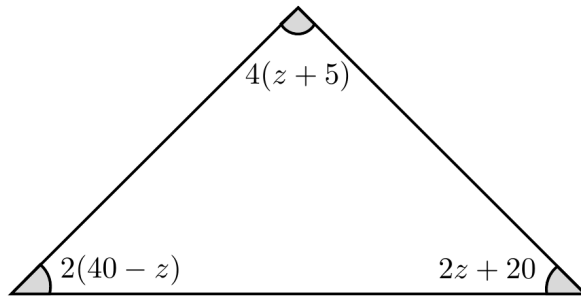
Achievement	Achievement with Merit	Achievement with Excellence
Apply algebraic procedures in solving problems.	Apply algebraic procedures, using relational thinking, in solving problems.	Apply algebraic procedures, using extended abstract thinking, in solving problems.

Overall level of performance

QUESTION ONE

- (a) The cost, $\$C$, of hiring a boat for T hours is given by the formula $C = 50T + 200$.
Use this formula to find the cost of hiring a boat for three and a half hours.

- (b) The sum of the interior angles of a triangle is 180° .

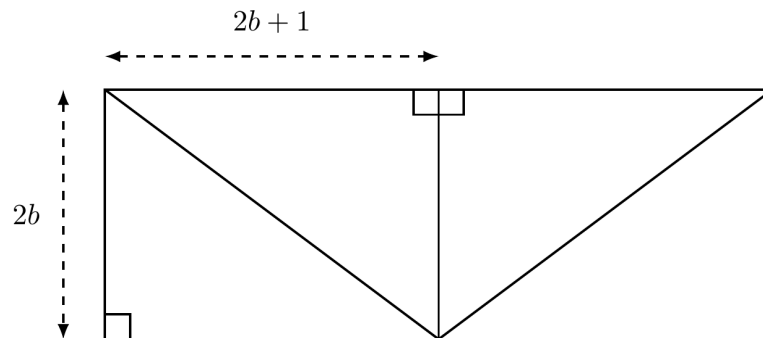


*Diagram is
NOT to scale*

Find the value of z in the diagram above.

(d) The total area of the three identical right-angled triangles shown below is 630 cm^2 .

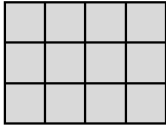
Diagram is
NOT to scale



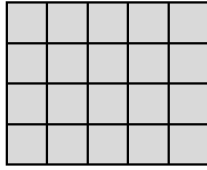
Find the value of b .

(e) If $c = \frac{a}{b + \sqrt{2v}}$, give the equation for v in terms of a , b and c .

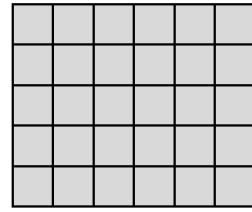
(d) The pattern shown below is made up of squares.



Pattern number = 1



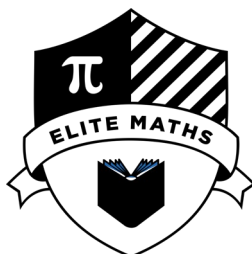
Pattern number = 2



Pattern number = 3

The number of squares, T , for the pattern number n is given by the formula $T = an^2 + bn + 6$.
Find the number of squares for pattern number 10.

9 1 0 2 8



Level 1 Mathematics and Statistics, 2021 v1

91028 Investigate relationships between tables, equations and graphs

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Investigate relationships between tables, equations and graphs.	Investigate relationships between tables, equations and graphs, using relational thinking.	Investigate relationships between tables, equations and graphs, using extended abstract thinking.

You should attempt **ALL** the questions in this booklet.

Show **ALL** working.

Grids are provided on some pages. This is working space for the drawing of a graph or a diagram, constructing a table, writing an equation, or writing your answer.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

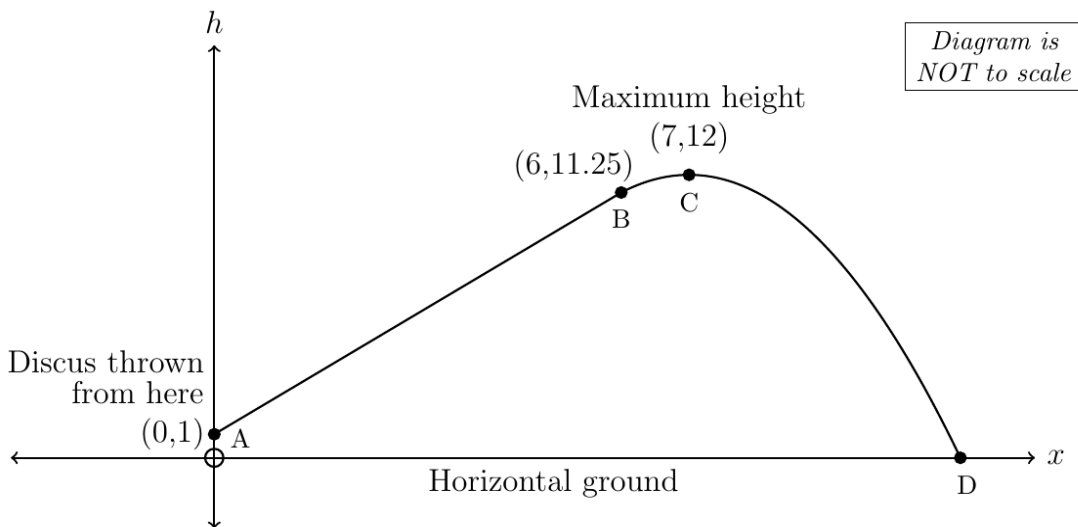
TOTAL

- (b) An Olympic athlete throws a discus across a field from point A, which is 1 metre above the ground.



The path of the discus initially follows a straight line until it reaches point B, which is at a horizontal distance of 6 metres from point A and 11.25 metres above the ground. From point B until it lands on the ground at point D, the discus follows a parabolic path. The maximum height of the discus during its flight occurs at point C, which is at a horizontal distance of 7 metres from point A and 12 metres above the ground.

The path of the discus is shown on the graph below, where the x -axis is at ground level.



- (i) Find the equation of the discus' path between point A and point B.

(ii) Find the equation of the discus' parabolic path between point B and point D.

(iii) Using equations OR graphs, find how far the discus has travelled horizontally from point A when it is 8.5 metres above the ground.

(b) Jake works at a factory where he packs stuffed animals into boxes.

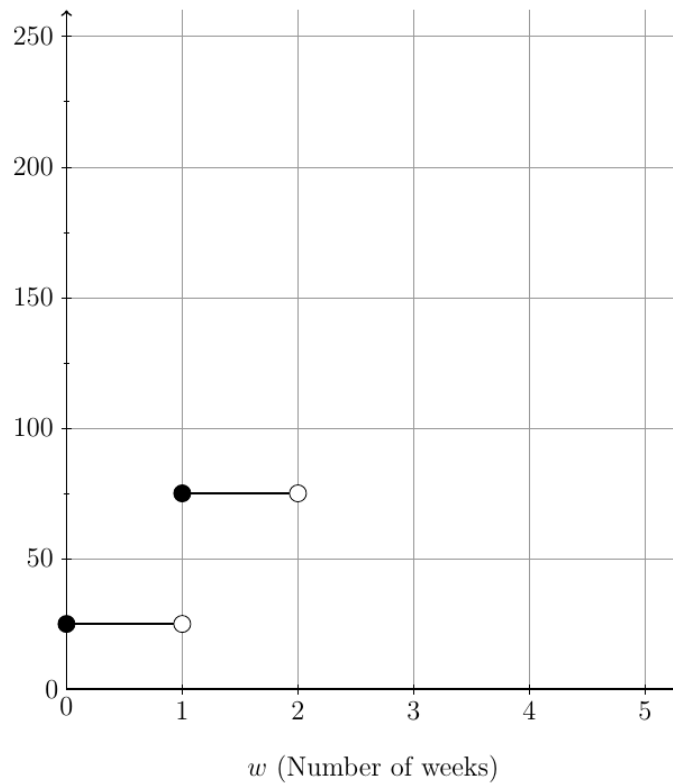
Jake has packed and delivered 25 boxes so far.

Over the next 5 weeks, he packs 50 boxes per week and then delivers the boxes he packed during that week at the end of the week.

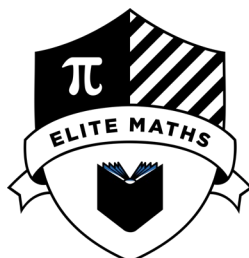
(i) Give the equation for the total number of boxes N that Jake packs after w weeks.

(ii) Complete the graph showing the total number of boxes N that Jake delivers by week w over the next 5 weeks.

N (Number of boxes delivered)



9 1 0 3 1



Level 1 Mathematics and Statistics, 2021 v1

91031 Apply geometric reasoning in solving problems

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply geometric reasoning in solving problems.	Apply geometric reasoning, using relational thinking, in solving problems.	Apply geometric reasoning, using extended abstract thinking, in solving problems.

You should attempt **ALL** the questions in this booklet.

Show ALL working.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

SCAFFOLDING

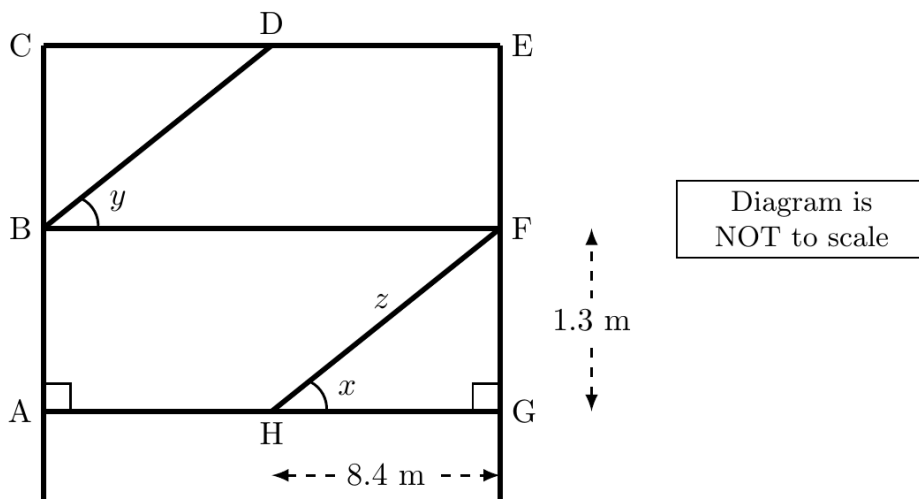
Scaffolding is a temporary structure used to aid in construction projects.
The following diagram shows some scaffolding in practice.



<https://scaffmag.com/2015/03/scaffolder-numbers-need-to-double-in-new-zealand/>

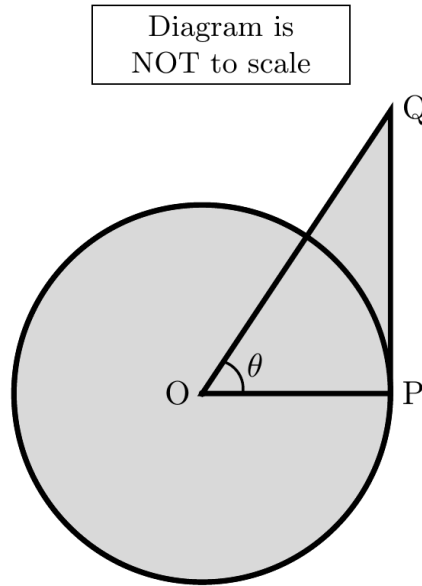
QUESTION ONE

- (a) A section of the scaffolding is shown below.
Straight lines BD and HF are parallel to each other.
Straight lines AG , BF and CE are parallel to each other.
 $GH = 8.4$ m $GF = 1.3$ m



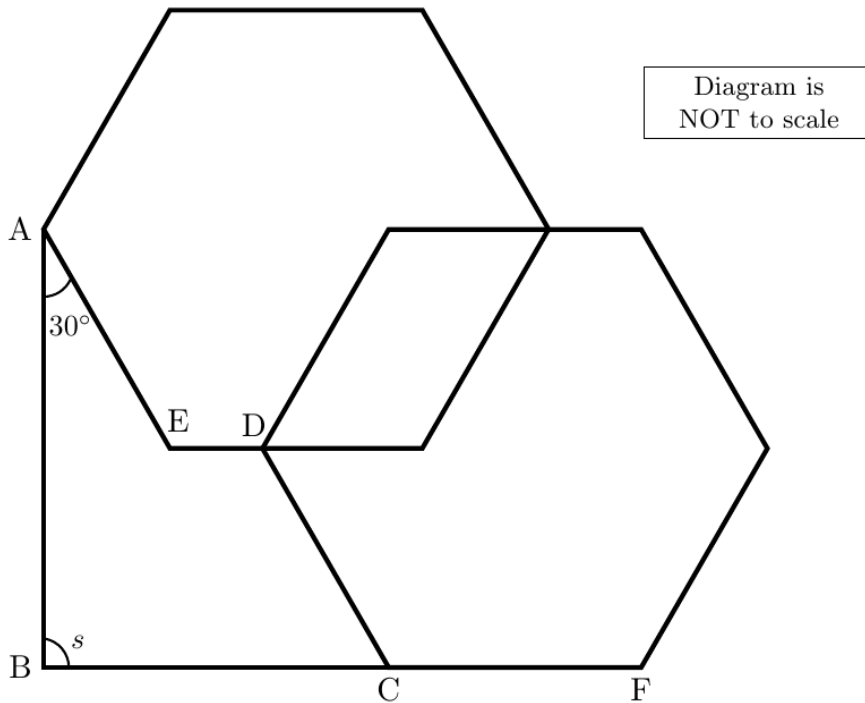
- (i) Calculate the length, z , from H to F .
Show your working clearly.

- (b) The construction company's alternative logo is shown below.
O is the centre of the circle.
The line segment, PQ, is tangent to the circle at the point P.
Angle POQ = θ



Find the size of angle OQP, in terms of θ .
Justify your answer with clear geometrical reasoning.

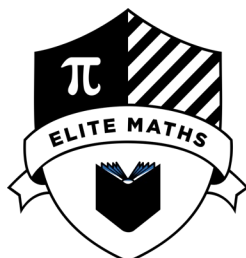
- (c) The diagram below shows the company's most popular tile among their commercial clients. This tile is made by joining two regular hexagons and an irregular pentagon. Straight lines ED and BF are parallel to each other. Angle $BAE = 30^\circ$
Angle $ABC = s$



- (i) Show that an interior angle of a regular hexagon is 120° .
Show your working clearly.

- (ii) Calculate the size, s , of angle ABC.
Justify your answer with clear geometric reasoning.

9 1 0 3 7



Level 1 Mathematics and Statistics, 2021 v1

91037 Demonstrate understanding of chance and data

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of chance and data.	Demonstrate understanding of chance and data, justifying statements and findings.	Demonstrate understanding of chance and data, showing statistical insight.

You should attempt **ALL** the questions in this booklet.

Show **ALL** working.

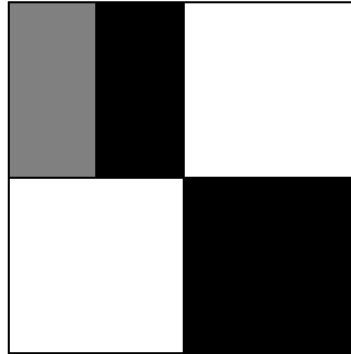
If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

QUESTION ONE

- (a) At a school camp, each child takes a turn throwing darts at the dart board shown below. The square dart board is made up of 4 smaller identical squares that have white, black or grey parts. Assume that all darts thrown hit the dart board in a random location.



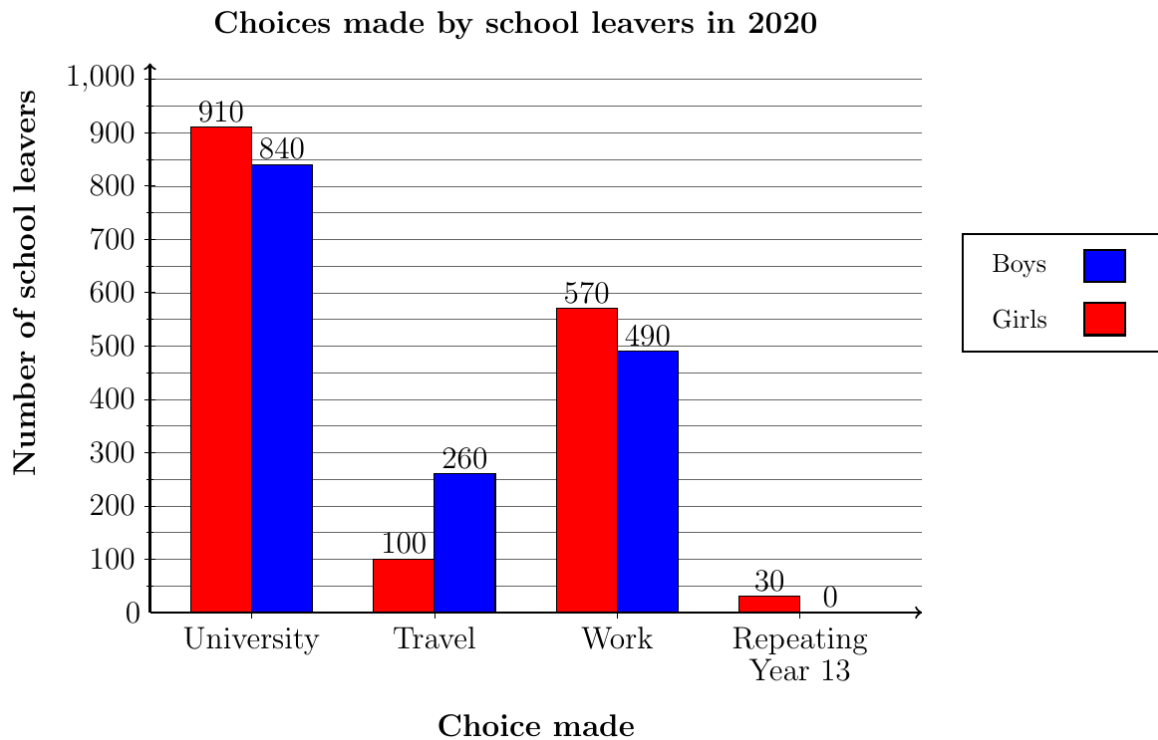
- (i) A child throws a dart. What is the probability that the dart lands on a black region?

- (ii) Another child throws two darts, one after another. What is the probability that one of the two darts lands on a black region?

(b) It was reported that many school leavers in 2020 found themselves carefully considering their next steps.

A survey was conducted on a random sample of 3,200 school leavers in 2020.

The graph below shows the results of the survey.



(i) How many more school leavers in 2020 chose to work than to travel?

(ii) What proportion of school leavers that chose to travel were boys?

Assessment Schedule – 2021 v1

L1 Mathematics and Statistics CAT: Apply algebraic procedures in solving problems (91027)

Candidates must show algebraic working.

Be aware that solutions in a multi-part question may be found in any part and awarded credit.

Equivalent answers are accepted.

Once a student has made an error, for any consistent working to provide evidence towards a grade, the procedure must be performed at curriculum level 6.

Evidence

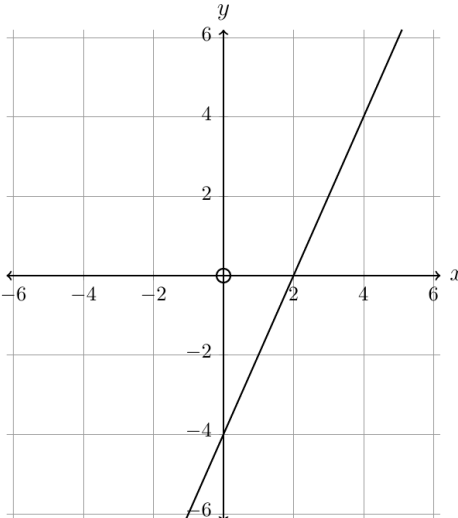
Q1	Expected Coverage	Grade (generated by correctly demonstrating the procedures listed in EN4) Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent
(a)	$C = 50 \times 3.5 + 200$ $= \$375$	For award of u: • correct solution – no alternative.
(b)	$2(40 - z) + 4(z + 5) + 2z + 20 = 180$ $80 - 2z + 4z + 20 + 2z + 20 = 180$ $4z = 60$ $z = 15$	For award of u: ONE of: • correct equation written down. • consistent simplification. • consistent solution.
(c)	$\frac{3y^2 + 2y - 8}{9y^2 - 16} = \frac{(3y - 4)(y + 2)}{(3y - 4)(3y + 4)}$ $= \frac{y + 2}{3y + 4}$	For award of u: ONE of: • factorised numerator or denominator • consistently simplified after factorisation.
		For award of r: • correct simplification of expression (the condition $y \neq \pm -\frac{4}{3}$ is not required)

Q3	Expected Coverage	<p>Grade (generated by correctly demonstrating the procedures listed in EN4)</p> <p>Requirements are for the student responses to be correct (ignoring numerical errors) unless the statement specifies consistent</p>
(d)	<p>Pattern number 1 has 12 squares. $a(1)^2 + b(1) + 6 = 12$ $a + b = 6$</p> <p>Pattern number 2 has 20 squares. $a(2)^2 + b(2) + 6 = 20$ $4a + 2b + 6 = 20$ $2a + b = 7$</p> <p>Subtracting the first equation from the second equation gives $a = 1$.</p> <p>Substituting $a = 1$ into either equation gives $b = 5$.</p> <p>Accept using the observation that $T = (n + 2)(n + 3)$.</p> <p>Therefore, pattern number 10 has $T = 1(10)^2 + 5(10) + 6$ $= 156$ squares</p>	<p>For award of u: ONE of: • formed both equations • consistent combination of their equations to eliminate one variable</p> <p>For award of r: ONE of: • correct combining of their equations to eliminate one variable. • consistent values of both a and b.</p> <p>For award of t: • correct number of squares for pattern number 10.</p>
(e)	<p>Let the radius of the larger circle be kr.</p> $\pi r^2 + \pi(kr)^2 = 26\pi r^2$ $\pi(1 + k^2)r^2 = 26\pi r^2$ $1 + k^2 = 26$ $k^2 = 25$ $k = 5$ <p>Therefore, the radius of the larger circle is $5r$.</p> $\frac{5r - r}{r} \times 100 = \frac{4}{1} \times 100$ $= 400\%.$	<p>For award of u: ONE of: • wrote expression for the total area. • correct equation formed. • consistent simplification of the equation.</p> <p>For award of r: • radius of the larger circle found in terms of r.</p> <p>For award of t: • correct percentage calculated.</p>

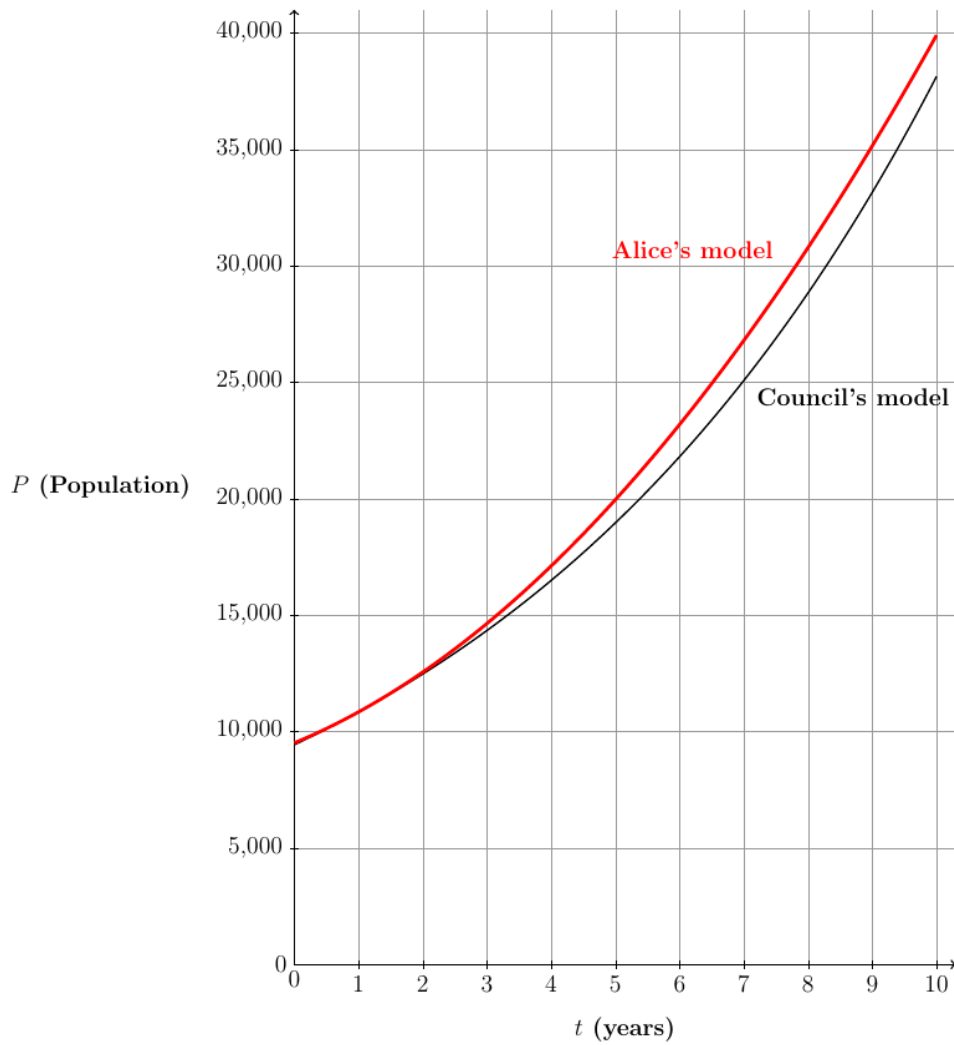
Assessment Schedule – 2021 v1

Mathematics and Statistics: Investigate relationships between tables, equations and graphs (91028)

Evidence Statement

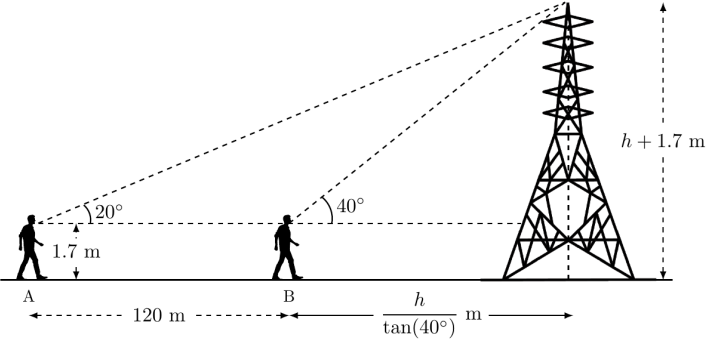
Question ONE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)		Correct graph.		
(b) (i)	$h = \frac{10.25}{6}x + c = \frac{41}{24}x + c$ <p>Substituting $x = 0$ and $h = 1$ gives $c = 1$</p> <p>Therefore, the equation is $h = \frac{41}{24}x + 1$.</p> <ul style="list-style-type: none"> ● Accept equivalent form ● Accept substituting $x = 6$ and $h = 11.25$ ● Accept using alternative methods 	Correct gradient OR Correct y-intercept	Correct equation.	
(b) (ii)	$h = -k(x - 7)^2 + 12$ <p>Substituting $x = 6$ and $h = 11.25$ gives</p> $-k(6 - 7)^2 + 12 = 11.25$ $-k = 11.25 - 12$ $k = \frac{3}{4}$ <p>Therefore, $h = -\frac{3}{4}(x - 7)^2 + 12$</p> <ul style="list-style-type: none"> ● Accept $h = -0.75x^2 + 10.5x - 24.75$ 	Set $k = 1$ without any justifications. OR Incorrect value of k found.	Correct equation.	

t	Year	Council's model	Alice's model	Difference
0	2011	9,430	9,510	80
1	2012	10,845	10,840	-5
2	2013	12,471	12,550	79
3	2014	14,342	14,640	298
4	2015	16,493	17,110	617
5	2016	18,967	19,960	993
6	2017	21,812	23,190	1,378
7	2018	25,084	26,800	1,716
8	2019	28,847	30,790	1,943
9	2020	33,174	35,160	1,986
10	2021	38,150	39,910	1,760

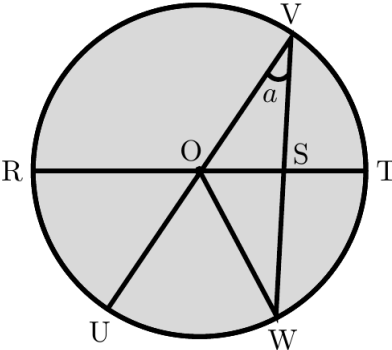


Assessment Schedule – 2021 v1**Mathematics and Statistics: Apply geometric reasoning in solving problems (91031)****Evidence Statement**

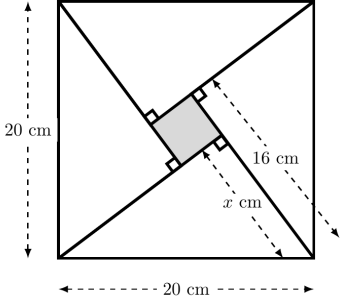
Q ONE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a) (i)	By Pythagoras' theorem $HF = \sqrt{8.4^2 + 1.3^2}$ $= \sqrt{72.25}$ $= 8.5 \text{ m}$	Correct answer obtained using Pythagoras' theorem.		
(a) (ii)	$\tan(x) = \frac{1.3}{8.4}$ $x = \tan^{-1}\left(\frac{1.3}{8.4}\right)$ $\approx 8.80^\circ$ <p><i>Accept using other correct ratios.</i></p>	Correct answer.		
(a) (iii)	Angle FHG = Angle BFH = x (alt \angle s //) Angle BFH = Angle DBF = y (alt \angle s //) Therefore, Angle DBF = Angle FHG OR $x = y$. <i>Accept any other valid method.</i>	One correct step is stated.	Complete proof complete with evidence	
(b)	$\frac{JL}{9} = \tan(45^\circ)$ $JL = 9 \tan(45^\circ)$ $= 9 \text{ m}$ <p>Therefore, the area of the shape IJKL is</p> $\frac{1}{2} \times 9 \times 9 + \frac{1}{2} \times 9 \times 15.6 = 110.7 \text{ m}^2$ <p><i>Accept any other valid method.</i></p>	Find the length JL.	Correct area found with correct steps.	

Q ONE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(c)	 <p>Let h be difference between the height of the tower and David's eye height.</p> <p>The horizontal distance between the base of the tower and point B is $\frac{h}{\tan(40^\circ)}$ m.</p> <p>Applying the tangent ratio to the right-angled triangle with 20° gives $\frac{h}{120 + \frac{h}{\tan(40^\circ)}} = \tan(20^\circ)$.</p> <p>Solving for h gives</p> $\frac{h \tan(40^\circ)}{120 \tan(40^\circ) + h} = \tan(20^\circ)$ $h \tan(40^\circ) = \tan(20^\circ) (120 \tan(40^\circ) + h)$ $h \tan(40^\circ) = 120 \tan(20^\circ) \tan(40^\circ) + h \tan(20^\circ)$ $h (\tan(40^\circ) - \tan(20^\circ)) = 120 \tan(20^\circ) \tan(40^\circ)$ $h = \frac{120 \tan(20^\circ) \tan(40^\circ)}{\tan(40^\circ) - \tan(20^\circ)}$ $= 77.13 \text{ m}$		Formed a correct equation using Pythagoras' theorem or trigonometry.	Correct length. Accept any rounding.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at ONE question.	1 of u OR partial solution in TWO questions.	2 of u	3 of u	1 of r	2 of r	Q1 (c) with justification not fully clear.	Q1 (c)

Q TWO	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(d)	 <p>Let $\angle OVS = a$.</p> <p>Let $\angle UOW = 2a$. (\angle centre = $2 \times \angle$ at circum.)</p> <p>Since $\angle SOV = 3a$, $\angle ROU = 3a$. (vert opp \angles)</p> <p>Therefore the ratio between arc RW and arc VT is</p> <p>$(3a + 2a) : 3a = 5:3$</p> <p>Therefore, the length of arc RW is $5/3$ times greater than the length of arc VT.</p> <p>Accept 1.67.</p> <p><i>Accept any other valid proof.</i></p>	<p>Found a relevant angle with justification.</p> <p>OR</p> <p>Wrote down any other statement apart from above two that is necessary to complete the required proof</p>	<p>Finding two angles with justifications.</p>	<p>Correct answer with every step justified.</p>

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempt at ONE question.	1 of u OR partial solution in TWO questions.	2 of u	3 of u	1 of r	2 of r	Q1 (d) with justification not fully clear.	Q1 (d)

Q THREE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)	<p>$u = 37^\circ$ (vert opp \angles) $v = 37^\circ$ (corres \angles) Therefore, $u = v$.</p> <p>Also accept “corresponding angles on parallel lines are equal, so it follows $u = v$”.</p>	Completed the correct proof with justification.		
(b)	<p>All four right-angled triangles are congruent.</p>  <p>The sides of the triangles that coincide with the square are 16 cm. Hence $x = \sqrt{20^2 - 16^2} = 12$</p> <p>Therefore, the side length of the smaller square is $16 - 12 = 4$ cm.</p> <p>Therefore, the area of the smaller square is $4 \times 4 = 16 \text{ cm}^2$.</p>	<p>Correct answer only.</p> <p>OR</p> <p>Stated that the four triangles are identical/ congruent.</p>	<p>Correct answer only.</p> <p>AND</p> <p>Stated that the four triangles are similar.</p>	
(c) (i)	<p>An interior angle of a regular hexagon is $(6 - 2) \times 180^\circ / 6 = 120^\circ$</p>	Correct answer.		
(c) (ii)	<p>The reflex angle AED is 240°. (angles at a point sum to 360°)</p> <p>The acute angle DCB is 60°. (\angles on a straight line = 180°)</p> <p>The obtuse angle EDC is 120°. (co-int \angles lines add to 180°)</p> <p>Since the sum of the interior angles of the pentagon ABCDE is 540°</p> $s + 30^\circ + 240^\circ + 120^\circ + 60^\circ = 540^\circ$ $s + 450^\circ = 540^\circ$ $s = 90^\circ$	Found one of the interior angles of the pentagon ABCDE with justification.	Correct answer with every step justified.	

Assessment Schedule – 2021 v1

Mathematics and Statistics: Demonstrate understanding of chance and data (91037)

Evidence Statement

ONE	Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence															
(a) (i)	$\frac{1}{8} + \frac{1}{4} = \frac{3}{8}$ OR 0.375	Correct answer.																	
(a) (ii)	$P(\text{black and not black}) + P(\text{not black and black})$ $= \frac{3}{8} \times \frac{5}{8} + \frac{5}{8} \times \frac{3}{8}$ $= \frac{30}{64}$ $= \frac{15}{32}$ Accept 0.4688		Correct answer.																
(a) (iii)	<table border="1" data-bbox="297 919 849 1205"> <thead> <tr> <th>Colour</th> <th>Frequency (experimental)</th> <th>Frequency (theoretical)</th> </tr> </thead> <tbody> <tr> <td>White</td> <td>46</td> <td>56</td> </tr> <tr> <td>Black</td> <td>42</td> <td>42</td> </tr> <tr> <td>Grey</td> <td>24</td> <td>14</td> </tr> <tr> <td>Total</td> <td>112</td> <td>112</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • The results from the experiment could vary from the expected results, therefore it cannot be concluded that there was bias. • Disagree as there has been just one experiment done. • Disagree as the experimental and theoretical frequencies match quite well. • No information given on how the experiment was done to determine that there was a bias. 	Colour	Frequency (experimental)	Frequency (theoretical)	White	46	56	Black	42	42	Grey	24	14	Total	112	112	ONE valid reason.	ONE valid reason, justified with correct calculations or comparisons	
Colour	Frequency (experimental)	Frequency (theoretical)																	
White	46	56																	
Black	42	42																	
Grey	24	14																	
Total	112	112																	

THREE	Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
(b) (i)	<p>Range is the same/very close for male patients and female patients. OR The range for female patients is slightly greater than that for male patients.</p>	Correct answer.		
(b) (ii)	<p>1. Shape Graph of female patients is bimodal (one peak at 30-34 and another one at 70-74), whereas the graph of male patients is unimodal (peak at 70-74).</p> <p>2. Symmetry/skew Graph of female patients is roughly symmetric whereas the graph of male patients is (negatively) skewed.</p> <p>3. Shift The middle 50% box of male patients is shifted slightly to the right of the 50% box of female patients.</p> <p>5. Centre The median age of male patients is greater than that for female patients.</p>	ONE valid comparison statement about ONE significant feature.	TWO valid comparison statements about TWO significant features.	
(b) (iii)	<p>If agree with the claim</p> <ul style="list-style-type: none"> • The box plots show that in this sample, male patients have a greater median age than female patients. <p>If disagree with the claim</p> <ul style="list-style-type: none"> • The middle 50% for males is shifted only slightly more to the right than the middle 50% for females, indicating that there is no significant difference. • The median of male patients is not outside the box for female patients and vice versa. • Data collected during only one quarter of one year, which is probably not representative of all patients at the hospital 	ONE valid statement with justification.	TWO valid statements with justification.	