

No part of the candidate's evidence in this exemplar material may be presented in an external assessment for the purpose of gaining an NZQA qualification or award.

SUPERVISOR'S USE ONLY

1

91947



Draw a cross through the box (☒) if you have NOT written in this booklet

+



Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Mathematics and Statistics 2025

91947 Demonstrate mathematical reasoning

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate mathematical reasoning.	Demonstrate mathematical reasoning with relational thinking.	Demonstrate mathematical reasoning with extended abstract thinking.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Pull out Resource Booklet 91947R from the centre of this booklet.

Show ALL working.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (▨▨▨▨). This area will be cut off when the booklet is marked.

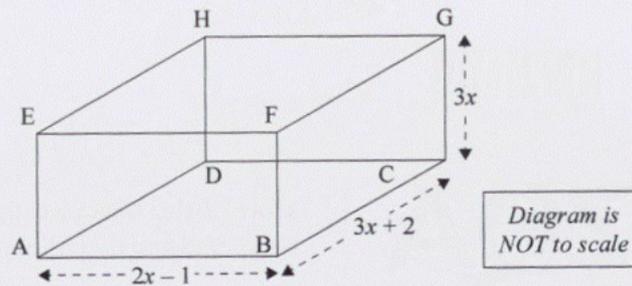
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 15

QUESTION ONE

- (a) The diagram below shows a cuboid.



Find the **total surface area** of this box, given that $x = 7$.

$$\begin{aligned} \text{area of EFBA} &= (2x-1)(3x) \\ &= (2 \times 7 - 1)(3 \times 7) \\ &= 273 \end{aligned}$$

$$\begin{aligned} \text{area of FGCB} &= (3x+2)(3x) \\ &= (3 \times 7 + 2)(3 \times 7) \\ &= 483 \end{aligned}$$

$$\begin{aligned} \text{area of DCBA} &= (2x-1)(3x+2) \\ &= (2 \times 7 - 1)(3 \times 7 + 2) \\ &= 299 \end{aligned}$$

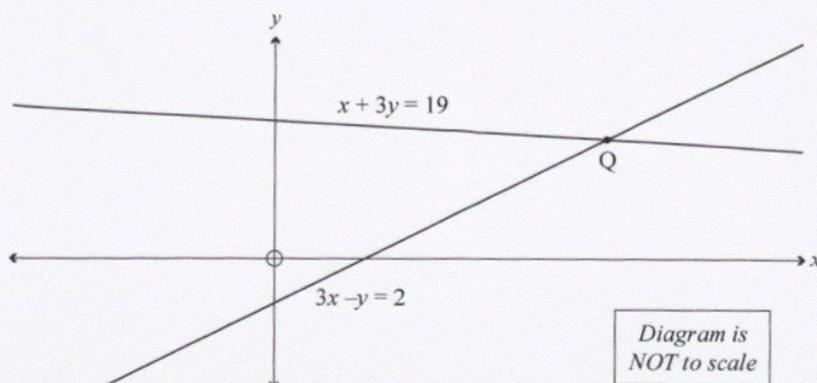
$$\begin{aligned} \text{total surface area} &= 2\text{EFBA} + 2\text{FGCB} + 2\text{DCBA} \\ &= 2 \times 273 + 2 \times 483 + 2 \times 299 \\ &= 2210 \end{aligned}$$

Since there are no units involved in the question I don't know what units this measurement is in, therefore I put a ?

- (b) The graph below shows two straight lines with equations:

$$3x - y = 2 \text{ and } x + 3y = 19$$

The lines intersect at the point Q.



Find the coordinates of the point Q, using an **algebraic** method.

Clearly show all steps of your working.

$$x + 3y = 19$$

$$3x - y = 2$$

~~$$3x - y = 2 + y$$~~

$$x = 19 - 3y$$

$$3(19 - 3y) - y = 2$$

$$57 - 9y - y = 2$$

$$57 - 10y = 2$$

$$-10y = -55$$

$$y = 5.5$$

$$x = 19 - 3y$$

$$x = 19 - 3 \times 5.5$$

$$x = 2.5$$

$$\text{so } x + 3y = 19$$

$$2.5 + 3 \times 5.5 = 19$$

$$\text{and } 3x - y = 2$$

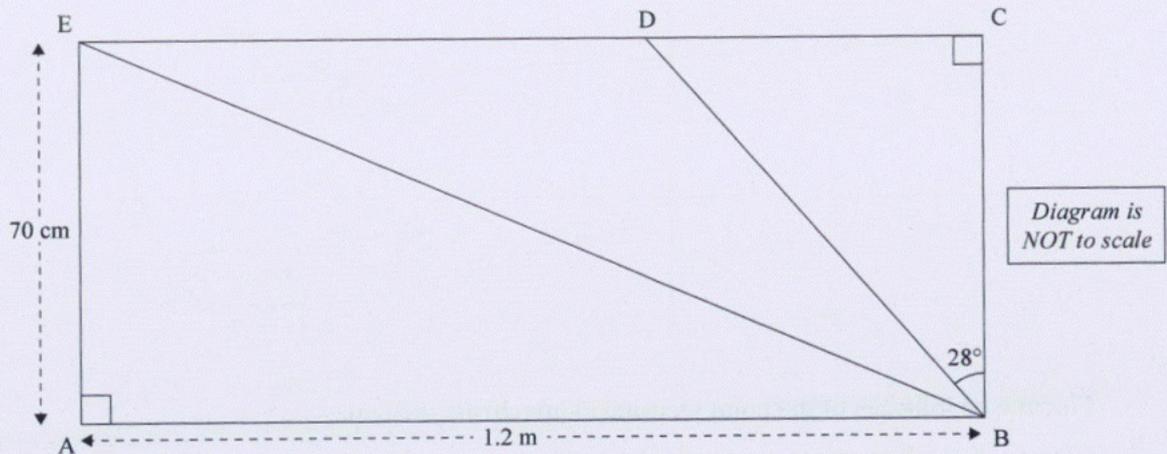
$$3 \times 2.5 - 5.5 = 2$$

therefore the coordinates of point Q = (2.5, 5.5)

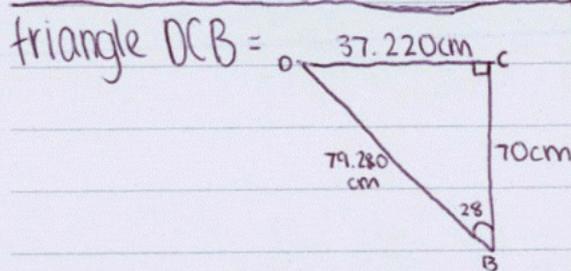
(c) The diagram below shows a rectangle ABCE.

Length AE = 70 cm, length AB = 1.2 m, angle CBD = 28° .

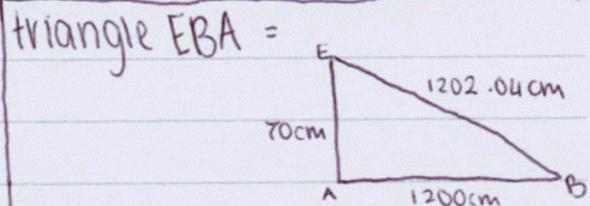
Find the perimeter of triangle BDE.



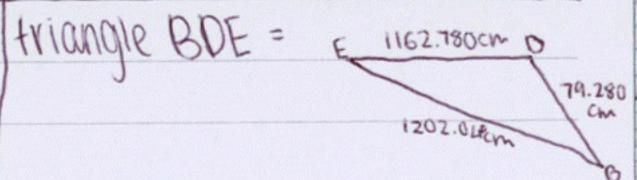
$$\begin{aligned} \text{length } DC &= \text{TOA} \\ &= \tan(28) \times 70 \\ &= 37.220 \text{ cm} \end{aligned}$$



$$\begin{aligned} \text{length } DB &= a^2 + b^2 = c^2 \\ &= 70^2 + 37.220^2 = DB^2 \\ &= \sqrt{6285.303} = DB^2 \\ &= 79.280 \text{ cm} \end{aligned}$$



$$\begin{aligned} \text{length } EB &= a^2 + b^2 = c^2 \\ &= 1200^2 + 70^2 = EB^2 \\ &= \sqrt{1444900} = EB^2 \\ &= 1202.040 \text{ cm} \end{aligned}$$



$$\begin{aligned} \text{length } ED &= 1200 - 37.220 \\ &= 1162.780 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{therefore triangle BDE's} \\ \text{perimeter is} &= ED + DB + EB \\ &= 1162.780 + 79.280 + 1202.040 \\ &= 2444.100 \text{ cm} \end{aligned}$$

all numbers rounded to 3 decimal points

**This page has been deliberately left blank.
The examination continues on the following page.**

- (d) The relationship between the x and y values in a sequence is shown in the table below:

x	y
1	11
2	29
3	83
4	245
5	731

Handwritten annotations to the right of the table show the differences between consecutive y values:

- Between $x=1$ and $x=2$, the difference is 17.
- Between $x=2$ and $x=3$, the difference is 54.
- Between $x=3$ and $x=4$, the difference is 162.
- Between $x=4$ and $x=5$, the difference is 486.

Further annotations show the differences between these differences:

- Between 17 and 54, the difference is 37.
- Between 54 and 162, the difference is 108.
- Between 162 and 486, the difference is 324.

Finally, the differences between these second-order differences are shown:

- Between 37 and 108, the difference is 71.
- Between 108 and 324, the difference is 216.
- The final difference between 216 and 145 is 145.

- (i) Find an equation that represents y , for any given x -value.

Show working to support your answer.

$y =$

(ii) The graph of y could be drawn, for all values of x .

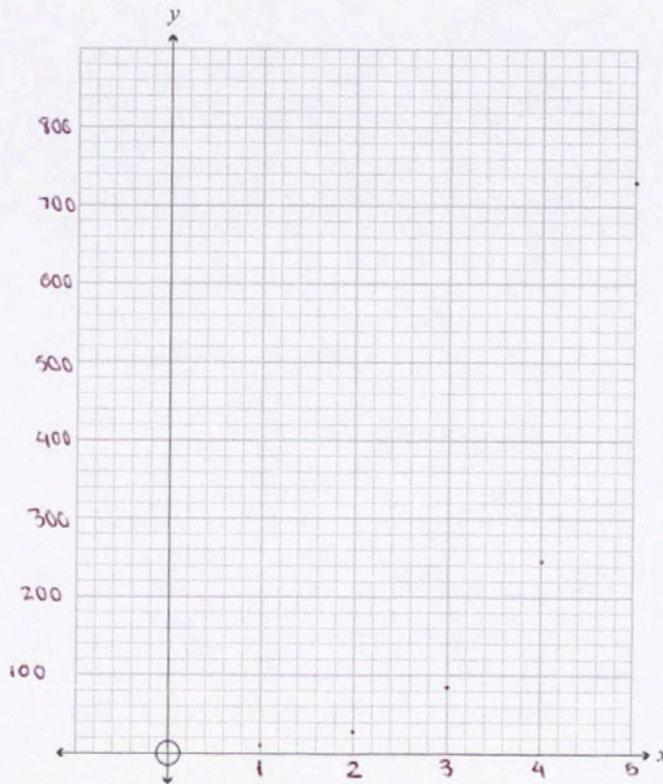
Identify THREE different features of the graph of y , using your equation found in part (d)(i).

You may choose to use the set of axes below, if it helps you.

Feature 1: _____

Feature 2: _____

Feature 3: _____

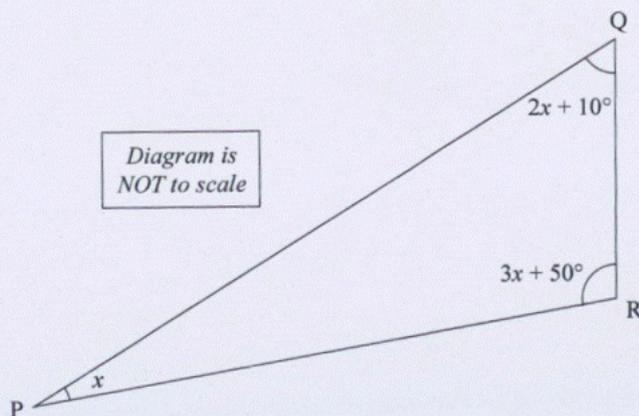


QUESTION TWO

- (a) The diagram below shows a triangle PQR.

Find the value of x .

Clearly show all steps of your working.

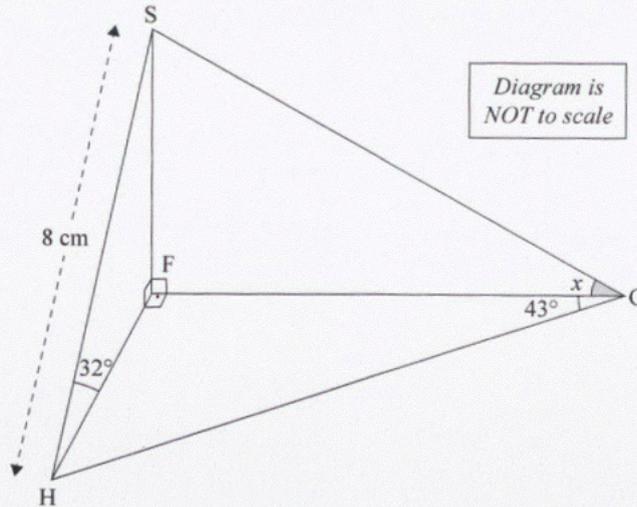


angle $\hat{PQR} = 2x + 10^\circ$

- (b) In the three-dimensional diagram below, triangle FGH is a right-angled triangle with angle $GFH = 90^\circ$.

Line FS is vertical and is perpendicular to the base triangle FGH .

Angle $SHF = 32^\circ$, angle $FGH = 43^\circ$, $SH = 8$ cm.



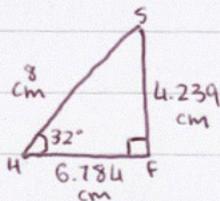
Find the size, x , of angle SGF .

Clearly show all steps of your working.

$$\begin{aligned} \text{length } SF &= SH \sin 32^\circ \\ &= 8 \sin 32^\circ \\ &= 4.239 \text{ cm} \end{aligned}$$

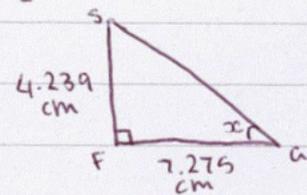
$$\begin{aligned} \text{length } FH &= \sqrt{SH^2 - SF^2} \\ &= \sqrt{8^2 - 4.239^2} \\ &= \sqrt{46.028} \\ &= 6.784 \text{ cm} \end{aligned}$$

triangle $SFH =$



$$\begin{aligned} \text{length } FG &= FH \tan 43^\circ \\ &= 6.784 \tan 43^\circ \\ &= 7.275 \text{ cm} \end{aligned}$$

triangle $SFG =$



$$\begin{aligned} \text{angle } SGF &= \tan^{-1} \left(\frac{SF}{FG} \right) \\ &= \tan^{-1} \left(\frac{4.239}{7.275} \right) \\ &= 30.229^\circ \end{aligned}$$

all numbers rounded to 3 decimal points

- (c) Factorise AND solve the equation below, using an algebraic method.
Give your answer(s) as simplified fractions.

$$15x^2 = 2 - 7x$$

$$0 = -15x^2 - 7x + 2$$

~~$$15x^2 + 7x - 2 = 0$$~~

~~$$15x^2 = (-15x)(-15x) - 7x + 2$$~~

~~$$225 - 15x - 15x + x^2 - 7x + 2 = 0$$~~

~~$$227 - 37x + x^2 = 0$$~~

~~$$x^2 - 37x + 227 = 0$$~~

~~$$(x - 20)(x - 576)$$~~

~~$$x^2 - 20x - 576x + 7424x$$~~

~~$$x^2 - 37x + 227$$~~

~~$$x(x - 37) + 227$$~~

~~$$x^2 = 7190$$~~

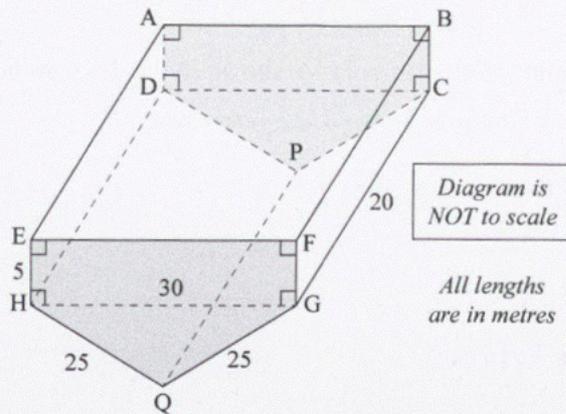
~~$$x = 5.749$$~~

checking:

~~$$15 \times 5.749^2 = 2 - 7 \times 5.749$$~~

~~$$495.765$$~~

- (d) The diagram below shows the cross-section and plan of a large hole dug in the ground. The top section is a cuboid and the hole is symmetrical about the line PQ. All sides and the two ends (ABCPD and EFGQH) are vertical. It is known that 1 m^3 of earth weighs 800 kg. One truck is able to transport 45 tonnes of earth in one single load.



Calculate the number of truck trips required to remove all the earth from the hole.

Show full working and justify your answer.

$$\begin{aligned} \text{volume of cuboid} &= h \times w \times l \\ \text{volume of cuboid on top section} \\ &= 5 \times 30 \times 20 \\ &= 3000 \text{ m}^3 \\ \text{volume of bottom section} \\ &= \text{area of triangle HGF} \times l \\ &= \frac{1}{2} \times b \times h \times l \end{aligned}$$

QUESTION THREE

- (a) (i) Find the equation of the straight line L, shown in the diagram below.

- (ii) Find the equation of the parabola M, shown in the diagram below.

Justify your working with appropriate reasoning.

$$y = a(x + p)(x + q)$$

$$x \text{ intercepts} = +5, -3$$

$$\text{point} = (-1, 6) \quad \text{substitute}$$

$$6 = a(-1 + 5)(-1 - 3)$$

$$6 = a(4)(-4)$$

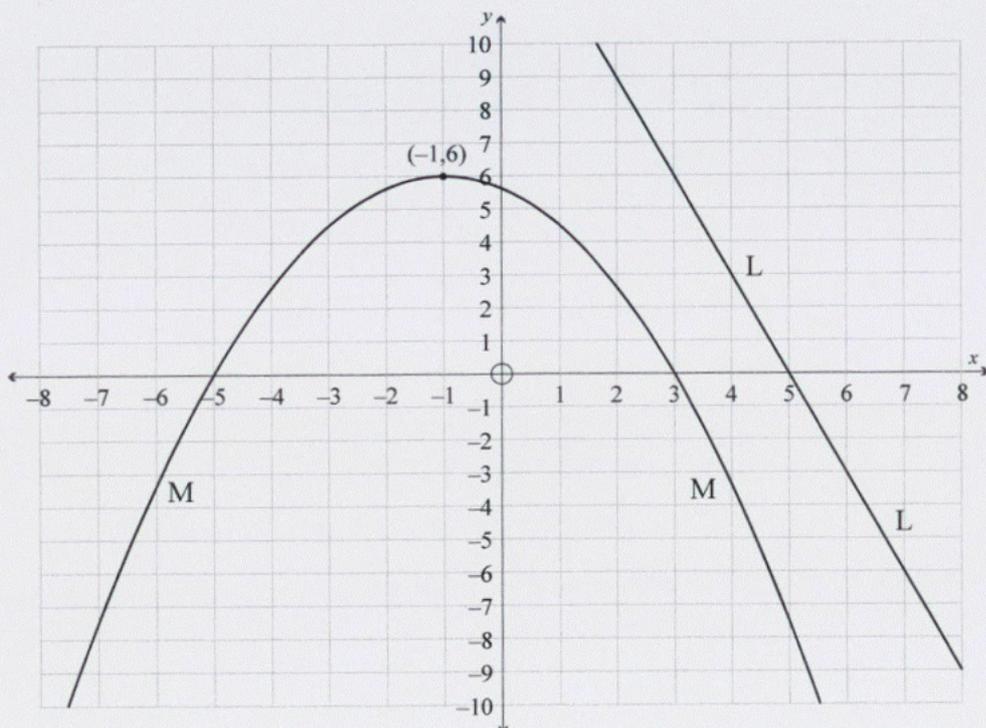
$$6 = a \times 4 \times -4$$

$$6 = -16a$$

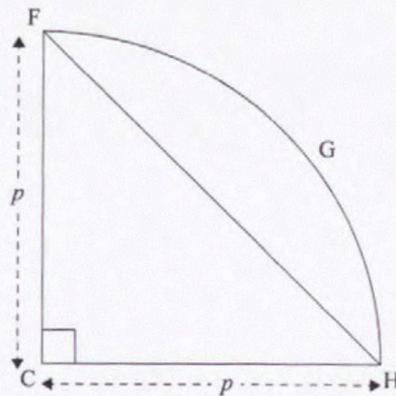
$$a = -0.375$$

$$y = -0.375(x + 5)(x - 3)$$

$$y = -0.375(x + 5)(x - 3) = \text{equation}$$



- (b) The diagram below shows a quarter of a circle, with radius p , and centre C .



Calculate how much longer the curve FGH is than the straight line FH .

Give your answer in terms of p .

Clearly show all steps of your working.

$$\begin{aligned} \text{circumference of circle} &= 2\pi r \\ &= 2 \times \pi \times p \\ &= 6.283p \end{aligned}$$

$$\text{quarter of circumference} = \frac{6.283p}{4}$$

$$\text{therefore } FGH \text{ line} = \frac{6.283p}{4}$$

$$\begin{aligned} \text{line } FH &= a^2 + b^2 = c^2 \\ &= p^2 + p^2 = FH^2 \\ &= p^4 = FH^2 \end{aligned}$$

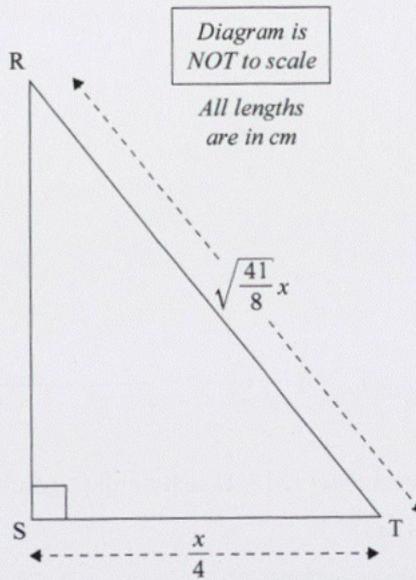
$$FH = \sqrt[4]{p^4}$$

$$\text{line } FGH = \frac{6.283p}{4}$$

$$\text{line } FH = \sqrt[4]{p^4}$$

Question Three continues
on the next page.

- (c) The area of the right-angled triangle shown below is 72 cm^2 .



Find the value of x .

$$\text{Area} = 72 \text{ cm}^2$$

$$\text{Area} = \frac{1}{2} \times \frac{x}{4} \times h$$

$$72 = \frac{1}{2} \times \frac{x}{4} \times h$$

$$144 = \frac{x}{4} \times h$$

$$144 - \frac{x}{4} = h$$

Merit

Subject: L1 Mathematics and Statistics

Standard: 91947

Total score: 15

Q	Grade score	Marker commentary
One	M5	The candidate has solved the simultaneous equations to find the coordinates of point Q. They have not found the perimeter of BDE, which would have given them M6.
Two	M5	The candidate has found angle SFG. They have not factorised and solved the quadratic for M6
Three	M5	The candidate has found the correct equation for the parabola, including calculating a .