Skills Checklist

(self-evaluation)

1.2 – Use Mathematical Methods to explore problems that relate to life in NZ

Internal, 5 credits

NCEA Level 1

(Updated for 2026)

Using this checklist

This checklist is designed as a **preparation tool** to give students an idea of which areas/skills tested in the assessment that they need more practice with.

Students should:

1. Try each question (with the solution covered up).
2. Check the model answer.
3. Tick the box in the right column to indicate how they did.

After this, the student should target their practice towards the particular topics/skills which they struggled with in this checklist (this can be done in consultation with their tutor or teacher).

Calculators are permitted in the test, so students should have full use of one when practicing.

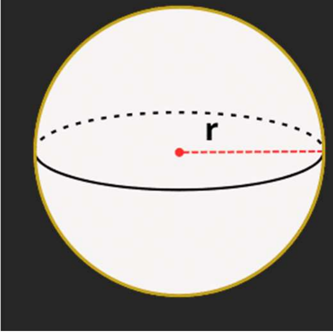
Please note, because 1.2 is internally assessed, it is entirely school-dependent what is in the actual test. The best source of information about what will be in the test is, and will always be, your teacher.

Good luck!

> the team at Trajectory Education

<table>
<tr><th rowspan="2">Competency</th><th rowspan="2">Past exam question</th><th rowspan="2">Solution</th><th colspan="3">How am I doing? (tick)</th></tr>
<tr><th>Not well</th><th>More work needed</th><th>Great!</th></tr>
<tr><td colspan="6">Topic #1: Number</td></tr>
<tr><td>Percentage change, including inverse percentage change</td><td>EXAMPLE 1: (Achieved)
A pitchfork costs $80.50 at Mitre 10, including GST. How much does this cost without GST?
EXAMPLE 2: (Achieved)
In 2025, Jamie sold her cupcakes for $2.60. She raises her price to $3.38 per cupcake. What percentage increase is this?</td><td>EXAMPLE 1:
$80.50 / 1.15 = $70
EXAMPLE 2:
% change = difference / original
% change = ($3.38 - $2.60) / $2.60
% change = 30% increase</td><td></td><td></td><td></td></tr>
<tr><td>Standard form (a.k.a ‘scientfiic form’)</td><td>EXAMPLE: (Achieved)
A snail moves at a rate of 0.0000083 km per second. Write this number in scientific form.</td><td>8.3 x 10^{-6}</td><td></td><td></td><td></td></tr>
<tr><td>Rates and Ratios</td><td>EXAMPLE: (Achieved/Merit)
Ari lives in Christchurch and is planning a holiday for the long weekend. He finds the following information from Google Maps.
He wonders on which journey do people tend to drive <i>slowest.</i>
<table>
<tr><th>Name</th><th>Distance of Journey</th><th>Average Time to complete</th></tr>
<tr><td>Christchurch to Timaru</td><td>162 km</td><td>2 hours and 26 minutes</td></tr>
<tr><td>Christchurch to Wainui</td><td>81.8 km</td><td>1 hour and 25 minutes</td></tr>
<tr><td>Christchurch to Arthur’s Pass</td><td>140 km</td><td>1 hour and 54 minutes</td></tr>
</table></td><td>Speed = Distance / Time
Chch to Timaru: 162km / 2.43 hours = 66.7 km/h
<i>(Note: 2.43 hours is calculated by dividing 26 minutes by 60 minutes to get 0.43 hours, and adding this to the 2 hours to get 2.43 hours)</i>
Chch to Wainui: 81.8 km / 1.42 hours = 57.61 km/h
Chch to Arthur’s Pass: 140 km / 1.42 hours = 73.68 km/h
People tend to drive slowest on the Chch to Arthur’s Pass route.</td><td></td><td></td><td></td></tr>
</table>

Topic #2: Algebra

Re-arranging formulae for a purpose	**EXAMPLE:** (Merit)  The surface area of a sphere is given by the formula: $A = 4\pi r^2$ If the surface area of this sphere is 30cm^2, what is the radius (r)?	$30 = 4\pi r^2$ $30/4\pi = r^2$ $30/4\pi = r^2$ $\sqrt{30/4\pi} = r$ **r = 1.55cm**	🟥 🟨 🟩
Expanding, factorising, and **applying exponential laws** *Recall: exponential laws are:* $a^m \bullet a^n = a^{m+n}$ $\frac{a^m}{a^n} = a^{m-n}$ $\left(a^m\right)^n = a^{mn}$	**EXAMPLE 1:** (Achieved/Merit) Factorise & Simplify $= \frac{x^2+4x-21}{3x^2-27}$ **EXAMPLE 2:** (Achieved) Expand $= -(x-3)^2 + 5$	**EXAMPLE 1:** $= \frac{(x-3)(x+7)}{3(x^2-9)}$ $= \frac{\cancel{(x-3)}(x+7)}{3\cancel{(x-3)}(x+3)}$ $= \frac{x+7}{3(x+3)}$ OR $\frac{x+7}{3x+9}$ **EXAMPLE 2:** $= -(x^2-6x+9)+5$ $= -x^2+6x-9+5$ $= -x^2+6x-4$	🟥 🟨 🟩 🟥 🟨 🟩
Solve simultaneous equations	*See Graphing Example 4, page 5.*		

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Topic #3: Graphing

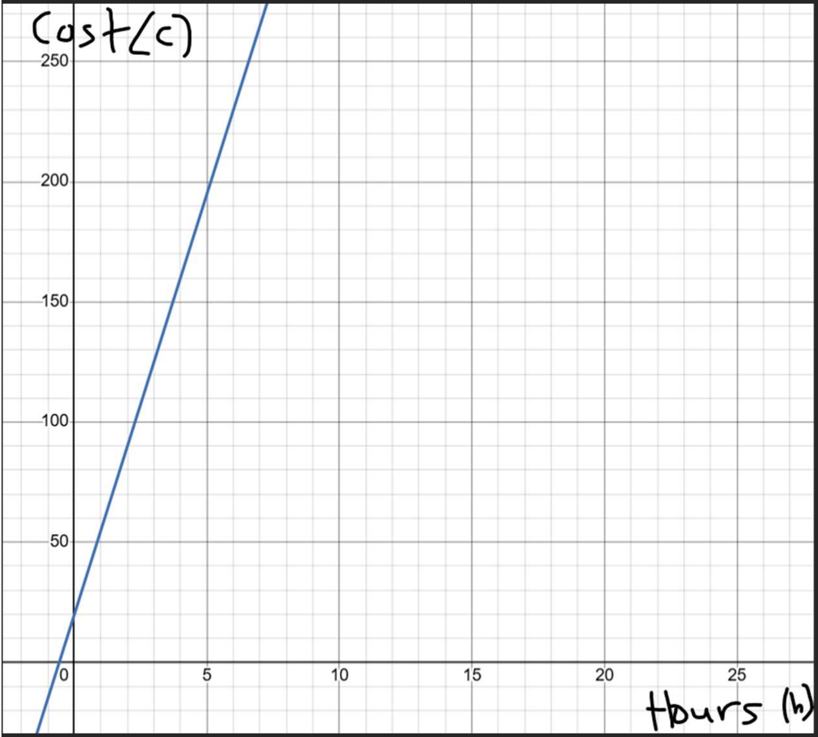
Forming, plotting, and using **linear equations**

Recall: The general equation of a line is:

y = mx + c

*where **m** = gradient ('rise over run') and*
***c** = y-intercept*

Mario's plumbing service charge $80 to turn up (known as a 'call-out fee') and $15 per hour of work. Another plumbing service, Luigi's, pricing is given on the graph below in **blue.**



EXAMPLE 1: (Achieved)

Plot the cost graph for Mario's plumbing service on the grid above.

EXAMPLE 2: (Merit)

Write the cost equation for Luigi's plumbing service.

EXAMPLE 1:

Solution on final page of this document.

EXAMPLE 2:

using $y = mx + c$

m = rise / run = 45 / 1 = 45 *(i.e., goes up $45 for every 1 hour)*

c = y-intercept = 20 *(i.e., crosses the y-axis at 20)*

y = 45x + 20 OR
Cost = 45h + 20

Forming, plotting, and using **linear equations**

(continued)

EXAMPLE 3 (Achieved)

How much would Luigi's plumbing service charge for 14.8 hours of work?

EXAMPLE 3:

Using Cost = 45h + 20 *(from previous question)*

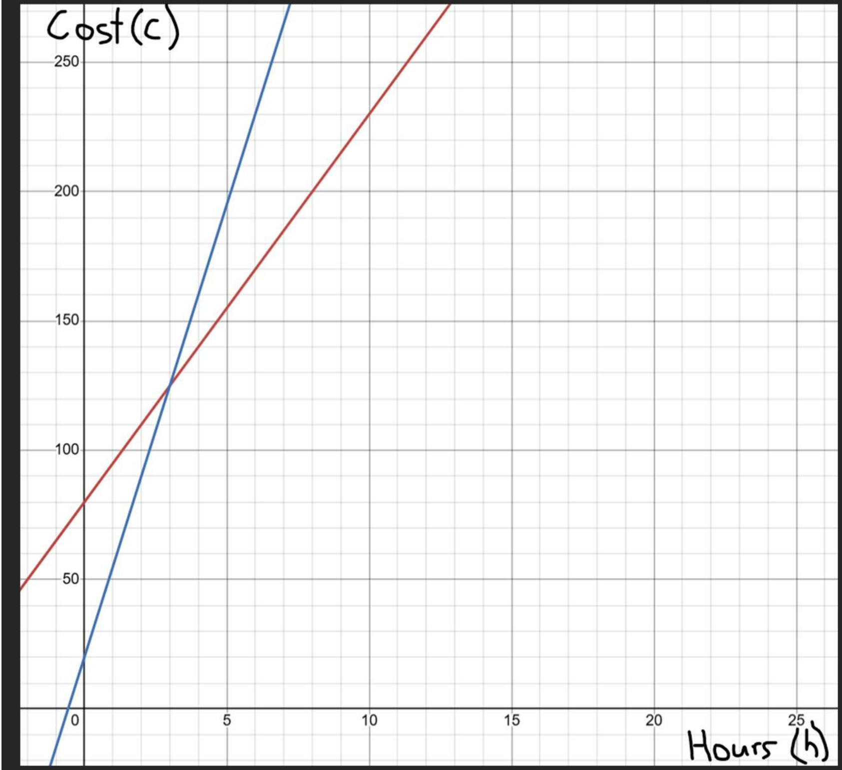
Cost = 45 x 14.8 + 20 = **$686**

EXAMPLE 4 (Excellence)

The cost for Mario's plumbing service is shown in red on the graph below. It is modelled using the equation **C = 15h + 80.**

The cost for Luigi's plumbing service is shown in **blue** on the graph below. It is modelled using the equation **C = 35h + 20**

Using **algebraic methods**, determine the number of hours at which the total cost for Mario's and Luigi's plumbing service will be the same. Also, calculate the cost at this number of hours.



EXAMPLE 4:

USING SIMULTANEOUS EQUATIONS

MARIO $C = 15h + 80$ ····①

LUIGI $C = 35h + 20$ ····②

SUBSTITUTING ① into ② (or ② into ①)

$15h + 80 = 35h + 20$

$-15h \quad -15h$

$80 = 20h + 20$

$-20 \quad -20$

$\frac{60}{20} = \frac{20h}{20}$

$3 = h \quad \boxed{h = 3}$

SUBSTTUTING h=3 INTO ① (or ②)

$C = 15 \times 3 + 80$

$C = 45 + 80 = 125$

$\boxed{C = 125}$

Therefore, the total costs for Mario's and Luigi's plumbing service will be the same for jobs that take exactly 3 hours. At this point, the cost of each of their services will be $125.

Forming, plotting, and using **linear equations**

(continued)

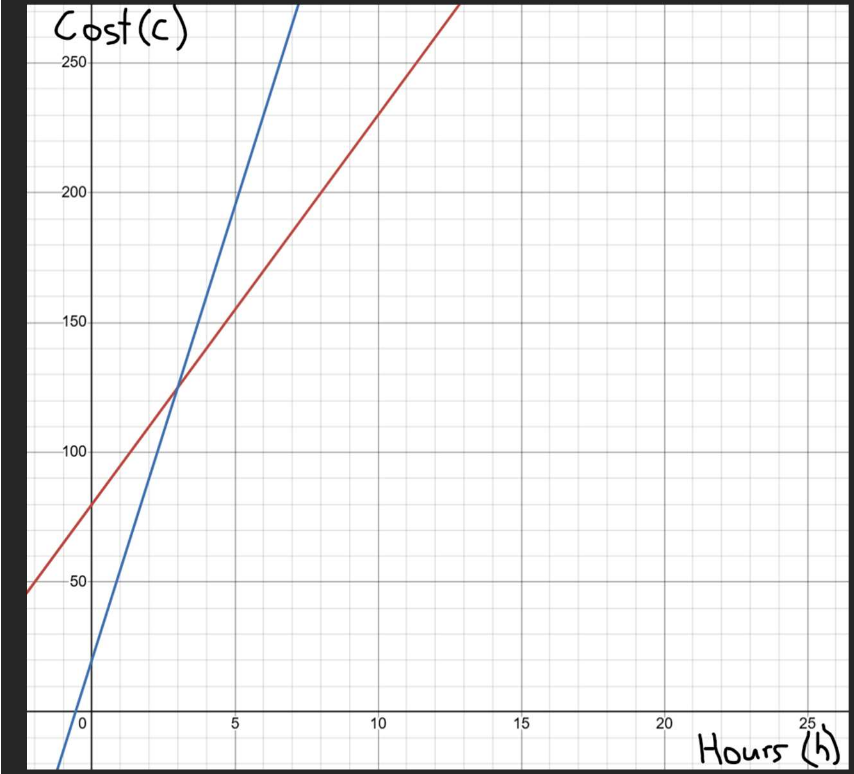
EXAMPLE 5: (Merit for Part A, and Excellence for Part B)

Part A

A third plumber, **Wario**, does not charge a 'call-out' fee. He also does not charge for the first hour of work. After that, he charges \$40 per hour for work done after the first hour, up until seven hours of total work.

After he's done seven hours work, Wario charges only \$10 per hour until the work is done.

On the graph below, plot the cost graph for Wario's plumbing service.



Part B

Find a set of equations to describe the costing for Wario.

EXAMPLE 5

Part A

Solution on final page of this document.

Part B

Wario's costing structure can be broken down into 3 equations.

①

He doesn't charge for the 1st hour of work and doesn't charge a 'call-out' fee.

Therefore, when $h=1$ or less, $C=0$.

This can be written as:

$C=0$ (where $h\leq 1$)

② After, he charges \$40/hour (up until he's done 7 hours).

Using $y=mx+c$

$m=\frac{rise}{run}=\frac{40}{1}=40$

$c=$ y-intercept $=-40$

(by continuing the line all the way to the y-axis)

So, $y=40x-40$ (up to 7 hours)

$C=40h-40$ (where $1<h\leq 7$)

③ After 7 hours, Wario charges \$10/hour until the job is done.

Using $y=mx+c$

$m=\frac{rise}{run}=\frac{10}{1}=10$

$c=$ y-intercept $=170$

So, $y=10x+170$ (after 7 hours)

$C=10h+170$ (where $h>7$)

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Forming, plotting, and using **quadratic** equations

Recall: The general form of parabolas are:

Vertex form:
$y = a(x - h)^2 + k$
where (h, k) is the vertex.

Intercept form:
$y = a(x - p)(x - q)$
where p and q are the x-intercepts

EXAMPLE 1: (Merit)

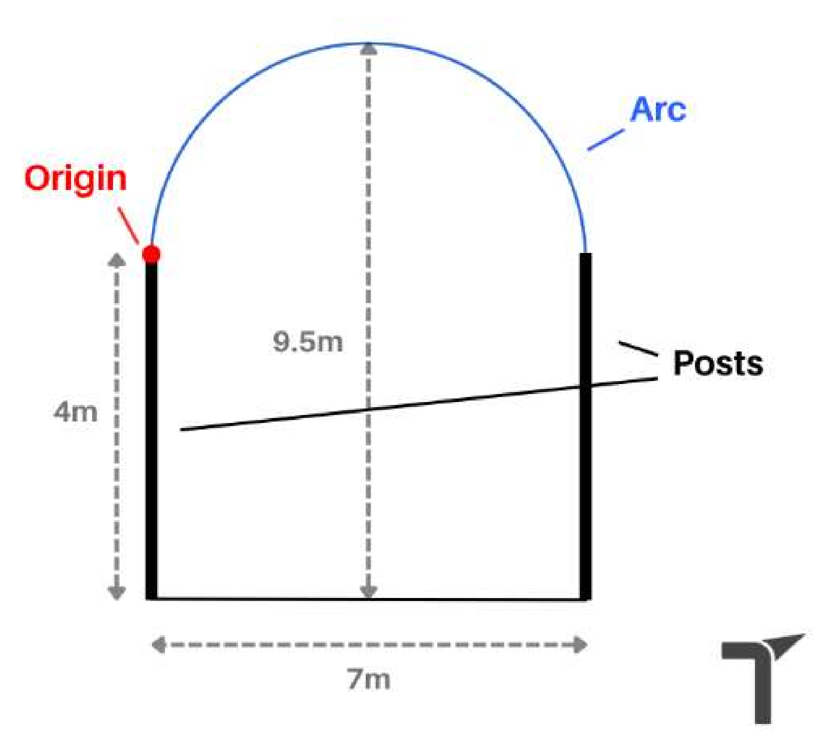
A structural engineer is designing a supporting arch for a new outdoor theatre stage.

The arch structure is modelled by a parabola.

The design specifications require that the **base supports (posts) must be 4 metres tall** on either side of the stage opening. The **maximum clearance (vertex) of the arch must be 9.5 metres** above the stage floor.

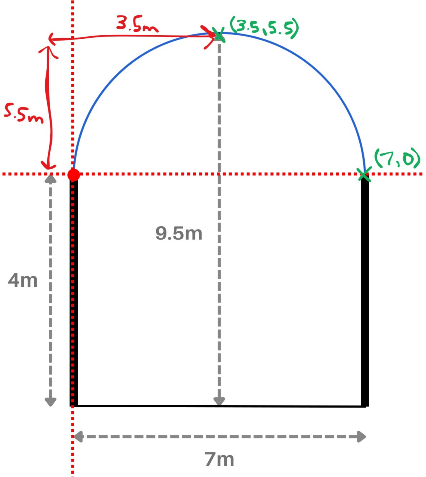
If the total span width between the two supports is **7 metres**, **determine the equation of a parabola that defines the curve of the arch structure**.

You can assume that the origin (0, 0) is on the point labeled in red on the diagram.



EXAMPLE 1

Using the below diagram, we can see that the co-ordinates of the parabola's turning point is (3.5, 5.5)



Using vertex form [$y = a(x - h)^2 + k$] and (h, k) = (3.5, 5.5):

$$y = a(x - 3.5)^2 + 5.5$$

To find 'a' (the 'scale factor'), substitute in another point on the parabola.

In this case, we can use $(\overset{x}{7},\overset{y}{0})$

$$0 = a(7 - 3.5)^2 + 5.5$$

$$0 = a(3.5)^2 + 5.5$$

$$\underset{-5.5}{0} = 12.25a \underset{-5.5}{+ 5.5}$$

$$\frac{-5.5}{12.25} = \frac{12.25a}{12.25}$$

$$a = -0.45 \text{ (2.d.p)}$$

Therefore, the equation of the parabola is:

$y = -0.45(x - 3.5)^2 + 5.5$

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Forming, plotting, and using **quadratic** equations

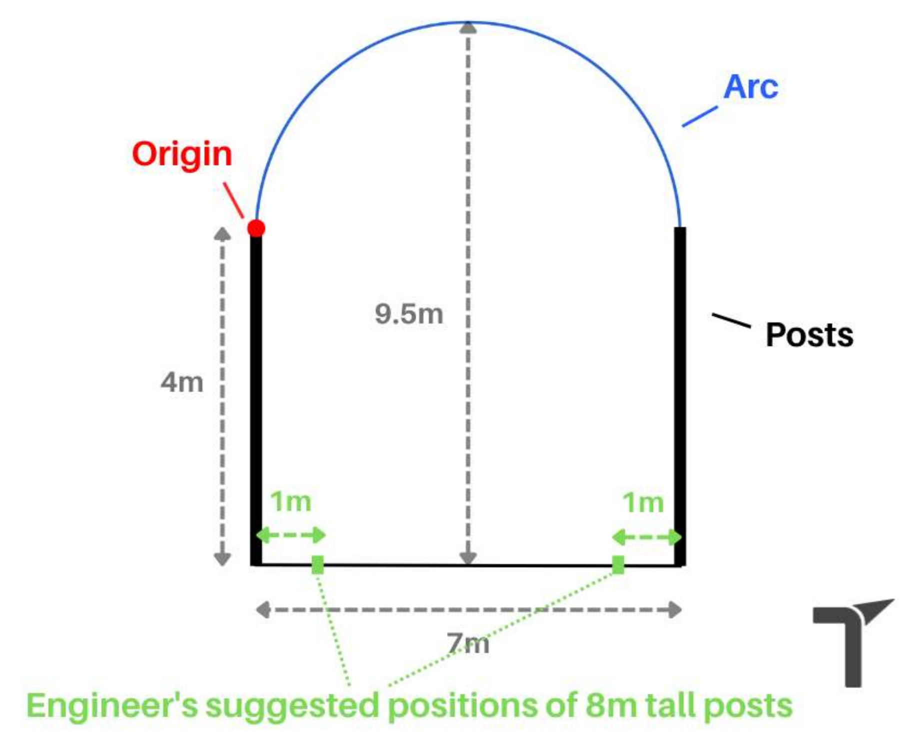
(continued)

EXAMPLE 2: (Excellence)

The engineer wants to place two extra posts on either side, to help hold up the support arch. The posts she wants to use are 8m tall each, she wants them to be placed 1m in from the existing posts (as shown on the diagram).

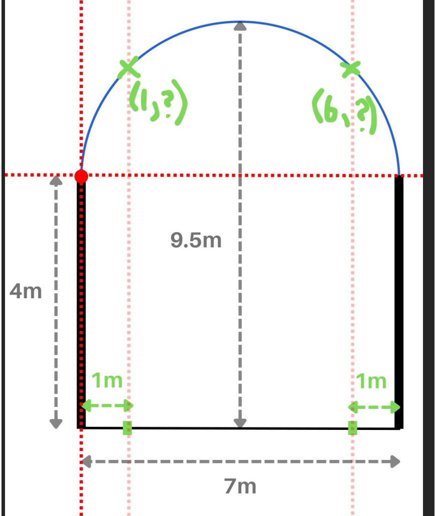
i. using your equation from Example 1, explain to the engineer why this cannot be done; and

ii. suggest a possible workaround solution.



i.)

The 1st post lies at x = 1 and the 2nd post lies at x = 6 (see diagram below).



Using our equation from Example 1, [$y = -0.45(x - 3.5)^2 + 5.5$], we can substitute in x = 1 and x = 6 to find out the y-co-ordinates.

SUBSTITUTING $x=1$

$y = -0.45(1-3.5)^2 + 5.5$

$y = -0.45(-2.5)^2 + 5.5$

$y = -0.45 \times 6.25 + 5.5$

$y = 2.6875$

SUBSTITUTING $x=6$

$y = -0.45(6-3.5)^2 + 5.5$

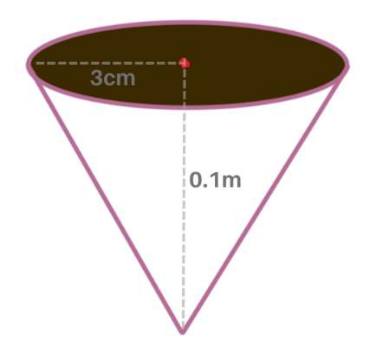
• • • • • • • • • • • • • • •

$y = 2.6875$

Therefore, at the points where the engineer wants to put the posts, the arc is 6.6875 metres (2.6874 metres +

		4 metres) above the ground. So, the 8m posts would not be able to fit. **ii.)** A possible workaround solution could be to cut down the 8m posts to be 6.6875 metres each. *Other possible workaround solutions could involve moving the posts to a different spot*	

Topic #4: Measurement

Surface area of 3D shapes (including metric unit conversion)	**EXAMPLE:** (Merit) Find the outside surface area of this ice cream cone (not including the hole for the ice cream), which is 0.1m tall and has a radius of 3cm.  	Use the formula for surface area of a cone (excluding the base). **SA = $\pi r l$** (where l is the slant height) Using pythagoras' theorem to find the slant height… $l = \sqrt{(3^2 + 10^2)}$ = 10.44cm r = 3 cm SA = π x 3 x 10.44 = **98.39cm^2**	🟥 🟧 🟩

Volume/ capacity of 3D shapes (including metric unit conversion)	**EXAMPLE:** Rollickin Gelato get asked to cater for a wedding. The wedding is expecting 140 guests. They need to know how many of their tubs of gelato to bring to the wedding. Each tub of gelato contains 4.5 litres. Rollickin estimates that each scoop of gelato has a radius of 3.5cm (or 35 mm). Each serving of gelato has 1 scoop. 1. How many tubs of gelato should Rollickin bring to the wedding? (Merit) 2. What assumptions did you have to make in your calculation? (Excellence) 	**1.** Use the formula for volume of a sphere. **Volume =** $\frac{4}{3}\pi r^3$ r = 3.5 cm Vol of 1 scoop = $\frac{4}{3} \times \pi \times 3.5^3$ = 179.54cm^3 Because 1cm^3 = 1ml, 179.54cm^3 is equavalent to 179.54ml Total gelato required for 140 guests = 179.54 x 140 = **25,135.6 ml** Each gelato tub contains 4.5 litres or **4,500 ml.** 25,135.6 / 4,500 = 5.59 tubs. **Therefore, 6 tubs are required in total.** **2.** One assumption is that all 140 guests will turn up to the wedding. In reality, some might have RSVP'd but not been able to make it. This means that Rollickin might not actually need 6 tubs, although they should still bring that much just in case. Another assumption is that all the gelato scoops will have the exact same radius (35mm). In reality, it is not possible to be this accurate and some scoops might be bigger or smaller. This means that Rollickin might need more or less than 6 tubs. It might be wise for them to get an extra tub or two in case the scoops end up being bigger than 35mm on average. *Plenty of other assumptions are possible – the above 2 are just examples.*	🟥 🟧 🟩

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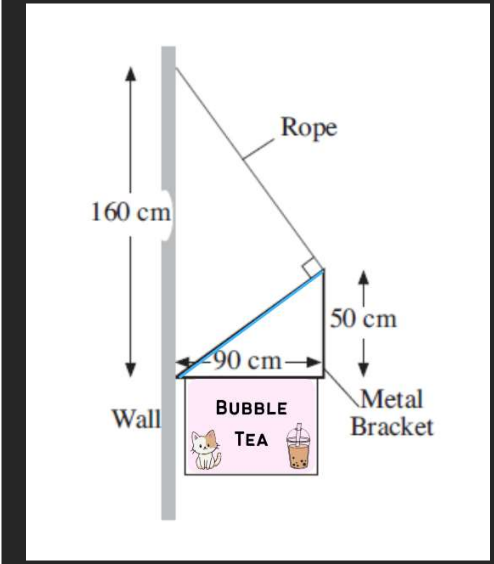
Topic #5: Geometry and Space

Using **Pythagoras' theorem** to solve problems.

Recall that Pythagoras' Theorem:
$a^2 + b^2 = c^2$
where 'c' is the length of the hypoteneuse.

EXAMPLE: (Achieved)
This diagram shows how the sign that hangs over a Bubble Tea shop is suspended by a rope and a triangular metal bracket.

Find the length of the rope.



First use Pythagoras' to find the length of the blue line, using the bottom triangle.

blue line = $\sqrt{(90^2 + 50^2)}$ = 102.96 cm (2.d.p)

Now, use Pythagoras' theorem to find the length of the rope.

rope = $\sqrt{(160^2 - 102.96^2)}$ = **122.47 cm (2.d.p)**

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Use **Trigonometry** to solve problems.

Finding sides

$$\sin\theta = \frac{opposite}{hypoteneuse}$$

$$\cos\theta = \frac{adjacent}{hypoteneuse}$$

$$\tan\theta = \frac{opposite}{adjacent}$$

Finding angles

$$\theta = \sin^{-1}\frac{opposite}{hypoteneuse}$$

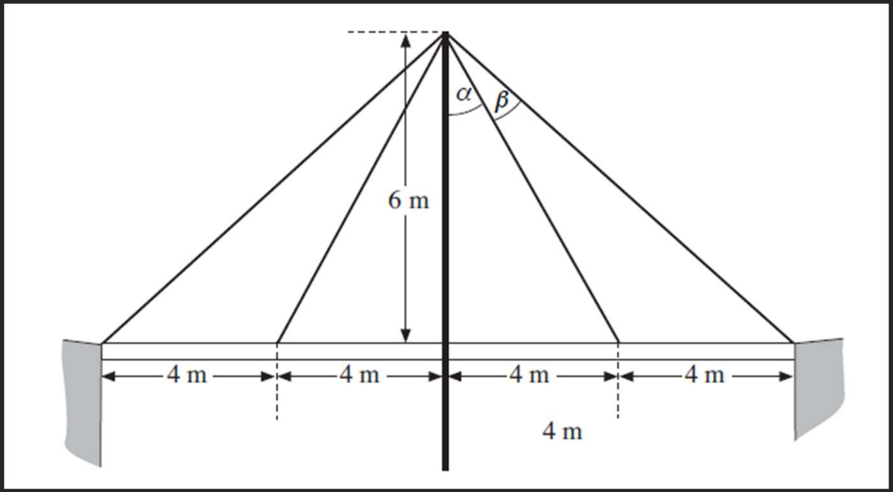
$$\theta = \cos^{-1}\frac{adjacent}{hypoteneuse}$$

$$\theta = \tan^{-1}\frac{opposite}{adjacent}$$

EXAMPLE:

This diagram shows a bridge which is supported by four steel cables.

a) Find the angles at $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$. (Merit)
b) Find the length of each cable. (Achieved)



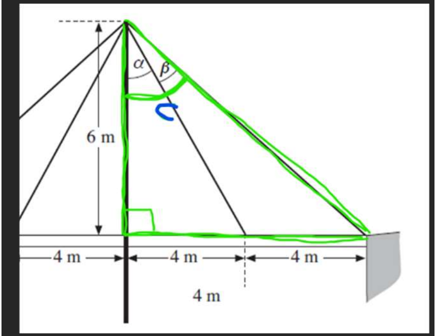
a)

$$\boldsymbol{\alpha} = \tan^{-1}\frac{opposite}{adjacent}$$

$$\boldsymbol{\alpha} = \tan^{-1}\frac{4}{6}$$

$$\underline{\boldsymbol{\alpha} = 33.69°}$$

To find β, we have to first find the total angle ‘C’ ($\alpha + \beta$). We’d do this by using the triangle outlined in green below.



$$\boldsymbol{C} = \tan^{-1}\frac{opposite}{adjacent}$$

$$\boldsymbol{C} = \tan^{-1}\frac{8}{6}$$

$$\boldsymbol{C} = 53.13°$$

$\boldsymbol{\beta} = C - \alpha = 53.13 - 33.69 = \underline{\mathbf{19.44°}}$

b)

1. Short cable (‘x’)

Using $\boldsymbol{\alpha} = 33.69°$ from a)

$$\sin\theta = \frac{opposite}{hypoteneuse}$$

$$\sin 33.69 = \frac{4}{x}$$

$$x = \frac{4}{\sin 33.69}$$

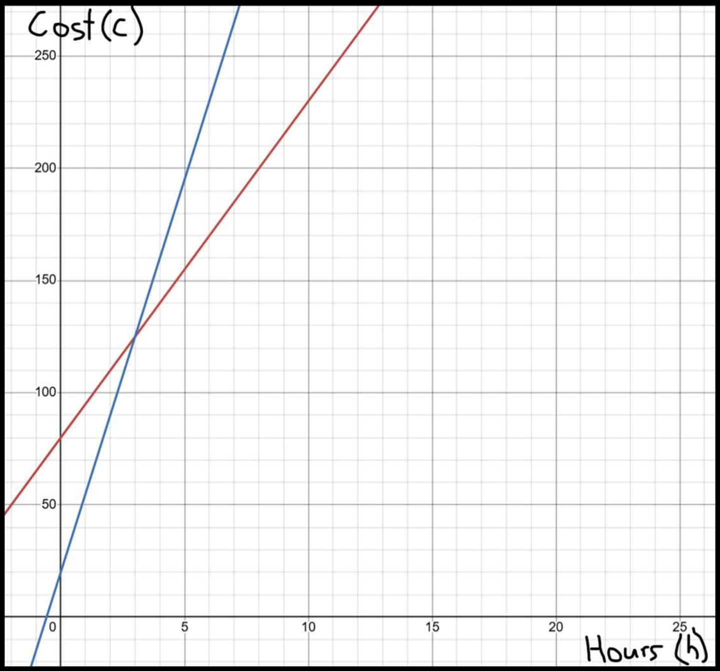
x = 7.21 metres

		2. Long cable (‘y’) Using $\boldsymbol{C}$ $= 53.13°$ from a) $\sin\theta = \frac{opposite}{hypoteneuse}$ $\sin 53.13 = \frac{8}{x}$ x = $\frac{8}{\sin 53.13}$ **x = 10 metres** *Pythagoras’ Theorem can also be used.*	

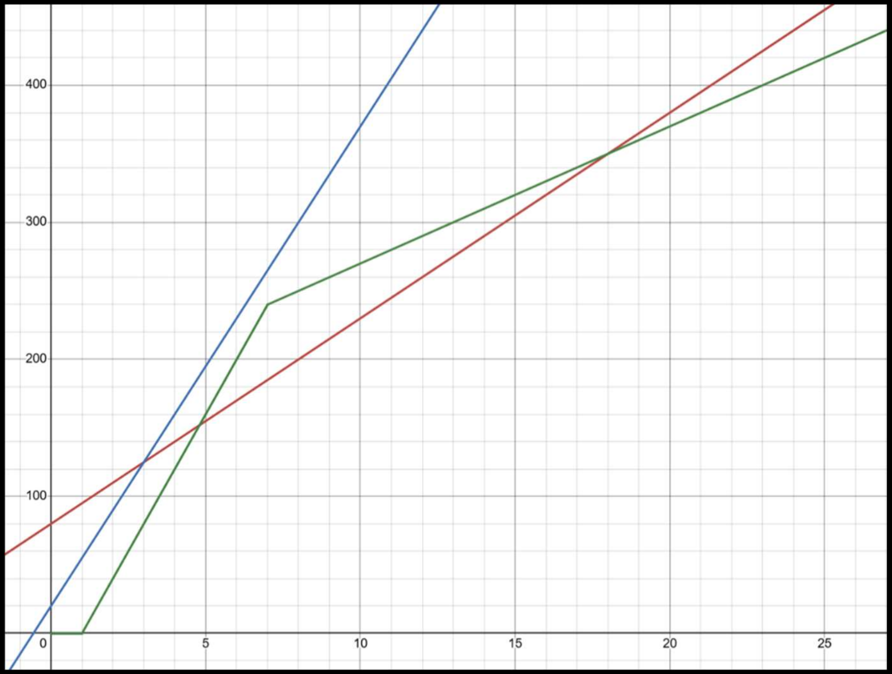
That’s it!

How did you do? Need help or clarification? We’re always just a message away.

Solution to graphing question, Example 1 (drawn in red):



Solution to graphing question, Example 5 (drawn in green):



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