Mathematics

Year 9
Satisfactory

WORK SAMPLE PORTFOLIO

Annotated work sample portfolios are provided to support implementation of the Foundation – Year 10 Australian Curriculum.

Each portfolio is an example of evidence of student learning in relation to the achievement standard. Three portfolios are available for each achievement standard, illustrating satisfactory, above satisfactory and below satisfactory student achievement. The set of portfolios assists teachers to make on-balance judgements about the quality of their students' achievement.

Each portfolio comprises a collection of students' work drawn from a range of assessment tasks. There is no pre-determined number of student work samples in a portfolio, nor are they sequenced in any particular order. Each work sample in the portfolio may vary in terms of how much student time was involved in undertaking the task or the degree of support provided by the teacher. The portfolios comprise authentic samples of student work and may contain errors such as spelling mistakes and other inaccuracies. Opinions expressed in student work are those of the student.

The portfolios have been selected, annotated and reviewed by classroom teachers and other curriculum experts. The portfolios will be reviewed over time.

ACARA acknowledges the contribution of Australian teachers in the development of these work sample portfolios.

THIS PORTFOLIO: YEAR 9 MATHEMATICS

This portfolio provides the following student work samples:

Sample 1	Measurement: Trigonometry
Sample 2	Measurement: Wheelchair access (Pythagoras' Theorem)
Sample 3	Measurement: Tall and short (volume of a cylinder)
Sample 4	Geometry: Similar triangles
Sample 5	Probability: Probabilities
Sample 6	Number: Index laws
Sample 7	Algebra: Linear relationships
Sample 8	Measurement: Volume of a prism
Sample 9	Measurement: Surface area and volume
Sample 10	Statistics: Data displays
Sample 11	Measurement and geometry: Trigonometry and similarity in right-angled triangles
Sample 12	Statistics: Academy Awards
Sample 13	Geometry: Similarity
Sample 14	Measurement: Cylinder volume

Mathematics

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This portfolio of student work shows the application of index laws to numbers (WS6) and expresses numbers in scientific notation (WS6). The student finds the distance between two points on the Cartesian plane, the gradient and midpoint of a line segment and sketches linear relationships (WS7). The student recognises the connection between similarity and trigonometric ratios (WS11) and uses Pythagoras' Theorem (WS2) and trigonometry to find unknown sides in right-angled triangles (WS1, WS11, WS13). The student uses measurement, ratio and scale factor to calculate unknown lengths in similar figures (WS4, WS11, WS13). The student calculates the areas of shapes and the volumes and surface areas of right prisms and cylinders (WS3, WS8, WS9, WS14). The student interprets and represents data in back-to-back stem-and-leaf plots and frequency histograms (WS10, WS12) and makes sense of the position of the median to compare skewed and symmetric sets of data (WS12). The student calculates relative frequencies to estimate probabilities, lists outcomes for two-step experiments and assigns probabilities for those outcomes (WS5).

Measurement: Trigonometry

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

By the end of Year 9, students solve problems involving simple interest. They interpret ratio and scale factors in similar figures. Students explain similarity of triangles. They recognise the connections between similarity and the trigonometric ratios. Students compare techniques for collecting data in primary and secondary sources. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.

Students apply the index laws to numbers and express numbers in scientific notation. They expand binomial expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment. They sketch linear and non-linear relations. Students calculate areas of shapes and the volume and surface area of right prisms and cylinders. They use Pythagoras' Theorem and trigonometry to find unknown sides of right-angled triangles. Students calculate relative frequencies to estimate probabilities, list outcomes for two-step experiments and assign probabilities for those outcomes. They construct histograms and back-to-back stem-and-leaf plots.

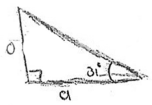
Summary of task

Students had completed a unit of work on the trigonometric ratios. They were given a quiz to be completed as a class test during a lesson.

Measurement: Trigonometry

Quiz 1 – Angles

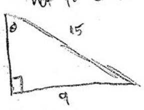
1. Consider Tan 31° Explain as much as you can from this information. What can this tell you about the triangle?



- tan 31° is a ratio of the side opposite the angle over the side adjacent to the angle.
- If you know the values for one of these sides, you can use the ratio to find the other.

2. Two of the side lengths of a right angled triangle are 9 and 15. What could the reference angle be? Explain your thinking.

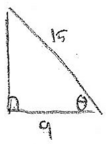
not to scale*



$\sin\theta = \frac{9}{15}$

$\sin^{-1}(\frac{9}{15}) = 36.9$

$\theta = 36.9°$ or $36°52'$



$\cos\theta = \frac{9}{15}$

$\cos^{-1}(9/15) = 53.1$

$\theta = 53.1$ or $53°8'$

Annotations

Demonstrates understanding of the tangent ratio.

Draws and labels the sides of two possible right-angled triangles, recognising that the hypotenuse must be the longer of the two sides when using the sine and cosine ratios.

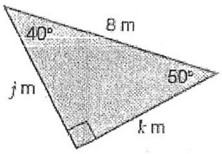
Demonstrates understanding of the use of the sine and cosine ratios.

Measurement: Trigonometry

Quiz 2 – Sides

1. The following answers were given by a student on a trigonometry test.

i. Find the value of k.



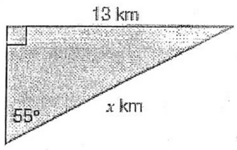
$\cos\theta = \frac{A}{H}$

$\cos 40° = \frac{k}{8}$

$8 \times \cos 40° = k$

$k = 6.13$ m

ii. Find the value of x.



$\sin\theta = \frac{O}{H}$

$\sin 55° = \frac{13}{x}$

$13 \times \sin 55° = x$

$x = 10.65$ km

a) Explain the mistake the student has made in each question.

i) should have used $\sin 40°$ not $\cos 40°$. $\cos 40°$ would be $\frac{j}{8}$

ii) on line three, they should have done this: $\frac{13}{\sin 55°} = x$

b) Show the correct calculations and answers.

i) $\sin\theta = \frac{O}{H}$

$\sin 40° = \frac{k}{8}$

$K = 8 \times \sin 40°$

$k = 5.1$ m

ii) $\sin\theta = \frac{O}{H}$

$\sin 55° = \frac{13}{x}$

$x = \frac{13}{\sin 55°}$

$x = 15.9$ km

Annotations

Identifies the mistakes and provides correct alternatives.

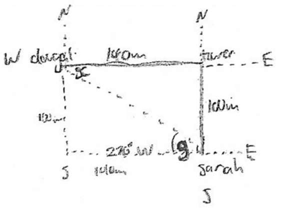
Uses trigonometry to find unknown sides of right-angled triangles solving both for the hypotenuse and another side.

Measurement: Trigonometry

Quiz 3 – Applications of Trigonometry

1. Sarah is standing 100m due south of a tower. Dougal is standing 140m due west of the same tower. Using both compass bearings and true bearings, find the bearing of:

a. Dougal from Sarah



$\tan g = \frac{100}{140}$

$\tan^{-1}\left(\frac{100}{140}\right) = 35°32'$

$g = 36°$

$\therefore$ 306°T

N 54° W

b. Sarah from Dougal

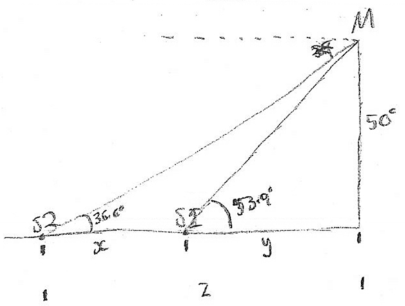
$g = 36°$

$\therefore x = 36°$

126°T

S 54° E

2. From her vantage point on a cliff, Maria sights two swimmers in a direct line in front of her at angles of depression of 38.6° and 53.9°. If Maria is 50m above the water level, find the distance between the two swimmers.



$\tan 53.9° = \frac{50}{y}$

$y = \frac{50}{\tan 53.9°}$

$y = 36.5m$

$\tan 38.6° = \frac{50}{z}$

$z = \frac{50}{\tan 38.6°}$

$z = 62.6m$

$x = z - y$

$x = 62.6 - 36.5$

$x = 26.1m$

The distance between the swimm is 26.1m

Annotations

Calculates an appropriate angle and uses this to determine the required bearings.

Calculates each distance and then uses them to answer the question.

Measurement: Wheelchair access (Pythagoras' Theorem)

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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> *Students apply the index laws to numbers and express numbers in scientific notation. They expand binomial expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment. They sketch linear and non-linear relations. Students calculate areas of shapes and the volume and surface area of right prisms and cylinders. They use Pythagoras' Theorem and trigonometry to find unknown sides of right-angled triangles. Students calculate relative frequencies to estimate probabilities, list outcomes for two-step experiments and assign probabilities for those outcomes. They construct histograms and back-to-back stem-and-leaf plots.*

Summary of task

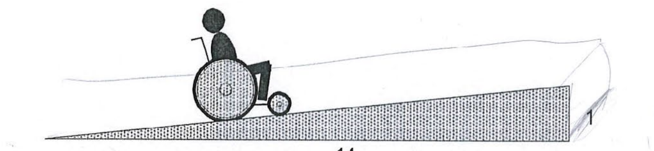
Students had completed a unit of work on Pythagoras' Theorem. They were given a worksheet with questions relating to Australian Standards Council regulations for slopes of ramps into buildings. Students completed the task as a class test during a lesson.

Measurement: Wheelchair access (Pythagoras' Theorem)

23. Wheelchair Ramps, Slopes and Accessibility

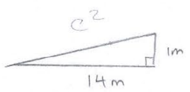
The Australian Standards Council has regulations for slopes of ramps into buildings, in order for wheelchairs to be accessible to the buildings. Such ramps must have no greater slope than 1 in 14.

By the term "1 in 14", we mean that for every 14 metres travelled horizontally (not actually on the ramp), we rise 1 metre. (The diagram below is not to scale.)



Use this information to answer the following question:

1. If a person effectively rises 1 metre vertically in moving along a 1 in 14 ramp, what is the length of the ramp? Please explain your working.



$14^2 + 1^2 = c^2$
$196 + 1 = c^2$
$197 = c^2$
$\sqrt{197} = c$
$14.04\text{m} \doteqdot c$

∴ The length of the ramp is 14.04m (Round it off to two decimal places)

2. You have been asked to work out the size and cost of a ramp for accessibility to a portable classroom at a school. The ramp must rise by a total of 0.5 m.

a) What would be the minimum length of such a ramp?

$7^2 + 0.5^2 = c^2$
$49 + 0.5 = c^2$
$49.5 = c^2$
$\sqrt{49.5} = c$
$c \doteqdot 7.04$

∴ The minimum length of such a ramp is approximately 7.04m.

b) If the ramp is 1.5 m wide, and non-slip materials used in making the ramp cost $25 per square metre, what will be the cost of the non-slip surface of the ramp? Once again, please show your working.

$1.5 \times 14.04 = 21.05\text{m}^2$
$25 \times 21.05 = \$526.5$

∴ Cost of the non-slip surface for the ramp is $526.5.

Annotations

Considers decimal places appropriate to measurements given.

Recognises that Pythagoras' Theorem applies and uses it to determine the required length.

Solves equation for unknown length.

Uses a correct approach to calculate the cost but uses an incorrect length in the area calculation.

Measurement: Tall and short (volume of a cylinder)

Year 9 Mathematics achievement standard

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Summary of task

Students had completed a unit of work on surface area and volume. They were given a worksheet pertinent to this topic and asked to complete it without assistance during a lesson.

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Measurement: Tall and short (volume of a cylinder)

"Tall and Thin" or "Short and Fat"

By taking appropriate measurements and carrying out calculations, answer the following question:

Which would hold the most:

- a cylinder made from an A4 sheet of paper, rolled so that it is "tall and thin";

Cylinder 1

OR

- a cylinder made from an A4 sheet of paper, rolled so that it is "short and fat".

Cylinder 2

Please calculate the capacity in each case, show all your working, and then answer the question: "which would hold the most?"

A4 paper = 29.5 × 21 (both cm)

Area of circle 1

~~A1~~ Circumference = 21

$r = 21 \div 2 \div \pi$
$= 3.34225\ldots$

$A = \pi r^2$
$= \pi \times 3.34^2$
$= 35.09366\ldots$

$V = Ah$
$= 35.09 \times 29.5$
$= 1035.2631\ldots$

∴ Volume is $1035.26\,cm^3$ (2dp)

$10.35\,m^3$
$= 10.35\,kL$

Area Circle 2

$C = 29.5$

$r = 29.5 \div 2\pi$
$= 4.69507\ldots$

$A = \pi r^2$
$= 4.70^2 \times \pi$
$= 69.2552\ldots$

$V = Ah$
$= 69.26 \times 21$
$= 1454.298\ldots$

∴ Volume is $1454.30\,cm^3$ (2dp)

$14.54\,m^3$
$= 14.54\,kL$

Cylinder 1 = 10.35kL (2dp)
Cylinder 2 = 14.54kL (2dp)
∴ Cylinder 2 would hold the most

Annotations

Records measurements of A4 sheet.

Calculates the radii of the cylinders given their circumferences.

Calculates the volume of each cylinder correct to two decimal places.

Attempts to convert from units of volume to units of capacity.

Compares capacities to determine which is the greater.

Geometry: Similar triangles

Year 9 Mathematics achievement standard

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Summary of task

Students had been investigating the concepts included in the study of similar triangles. They were given the task of measuring the angle of elevation of some common objects around the school, and worked in pairs to complete a short worksheet using the measurements to make a series of measurements and calculations.

Geometry: Similar triangles

Task: Work in pairs

1. Use the clinometers to measure the angles of elevation of 4 objects around the school. Eg basketball stand, flagpole, street light, building, tree, football goal posts. ***Record the angles.*** Each person is to choose 4 objects that are **different from their partner's** objects.
2. Measure the distance from where you were standing to the base of the object whose angle of elevation you measured. ***Record the distances.***
3. Measure your own height from floor to eye level. ***Record the height.***
4. In the classroom, draw four right-angled triangles, each with a base length of 5 cm and an angle that corresponds to each of the angles of elevation that you measured outside.
5. Calculate the height of each object using the similar triangles

Object	Angle of elevation	Distance to object
Palm Tree	36	6m
Big tree	47°	21m
Height of Gym	38°	10m
Lamp	33°	9m

Your height to eye level

160cm

What to hand in:

1. This sheet with your measurements included.
2. **Introduction** – a paragraph to explain what you are doing or finding out in this D.I. and how you went about the task.
3. **Mathematical procedures** – all diagrams and calculations.
4. **Analysis** – answer the questions below in well-written sentences.
   - Why did you have to measure your height?
   - List 3 ways in real life that this similar triangle procedure would be useful.
5. **Conclusion** – a paragraph to explain what you found out, where you could have made mistakes and how these mistakes could have been avoided.

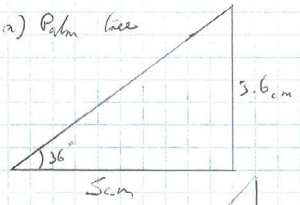
- Communication – is your work easily understood, do your sentences make sense and have no spelling or grammar mistakes?
- Presentation – is your work neat and tidy? Are your diagrams large enough with names and labels? Are all your calculations clearly set out including formula used and working out done?

Annotations

Records angles of elevation, own height and distances as measured.

Geometry: Similar triangles

a) Palm tree

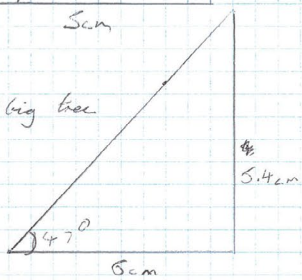


$$\frac{x}{3.6} = \frac{6}{5}$$

$$x = \frac{6}{5} + 3.6 = 4.32$$

$$4.32 + 1.6 = 5.92m$$

b) big tree

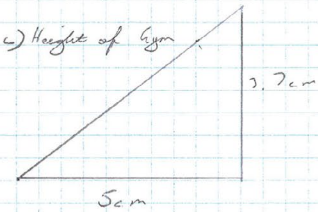


$$\frac{x}{5.4} = \frac{21}{5}$$

$$x = \frac{21}{5} \times 5.4 = 22.68$$

$$22.68 + 1.6 = 24.28m$$

c) Height of Gym

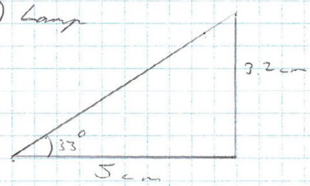


$$\frac{x}{3.7} = \frac{10}{5}$$

$$x = \frac{10}{5} + 3.7 = 7.4$$

~~926~~ $7.4 + 1.6 = 9m$

d) Lamp



$$\frac{x}{3.2} = \frac{9}{5}$$

$$x = \frac{9}{5} + 3.2 = 5.76$$

$$5.76 + 1.6 = 7.36$$

Why did you have to measure your height?

We had to measure our height or more specifically eye level, because when we ~~——~~ work out the height of the object our eye level is part of the height.

3 ways this could be useful in real life
- Architects could use this method to measure the height of buildings
- Measuring trees
- Measuring power lines

Annotations

Uses similar triangles to calculate unknown sides.

Observes height correctly in final calculation.

Uses centimetres correctly in diagrams and metres consistently in final height calculations.

Attempts to explain why the height of the eye level of the person must be taken into account.

Probability: Probabilities

Year 9 Mathematics achievement standard

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Summary of task

Students had been collecting data from experiments and using their data to investigate probabilities. Students were given the objects to complete this task in a 15-minute time period.

Probability: Probabilities

Probabilities

You have a bag of 10 balls containing 4 red ball and 6 green balls. You also have a coin which you can toss to get a head or a tail. You are going to pick a ball from your bag and then toss a coin 20 times.

Record your results in the table below.

	Colour of ball R or G	Toss of the coin H or T
1	G	H
2	G	H
3	R	H
4	G	T
5	G	H
6	R	T
7	R	H
8	G	T
9	R	H
10	G	H
11	G	H
12	R	H
13	R	T
14	G	H
15	G	T
16	R	H
17	R	H
18	R	T
19	G	H
20	G	T

List below all the possible results from choosing a ball and tossing a coin

G – Tails
G - Heads
R - Tails
R - Heads

60% of balls are green
40% of balls are red
H / T = 50%

8 times 12 times

1. How many times would you expect to choose a green ball and toss a tail?........6
2. How many times would you expect to choose a red ball and toss a head?........4
3. Did your results differ from what you would expect?........Yes

Can you explain why there might be a difference?........whether a coin toss is heads or tails + whether a green or red ball is picked are both random variables. If we did this more than 20 times the results would be more + more likely to match the calculated expectations

Annotations

Lists possible outcomes of the experiment.

Completes given table based on their experiment.

Calculates expected frequencies.

Displays insight into the relationship between relative frequencies obtained from an experiment and theoretical probability.

Number: Index laws

Year 9 Mathematics achievement standard

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Summary of task

Students had been revising index laws and applying them to numbers. They had investigated the use of scientific notation in various contexts. Students were asked to complete this quick quiz in a 15-minute time period.

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Number: Index laws

Index laws and Numbers

1. Answer the following questions

Question	Answer	Question	Answer
1. $2^3 \times 2^5 =$	2^8	2. $2^6 \div 2^4 =$	2^2
3. $4^2 \times 4^1 =$	4^3	4. $7^7 \div 7^5 =$	7^2
5. $6^1 \times 6^1 =$	6^2	6. $8^4 \div 8^4 =$	$= 8^0$
7. $(2^3)^2 =$	2^6	8. $10^0 =$	1
9. $2(3^0)^2 =$	2^2 $= 4$	10. $2^3 \div 2^5 =$	2^{-2}
11. $25^{\frac{1}{2}} =$	$\sqrt{25}$ $= 5$	12. $16^{\frac{1}{2}} \times 16^{\frac{1}{2}} =$	16^1

2. Express the following numbers in scientific notation:

Question	Answer	Question	Answer
1. 100	1.00×10^2	2. 5010	5.01×10^2
3. 210000	2.1×10^4	4. 7567	7.567×10^3
5. 0.0025	2.5×10^{-2}	6. 0.00000012	1.2×10^{-6}
7. 32654	3.2654×10^4	8. 0.000003652	3.652×10^{-5}
9. 10001000	1.0001×10^6	10. 0.001000356	1.000365×10^6

3. Why is it necessary to write numbers in scientific notation? Can you give examples?

It is easier than writing numbers out in full.
e.g. 2.5×10^7 instead of 250000000.

Annotations

Uses index laws to correctly evaluate most numerical expressions, leaving answers in index form.

Correctly identifies the positive and negative powers of 10 in most cases with some errors in counting the number of decimal places.

Gives an explanation and a simple example of how to write a number in scientific notation.

Algebra: Linear relationships

Year 9 Mathematics achievement standard

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Summary of task

Students had completed a unit of work on linear relationships. They had investigated the gradient and midpoint of the interval joining two points and the distance between those two points on the Cartesian plane. Students were given a series of questions on the topic and completed the task as a test in class.

Algebra: Linear relationships

Number and Algebra	

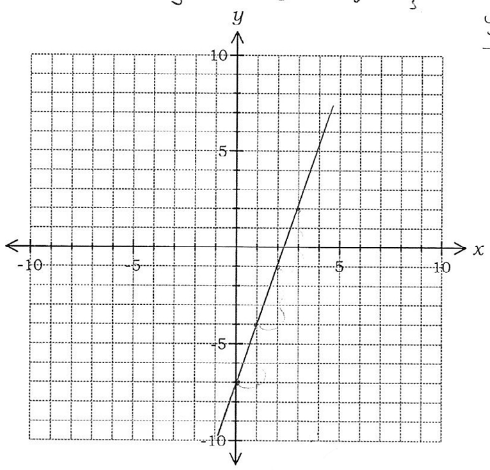
- Answer all questions neatly in the spaces provided.
- **Show all working** where appropriate.
- If necessary, round all answers to **2 decimal places** unless stated otherwise.
- **Calculator allowed.**

Question 1

Plot the line represented by the points in the following table on the axes provided below.

x	0	1	2	3	4
y	-7	-4	-1	2	5

$y = 3x - 7$



Annotations

Constructs line in correct position using the ordered pairs provided.

Algebra: Linear relationships

Question 2

(a) The tables below represent linear relationships. How can you tell?

(i) not sure.

x	0	1	2	3	4
y	4	9	14	19	24

5 5 5 5

(ii)

x	1	2	3	4	5
y	10	7	4	1	-2

-3 -3 -3

Because once you find out the formula, if you try with other numbers, it works with the same formula.

e.g (0,4)(1,9)......

(b) Determine the rule between x and y for the tables in (a).

(i) $y = 5x + 4$

(ii) $y = -3x + 13$

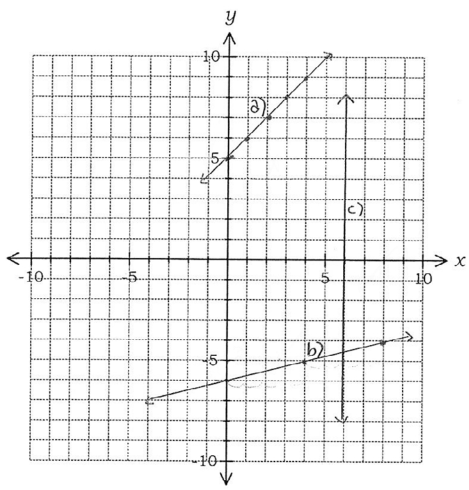
Question 3

On the axes below, plot the following lines, labelling each one.

A: a line that has a gradient of 3 and a y-intercept at (0, 5).

B: the line $y = \frac{1}{4}x - 6$.

C: the line $x = 6$.



a) $y = 3x + c$

$5 = 3 \times 0 + c$

$5 = 0 + c$

$c = 5$

$y = x + 5$

b) $\frac{1}{4}x - 6$

c) $x = 6$

Annotations

Identifies the 'common difference' for each table of values.

Determines the rule for each table of values.

Plots linear relationships using correct intercepts but not always the correct gradient.

Algebra: Linear relationships

Question 4

Determine the equations of the following lines. Show all working.

(a) The line with a gradient of $\frac{1}{2}$ with a y-intercept of 6.

$y = mx + c$

$y = \frac{1}{2}x + 6$

(b) The line that has a gradient of 4 and passes through the point (2, 3).

$x \quad y$

$y = mx + c$

$y = 4x + c$

$3 = 4 \times 2 + c$

$3 = 8 + c$

$3 = 8 - 5$

$y = 4x - 5$

(c) The line that passes through the points (2, 5) and (-3, -10).

$\frac{y_2 - y_1}{x_2 - x_1}$

$\frac{-10 - 5}{-3 - 2}$ $\quad \frac{-15}{-5}$ $\quad \frac{3}{1} = 3$

gradient = 3

$(2, 5)$
$x \quad y$

$y = mx + c$

$5 = 3 \times 2 + c$

$5 = 6 + c$

$5 = 6 - 1$

$y = 3x - 1$

Annotations

Determines the equations of lines from a variety of given information.

Algebra: Linear relationships

Question 5

Tahleah babysits to earn money. For all her clients she charges an hourly fee and also an additional one off fee for each babysitting job.

(a) If for a 2 hour babysitting job she charges $16 and for a 5 hour babysitting job she charges $34, determine the rule that she uses to calculate the amount she charges, $C, for each babysitting job of h hours.

2 hour = $16.
5 hour = $34

h	0	1	2	3	4	5
$ C	4	10	16	22	28	34

6 6 6 6

C = 6h+4

(b) Use your rule from (a) to calculate how much Tahleah would charge for a three and a half hour babysitting job.

1. 3 hours = 6 x 3 + 4 = $22
2. 1 hour = 6 x 1 + 4 = $10
3. 1 hour ÷ 2 = 30 minutes
4. 30 minutes = $~~10~~ 6 ÷ 2 = ~~5~~ 3
5. $22 + $5 = $27

answer = $27

(c) (i) With reference to your rule, state the amount the Tahleah charges per hour. If you graphed the line, what feature would this value represent?

Per hour = $10.

(ii) With reference to your rule, state the amount the Tahleah charges as the additional fee per job. If you graphed the line, what feature would this value represent?

Annotations

Recognises that there is a one-off payment of $4 for each babysitting job.

Recognises that the relationship is linear and determines a rule using the given information.

Attempts to reason a conclusion instead of simply substituting into the equation.

Algebra: Linear relationships

Question 6

Determine the co-ordinates of the midpoint between the points (3, -7) and (5, 3).

Mid point $(x, y) = \left(\frac{x_1 + x_2}{2} , \frac{y_1 + y_2}{2} \right)$

$\left(\frac{3+5}{2} , \frac{-7+3}{2} \right)$

$= \left(\frac{\cancel{8}\ 4}{\cancel{2}\ 1} , \frac{-\cancel{4}\ -2}{\cancel{2}\ 1} \right) \left(\frac{4}{1} , \frac{-2}{1} \right) = (4, -2)$

Question 7

Determine the distance between the points (3, 9) and (6, 4), giving your answer to 2 decimal places.

x y x y

Distance $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

run rise.

$= \sqrt{(6-3)^2 + (9-4)^2}$

$= \sqrt{3^2 + 5^2}$

$= \sqrt{9 + 25}$

$= \sqrt{9 + 25}$

$= \sqrt{34}$

Annotations

Uses the midpoint formula to determine the coordinates of the midpoint of an interval on the Cartesian plane.

Uses the distance formula to determine the distance between two points on the Cartesian plane but does not leave answer in requested format.

Mathematics

Year 9
Satisfactory

Algebra: Linear relationships

Question 8

During a sailing competition all of the boats' positions are taken relative to a buoy (ie. the buoy has co-ordinates (0, 0)). A few minutes into the competition, a boat at (3, 7) launches a distress flare. A rescue boat, positioned at (-4, -5), sees the flare and sets out immediately to assist them. [All units are in kilometres.]

(a) How far must the rescue boat travel to reach the distressed boat?

distressed boat – (3, 7). (-4, -5) (3, 7)

rescue boat – (-4, -5)

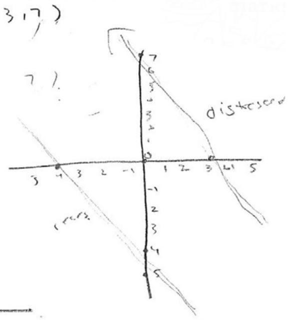
Distance – $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$= \sqrt{(7 - 5)^2 + (3 - 4)^2}$

$= \sqrt{2^2 + -1^2}$

$= 4 + 1$

$= \sqrt{5}$ = 2.24 km



(b) Exactly halfway to the distressed boat the rescue boat passed a second boat that needed assistance. They instructed this boat to drop anchor and said they would return to them once they had seen to the first distress signal. Determine the co-ordinates of the second troubled boat.

Annotations

Draws a diagram but misinterprets the coordinates of the points as intercepts of lines.

Recognises that the distance formula is required but substitutes negative values incorrectly.

Measurement: Volume of a prism

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *By the end of Year 9, students solve problems involving simple interest. They interpret ratio and scale factors in similar figures. Students explain similarity of triangles. They recognise the connections between similarity and the trigonometric ratios. Students compare techniques for collecting data in primary and secondary sources. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.*
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Summary of task

Students had completed a unit of work on volume and surface area. The activity involved a real-world problem in which they were given the volume of a cuboid and asked to determine appropriate dimensions given a particular relationship between them. Students were given 10 minutes to complete the task in class.

Measurement: Volume of a prism

A juice manufacturing company wishes to change the packaging of their 1 litre fruit juice products. Research has shown the most appealing dimensions of a cuboid are in the ratio of 1:1:3.

Is it possible to have a cuboid with a ratio of sides of 1:1:3 which contains exactly 1 litre of liquid? Explain.

It is not possible to have a cuboid with a capacity of exactly 1 litre at the ratio of 1:1:3.

1 litre = 1000cm³

$\because$ 1 x 1 x 3 = 3cm³
2 x 2 x 6 = 24cm³
3 x 3 x 9 = 81cm³
4 x 4 x 12 = 192cm³
5 x 5 x 15 = 375cm³
6 x 6 x 18 = 648cm³
7 x 7 x 21 = 1029cm³
8 x 8 x 24 = 1536cm³
9 x 9 x 27 = 2187cm³
10 x 10 x 30 = 3000cm³

$\therefore$ it is impossible to have a cuboid with a capacity of exactly 1 litre at the ratio of 1:1:3 because 6x6x18 equalls 648cm³ and 7x7x21 equalls 1029cm³, therefore it must be between 6x6x18 and 7x7x21 which would not be at the ratio 1:1:13.

Annotations

Correctly converts litres to cubic centimetres.

Demonstrates an understanding of the problem posed, but only considers whole number dimensions for the cuboid.

Provides an answer to the problem and explains reasoning using the working shown.

Measurement: Surface area and volume

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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Summary of task

Students had completed a unit of work on volume and surface area. This activity involved determining the dimensions of a cylinder with a capacity of one litre and then using the dimensions to calculate the surface of the cylinder. Students were given 10 minutes to complete the task in class.

Measurement: Surface area and volume

Task 4 Surface Area and Volume

Determine the dimensions (height and radius) of a cylinder that would have a capacity of one litre. Use these dimensions to calculate the surface area of your cylinder.

1. Relevant calculations showing how you have determined the dimensions of the cylinder
2. A labelled 3D drawing/sketch of the cylinder
3. Relevant calculations for determining the surface area of the cylinder

1. let "r" be equal to 5cm

1 liter = 1 000 cm^2

$V = \pi h r^2$

$1000 = \pi \times h \times 5^2$

$1000 = \pi \times h \times 25$

$\frac{1000}{\pi} = h \times 25$

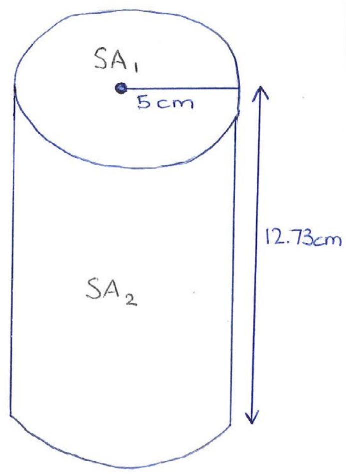
$318.31 = h \times 25$

$\frac{318.31}{25} = h$

$12.7324 = h$

$\therefore h \approx 12.73cm$

2.



3. $TSA = (2 \times SA_1) + SA_2$

$SA_1 = \pi r^2$

$= \pi \times 5^2$

$= \pi \times 25$

$SA_1 \approx 78.54cm^2$

SA_2 = circumference x height

$\therefore c = 2\pi r$

$= 2 \times \pi \times 5$

≈ 31.42

$SA_2 = 31.42 \times 12.73$

$= 399.9766 cm^2$

$TSA = (2 \times 78.54) + 399.9766$

$= 157.08 + 399.9766$

$= 557.0566$

$\approx 557.1 cm^2$

Annotations

Correctly converts litres to cubic centimetres.

Sets up an appropriate equation that can be solved to find the height of the cylinder but works with approximate values instead of exact values.

Draws a cylinder and labels it with the dimensions obtained in the previous part of the task.

Finds the area of one circular surface of the cylinder.

Finds the area of the curved surface of the cylinder using the dimensions obtained in the previous part of the task.

Calculates the total surface area of the cylinder.

Statistics: Data displays

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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Summary of task

Students had completed a unit of work on displaying data over a two-week period. In this activity students were asked to represent the given data in a back-to-back stem-and-leaf plot and frequency histograms. The activity was given as a class test to be completed in a lesson.

Statistics: Data displays

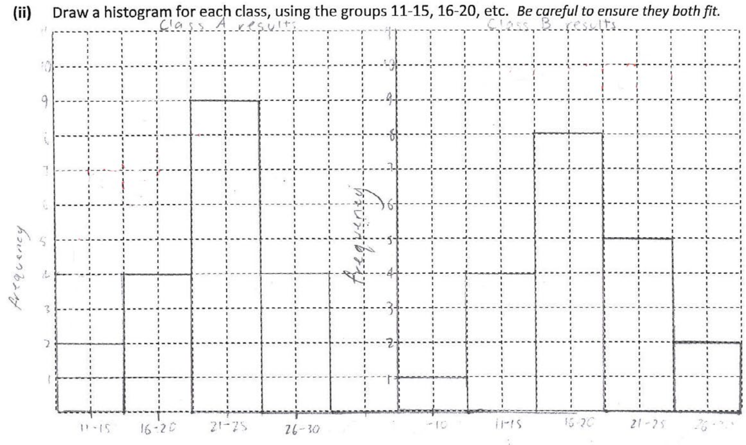
1 The data sets below show the marks scored by two classes in a class test (out of 30).

Class A	25	21	29	22	25	23	17	21	19	22	28	15	20
	27	23	20	21	14	27							
Class B	22	19	18	26	15	18	20	25	18	19	24	23	27
	11	18	14	9	20	15	21	13					

(i) Draw an **ordered** back-to-back stem-and-leaf plot to show the two classes' results.
The blank space is for working.

Class B		Class A
9	0	
8 8 8 8 5 5 4 3 1	1	4 5 7 9
9 9	1	
7 6 5 4 3 2 1 0 0	2	0 0 1 1 1 2 2 3 3 5
	2	5 7 7 (1

(ii) Draw a histogram for each class, using the groups 11-15, 16-20, etc. *Be careful to ensure they both fit.*



Annotations

Splits the data into class intervals but does not assign the data to the class intervals consistently.

Constructs an ordered back-to-back stem-and-leaf plot showing all data values from smallest to largest on each side of the stem.

Constructs frequency histograms to represent the data but with a few errors, including an incorrect frequency value.

Labels values on the axes and names the vertical axis but does not name what the horizontal axis represents.

Measurement and geometry: Trigonometry and similarity in right-angled triangles

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *By the end of Year 9, students solve problems involving simple interest. They interpret ratio and scale factors in similar figures. Students explain similarity of triangles. They recognise the connections between similarity and the trigonometric ratios. Students compare techniques for collecting data in primary and secondary sources. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.*
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Summary of task

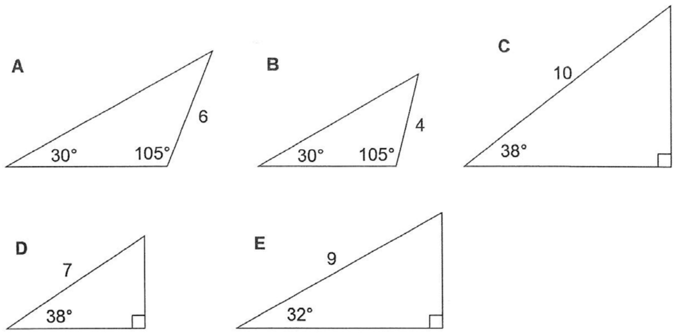
Students had completed a unit of work on trigonometry, including links to the topic of similarity that was studied earlier. In this activity, students were asked to apply their knowledge of similarity and trigonometry and apply the links between the two. The activity was given as a class test in 20 minutes.

Mathematics

Year 9
Satisfactory

Measurement and geometry: Trigonometry and similarity in right-angled triangles

1 Consider the following triangles.



(i) Are triangles A and B similar? Explain.

Yes the angles stayed the same even afte the triangled reduceel in size

Understands the concept of similarity and is able to explain why triangles are or are not similar.

(ii) Are triangles C and D similar? Explain.

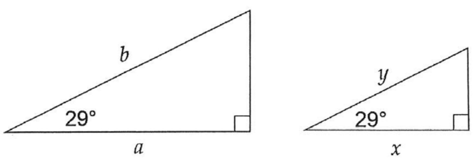
yes the angle is still the same even after the ~~old~~ triangle was enlarged.

(iii) Are triangles D and E similar? Explain.

No, the second, enlarged triangle has increased its side lengths and the angle has changed as well.

Demonstrates some understanding of why these triangles are not similar.

2 The two triangles shown are similar.



Give **two** reasons why $\frac{a}{b} = \frac{x}{y}$.

1. Because they are the same triangles but the smaller one has just been reduced in size.

2. The angle (29°) is the same for both triangles, as well as the other 90° angle meaning that $\frac{b}{a} = \frac{x}{y}$. because they're the same length.

Uses similarity to explain why the ratios of corresponding sides are equal but is not able to give a second reason using trigonometry.

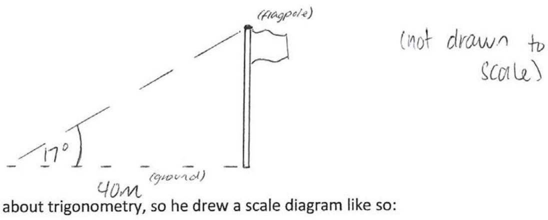
Annotations

Measurement and geometry: Trigonometry and similarity in right-angled triangles

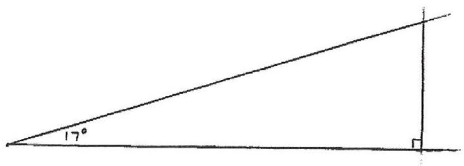
3 Terry wanted to find the height of his school's flagpole.

Having walked 40m from its base (on level ground), he measured the angle from the ground to the top of the flagpole to be 17°.

(i) Draw a neat diagram to show this information.



(ii) Terry doesn't yet know about trigonometry, so he drew a scale diagram like so:



Using a ruler, show the working Terry used to find the height of the flagpole.

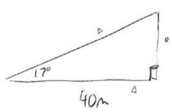
9cm = 40m

flagpole height = 3cm

$\frac{40}{3} = 13.3$

∴ height of the flagpole ≑ 13.3m

(iii) Now do your own working using trigonometry and your own diagram to find the height of the flagpole.



SOHCAHTOA

$\tan 17° = \frac{x}{40}$

$\doteqdot 13.9m$

(iv) Why do the two approaches above give similar answers?

Because the height of the flagpole was determined by a scale-drawing in the first method and trigonometry allowed me to determine the height of the flagpole in the second method.

4 Explain why sin 75° always has the same value, no matter the size of the triangle.

Annotations

Represents mathematical information given in words in diagrammatic form.

Chooses and understands an appropriate method to solve the problem but uses an inaccurate measurement.

Sets up an equation using the correct trigonometric ratio but is unable to solve the equation.

Statistics: Academy Awards

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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Summary of task

Students had completed a unit of work on statistical displays and analysis. They were given some statistics relating to the age and gender of Academy Award winners and asked to respond to a set of questions under test conditions during a lesson.

Statistics: Academy Awards

1. Academy Awards, Age and Gender

Each year, we hear of the winners of the Academy Awards (the "Oscars") in the United States. The back-to-back stem and leaf plot below shows the ages of the Best Actors (male and female) for each year up to 1997.

Actors (male)		Actors (female)
	2	1244444
	·	56666667778889999
443322110	3	000011233334444444
9988888887775555	·	5556778889
4433332221111110000	4	01111122
999888776655	·	5589
432211	5	0
6665	·	
2100	6	0112
	·	
	7	4
6	·	
	8	0

3 | 2 means 32 years

1. Use these data to find the median age of male winners and median age of female winners. Please write these below:

   median males: 41.   median females: 34

2. Write approximately 100 words about some things you've noticed from the data, and some possible reasons for what you've observed. (Please use the terms "median", "range", and "outlier" in your discussion if possible.)

   Things that I have noticed from the data is firstly there is more females between 20-40 where as the males have more between the ages of 30-50. The median shows this. The distinict outlier of the ages is 74 as only one 74 year old has won an Academy award at this age. There is a wide range of ages Throuhout this survey, ranging from 21 to 80 giving the range of 59.

Annotations

Finds the median age of each group from the stem-and-leaf plot.

Interprets the distribution of scores in the plot.

Considers outliers in the data and range but does not use either of these statistical features in the comparison of both sets of data.

Geometry: Similarity

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

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Summary of task

Students had completed a unit of work on similarity. This task consisted of a set of formal questions for written response and was completed as a test in class.

Geometry: Similarity

Question 1

a) A triangle with an area of 40cm² is dilated by a scale factor of 1.25. What will be the area of the image?

$40 \times 1.25^2 = 62.5\text{cm}^2$

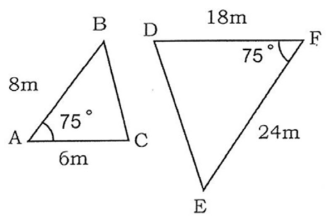
b) **After** a dilation by a scale factor of 2.5, a rectangle has an area of 100cm². What was the area of the **original** rectangle?

$100 \div 2.5^2 = 16\text{cm}^2$

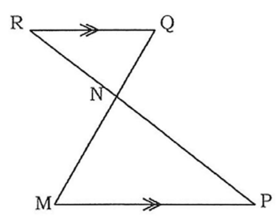
Question 2

Complete the similarity statements for the triangles below, putting letters in the correct order and stating the reason (AAA,RHS,SAS or SSS) for similarity.

a)



b)



$\Delta ABC \sim \Delta EFD$ (SAS)

$\Delta MPN \sim \Delta QRN$ (AAA)

Annotations

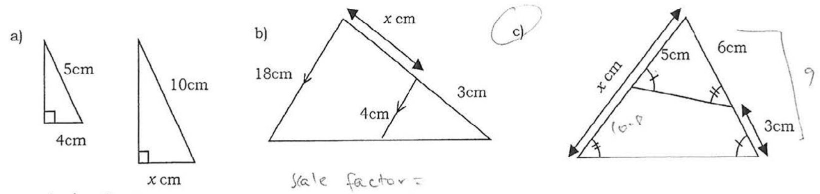
Accounts for the two dimensions when solving problems involving the dilation of an area by a scale factor.

Identifies tests used to determine similarity but does not always write vertices in corresponding order when describing triangles.

Geometry: Similarity

Question 3

In each diagram below, the two triangles are similar. Determine the value of x in each diagram.



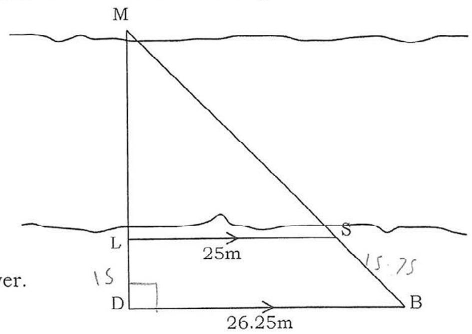
a)
Scale Factor
= 2
$x = 4 \times 2$
$\boxed{x = 8cm}$

b)
Scale factor =
4.5
3×4.5
$= 13.5$
$- 3$
$\boxed{x = 10.5cm}$

c)
$5 \div 3 = 1.8$
$6 \times 1.8 = 10.8$
$10.8 + 5 =$
$\boxed{x = 15.8}$

Question 4

To measure the width of a raging river, sisters Lindy and Diana Jones both position themselves on one side of the river, opposite a marker tree, M. Lindy is on the river bank at L, and Diana is 15m back from the bank at D. Both girls walk parallel to the riverbank until they reach sighter bushes (S and B)that both line up with the marker tree. The distances they walk are shown in the diagram below.



a) State why triangles MLS and MDB are similar.

AAA

b) Determine the width of the river.

Annotations

Uses scale factor to determine unknown lengths in similar figures but with some errors.

Identifies the correct similarity test to determine that the triangles are similar.

Calculates the length of an unknown side but does not find the length of the side required to answer the question.

Measurement: Cylinder volume

Year 9 Mathematics achievement standard

The parts of the achievement standard targeted in the assessment task are highlighted.

> *By the end of Year 9, students solve problems involving simple interest. They interpret ratio and scale factors in similar figures. Students explain similarity of triangles. They recognise the connections between similarity and the trigonometric ratios. Students compare techniques for collecting data in primary and secondary sources. They make sense of the position of the mean and median in skewed, symmetric and bi-modal displays to describe and interpret data.*
>
> *Students apply the index laws to numbers and express numbers in scientific notation. They expand binomial expressions. They find the distance between two points on the Cartesian plane and the gradient and midpoint of a line segment. They sketch linear and non-linear relations. Students calculate areas of shapes and the volume and surface area of right prisms and cylinders. They use Pythagoras' Theorem and trigonometry to find unknown sides of right-angled triangles. Students calculate relative frequencies to estimate probabilities, list outcomes for two-step experiments and assign probabilities for those outcomes. They construct histograms and back-to-back stem-and-leaf plots.*

Summary of task

Students had completed a section of work on cylinders. The investigation to find the volume of cylinders was given as an assignment to be completed over a week.

Mathematics

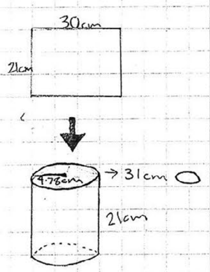
Year 9
Satisfactory

Measurement: Cylinder volume

Cylinder Volume Investigation
Part A:
1. $V = \pi r^2 h$

$V = \pi \times 4.78^2 \times 21$

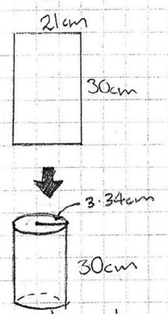
$V = 1507.39cm^3$



2. $V = \pi r^2 h$

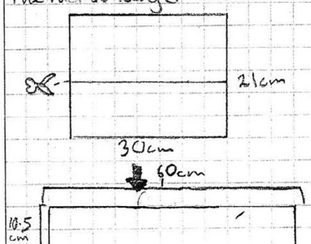
$V = \pi \times 3.34^2 \times 30$

$V = 1051.39cm^3$



Cylinder 1 has a greater volume then Cylinder 2.

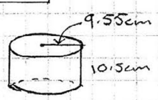
Part B:
To Get a larger volume you must decrease the height to make the circumference larger which also makes the radius larger



$V = \pi r^2 h$

$V = \pi \times 9.55^2 \times 10.5$

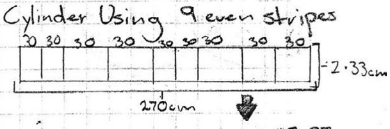
$V = 3008.47cm^3$



5. Yes it would be possible, the reason being is because, there is a pattern of doubling as it is halved (The Height) so to reach 10L it would probably be cut into 9/10 even stripes end to end.

Part C:

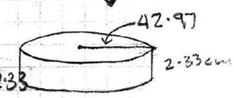
Cylinder Using 9 even stripes



$V = \pi r^2 h$

$V = \pi \times 42.97^2 \times 2.33$

$V = 13{,}516.79cm^3$



The results suggest that 7/8 even stripes should be 10L

1./2.

Stripes	radius	Width	Height	Volume
4	19.09	120	5.25	6010.64
9	42.97	270	2.33	13,516.79
10	47.74	300	0.44	4940.42

3. The results are telling us that 10 even stripes is the max to reduce the height because the height for 10 stripes is now less then one.

Annotations

Applies formula to calculate volume of cylinders.

Measures are not well described since units in table are used incorrectly.

Considers the relationship between the height and radius under the constraint of producing a cylinder from an A4 sheet but does not recognise that squaring the radius will produce a larger increase in volume.