QCATs
Queensland Comparable Assessment Tasks
9
2009
MATHEMATICS
SAMPLE RESPONSES

Rainwater

This booklet is designed to help teachers make overall, on-balance judgments by providing examples of student responses. The responses are not an exhaustive set.

E samples

Queensland Government
Queensland Studies Authority
Partnership and innovation

Contact information:

Information about QCATs is available on the QSA website <www.qsa.qld.edu.au>.

Direct questions concerning implementation or receipt of materials to:

Project Officer (Operations)
Phone: 07 3864 0299
Email: QCARadmin@qsa.qld.edu.au

Queensland Studies Authority Ground floor, 295 Ann Street Brisbane. PO Box 307 Spring Hill Qld 4004.
Phone: (07) 3864 0299 Fax: (07) 3221 2553 Email: office@qsa.qld.edu.au Website: www.qsa.qld.edu.au

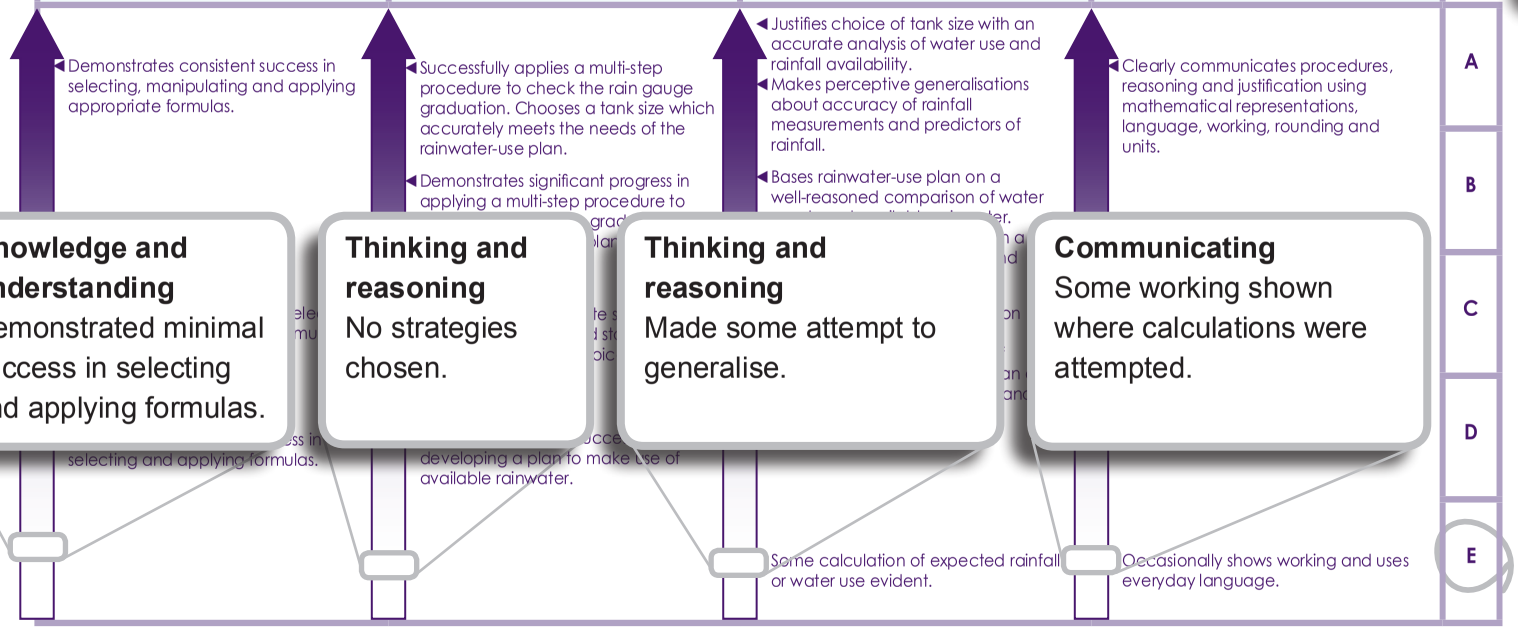
E sample: Response 1

Guide to making judgments — Year 9 Mathematics

Student .....

Purpose: To use mathematical reasoning to develop an appropriate local plan for storage and use of rainwater.

Knowledge and understanding	Thinking and reasoning	Thinking and reasoning	Communicating
Selection and manipulation of formulas to calculate lengths, volumes and statistical measures of central tendency.	Choice of strategies and procedures to generate solutions.	Generalisation and justification of reasoning.	Use of mathematical language and representations to communicate thinking and to justify reasoning.
Questions 1, 3, 5, 6, 8, 9	*Questions 7, 10*	*Questions 2, 4, 10*	*Questions 1–10*



Knowledge and understanding
Demonstrated minimal success in selecting and applying formulas.

Thinking and reasoning
No strategies chosen.

Thinking and reasoning
Made some attempt to generalise.

Communicating
Some working shown where calculations were attempted.

Overall grade
This response demonstrates a very limited level of Knowledge and understanding, Thinking and reasoning and Communicating and is judged to be an overall E.

Feedback .....

.....

E sample: Response 1

1. Calculate Birdsville's mean and median April rainfall for the period 1997 to 2006.

Show all working

0.0+0.0+52.8+2+86.6+1+0+67.4+0
= 150.1 ÷10 = 15.01

Mean April rainfall = 15.01 mm

Show all working

Median April rainfall = ...

2. The median is a more useful predictor of typical monthly rainfall than the mean. Use the April data for Birdsville to explain why.

It shows the average rainfall which is better because yous seeing overall what the rain fall is

E sample: Response 1

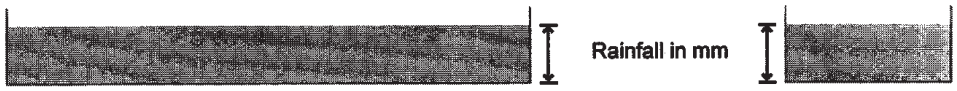
Measuring rainfall

A rain gauge is used to measure rainfall (usually in millimetres).

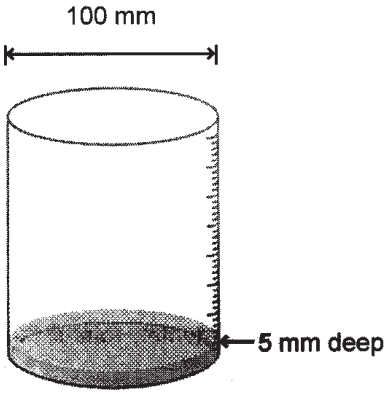
The level in the gauge represents the depth of rainwater that would build up on a flat horizontal surface if it didn't run off or soak in.

Any open container with straight vertical sides can be used as a simple rain gauge. The depth of water collected is a measure of the amount of rain.

Rain gauges A and B both measure the same amount of rainfall, even though A collects a greater volume of water because of its larger opening.



3. **If 5 mm of rain falls and is collected in a 100 mm diameter rain gauge, calculate the volume of rainwater in the gauge.**



Volume of a cylinder
$= \pi r^2 h$

Show all working

5mm × 100mm = 500

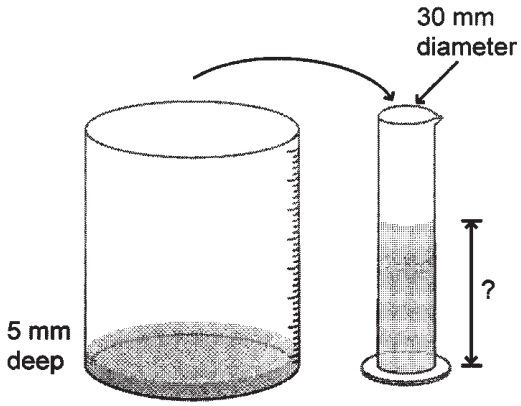
Volume of rainwater = ...500..... **mm³.**

E sample: Response 1

To improve the accuracy of rainfall measurement, the collected rainwater can be poured into a narrower cylinder.

4. How is the accuracy of rainfall measurements improved by pouring the collected rainwater into a narrower cylinder?

~~her~~ Is able to measure smaller amounts of rainfall



5. Calculate the depth of the rainwater collected in Question 3 after it is poured into a narrow, 30 mm diameter cylinder.

Show all working

100 ÷ 30 = 3....

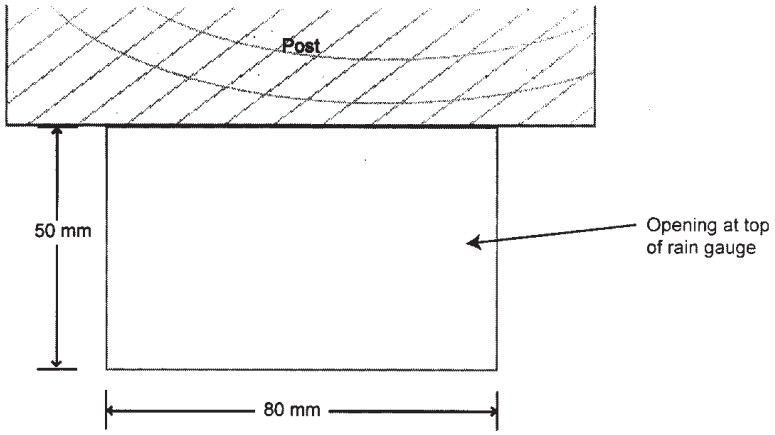
5 × 3 = 15

Depth of water in the narrow cylinder = 15 **mm.**

E sample: Response 1

Not all rain gauges are cylinders.

The diagram below shows the top view of a rain gauge attached to a post.



Not to scale

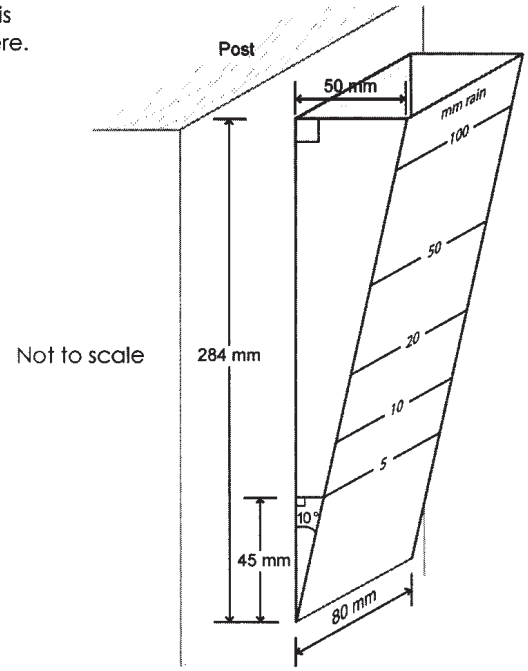
6. If 5 mm of rain falls, calculate the volume of water collected in the rain gauge above.

Show all working

Volume of rainwater collected = ... mm^3

E sample: Response 1

The rain gauge from page 8 is wedge-shaped, as shown here.



7. Use the volume calculated in Question 6 to check if the 5 mm graduation on the rain gauge is in the correct place.

Show all working

Tick the correct answer.

The 5 mm graduation is:

☐ in the correct place

☐ too high

☐ too low.

E sample: Response 1

Section 2: Planning a rainwater supply

Table 2 below shows typical roof areas for homes of different sizes.

Table 2

Typical roof areas	
Home type	**Roof area (m^2)**
2 bedroom home	100
3 bedroom home	150
4 bedroom home	200
5 bedroom home	250

Assume the roof is flat.

(This makes little difference to the amount of rain collected.)

From the table, choose a home that most closely matches the one you live in (or would like to live in).

My choice of home: ....4 bedroom home

8. **Calculate the amount of rainwater in litres (L) collected by the roof of your chosen home when one millimetre (1 mm) of rain falls.**

Show all working

1 mm = 0.001 m
1 m^3 holds 1000 L

Amount of rainwater collected by the roof when 1 mm of rain falls = ... L

E sample: Response 1

Your teacher has supplied you with median monthly rainfall data for:

..... (location).

9 a. Copy the median rainfall values for each month into column A of Table 3.

b. Using your answer to Question 8, calculate the expected amount of rainwater collected from your chosen roof during each month. Write these values in column B of Table 3.

Table 3

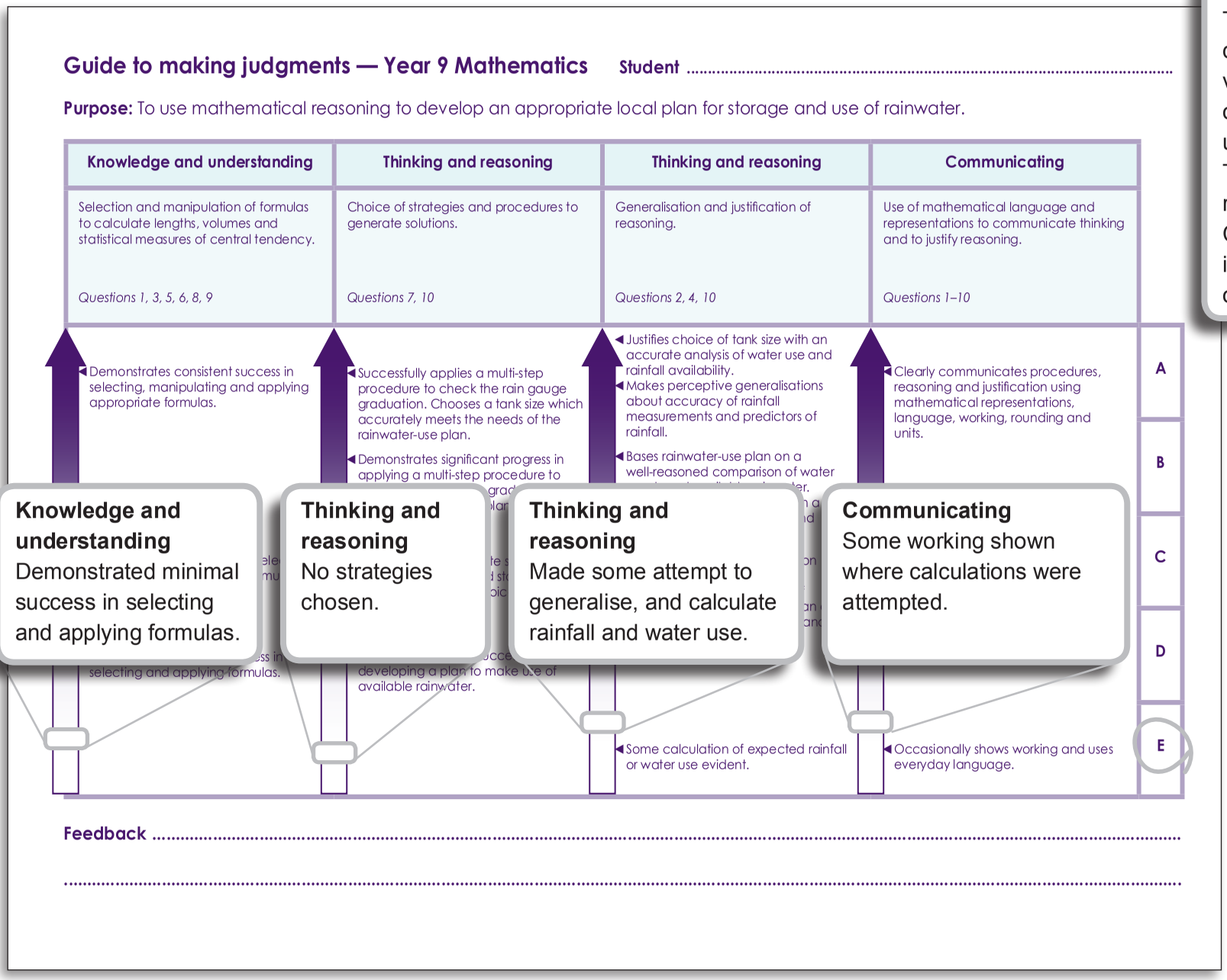
Expected rainwater collected		
Month	**A** Median rainfall (mm)	**B** Rainwater collected by the roof (L)
Jan	85.6	
Feb	110.4	
Mar	103.8	
Apr	70.7	
May	90.9	
Jun	45.2	
Jul	38.2	
Aug	39.2	
Sep	27.2	
Oct	17.4	
Nov	91.4	
Dec	125.8	

E sample: Response 1

Buy a 3000 Litre tank for $1100 which you could use to help supply water but not all of your water but you wont have enough rain fall to fill your tank anyway

Have you checked all the boxes in Question 10?
Continue your answer over the page if necessary.

E sample: Response 2



Guide to making judgments — Year 9 Mathematics **Student** .....

Purpose: To use mathematical reasoning to develop an appropriate local plan for storage and use of rainwater.

Knowledge and understanding	Thinking and reasoning	Thinking and reasoning	Communicating
Selection and manipulation of formulas to calculate lengths, volumes and statistical measures of central tendency.	Choice of strategies and procedures to generate solutions.	Generalisation and justification of reasoning.	Use of mathematical language and representations to communicate thinking and to justify reasoning.
Questions 1, 3, 5, 6, 8, 9	*Questions 7, 10*	*Questions 2, 4, 10*	*Questions 1–10*

A
- Demonstrates consistent success in selecting, manipulating and applying appropriate formulas.
- Successfully applies a multi-step procedure to check the rain gauge graduation. Chooses a tank size which accurately meets the needs of the rainwater-use plan.
- Justifies choice of tank size with an accurate analysis of water use and rainfall availability.
- Makes perceptive generalisations about accuracy of rainfall measurements and predictors of rainfall.
- Clearly communicates procedures, reasoning and justification using mathematical representations, language, working, rounding and units.

B
- Demonstrates significant progress in applying a multi-step procedure to
- Bases rainwater-use plan on a well-reasoned comparison of water

C

D

E
- Some calculation of expected rainfall or water use evident.
- Occasionally shows working and uses everyday language.

Knowledge and understanding
Demonstrated minimal success in selecting and applying formulas.

Thinking and reasoning
No strategies chosen.

Thinking and reasoning
Made some attempt to generalise, and calculate rainfall and water use.

Communicating
Some working shown where calculations were attempted.

Feedback .....

.....

Overall grade
This response demonstrates a very limited level of Knowledge and understanding, Thinking and reasoning and Communicating and is judged to be an overall E.

E sample: Response 2

1. Calculate Birdsville's mean and median April rainfall for the period 1997 to 2006.

Show all working

mean = 0.0+0.0+0.0+0.0+1.0+
1.0+2.0+52.8+6.7+86.6.

Show all working

Median = 0.0, 0.0, 0.0, 0.0
1.0, 1.0, 2.0, 52.8, 6.7, 86.6

Mean April rainfall = 150.1

Median April rainfall = 0.57

2. The median is a more useful predictor of typical monthly rainfall than the mean. Use the April data for Birdsville to explain why.

in 1996 we got nothing which is the same as in 2005, 2007 and in 1997 we got the most rain in 2000. In 2003 we got 6.7 and in 1998 we got 52.8mm of rain. In 2001 and in 2004 we got 1.0mm and in 1999 we got 2.0mm of rain.

E sample: Response 2

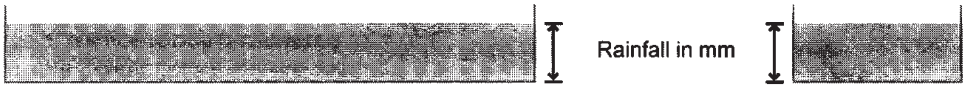
Measuring rainfall

A rain gauge is used to measure rainfall (usually in millimetres).

The level in the gauge represents the depth of rainwater that would build up on a flat horizontal surface if it didn't run off or soak in.

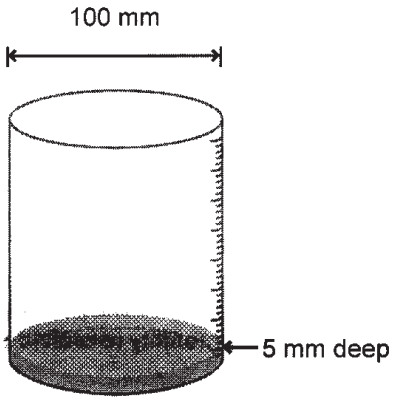
Any open container with straight vertical sides can be used as a simple rain gauge. The depth of water collected is a measure of the amount of rain.

Rain gauges A and B both measure the same amount of rainfall, even though A collects a greater volume of water because of its larger opening.



Rain gauge A Rain gauge B

3. If 5 mm of rain falls and is collected in a 100 mm diameter rain gauge, calculate the volume of rainwater in the gauge.



Volume of a cylinder
$= \pi r^2 h$

Show all working

$\pi r^2 h$ = Diamater
= 100 x 5
= 500

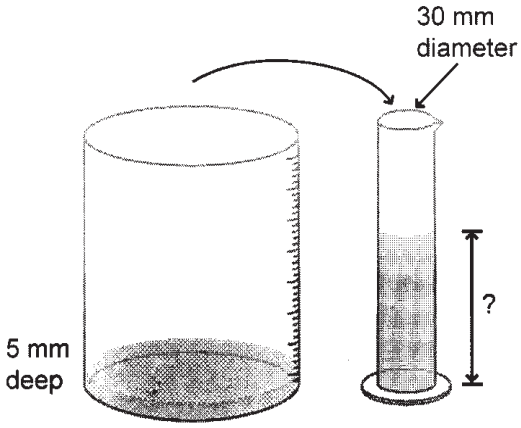
Volume of rainwater = ...500..... mm³

E sample: Response 2

To improve the accuracy of rainfall measurement, the collected rainwater can be poured into a narrower cylinder.

4. How is the accuracy of rainfall measurements improved by pouring the collected rainwater into a narrower cylinder?

Because the diamater is 30mm and the big jug is 5mm deep.



5. Calculate the depth of the rainwater collected in Question 3 after it is poured into a narrow, 30 mm diameter cylinder.

Show all working

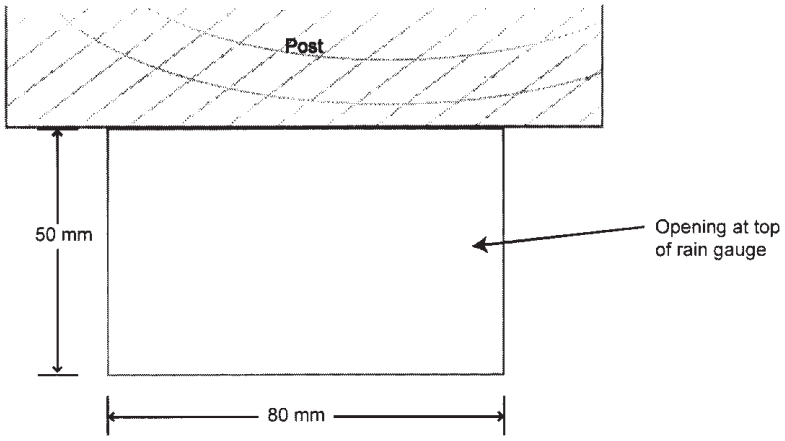
$\pi r^2 h$ = Diamater
$= 30 \times 5$
$= 150$

Depth of water in the narrow cylinder = 150 mm

E sample: Response 2

Not all rain gauges are cylinders.

The diagram below shows the top view of a rain gauge attached to a post.



Not to scale

6. If 5 mm of rain falls, calculate the volume of water collected in the rain gauge above.

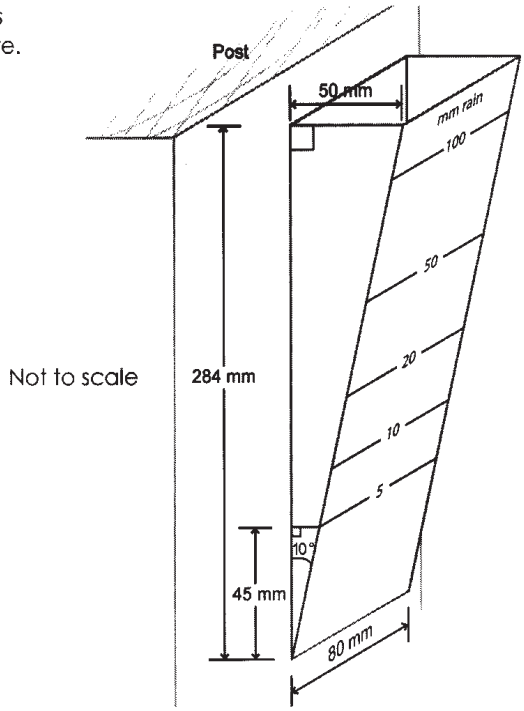
Show all working

$\pi r^2 h$
$= 50mm \times 50mm$
$= 4000$

Volume of rainwater collected = ...4000..... mm^3

E sample: Response 2

The rain gauge from page 8 is wedge-shaped, as shown here.



7. **Use the volume calculated in Question 6 to check if the 5 mm graduation on the rain gauge is in the correct place.**

Show all working

4000mm ÷ 5
800 ÷ 5
=160mm

Tick the correct answer.

The 5 mm graduation is:

☐ in the correct place

☑ too high

☐ too low.

E sample: Response 2

Section 2: Planning a rainwater supply

Table 2 below shows typical roof areas for homes of different sizes.

Table 2

Typical roof areas	
Home type	**Roof area (m^2)**
2 bedroom home	100
3 bedroom home	150
4 bedroom home	200
5 bedroom home	250

Assume the roof is flat.

(This makes little difference to the amount of rain collected.)

From the table, choose a home that most closely matches the one you live in (or would like to live in).

My choice of home: 5 bedroom home

8. **Calculate the amount of rainwater in litres (L) collected by the roof of your chosen home when one millimetre (1 mm) of rain falls.**

Show all working

[redacted]

250 ÷ 0.001

1 mm = 0.001 m
1 m^3 holds 1000 L

Amount of rainwater collected by the roof when 1 mm of rain falls = 250.00 L

E sample: Response 2

Your teacher has supplied you with median monthly rainfall data for:

..... (location).

9 a. Copy the median rainfall values for each month into column A of Table 3.

b. Using your answer to Question 8, calculate the expected amount of rainwater collected from your chosen roof during each month.
Write these values in column B of Table 3.

Table 3

Expected rainwater collected		
Month	**A** Median rainfall (mm)	**B** Rainwater collected by the roof (L)
Jan	123.4	20L
Feb	175.2	14 L
Mar	118.1	21L
Apr	41.2	60L
May	31.0	80L
Jun	49.3	50L
Jul	28.0	89L
Aug	19.1	130L
Sep	28.4	88L
Oct	46.7	53L
Nov	67.4	37L
Dec	66.2	37L

E sample: Response 2

D
1300
150
2500
+ 200
3150L

② 3150L
÷ 4
787.5L

③ 787.5L
÷ 4
196.8L

④ 196.8L
÷ 4
49.2

Have you checked all the boxes in Question 10?
Continue your answer over the page if necessary.