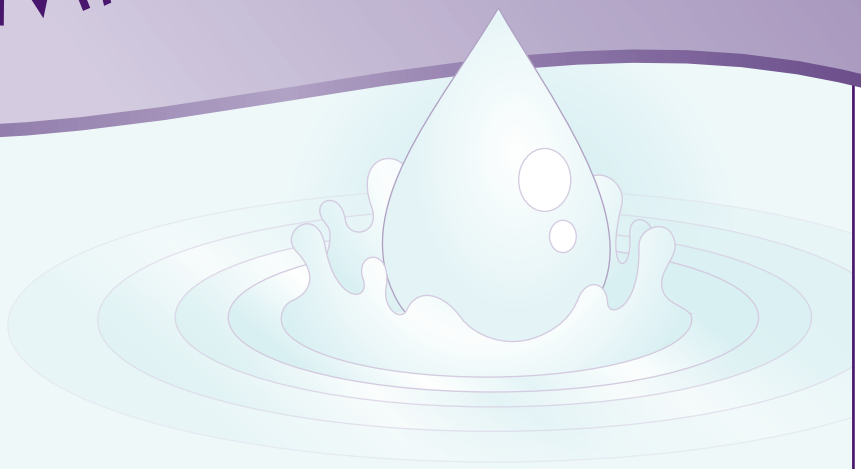
QCATs
Queensland Comparable Assessment Tasks
9
2009
MATHEMATICS
SAMPLE RESPONSES



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.

D samples

Queensland Government
QSA Queensland Studies Authority
Partnership and innovation

Contact information:

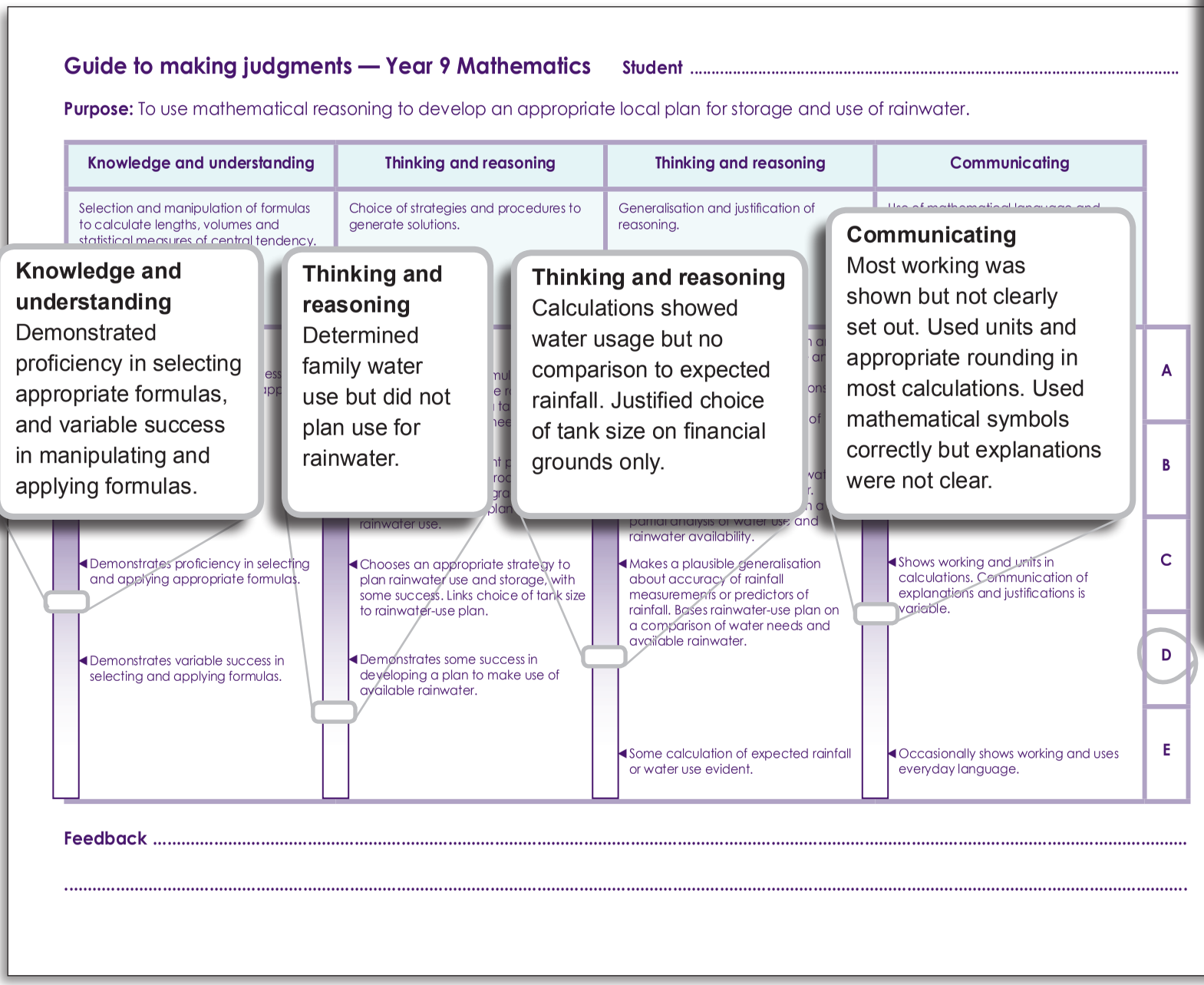
Information about QCATs is available on the QSA website <www.qsa.qld.edu.au>.

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

D sample: Response 1



Knowledge and understanding
Demonstrated proficiency in selecting appropriate formulas, and variable success in manipulating and applying formulas.

Thinking and reasoning
Determined family water use but did not plan use for rainwater.

Thinking and reasoning
Calculations showed water usage but no comparison to expected rainfall. Justified choice of tank size on financial grounds only.

Communicating
Most working was shown but not clearly set out. Used units and appropriate rounding in most calculations. Used mathematical symbols correctly but explanations were not clear.

Overall grade
Although this response demonstrates a sound level of achievement in Knowledge and understanding and Communicating, the limited level of achievement in Thinking and reasoning suggests an overall D. This on-balance judgment is made in light of the emphasis on Thinking and reasoning in the purpose of the assessment.

D 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+2.0+86.6+
1.0+0.0+6.7+1.0+0.0
= 150.1 ÷ 10

Show all working

0.0, 0.0, 0.0, 0.0, 1.0, 1.0,
2.0, 6.7, 52.8, 86.6

0.0, 1.0, 2.0, 6.7, 52.8, 86.6

Mean April rainfall = 15.01mm ~~50.01~~ Median April rainfall = 10mm

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

The median is more useful predictor of typical monthly rainfall than the mean because ~~the amount of numbers~~ it uses all the numbers separately instead of adding it up than dividing

D sample: Response 1

Measuring rainfall

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

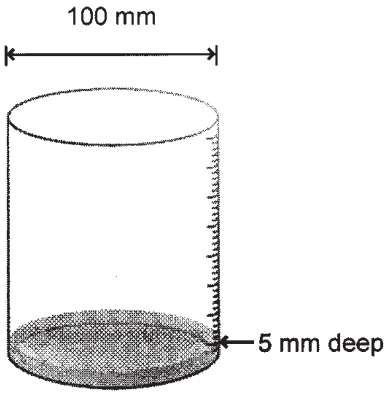
The level in the gauge represents the depth of rainwater that would build up on a flat horizontal surface if it didn't run off or soak in.

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.

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

V= area of base × height
V= 7850mm² × 5mm
V= 39 250mm³

a=πr²
a=3.14×50m²
a=3.14×
a=3.14×2500
a=7850mm²

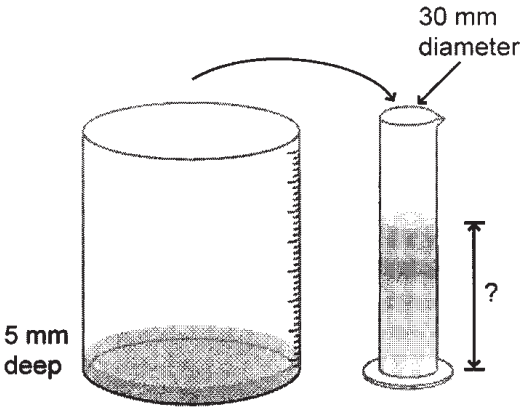
Volume of rainwater = 39 250 **mm³.**

D 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?

It's more accurate because you can see the precise amount instead of rounding the one you think is right It's more space to see the number.



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

~~V = a × h~~

$a = \pi r^2$

$a = 3.14 \times 30^2$

$a = 3.14 \times 900$

$a = 2826$

$V = 39250 \div 2826$

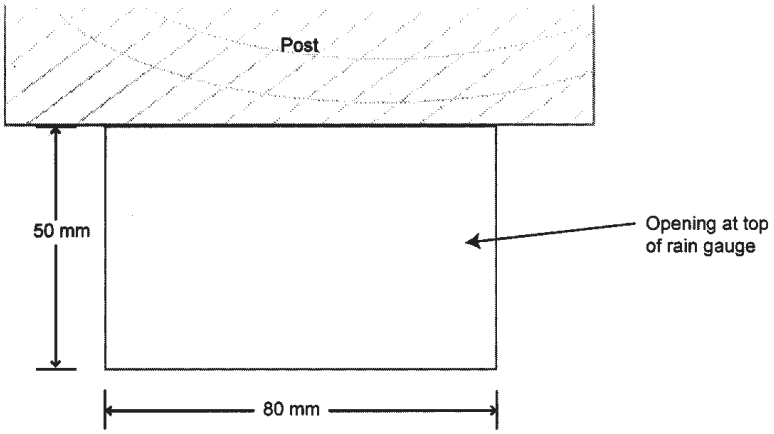
$V = 13.89$ m

Depth of water in the narrow cylinder = 13.89 **mm.**

D 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.

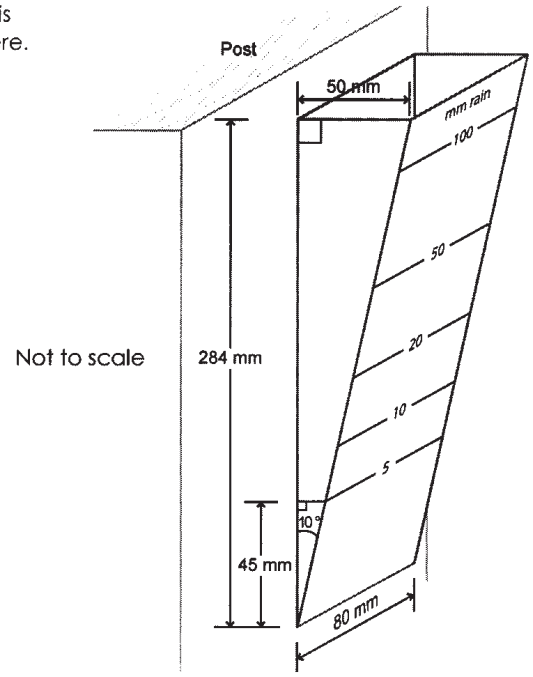
Show all working

$V = 50 \times 80 \times$

Volume of rainwater collected = ... mm^3

D 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.

D 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: .....

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

150 × 0·001 = 0·015

150 × 1 = 150

Amount of rainwater collected by the roof when 1 mm of rain falls = ..0·015.. L

D sample: Response 1

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

.....Redcliffe..... (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	1.284
Feb	110.4	1.656
Mar	103.8	1.557
Apr	70.7	1.0605
May	90.9	1.3635
Jun	45.2	0.678
Jul	38.2	0.573
Aug	31.0	0.465
Sep	27.2	0.408
Oct	71.4	1.071
Nov	91.4	1.371
Dec	125.8	1.887

D sample: Response 1

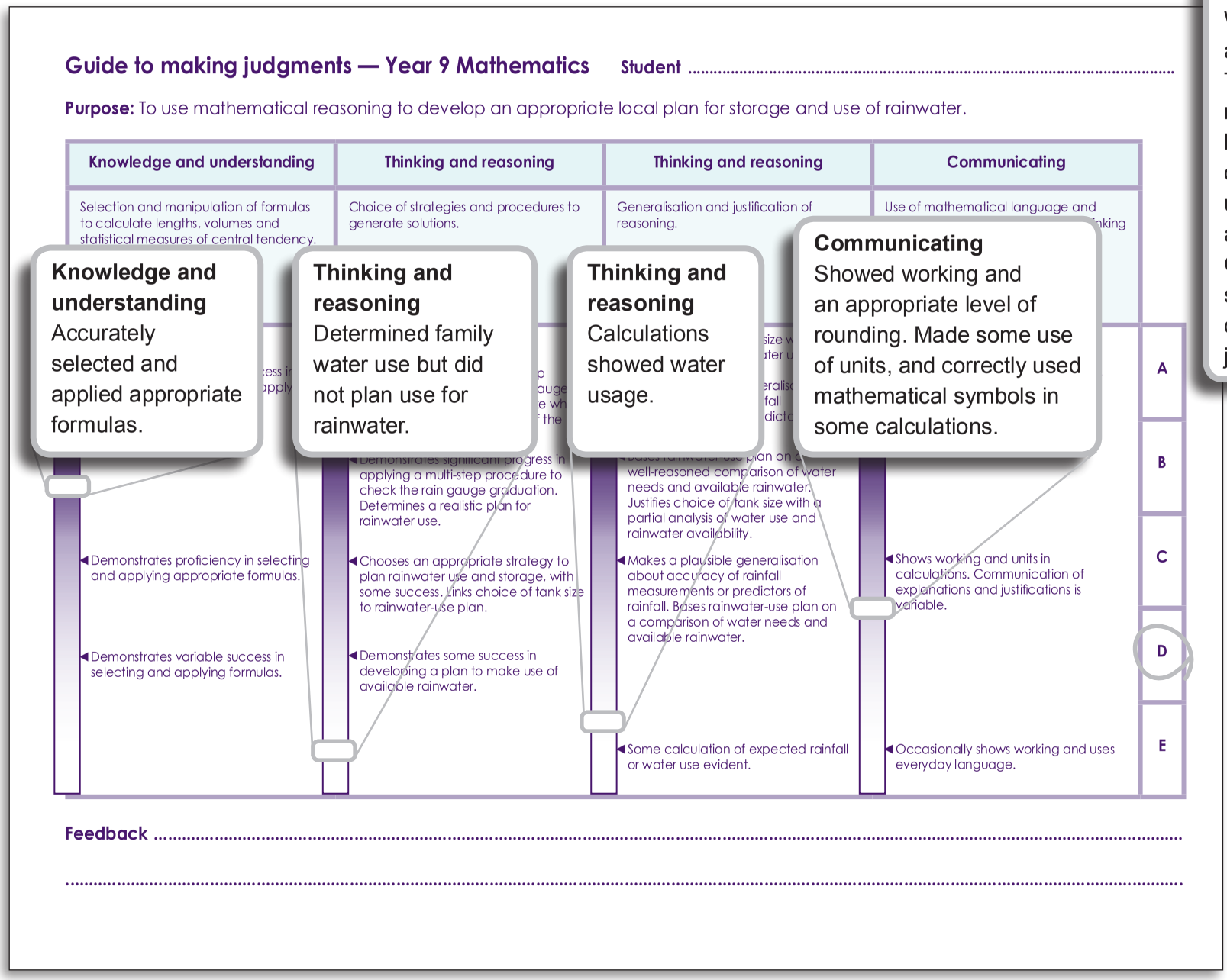
I ~~would~~ choose ~~20000L~~ rain water ~~tank~~.

300 × 4 = 1200
150 × 4 = 600
2500 × 4 = 10000
200 × 4 = 800
= 12 600L amonth

I would choose the 20 000L rain water tank becaus theyre are 4 people living there and they garden a fair bit. Its sort of cheaper to get it because 500 × 40 = 20 000 and you're only paying $3 000 for it. The roof would be abt to catch a fair bit of it. Our family would use around 18 600L amonth. for everything and the gardening.

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

D 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

Knowledge and understanding
Accurately selected and applied appropriate formulas.

Thinking and reasoning
Determined family water use but did not plan use for rainwater.

Thinking and reasoning
Calculations showed water usage.

Communicating
Showed working and an appropriate level of rounding. Made some use of units, and correctly used mathematical symbols in some calculations.

Demonstrates proficiency in selecting and applying appropriate formulas.	Demonstrates significant progress in applying a multi-step procedure to check the rain gauge graduation. Determines a realistic plan for rainwater use.	well-reasoned comparison of water needs and available rainwater. Justifies choice of tank size with a partial analysis of water use and rainwater availability.	Shows working and units in calculations. Communication of explanations and justifications is variable.	A
				B
	Chooses an appropriate strategy to plan rainwater use and storage, with some success. Links choice of tank size to rainwater-use plan.	Makes a plausible generalisation about accuracy of rainfall measurements or predictors of rainfall. Bases rainwater-use plan on a comparison of water needs and available rainwater.		C
Demonstrates variable success in selecting and applying formulas.	Demonstrates some success in developing a plan to make use of available rainwater.			D
		Some calculation of expected rainfall or water use evident.	Occasionally shows working and uses everyday language.	E

Feedback .....

.....

Overall grade
While the student's achievement in Thinking and reasoning is very limited, a high level of Knowledge and understanding and a sound level of Communicating suggest an on-balance judgment of D.

D sample: Response 2

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

Show all working

2
0.0
+10.0
+52.8
+ 2.0
+86.6
+ 1.0
+ 0.0
+ 6.7
+ 1.0
+ 0.0
150.1 ÷10 = 15.01mm

Show all working

0.0
0.0
0.0
0.6
1.0
1.0
2.0
6.7
52.8
86.6

Mean April rainfall = 15.01 Median April rainfall = 1.0

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

.....

.....

.....

.....

.....

D sample: Response 2

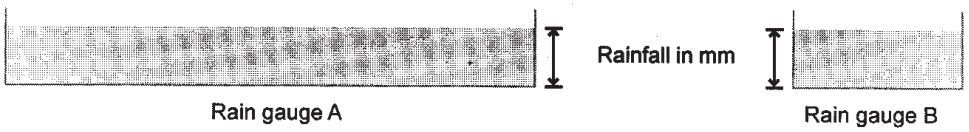
Measuring rainfall

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

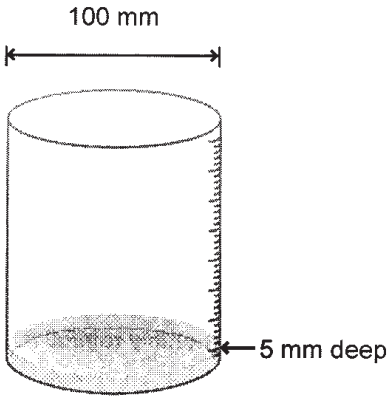
The level in the gauge represents the depth of rainwater that would build up on a flat horizontal surface if it didn't run off or soak in.

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.



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

$= \pi r^2 \times h$
$= \pi \times 50 \times 50 \times h$
$= 7853.98 \times 5$
$= 39269.9 \text{ mm}^3$

Volume of rainwater = 39269.9 mm^3

D sample: Response 2

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

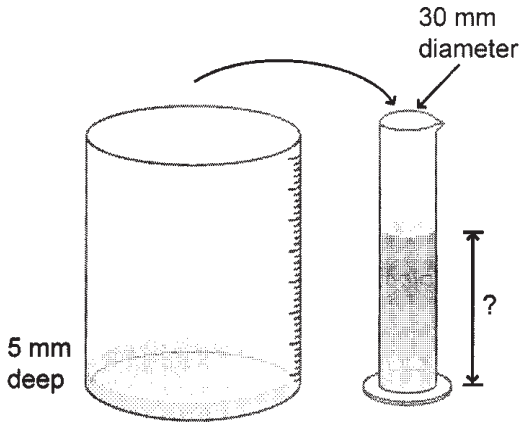
4. How is the accuracy of rainfall measurements improved by pouring the collected rainwater into a narrower cylinder?

.....

.....

.....

.....



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

$= 100 \div 5$

$= 20$ mm $= 1$ mm deep

$= 0.25$ mm per 1 mm deep

$= 0.25 \times 10 + 1$

$= 2.5 + 1$

$= 3.5 \times 10$

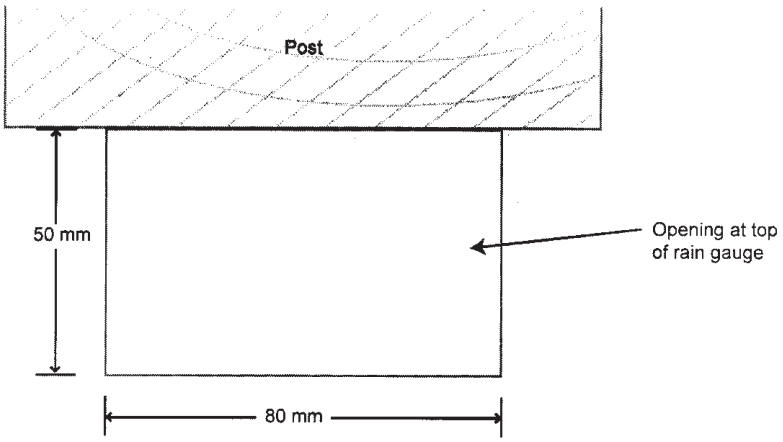
$= 35$

Depth of water in the narrow cylinder = 35 mm

D 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

$= (L \times W) \times Ht$

$= 80 \times 50 \times Ht$

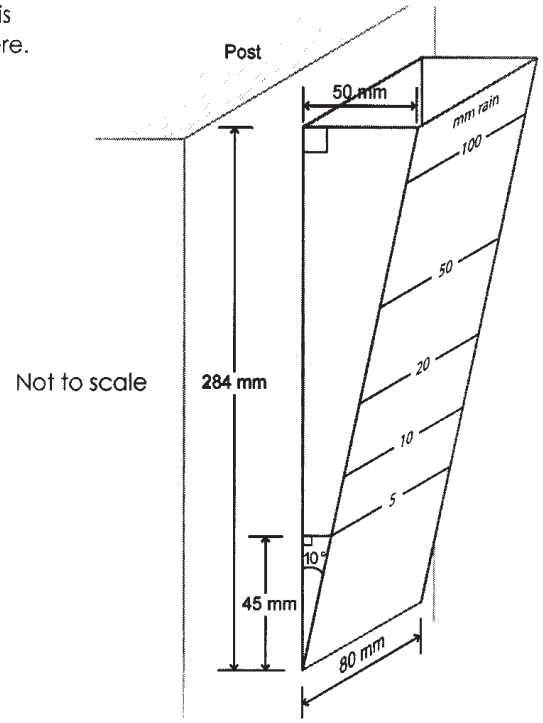
$= 4000 \times 5$

$= 20\,000$

Volume of rainwater collected = 20 000 mm^3

D 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

Tick the correct answer.

The 5 mm graduation is:

☐ in the correct place

☐ too high

☐ too low.

D 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: .....3 bedroom.....

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

: base x ht
= 150 x 1
= 150 ÷ 0.001
= 0.15 x 1000L
= 150L

Amount of rainwater collected by the roof when 1 mm of rain falls = .150..... L

D 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	122.6	18390L
Feb	113.9	17085 L
Mar	88.4	13260L
Apr	52.0	7800L
May	72.4	10860L
Jun	42.0	6300L
Jul	34.8	5220L
Aug	34.4	5160L
Sep	21.0	3150L
Oct	71.7	10755L
Nov	103.2	15480L
Dec	101.6	15240L

D sample: Response 2

10. Explain how you could make the best use of the collected rainwater (Table 3) to reduce your need to use water from the local supply.

In your answer:

- ☑ record the number of people living in the house
- ☑ work out approximately how much water your household uses each month (refer to Table 4 below)
- ☐ compare the expected amount of rainwater collected (Table 3) to your monthly usage
- ☐ explain how you could use the collected rainwater to supply some or all of your needs
- ☐ select an appropriately sized tank to store rainwater for use in drier months (refer to Table 5 below)
- ☐ justify all your reasoning and show all calculations.

Answer on the following pages.
Check the box next to each point above as you complete it.

Table 4

Careful water use (using water wisely)	
Use	**Litres *per person* per month**
Drinking, cooking	**300**
Dish washing	**150**
Bathroom and toilet	**2500**
Washing clothes	**200**
A garden hose uses about 700 litres ***per hour***	

Table 5

Rainwater tank sizes and prices										
Tank capacity (litres)	500	1000	1500	2000	2500	3000	5000	10000	20000	50000
Installed cost	$500	$700	$750	$800	$1000	$1100	$1400	$2000	$3000	$7000

D sample: Response 2

1. 2 people in home

Drinking cooking. 300 x 2 = 600
Dishwashing 150 x 2 = 300
Bathroom, toilet 2500 x 2 = 5000
washing clothes 200 x 2 = 400

= 600 + 300 + 5000 + 400

= 6300 L per month

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