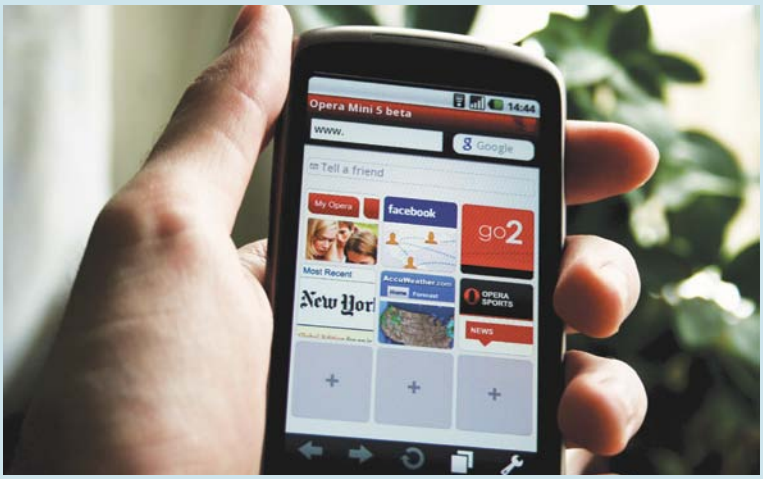
Smartphones, smart thinking

Teacher guidelines



9

Mathematics

Queensland Comparable
Assessment Tasks
(QCATs) 2011

Queensland Government
Queensland Studies Authority

Queensland Studies Authority

Contact information

Direct questions about receipt of QCAT materials or QCAT implementation to the Senior Operations Officer.
Phone: (07) 3120 6187 email: qcats.administrator@qsa.qld.edu.au

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The 2011 QCATs

What are QCATs?

Queensland Comparable Assessment Tasks (QCATs) are designed to provide evidence of what students know, understand and can do in relation to a selection of Essential Learnings for English, mathematics and science in Years 4, 6 and 9, and to the Standards.

QCATs are authentic, performance-based assessments that:

- engage students in solving meaningful problems
- emphasise critical thinking and reasoning
- provide teachers, students and parents/carers with information about student progress and a focus for future teaching and learning.

Consistency of teacher judgments

QCATs support teachers in making consistent judgments about the quality of student work. Improved consistency of teacher judgments is achieved when teachers:

- engage in professional conversations about the quality of evidence in student responses
- reach consensus about the quality of student work
- adopt a consistent approach when using the Guide to making judgments (back page).

Information gathered may be used by teachers to promote, assist and improve key learning area programs, and to help students achieve the highest standards they can.

Additional resources

2011 QCATs Information statement
www.qsa.qld.edu.au/3163.html

Essential Learnings and Standards
www.qsa.qld.edu.au/574.html

Important dates

Friday 24 June	QCATs packages have arrived in schools
Monday 11 July ↓ Friday 16 September	Schools: • administer QCATs at any time during the school weeks of this period • grade QCATs • select five student samples that are representative of grades awarded
Monday 10 October	Schools are notified if selected to submit student samples for QSA's random sampling process
Monday 21 November	Final day for schools to submit student data to QSA
Friday 9 December*	Schools must retain all Student booklets until the end of the school year

* this date may vary from school to school

Getting ready

Student preparation

Students should have the opportunity to do their best work. For this to occur, student preparation should include:

- opportunities to engage with the Selected Essential Learnings (page 25) well in advance of participating in QCATs — if students have not engaged with the Selected Essential Learnings recently, review and consolidation may be necessary
- experience with the types of questions used within the QCAT.

Suggested learning experiences and resources are outlined in the document 2011 QCATs – Preparation.

The quality of information provided by the QCATs is enhanced by the level of interaction teachers have with their students before, during and after implementation.

Additional resources Queensland Comparable Assessment Tasks (QCATs)
www.qsa.qld.edu.au/3163.html

Catering for diversity — Special provisions

All students should have the opportunity to participate in school-based assessment. Schools are responsible for determining which students require special provisions.

The QCATs are designed to be part of a classroom assessment program, and principles of participation and equity apply. The Queensland Studies Authority (QSA) offers this general advice:

- Students who have been identified as having specific educational requirements may be assisted using those adjustments and supports usually available in the classroom. To make participation possible in all or part of the assessment task, such help may be in the form of inclusive learning technologies, reading support or the use of support personnel.
- Students for whom English is not their first language, and who are assessed as not achieving a reading level appropriate to complete the task, may be assisted by an interpreter or educational devices (e.g. pictures, electronic whiteboards, interactive devices) to allow participation in all or part of the task.
- In exceptional circumstances, where a student's learning difficulties have precluded them from engaging with the Selected Essential Learnings, the principal (in consultation with specialist and support staff and parents/carers) may make a decision about the participation of that student in the task. Some students may be given an opportunity to complete some aspects of the assessment.

Additional resources Inclusive strategies for implementing QCATs
www.qsa.qld.edu.au/3163.html

Equity
www.qsa.qld.edu.au/10188.html

Teacher preparation

Check the contents of QCAT packages as soon as they arrive at your school

- Check that you have the appropriate number of Student booklets (one per student) and Teacher guidelines (one per implementing teacher).
- Check for any defective Student booklets.
- Contact the QSA if any additional copies are required.

Familiarise yourself with the assessment

- Read all the documents provided.
- Review the Selected Essential Learnings (page 25).
- Complete a Student booklet yourself, and then refer to the Model response (page 27) so that you understand what students are required to do.
- Download and view Sample responses from the QSA Assessment Bank (see Additional resources below).

Plan implementation

- Discuss the assessment with your colleagues, and plan any teaching or revision that may be required.
- Set the times and dates for implementation, considering these points:
  - teachers have flexibility to implement the QCATs at any time during the designated period
  - QCATs may be completed in one, two or more sessions over one or more days
  - implementation times may differ for verified students, students with specific educational requirements or students who have English as a second language
  - QCATs will ideally replace an existing piece of assessment in the student portfolio of work for Semester 2.
- Plan:
  - any support required to enable students to do their best work (e.g. teacher aides or other support personnel)
  - any materials or equipment needed to implement the assessment.
- Decide:
  - how you will implement this task for all classes at this year level
  - the processes you will use to achieve consistency of teacher judgment
  - how you will select student samples for the QSA's random sampling process
  - when, how and who will submit your school's data.

Additional resources

Queensland Comparable Assessment Tasks (QCATs)
www.qsa.qld.edu.au/3163.html

Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

8 – Using Queensland Comparable Assessment Tasks (QCATs) to support learning
www.qsa.qld.edu.au/3166.html

Implementation

Setting up

Stimulus sheet — e-tel brochure

You may wish to give students the Stimulus sheet to take home the day before you implement the QCAT to promote discussion.

Equipment

All students should have access to a calculator.

Working with the Student booklet

Use advice given in the Annotated Student booklet (page 8) to set the conditions that ensure all students have the opportunity to do their best work.

Encourage students to interact with teachers to seek clarification when required, and with other students if appropriate to the task.

Suggested implementation timeline

Preparation

Setting the scene: Group discussion	15 minutes

The assessment task

Trends in mobile phone ownership	20 minutes
Smartphones adjust for different time zones	20 minutes
Storing, sending and displaying photos Using a phone for social networking and email	30 minutes
Joe's phone use on a prepaid plan Can Joe afford a new smartphone?	30 minutes

Annotated Student booklet

Stimulus pictures.

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Images Creative Commons Attribution 2.0 Generic licensed photos <http://creativecommons.org/licenses/by/2.0> accessed 15 Feb 2011. **Cover** Smartphone: Johan Larsson's photostream, "Opera Mini 5 Beta" <www.flickr.com/photos/johanl/4424185115/in/set-72157623336975827>; p. 2 Girl texting: rayand's photostream, "Phone Use-20" <www.flickr.com/photos/rayand/3868086106>; Girls on phones: Pink Sherbet Photography's photostream, "Free Train Station Girls Talking on Cell Phones Creative Commons", <www.flickr.com/photos/pinksherbet/2796862756>; Smartphone GPS: miss_hg's photostream, "iPhone testing 2", <www.flickr.com/photos/32615508@N02/3047982712>; Boy texting: dmjarvey's photostream, "I swear, he is texting everywhere he goes.", <www.flickr.com/photos/28009451@N03/4506519539>; Teen on stairs: FaceMePLS' photostream, "Texting", <www.flickr.com/photos/faceme/2342704711/sizes/o>; Music player on smartphone: Johan Larsson's photostream, "Spotify", <www.flickr.com/photos/johanl/4369336197/in/photostream>; p. 6 Smartphone with time: whatleydude's photostream, "The HTC Diamond has got a very, very nice screen...", <www.flickr.com/photos/whatleydude/3254554591>; p. 9 and stimulus Photo on smartphone: Noize Photography's photostream, "Millie V. QS1", <www.flickr.com/photos/noizephotography/3966882971>. All other images © QSA.

Suggested time: 15 minutes

Use the stimulus pictures, dot points and disorders definitions to promote discussion about mobile phones, smartphones, phone plans and teenage debt.

Setting the scene: Group discussion

- 76% of 12- to 14-year-olds own a mobile phone (Australian Bureau of Statistics, 2009).
- Mobile phones are a major source of youth debt (Office of Fair Trading, 2003).
- Texting — why is it many teens' preferred method of communicating?
- Smartphones — what are they, and what can they do?
- Can I own a mobile without getting into debt?
- Contract, prepaid, cap, postpaid — what do they mean, and which is best for me?
- Mobile plan terms — look at the **e-tel brochure**.

Use the e-tel brochure to ensure all students are familiar with common terminology used with mobile phones and plans.

Disorders in the communication age? (Boost mobile, 2010)

These terms were coined by a mobile phone company.

Textiety: A feeling of anxiety caused when not receiving or sending any text messages.

Textaphrenia: Thinking you've heard or felt a text message arrive when it hasn't.

Binge texting: Sending massive numbers of texts to build self-esteem among peers.

Post-traumatic text disorder: Injuries related to texting, such as walking into objects by not paying attention to your surroundings.

Textaholic: One who sends more than 50 texts a day.

In this assessment, you will use mathematical reasoning to:

- analyse and infer from data about mobile phone ownership
- analyse and interpret smartphone features
- reflect on your understandings to give financial advice.

Show your working

- Your teacher is looking for evidence of mathematical thinking and reasoning, not only correct answers.
- When using a calculator, show enough working so that your teacher can see the method you used.
- If you cannot complete a question, show what you have been able to do.
- Credit will be given if an incorrect answer is used correctly in a later question.

Explain to students how showing working can improve their achievement.

Remind them that they will not be penalised for consequential errors — credit will be given if an incorrect answer is used correctly in a later question.

Show all working

When you see a space like this, show all your working.

Work through the Guide to making judgments on the last page of the Student booklet with students to highlight the assessable elements for this QCAT.

Explain, in student-friendly terms, the task-specific descriptors. These identify what is being valued in the student responses.

Suggested time: 20 minutes

Trends in mobile phone ownership

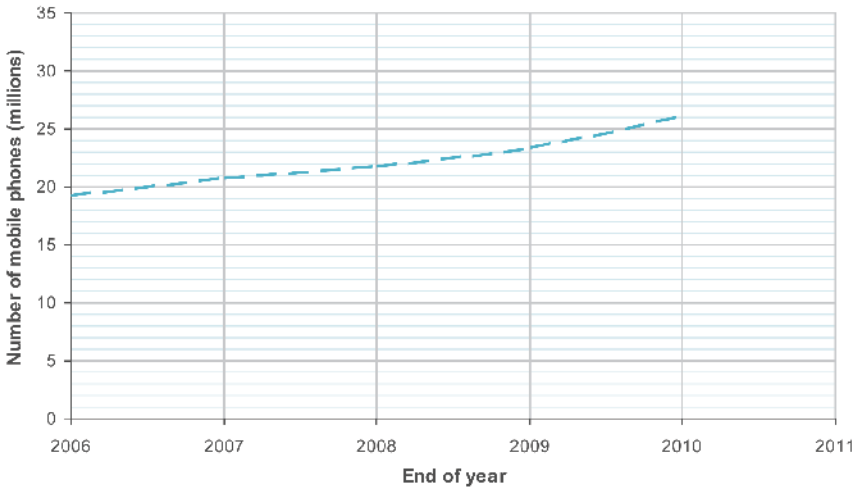
Table 1: Mobile phone ownership in Australia (2006 to 2010)

End of year	Total number of mobile phones (millions)	Internet-capable mobile phones (millions)
2006	19.3	1.6
2007	20.8	4.6
2008	21.8	8.6
2009	23.4	12.3
2010	26.1	16.8

Source of data: <www.acma.gov.au>

1. **Complete Graph 1 to show all the data from Table 1:**
   - **include a title**
   - **plot the data for internet-capable mobile phones**
   - **complete the key.**

Graph 1: .....



Key	– – –	Total number of mobile phones
		.....

As you work through the QCAT with the students, check for understanding of the task and provide clarification as needed.

Where students ask individual questions, answers should be shared with all students wherever possible.

2. a) **Describe the trend in total mobile phone ownership in Australia since 2006.**
Use Graph 1 to help you.

.....

.....

.....

.....

b) **Describe how rapidly ownership of internet-capable mobile phones has changed compared to total mobile phone ownership.** Refer to Graph 1 in your answer.

.....

.....

.....

.....

3. **During which year did internet-capable phones make up half of all mobiles?**
Justify your answer.

Show all working

.....

4. **Use Graph 1 to make the following predictions.**

Total number of mobile phones at the end of 2011: .....

Total number of internet-capable phones at the end of 2011: .....

Stop here: Wait for your teacher's directions.

Stop here directions are placed at convenient points to finish a session, or to discuss the next part of the QCAT.

What is being assessed

Questions 1 to 4 gather evidence of displaying and analysing data to make inferences about trends in mobile phone use.

Suggested time: 20 minutes

Discuss time zones and ensure that students understand the meaning of statements such as "AEST – 0.5 hours".

Smartphones adjust for different time zones

Smartphones can automatically adjust to local time when the phone moves into a different time zone. They can even adjust for daylight saving.

Table 2: Flight durations

From	To	Duration (hours:minutes)
Cairns	Alice Springs	1:45
Alice Springs	Perth	3:05

The clock in Nadia's smartphone automatically updates when she moves to a new time zone.

5. a) If Nadia's plane leaves Cairns at 8:14 am, what time will her smartphone show when she arrives in Alice Springs?

Show all working

Time shown on phone: .....

Nadia stops for 45 minutes in Alice Springs, then flies on to Perth.

b) What time will Nadia's smartphone show when she arrives in Perth?

Show all working

Time shown on phone: .....

Nadia's friend Lillian lives in Victoria. Nadia promised to send Lillian a text from Perth before Lillian goes to bed.

6. What is the latest time that Nadia can text Lillian?

- Lillian goes to bed at 10:00 pm.
- It is summer and Victoria uses Australian Eastern Daylight Time (AEDT).
- AEDT = Australian Eastern Standard Time (AEST) + 1 hour
- Queensland, Western Australian and Northern Territory do not use Daylight Saving Time.
- Allow 5 minutes for the text to arrive.

Show all working

Latest Nadia can text: .....

Stop here: Wait for your teacher's directions.

What is being assessed

Question 5 gathers evidence of performing calculations involving time zones.

Question 6 gathers evidence of solving problems involving time.

Suggested time: 30 minutes

Note on the use of kB and MB

Point out to students that the prefix kilo means 1000 (10^3) and mega means 1 000 000 (10^6).

i.e. 1 kilobyte (kB) = 1000 bytes,
and *not* 1024 bytes, which is 1 kibibyte (KiB).

The International Standard names for binary prefixes are outlined here: ‹http://physics.nist.gov/cuu/units/binary.html›.

Discuss the concepts of pixels and data files.

Storing, sending and displaying photos

- Digital photos are made up of tiny dots called pixels.
- Each pixel contains 3 bytes of data.
- A digital photo is stored as a file containing the data in every pixel.

Remember:
kilo = 1 thousand
mega = 1 million

7. a) What is the file size of a 5-megapixel photo?
Give your answer in megabytes (MB).

Show all working

File size: ..... **MB**

Photo files are usually compressed to reduce the total file size.

b) What is the new file size if the photo file in Question 7a is compressed to 12% of its original size?

Show all working

File size: ..... **MB**

When Nadia sends Lillian a photo in a multimedia message (MMS), her phone compresses the 1.84 MB file to 300 kB.

8. What percentage is the compressed file (300 kB) of the original file (1.84 MB)?

Show all working

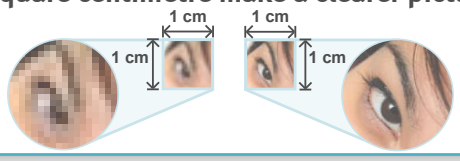
..... **%**

What is being assessed

Questions 7 and 8 gather evidence of performing calculations involving data measurement and percentage.

More pixels per square centimetre make a clearer picture

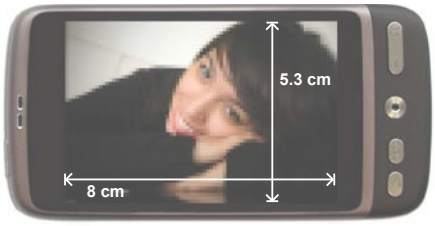
A pixelated photo
Less than
10 000 pixels per
square centimetre



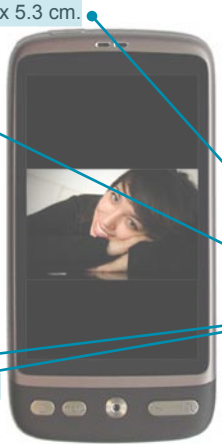
A clear photo
10 000 pixels
or more per
square centimetre

- The smartphone shown in A and B below has a screen size of 8 cm x 5.3 cm.
- The photo displayed is made up of 250 000 pixels.

A



B



When the phone is rotated from A to B:

- the photo stays the same shape (the ratio of the sides stays the same)
- the number of pixels does not change.

9. Use calculations to explain why the photo in A is pixelated and in B is clear.

A Show all working

B Show all working

Discuss the relationship between pixels/cm² and photo clarity.

Point out key information provided.

What is being assessed

Question 9 gathers evidence of solving problems involving area and ratio.

Discuss the use of data with a smartphone:

- social networking
- web browsing
- uploading and downloading files
- sending and receiving email.

Using a phone for social networking and email

Social networking on a mobile phone

- Aaron has a data allowance of 200 MB per month (assume 1 month = 30 days).
- Accessing a social networking site such as Facebook uses about 10 MB of data per hour.
- Assume Aaron does not download or upload any other data.

10. **How many minutes each day, on average, can Aaron spend on Facebook without going over his data limit?** Give your answer to the nearest minute.

.....

Text or email — which is better value?

- Aaron can send data (including email) from his phone at a cost of 50 cents per MB.
- It costs Aaron 28 cents to send a text message.

11. **How many 10 kB emails can Aaron send for the cost of one text message?**

.....

What is being assessed

Question 10 and 11 gather evidence of solving problems involving the data features of a smartphone.

Extra working space

Advise students that they can use this space for any question.

Include the question number with any working.

Stop here: Wait for your teacher's directions.

Suggested time: 30 minutes

Discuss the purpose of this section, i.e. *Analyse Joe's phone usage to see how long a prepaid recharge lasts.*

For call and message rates, direct students to the Rates for prepaid and contract plans on the e-tel brochure.

Joe's phone use on a prepaid plan

Joe uses e-tel's **$29 prepaid** plan, and his typical weekly phone use is shown in Table 3.
Look at your **e-tel brochure** for details of Joe's plan.

12. Complete Table 3 below to show:

- cost of calls and messages
- total data that Joe uses in a typical week.

Table 3: Joe's typical weekly phone use

Weekly calls and messages		Cost ($)	Weekly data use		Data (MB)
8	2-minute voice calls	.....	3 hrs	Facebook	.....
110	text messages	.....	40	sent emails	0.4
4	multimedia messages	2.00	25	received emails	.....
			1	song download	5.0
Total cost of calls and messages		**$50.00**	**Total data used**		.....

Working space for Question 12 (if required)

12 | **QCATs 2011 Student booklet** Year 9 Mathematics

13. a) Show that the included value ($) in a $29 prepaid recharge lasts Joe 3 weeks.

Show all working

.....

b) How long could the included data (MB) in Joe's $29 prepaid recharge last?

Show all working

.....

c) How often will Joe need to buy a $29 prepaid recharge so that he can continue to use his phone as shown in Table 3?

.....

Direct students to the $29 prepaid plan in the e-tel brochure for included value and included data.

What is being assessed

Question 12 and 13 gather evidence of analysing a mobile phone prepaid plan to solve problems.

Discuss the purpose of this section, i.e. *Use your mathematical understandings to decide if Joe can afford to change to the $29 contract plan and get a new smartphone.*

Direct students to the $29 contract plan on the e-tel brochure.

Suggest to students that they use these points as a checklist.

Remind students to take their time to respond thoughtfully and to ask clarifying questions if necessary.

Can Joe afford a new smartphone?

- Joe would like to change from the **$29 prepaid** to the **$29 contract** plan so that he can get a new smartphone.
- He cannot afford to spend much more each month than he is now spending on his prepaid plan.
- Look at the **e-tel brochure** for plan details.

14. Advise Joe whether he could change to the $29 contract plan without spending much more than he is now spending on his prepaid plan.

In your answer, use mathematical reasoning to:

- ❑ work out how much Joe is spending per month (30 days) on his $29 prepaid plan, using your answer in Question 13c
- ❑ find out how much Joe would spend each month if he changed to the $29 contract plan, based on his typical phone usage as shown in Table 3 (remember that in a contract plan, you pay extra when you exceed included data or value)
- ❑ work out how Joe could make better use of his included data so that he does not exceed the included value in the $29 contract plan
- ❑ provide advice to Joe based on your calculations and relevant information in the task.

Show all working

Show all working

I would advise Joe to **change** / **not change** to the $29 contract plan because: .....
(circle one)

.....

.....

.....

.....

.....

.....

.....

.....

What is being assessed

Question 14 gathers evidence of reflecting on learning to choose mathematical strategies and justify financial advice.

Making judgments

Use the Guide to making judgments (GTMJ) on the back page to grade student responses.

The Model response (page 27) and Sample responses are provided for reference purposes only. They each demonstrate possible responses and should be used to support the GTMJ.

Making judgments is not about determining whether one student's work is better than that of another. Rather, you should make standards-based judgments by matching evidence in student responses to descriptors in the GTMJ.

Read and consider all of the evidence in the student's responses before making and recording a judgment about the quality of the performance for each assessable element.

Additional resources Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

Using the GTMJ

This QCAT uses a continua-style GTMJ, where descriptors are placed along a continuum within each column. The diagrams below show the different parts of the GTMJ continua model, and how to use the GTMJ when grading student responses.

Record a nil award of "N" only when there is insufficient evidence to make a judgment for an overall grade.

In the following diagrams:

- Diagram 1: Understanding the GTMJ points out the different parts of the GTMJ
- Diagram 2: Using the GTMJ — the judgment process gives steps to follow when grading student responses.

Diagram 1: Understanding the GTMJ

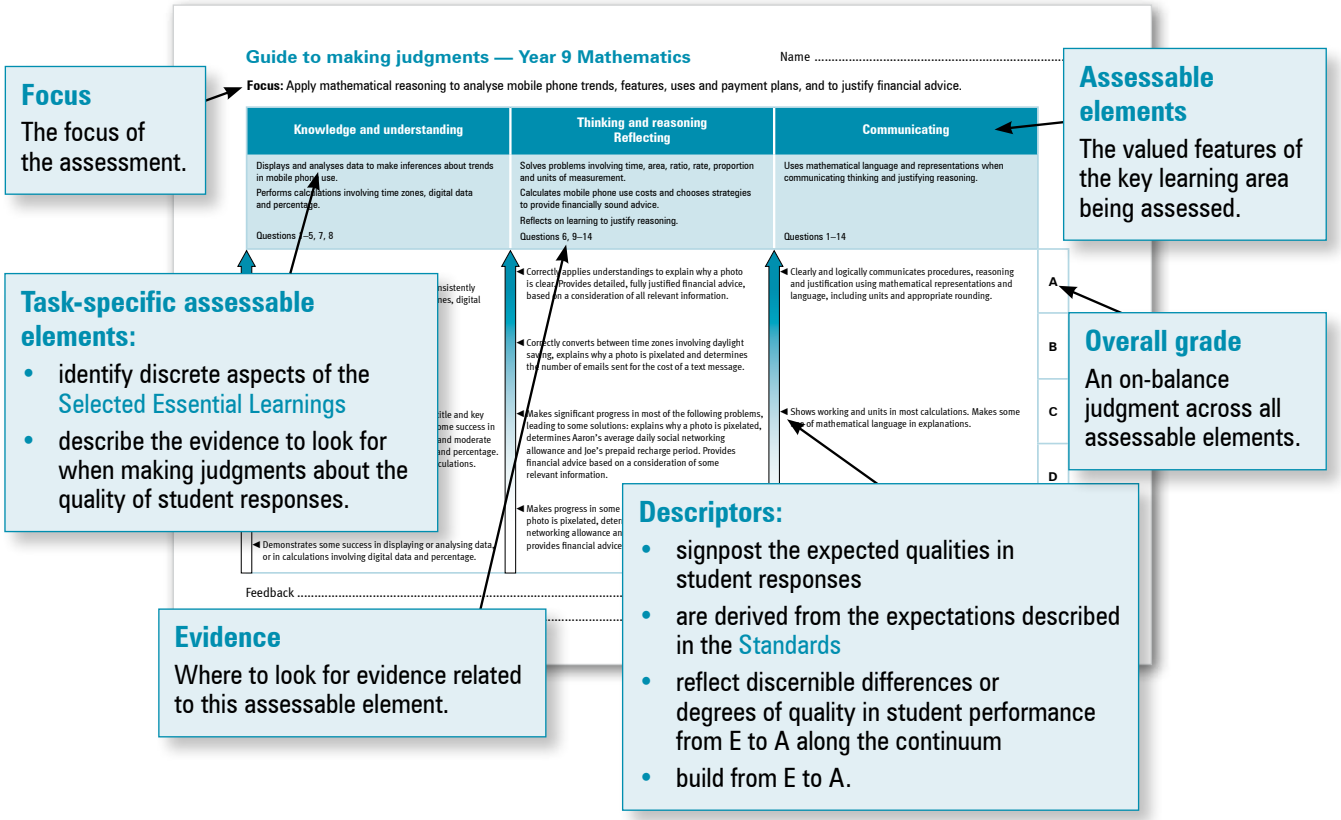
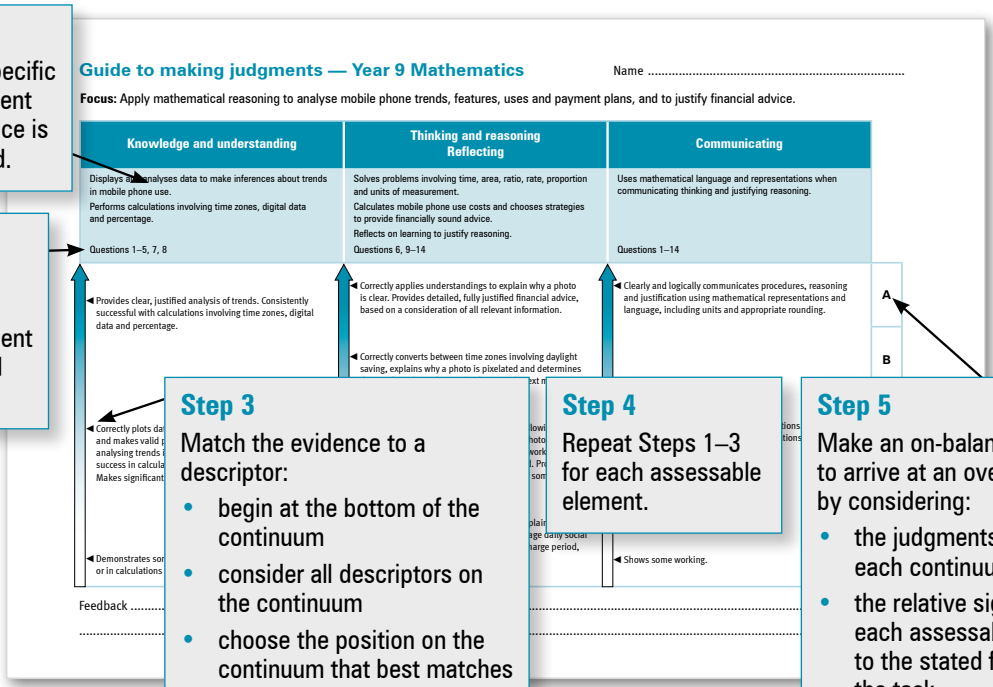


Diagram 2: Using the GTMJ — the judgment process



Step 1

Read the task-specific assessable element for which evidence is being considered.

Step 2

Locate all the evidence for an assessable element in the completed Student booklet.

Step 3

Match the evidence to a descriptor:

- begin at the bottom of the continuum
- consider all descriptors on the continuum
- choose the position on the continuum that best matches the evidence to produce an on-balance judgment for the assessable element
- look at Model and Sample responses for clarification if necessary.

Step 4

Repeat Steps 1–3 for each assessable element.

Step 5

Make an on-balance judgment to arrive at an overall grade by considering:

- the judgments recorded on each continuum
- the relative significance of each assessable element to the stated focus of the task.

Using feedback

Assessment alone will not contribute significantly to improved learning — it is what teachers and students do with the information gathered that makes the difference. Providing quality and useful feedback is a crucial step in using assessment information to support future learning.

Assessment feedback goes beyond a simple mark or grade. Comments on the strengths of students' achievements, and on areas for improvement, provide quality feedback that can be used to inform future teaching and learning. Assessment feedback is most helpful if the specific elements of the knowledge and skills are identified and specific suggestions are provided.

The information gathered from the implementation, marking and moderation of QCATs should feed back into future planning of teaching and learning.

Feedback to help students learn

Quality feedback to a student:

- focuses on their achievement in relation to either the assessable elements with their task-specific descriptors or the Selected Essential Learnings (page 25) and their associated questions
- includes strengths of achievements
- identifies areas for improvement and strategies for future learning
- is communicated in student-friendly language
- is appropriate (e.g. in quantity and detail) to the student's age and their capacity to respond
- includes the use of Sample responses to provide examples of the quality of work corresponding to each standard.

Feedback to help teacher planning

Individual and collective student performance on QCATs, along with other school-based assessment, can be used to inform teaching and learning.

Additional resources

Using feedback to inform teaching and learning
www.qsa.qld.edu.au/3163.html

Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

Resources

Selected Essential Learnings

This QCAT will assess what students know, understand and can do in relation to the following selection of Essential Learnings.

Mathematics Essential Learnings by the end of Year 9	
Assessable elements The valued features of the key learning area about which evidence of learning is collected and assessed.	**Ways of working** The processes students use to develop and demonstrate their knowledge and understanding. Students are able to:
Thinking and reasoning	• analyse situations to identify the key mathematical features and conditions, strategies and procedures that may be relevant in the generation of a solution • select and use mental and written computations, estimations, representations and technologies to generate solutions and to check for reasonableness of the solution • use mathematical interpretations and conclusions to generalise reasoning and make inferences
Communicating	• communicate thinking, and justify and evaluate reasoning and generalisations, using mathematical language, representations and technologies
Reflecting	• reflect on learning, apply new understandings and justify future applications.
	Knowledge and understanding The essential concepts, facts and procedures.
Knowledge and understanding	***Number*** **Number properties and operations and a range of strategies can be applied when working with integers and rational numbers.** • Rational numbers (integers, fractions and decimals) can be used to describe and solve problems involving rate, ratio, proportion and percentage. • Financial decisions can be made based on the analysis of short- and long-term benefits and consequences of cash, credit and debit transactions. ***Measurement*** **Units of measure, instruments, formulas and strategies can be used to estimate and calculate measurement and consider reasonable error.** • Instruments, technologies, strategies and formulas are used to estimate, compare and calculate measures and derived measures, including rate, area, duration and Australian time zone differences. ***Chance and data*** **Judgments can be based on theoretical or experimental probability. Data can be displayed in various ways and analysed to make inferences and generalisations.** • Data interpretation is simplified through the use of suitable representations and descriptive statistics.

Source: www.qsa.qld.edu.au/7296.html

Connection to the Australian Curriculum

This QCAT connects to the following proficiencies and content descriptions of the Australian Curriculum.

The Australian Curriculum: Mathematics		Version 1.2
Proficiency strands		Assessed proficiencies are **highlighted**.
Understanding		**Students** build a robust knowledge of adaptable and transferable mathematical concepts. They make connections between related concepts and progressively **apply the familiar to develop new ideas**. They develop an understanding of the relationship between the "why" and the "how" of mathematics. Students build understanding when they connect related ideas, when they represent concepts in different ways, when they identify commonalities and differences between aspects of content, when they **describe their thinking mathematically** and when they **interpret mathematical information**.
Fluency		**Students develop skills in choosing appropriate procedures, carrying out procedures** flexibly**, accurately, efficiently and appropriately**, and recalling factual knowledge and concepts readily. Students are fluent when they calculate answers efficiently, when they recognise robust ways of answering questions, when they choose appropriate methods and approximations, when they recall definitions and regularly use facts, and when they can manipulate expressions and equations to find solutions.
Problem Solving		**Students** develop the ability to **make choices, interpret**, formulate, model **and investigate problem situations, and communicate solutions effectively. Students** formulate and solve problems when they **use mathematics to represent unfamiliar or meaningful situations**, when they design investigations and plan their approaches, **when they apply their existing strategies to seek solutions, and when they verify that their answers are reasonable**.
Reasoning		**Students develop** an increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, **evaluating, explaining, inferring, justifying and generalising. Students are reasoning mathematically when they explain their thinking, when they deduce and justify strategies used and conclusions reached, when they adapt the known to the unknown, when they transfer learning from one context to another**, when they prove that something is true or false and when they compare and contrast related ideas and **explain their choices**.
Content strands		**Content descriptions**
Number and Algebra	Year 8	***Number and place value*** • Carry out the four operations with integers, using efficient mental and written strategies and appropriate digital technologies. ***Real numbers*** • Solve problems involving the use of percentages, including percentage increases and decreases, with and without digital technologies. • Solve a range of problems involving rates and ratios, with and without digital technologies.
	Year 9	***Real numbers*** • Solve problems involving direct proportion. Explore the relationship between graphs and equations corresponding to simple rate problems. ***Linear and non-linear relationships*** • Sketch simple non-linear relations with and without the use of digital technologies.
Measurement and Geometry	Year 8	***Using units of measurement*** • Choose appropriate units of measurement for area and volume and convert from one unit to another. • Solve problems involving duration, including using 12- and 24-hour time within a single time zone.

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA) 2011, www.australiancurriculum.edu.au/Mathematics
Resources: QSA 2011, www.qsa.qld.edu.au/13656.html

Model response

This Model response gives one example of a very high quality response for each question. The Sample responses, available for download from the QSA Assessment Bank, demonstrate the quality of student responses for each standard, A to E.

Trends in mobile phone ownership

Table 1: Mobile phone ownership in Australia (2006 to 2010)

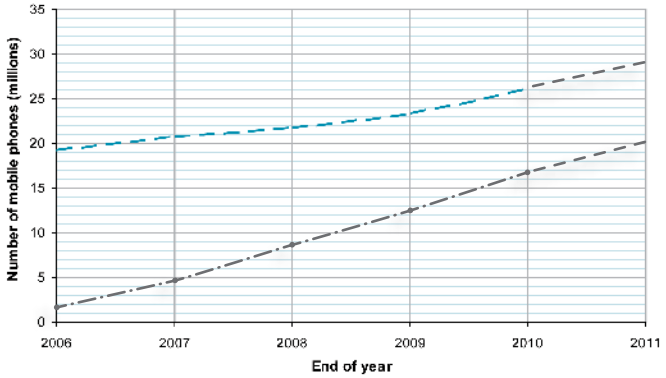
End of year	Total number of mobile phones (millions)	Internet-capable mobile phones (millions)
2006	19.3	1.6
2007	20.8	4.6
2008	21.8	8.6
2009	23.4	12.3
2010	26.1	16.8

Source of data: <www.acma.gov.au>

1. Complete Graph 1 to show all the data from Table 1:

- **include a title**
- **plot the data for internet-capable mobile phones**
- **complete the key.**

Graph 1: Mobile phone ownership 2006 to 2010



Key		
	– – –	Total number of mobile phones
	-·-·-	Internet-capable mobile phones

2. a) Describe the trend in total mobile phone ownership in Australia since 2006.
Use Graph 1 to help you.

Mobile phone ownership has increased steadily from 19.3 million in 2006 to 26 million in 2010.

b) Describe how rapidly ownership of internet-capable mobile phones has changed compared to total mobile phone ownership. Refer to Graph 1 in your answer.

The steeper line shows that ownership of internet-capable phones has increased more rapidly than total mobile phone ownership. (An average increase of 3.8 million per year compared to 1.7 million per year).

3. During which year did internet-capable phones make up half of all mobiles?
Justify your answer.

Show all working

$$\% \text{ at end of 2008} = \frac{8.6}{21.8} = 39\ \%$$

$$\% \text{ at end of 2009} = \frac{12.3}{23.4} = 53\ \%$$

During 2009

4. Use Graph 1 to make the following predictions.

Total number of mobile phones at the end of 2011: 29 million

Total number of internet-capable phones at the end of 2011: 20 million

Stop here: Wait for your teacher's directions.

Model response

Smartphones adjust for different time zones

Smartphones can automatically adjust to local time when the phone moves into a different time zone. They can even adjust for daylight saving.

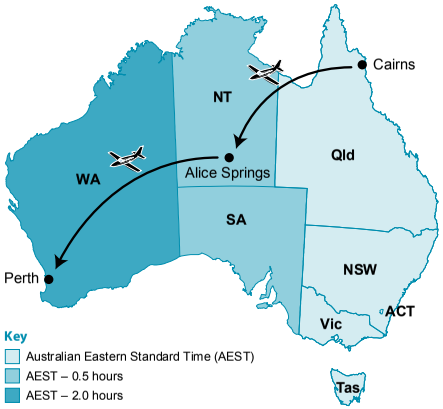


Table 2: Flight durations

From	To	Duration (hours:minutes)
Cairns	Alice Springs	1:45
Alice Springs	Perth	3:05

The clock in Nadia's smartphone automatically updates when she moves to a new time zone.

5. a) If Nadia's plane leaves Cairns at 8:14 am, what time will her smartphone show when she arrives in Alice Springs?

Show all working

Time on phone
= departure time + flight time – 0.5 hours
= 8:14 + 1:45 – 0:30
= 9:29

Time shown on phone: 9:29 am

Nadia stops for 45 minutes in Alice Springs, then flies on to Perth.

b) What time will Nadia's smartphone show when she arrives in Perth?

Show all working

Time on phone
= departure time + flight time – 1.5 hours
= (9:29 + 0:45) + 3:05 – 1:30
= 11:49

Time shown on phone: 11:49 am

Nadia's friend Lillian lives in Victoria. Nadia promised to send Lillian a text from Perth before Lillian goes to bed.

6. What is the latest time that Nadia can text Lillian?

- Lillian goes to bed at 10:00 pm.
- It is summer and Victoria uses Australian Eastern Daylight Time (AEDT).
- AEDT = Australian Eastern Standard Time (AEST) + 1 hour
- Queensland, Western Australian and Northern Territory do not use Daylight Saving Time.
- Allow 5 minutes for the text to arrive.

Show all working

10:00 pm AEDT = 9:00 pm AEST
= 9:00 – 2:00 Perth time
= 7:00 pm Perth time
Latest time = 7:00 – 0:05
= 6:55 pm

Latest Nadia can text: 6:55 pm

Stop here: Wait for your teacher's directions.

Model response

Storing, sending and displaying photos

- Digital photos are made up of tiny dots called pixels.
- Each pixel contains 3 bytes of data.
- A digital photo is stored as a file containing the data in every pixel.

Remember:
kilo = 1 thousand
mega = 1 million

7. a) What is the file size of a 5-megapixel photo?
Give your answer in megabytes (MB).

Show all working

5 megapixels = 5 million pixels
Amount of data = 5 million x 3 bytes
= 15 million bytes
= 15 megabytes

File size: 15 **MB**

Photo files are usually compressed to reduce the total file size.

b) What is the new file size if the photo file in Question 7a is compressed to 12% of its original size?

Show all working

New file size = 12% of 15 MB
$= \frac{12}{100} \times 15$ MB
= 1.8 MB

File size: 1.8 **MB**

When Nadia sends Lillian a photo in a multimedia message (MMS), her phone compresses the 1.84 MB file to 300 kB.

8. What percentage is the compressed file (300 kB) of the original file (1.84 MB)?

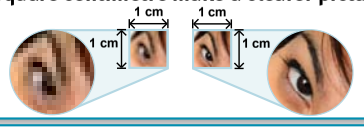
Show all working

1.84 MB = 1840 kB
% of original file size $= \frac{300 \text{ kB}}{1840 \text{ kB}} \times 100$
= 16.3%

16.3 **%**

More pixels per square centimetre make a clearer picture

A pixelated photo
Less than 10 000 pixels per square centimetre



A clear photo
10 000 pixels or more per square centimetre

- The smartphone shown in A and B below has a screen size of 8 cm x 5.3 cm.
- The photo displayed is made up of 250 000 pixels.

A

B

When the phone is rotated from A to B:

- the photo stays the same shape (the ratio of the sides stays the same)
- the number of pixels does not change.

9. Use calculations to explain why the photo in A is pixelated and in B is clear.

A

Show all working

Area = 8 x 5.3 cm²
= 42.4 cm²

Pixels/cm² = $\frac{250\,000 \text{ pixels}}{42.4 \text{ cm}^2}$
= 5896 pixels/cm²

This is < 10 000 pixels/cm², so the photo is pixelated.

B

Show all working

Length = 5.3 cm

Width = $\frac{5.3}{8} \times 5.3$ cm
= 3.5 cm
Area = 5.3 x 3.5 cm²
= 18.6 cm²
Pixels/cm² = $\frac{250\,000 \text{ pixels}}{18.6 \text{ cm}^2}$
= 13441 pixels/cm²

This is > 10 000 pixels/cm², so the photo is clear.

Model response

Using a phone for social networking and email

Social networking on a mobile phone

- Aaron has a data allowance of 200 MB per month (assume 1 month = 30 days).
- Accessing a social networking site such as Facebook uses about 10 MB of data per hour.
- Assume Aaron does not download or upload any other data.

10. How many minutes each day, on average, can Aaron spend on Facebook without going over his data limit? Give your answer to the nearest minute.

Show all working

$$\text{Total hours} = \frac{200 \text{ MB}}{10 \text{ MB/hr}}$$
$$= 20 \text{ hours}$$

$$\text{Time/day} = \frac{20 \text{ hours}}{30 \text{ days}}$$
$$= 0.67 \text{ hours/day}$$
$$= 40 \text{ minutes/day}$$

40 minutes/day

Text or email — which is better value?

- Aaron can send data (including email) from his phone at a cost of 50 cents per MB.
- It costs Aaron 28 cents to send a text message.

11. How many 10 kB emails can Aaron send for the cost of one text message?

Show all working

1 MB costs 50c

x MB costs 28c

$$x = \frac{28}{50} \times 1 \text{ MB}$$
$$= 0.56 \text{ MB}$$
$$= 560 \text{ kB}$$

$$\text{No. of emails} = \frac{560 \text{ kB}}{10 \text{ kB}}$$
$$= 56 \text{ emails}$$

56 emails

Extra working space

Stop here: Wait for your teacher's directions.

Model response

Joe's phone use on a prepaid plan

Joe uses e-tel's **$29 prepaid** plan, and his typical weekly phone use is shown in Table 3.
Look at your **e-tel brochure** for details of Joe's plan.

12. Complete Table 3 below to show:

- cost of calls and messages
- total data that Joe uses in a typical week.

Table 3: Joe's typical weekly phone use

Weekly calls and messages		Cost ($)	Weekly data use		Data (MB)
8	2-minute voice calls	17.20	3 hrs	Facebook	30
110	text messages	30.80	40	sent emails	0.4
4	multimedia messages	2.00	25	received emails	0.25
			1	song download	5.0
Total cost of calls and messages		**$50.00**	**Total data used**		35.65

Working space for Question 12 (if required)

13. a) Show that the included value ($) in a $29 prepaid recharge lasts Joe 3 weeks.

Show all working

Included value = $150
Use = $50/week
Time = $\frac{\$150}{\$50/wk}$
= 3 weeks

3 weeks

b) How long could the included data (MB) in Joe's $29 prepaid recharge last?

Show all working

Included data = 150 MB
Use = 35.65 MB/week
Time = $\frac{150\ MB}{35.65\ MB/wk}$
= 4.2 weeks

4.2 weeks

c) How often will Joe need to buy a $29 prepaid recharge so that he can continue to use his phone as shown in Table 3?

Every 3 weeks

Model response

Can Joe afford a new smartphone?

- Joe would like to change from the **$29 prepaid** to the **$29 contract** plan so that he can get a new smartphone.
- He cannot afford to spend much more each month than he is now spending on his prepaid plan.
- Look at the **e-tel brochure** for plan details.

14. Advise Joe whether he could change to the $29 contract plan without spending much more than he is now spending on his prepaid plan.

In your answer, use mathematical reasoning to:

- ❑ work out how much Joe is spending per month (30 days) on his $29 prepaid plan, using your answer in Question 13c
- ❑ find out how much Joe would spend each month if he changed to the $29 contract plan, based on his typical phone usage as shown in Table 3 (remember that in a contract plan, you pay extra when you exceed included data or value)
- ❑ work out how Joe could make better use of his included data so that he does not exceed the included value in the $29 contract plan
- ❑ provide advice to Joe based on your calculations and relevant information in the task.

Show all working

Monthly cost of prepaid plan

Cost = $29 every 3 weeks (21 days)

$$\text{Cost/month} = \frac{30 \text{ days}}{21 \text{ days}} \times \$29$$

$$= \$41.43$$

Monthly cost of contract plan

Cost/month = $39 + extra calls and data

$$\text{Monthly \$ use} = \$50 \times \frac{30}{7}$$

$$= \$214.29$$

Cost of extra calls and messages

$$= \$214.29 - \$180$$

$$= \$34.29$$

$$\text{Monthly data use} = 35.65 \text{ MB} \times \frac{30}{7}$$

$$= 152.8 \text{ MB}$$

(Less than the monthly included data of 200 MB)

Show all working

Total monthly cost of the contract plan for use in Table 2

$$= \$39.00 + \$34.29$$

$$= \$73.29$$

Making better use of included data

Cost of extra calls and messages each week

$$= \$34.29 \times \frac{7}{30}$$

$$= \$8/\text{week}$$

30 less texts per week would save Joe $8.40 per week (30 x 28c)
He has 46.7 MB ($200 \times \frac{7}{30}$) of data available each week and only uses about 36 MB/week.

30 brief emails uses about 300 kB of data, and he still has over 10 MB to use for social networking (about 1 hour on Facebook).

I would advise Joe to **change** / **not change** to the $29 contract plan because: .....
(circle one)

he can get the new phone and spend only $39 per month,which

is less than the $41.43 per month he is spending on his prepaid.

To do this he will need to monitor his text usage (send less than

80 texts per week) and use email and Facebook instead.

Notes

Notes

Notes

Guide to making judgments — Year 9 Mathematics

Name .....

Focus: Apply mathematical reasoning to analyse mobile phone trends, features, uses and payment plans, and to justify financial advice.

Knowledge and understanding	Thinking and reasoning Reflecting	Communicating	
Displays and analyses data to make inferences about trends in mobile phone use. Performs calculations involving time zones, digital data and percentage. Questions 1–5, 7, 8	Solves problems involving time, area, ratio, rate, proportion and units of measurement. Calculates mobile phone use costs and chooses strategies to provide financially sound advice. Reflects on learning to justify reasoning. Questions 6, 9–14	Uses mathematical language and representations when communicating thinking and justifying reasoning. Questions 1–14	
◀ Provides clear, justified analysis of trends. Consistently successful with calculations involving time zones, digital data and percentage.	◀ Correctly applies understandings to explain why a photo is clear. Provides detailed, fully justified financial advice, based on a consideration of all relevant information.	◀ Clearly and logically communicates procedures, reasoning and justification using mathematical representations and language, including units and appropriate rounding.	**A**
	◀ Correctly converts between time zones involving daylight saving, explains why a photo is pixelated and determines the number of emails sent for the cost of a text message.		**B**
◀ Correctly plots data, includes an appropriate title and key and makes valid predictions. Demonstrates some success in analysing trends in mobile phone ownership and moderate success in calculations involving digital data and percentage. Makes significant progress with time zone calculations.	◀ Makes significant progress in most of the following problems, leading to some solutions: explains why a photo is pixelated, determines Aaron's average daily social networking allowance and Joe's prepaid recharge period. Provides financial advice based on a consideration of some relevant information.	◀ Shows working and units in most calculations. Makes some use of mathematical language in explanations.	**C**
	◀ Makes progress in some of the following: explains why a photo is pixelated, determines Aaron's average daily social networking allowance and Joe's prepaid recharge period, provides financial advice.		**D**
◀ Demonstrates some success in displaying or analysing data, or in calculations involving digital data and percentage.		◀ Shows some working.	**E**

Feedback .....

.....