Essential Mathematics 2019 v1.1

IA3 high-level annotated sample response

September 2018

Problem-solving and modelling task

This sample has been compiled by the QCAA to assist and support teachers to match evidence in student responses to the characteristics described in the instrument-specific standards.

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. select, recall and use facts, rules, definitions and procedures drawn from Fundamental topic: Calculations and Unit 4 Topics 1 and 3
2. comprehend mathematical concepts and techniques drawn from Fundamental topic: Calculations and Unit 4 Topics 1 and 3
3. communicate using mathematical, statistical and everyday language and conventions
4. evaluate the reasonableness of solutions
5. justify procedures and decisions by explaining mathematical reasoning
6. solve problems by applying mathematical concepts and techniques drawn from Fundamental topic: Calculations and Unit 4 Topics 1 and 3.

Queensland Government
Queensland Curriculum & Assessment Authority
181238
For all Queensland schools

Instrument-specific standards

Formulate	Solve	Evaluate and verify	Communicate	Grade
The student work has the following characteristics:				
• documentation of appropriate assumptions • accurate documentation of relevant observations • accurate translation of all simple and complex aspects of the problem by identifying mathematical concepts and techniques.	• accurate use of complex procedures to reach a valid solution • discerning application of simple and complex mathematical concepts and techniques relevant to the task • accurate and appropriate use of technology.	• evaluation of the reasonableness of solutions by considering the results, assumptions and observations • documentation of relevant strengths and limitations of the solution and/or model • justification of decisions made using mathematical reasoning.	• correct use of appropriate technical vocabulary, procedural vocabulary and conventions to develop the response • coherent and concise organisation of the response, appropriate to the genre, including a suitable introduction, body and conclusion.	**A**
• statements of appropriate assumptions • statements of relevant observations • translation of simple and complex aspects of the problem by identifying mathematical concepts and techniques.	• use of complex procedures to reach a reasonable solution • application of simple and complex mathematical concepts and techniques relevant to the task • appropriate use of technology.	• statements about the reasonableness of solutions by considering the context of the task • statements about relevant strengths and limitations of the solution and/or model • statements about decisions made relevant to the context of the task.	• use of technical vocabulary, procedural vocabulary and conventions to develop the response • organisation of the response, including a suitable introduction, body and conclusion.	**B**
• statement of assumptions • statement of observations • translation of simple aspects of the problem by identifying mathematical concepts and techniques.	• use of simple procedures to make some progress towards a solution • application of simple mathematical concepts and techniques relevant to the task • use of technology.	• statement about the reasonableness of solutions • statement about strengths and/or limitations of the solution and/or model • statement about decisions made.	• use of some appropriate language and conventions to develop the response • adequate organisation of the response.	**C**
• statement of an assumption or an observation • translation of some simple aspects of the problem by identifying mathematical concepts and techniques.	• application of some simple procedures, mathematical concepts or techniques • superficial use of technology.	• statement about a decision and/or the reasonableness of a solution.	• use of everyday language to develop a response • basic organisation of the response.	**D**
• statement of an assumption, observation or translation of an aspect of the problem.	• inappropriate use of technology or procedures.	• inappropriate statement about a decision or the reasonableness of a solution.	• unclear and disjointed organisation of the response.	**E**

Task

Context

Albert Einstein reportedly said, ‘Compound interest is the eighth wonder of the world. He who understands it, earns it. He who doesn’t, pays it.’

An important aspect of managing money is understanding how to make the most of compound interest and loans. Compound interest means interest is earnt on the interest. Over time, this can mean a significant return on investments. Loans are often used to buy a house or a car. However, it is important to ensure that the repayments can be made.

Charlotte is 21 and has just started a full-time job. For her 21st birthday, her grandparents gave her some money to either invest or put towards buying a car or a house.

As Charlotte’s financial adviser, you must help her decide how to best use her money to achieve her financial goals.

Task

You are to develop recommendations for Charlotte to help her achieve two of her financial goals. Her goals include:

1. buying a car
2. paying off her credit card debt
3. establishing a savings account
4. buying a house.

Your teacher will give you Charlotte’s current financial information, including:

- her gross annual salary
- her current credit card debt
- the amount of money Charlotte received from her grandparents.

Your response will be in the form of a report to give to Charlotte. The report should outline different options and considerations for her financial goals, so Charlotte can prioritise them.

Sample response

Criterion	Grade awarded
Formulate Assessment objectives 1, 2, 5	**A**
Solve Assessment objectives 1, 6	
Evaluate and verify Assessment objectives 4, 5	
Communicate Assessment objective 3	

The annotations show the match to the standard descriptors of the instrument-specific standards.

Communicate [A]

coherent and concise organisation of the response

The introduction clearly describes what the task is about and concisely outlines the intent of the task.

Formulate [A]

documentation of appropriate assumptions

Communicate [A]

correct use of appropriate technical vocabulary, procedural vocabulary and conventions to develop the response

Formulate [A]

accurate documentation of relevant observations

Introduction

This task was developed based on the financial information provided to Charlotte as shown below. Using a variety of models developed with the financial calculators and tools in a spreadsheet program, it provides an overview of possible ways Charlotte can manage and make best use of her current income and debts.

Assumptions underpinning this financial plan

- Charlotte has no significant assets and she is only supporting herself, which means that she can pool as much of her financial resources towards her goals.
- All bank interest rates are fixed and her income remains stable for the period of consideration as evidenced by her last three years of bank statements and payslips.
- Charlotte's net salary will be estimated based on her income tax rates, and will not include other possible reductions in net income such as employee superannuation contributions, Medicare levy, HELP debt or salary sacrifice.

Financial goals and current information

The two financial goals:

1. Buying a car, as this will be the only available and efficient mode of transport from her home to work.
2. Paying off the credit card debt, as part of a personal student loan from the bank, due to incurring university and travel expenses.

Financial status:

- Gross annual salary: $62 675
- Credit card debt: $2245
- One-off gift of money from grandparents: $12 500

Formulate [A]

accurate translation of simple aspects of the problem by identifying mathematical concepts and techniques

Solve [A]

accurate use of complex procedures to reach a valid solution

The solution consists of an involved combination of parts that are interconnected.

Communicate [A]

correct use of appropriate technical vocabulary, procedural vocabulary and conventions

Net income

In order to provide advice about Charlotte's financial goals, we needed to know her yearly net income and use it to calculate her fortnightly and monthly net incomes respectively. This will allow us to easily see if she can afford the various fortnightly or monthly repayments as a starting point.

- Charlotte's gross annual salary: $62 675

Net annual salary = Gross annual salary – Income tax (estimation from www.ato.gov.au/Calculators-and-tools)
= $62 675 – $11 916.37
= $50 758.63
The two different net income options were calculated and rounded to the nearest cent as shown below:

$$Fortnightly\ net\ income = \frac{\$50\ 758.63}{26} = \$1952.26$$

$$Monthly\ net\ income = \frac{\$50\ 758.63}{12} = \$4229.89$$

Analysis and discussion of financial goals

1. Buying a car

Charlotte has decided that a Hyundai i30 will be her car of interest. A 2013 SE Auto priced at $14 990 excluding Government charges has been used as the basis for the financial analysis and discussion.

Image: 2013 Hyundai i30 (GD) SE 3-door hatchback, Creative Commons Attribution 4.0, https://commons.wikimedia.org/wiki/File:2013_Hyundai_i30_(GD)_SE_3-door_hatchback_(2015-10-07)_01.jpg,accessed Feb 22, 2018.

A five-year personal loan

Formulate [A]

documentation of appropriate assumptions

Charlotte needs to take out a personal loan at her local bank to buy this vehicle. Using an online personal calculator from a reputable government website, and assuming no administrative fees, an interest rate of 8.99% p.a. for 5 years yields the following figures (and calculations):

Source: *ASIC*, 'Personal loan calculator', www.moneysmart.gov.au/tools-and-resources/calculators-and-apps/personal-loan-calculator

Solve [A]

discerning application of simple mathematical concepts relevant to the task

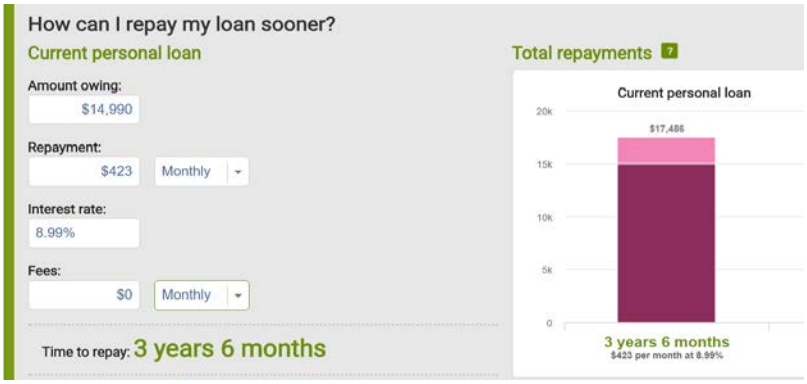
Interest = Final amount – Principal amount
Interest = $18 666 – $14 990
Interest = $3676
Charlotte's monthly payments would be $311 (or $143 per fortnight according to the online calculator). She would need to pay $3676 in interest over the 5 years, paying $18 666 in total.

Evaluate and verify [A]

evaluation of the reasonableness of solutions by considering the results, assumptions and observations

Paying it off early

The minimum monthly repayment is less than 10% of Charlotte's monthly net income, i.e. 10% of $4229.88 < $311. Charlotte could consider repaying more per month in order to pay the loan off earlier. If she was to repay this loan at 10% of her monthly net income, approx. $423 per month, Charlotte could pay off the car loan in 3.5 years, i.e. 18 months earlier.



Source: *ASIC*, 'Personal loan calculator', www.moneysmart.gov.au/tools-and-resources/calculators-and-apps/personal-loan-calculator

Evaluate and verify [A]

documentation of relevant strengths and limitations of the solution and/or model

Paying off the loan over 5 years compared to 3.5 years would also save her money in total, specifically: $18 666 – $17 486 = $1180.

A limitation to both these models is that there are no bank fees included in the loan. It is not in the scope of this report to investigate the benefits of different loans in detail, so this information was not included in the calculations. Some loans have upfront fees and some can be monthly or

yearly, therefore the strengths of these alternative options should be considered in the report. If Charlotte chooses to finance her car through a personal loan option then she should definitely review the terms and conditions in detail.

Formulate [A]

documentation of appropriate assumptions

2. Paying off the credit card

Charlotte currently owes $2245 on her credit card. Assuming her current credit card's interest rate is at 13.99% p.a., she will be paying more than $314 per year in interest. (That is, 13.99% of $2245. But credit cards calculate interest daily and charge interest monthly, so it would be more than this.)

Formulate [A]

accurate translation of complex aspects of the problem by identifying mathematical concepts and techniques

One reason credit cards can be hard to pay off is because of the interest. The following plan removes this challenge by moving her debt to a new card with a 16-month interest-free period on balance transfers. The model I have developed is based on Charlotte making a payment of $60 per fortnight (i.e. the balance reduces by $60 per fortnight until it reaches $0).

Communicate [A]

coherent and concise organisation of the response

use of table to clearly summarise information and data

Date	Transaction	Balance
15-Oct-17	Balance transfer	$2,245.00
29-Oct-17	-$60.00	$2,185.00
12-Nov-17	-$60.00	$2,125.00
26-Nov-17	-$60.00	$2,065.00
10-Dec-17	-$60.00	$2,005.00*

* Balance = Balance above + transaction (e.g. C6 = C5 + B6)

Solve [A]

accurate and appropriate use of technology

Evaluate and verify [A]

justification of decisions made using mathematical reasoning

As can be seen by extrapolating the trend line in the graph below, if Charlotte continued repayments at this rate, she could be free of the credit card debt by late March 2019, and will have paid off her debt in less than 16 months.

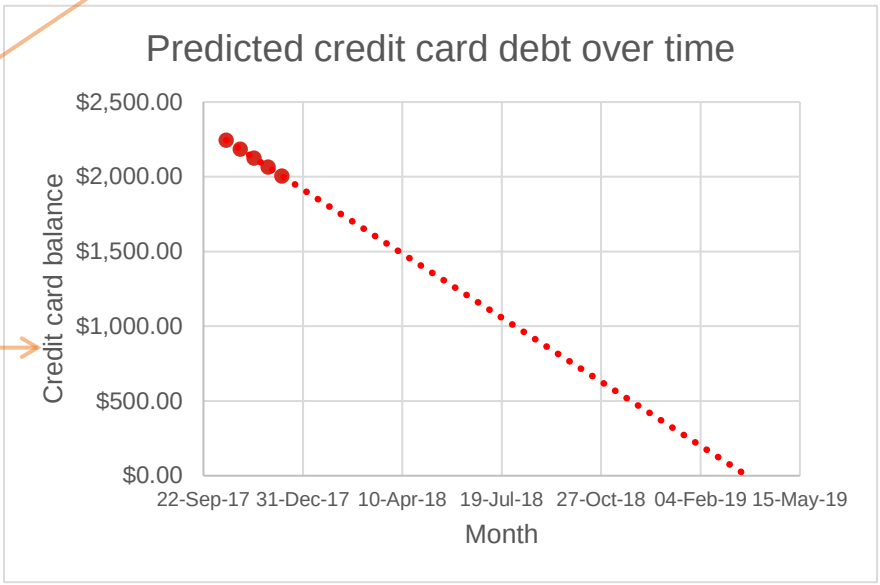
Solve [A]

discerning application of complex mathematical concepts and techniques relevant to the task

Solve [A]

accurate and appropriate use of technology

use of spreadsheet software to produce a scatterplot for extrapolation of data trend



Evaluate and verify [A]

documentation of relevant strengths and limitations of the solution and/or model

A possible limitation of this model is the assumption that Charlotte would no longer use the credit card to make any more purchases/transactions. It also doesn't include interest because of the 0% balance transfer period. If this credit card is still being used, then further repayments should be increased to compensate. The strength of this model greatly depends on Charlotte's credit card usage.

Conclusion

Communicate [A]

coherent and concise organisation of the response, appropriate to the genre, including a suitable conclusion

The table below outlines Charlotte's fortnightly budget based on her income and fortnightly repayments required for paying off her credit card and possible car loan.

use of table to clearly summarise information and data

Item	Amount
Net income	$1952.26
Car repayments	– $143.00
Credit card repayments	– $60.00
Remaining budget	$1749.26

Evaluate and verify [A]

evaluation of the reasonableness of solutions by considering the results and observations

Considering the analysis and discussion above, Charlotte's financial goals are achievable. Making the minimum repayments, as outlined in the analysis above, leaves her with just less than $1750 per fortnight for other expenses, saving further, considering a home loan and/or to make larger repayments if she chooses.

Communicate [A]

correct use of appropriate technical vocabulary, procedural vocabulary and conventions

The models outlined above are of great use in assisting Charlotte with her financial decisions. It shows how changing relevant constants can affect interest, which, if she correctly understands, can be used to her advantage and protect her from any poor financial decisions.

Formulate [A]

documentation of appropriate assumptions

However, Charlotte is limited by some of the assumptions that underpin them, such as fixed interest rates, and different accounts and loans that have no initial or ongoing administrative fees. What Charlotte will gain from this report will hopefully provide her with a greater understanding and appreciation of the financial implications for her future.

Appendix

Credit card repayment spreadsheet

Date	Transaction	Balance
15-Oct-17		$2,245.00
29-Oct-17	-$60.00	$2,185.00
12-Nov-17	-$60.00	$2,125.00
26-Nov-17	-$60.00	$2,065.00
10-Dec-17	-$60.00	$2,005.00
24-Dec-17	-$60.00	$1,945.00

Credit card repayment spreadsheet showing formulas

Date	Transaction	Balance
43023		2245
43037	-60	=C2+B3
43051	-60	=C3+B4
43065	-60	=C4+B5
43079	-60	=C5+B6
43093	-60	=C6+B7