

Name: .....

Year Level: ..... Date: .....



# **ALGEBRA FORM B**

## **Assessment Booklet**

**Reframing Mathematical Futures II**

*An Australian Mathematics & Science Partnership Project  
(2015-2018)*

# ALGEBRA FORM B

## 1. Hot Air Balloon Trip

Jenny was given a ride in a hot air balloon for her birthday.

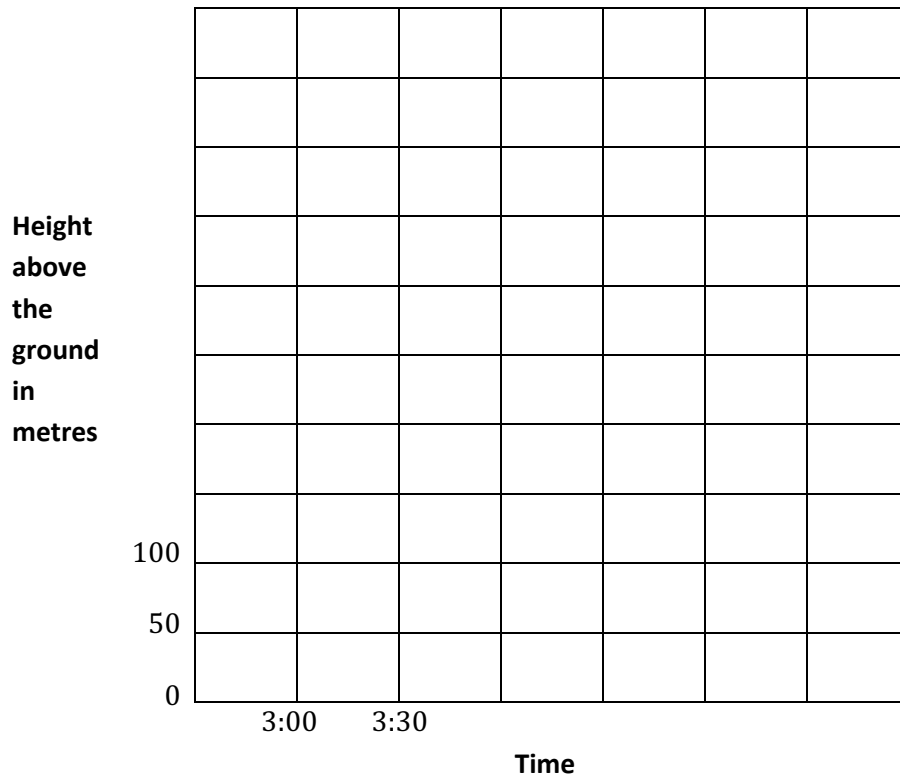
The table below shows some information about the trip.



Time	2:30 pm	3:00 pm	3:30 pm	4:00 pm	4:30 pm	5:00 pm	5:30 pm	6:00 pm
Height above ground in metres	0	150	250	350	500	250	100	0

**a** [AHAB1]

Complete the scale on the axis and draw the graph to show the information on the table.



**b** [AHAB2]

About how long did the balloon stay at or above 250 metres? \_\_\_\_\_

**c** [AHAB3]

When was the balloon at 400 metres? \_\_\_\_\_

Explain your reasoning using as much mathematics as you can.

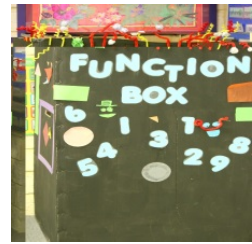
## 2. Black Box

[ABBEQ]

Sarah put 5 into a black box and 14 came out.

She knows the box changes a number according to a rule.

Write in symbols or describe in words five different rules that the box could be using. (Use as many operations as you wish)



1.

2.

3.

4.

5.

## 3. Odds and Evens

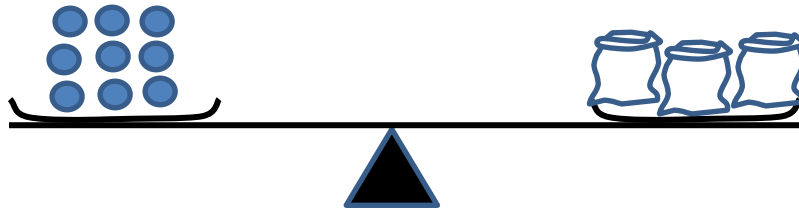
[AMUST]

Mustafa said “the sum of two odd numbers is always an even number”. Do you agree? Show your reasoning to convince someone else that your decision is correct.

**4. Balancing Scales**

The bags on these scales all weigh the same.

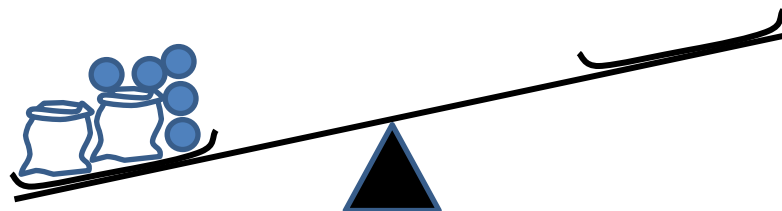
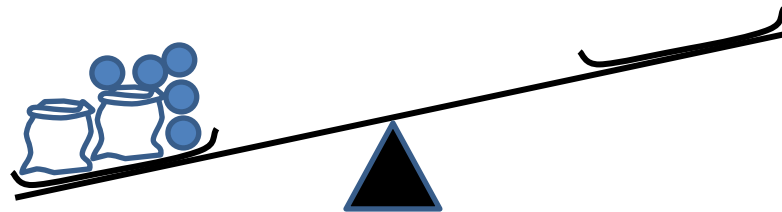
The balls on these scales all weigh the same.



**a**

[AEQB1]

Using the information above, draw two different ways to make the scales balance (you may use as many bags and/or balls as you wish).



**b**

[AEQB2]

Write an equation for each scale you drew.

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5. **Number boxes**

a

[ARLT2]

What number would go in the  box to make this a true number sentence?

$$\boxed{\phantom{000}} - 347 = 671 - 357$$

Explain your reasoning.

b

[ARELS1]

What numbers would go in these boxes to make a true number sentence (the numbers may be different). Explain your reasoning.

$$\boxed{\phantom{000}} + 521 = 527 \quad \boxed{\phantom{000}} +$$

c

[ARELS2]

Find a different pair of numbers that would make the number sentence above true.

d

[ARELS3]

Describe how you could find **all** possible pairs of numbers that would make this a true number sentence.

- e** [ARELS4]  
What numbers would go in these boxes to make a true number sentence (the numbers may be different).

$$\square - 521 = \square - 527$$

Explain how you worked it out.

- f** [ARELS5]  
Find another pair of numbers that would make the number sentence in part **e** true.

- g** [ARELS6]  
Describe how you could find all possible pairs of numbers that would make this a true number sentence.

**6. Best Buy Music Downloads**

Peter is investigating deals for music downloads. He has found two special offers and he wants to choose the best value for money.

**MEMORABLE  
MUSIC**

25 downloads  
for \$20



**SENSATIONAL  
SONGS**

\$20 membership  
plus  
\$10 for 25 downloads



**a** [ABBUY1]  
If he wants 25 downloads, which deal should he choose? Explain your reasoning using as much mathematics as you can.

**b** [ABBUY2]  
If Peter does not know how many downloads he will need, what deal would you advise. Explain your reasoning using as much mathematics as you can.

**c** [ABBUY3]  
Confirm your answer to part (b) using a different approach. Explain your reasoning using as much mathematics as you can.

## ALGEBRA FORM B RUBRIC

### 1. AHAB1

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Axes labelled correctly but graph not drawn or graph drawn but axes incomplete
2	Partially correct graph with axes labelled correctly (e.g., bar graph or points drawn but not connected) or one or two points plotted incorrectly
3	Line graph and axes drawn and labelled correctly

### AHAB2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Correct response (1 ½ hours or 1 hour 30 min)

### AHAB3

SCORE	DESCRIPTION
0	No response or irrelevant response
1	General response (e.g., <i>look at the graph</i> ) or specific time(s) provided
2	Correct response (between 4:05 and 4:15 and between 4:35 and 4:45) but with no explanation
3	Correct response with explanation (e.g., find 400m on the graph and look at where the graph crosses the 400 metre mark to determine the time, at 4:00 the balloon reached 350m and at 4:30 the balloon reached 500m. Therefore, the balloon hit 400m in between these two times at around 4:10 or 4:15 and again somewhere between 4:35 and 4:45).

### 2. ABBEQ

SCORE	DESCRIPTION
0	No response or irrelevant response
1	One or more correct rules expressed in words or symbols (e.g., add 9; add 2 and double; double and add 4; $3x - 1$ ; $4x - 6$ ; $5x - 11$ )
2	3 or more correct rules expressed in words or symbols
3	5 correct rules using either words or symbols

### 3. AMUST

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Correct (Yes) or incorrect with no reasoning or examples to support conclusion
2	Correct supported with an example
3	Correct supported by generalised argument (e.g., $\text{Odd} + \text{Odd} = \text{Even} + 1 + \text{Even} + 1 = \text{Even} + 2 = \text{Even number}$ ).



#### 4. AEQB1

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Attempt made but uses incorrect weights of bags and balls (i.e., does not use 1 bag = 3 balls)
2	One way drawn correctly
3	Two different ways drawn correctly (e.g., 0 bags, 11 balls; 1 bag, 8 balls or 3 bags, 2 balls)

#### AEQB2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	One equation written correctly or expression only written (e.g., $3x + 2$ )
2	Two equations written correctly (e.g., $2 \text{ bags} + 5 \text{ balls} = 3 \text{ bags} + 2 \text{ balls}$ or $2x + 5 = 3x + 2$ )

#### 5. ARLT2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Correct answer (661) with no reasoning or reasoning based on full calculation or incorrect answer (e.g., 681) but correct reasoning based on the relationship between 347 and 357 (difference of 10)
2	Correct answer with reasoning based on the relationship between 347 and 357 (there is a difference of 10 between the two numbers therefore 671 and answer must also have a difference of 10).

#### ARELS1

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect response (perhaps due to errors in calculation) but with correct reasoning based on the relationship between 521 and 527 (difference of 6)
2	Two correct numbers given (e.g., 13 and 7; 527 and 521) but little/no reasoning.
3	Two correct numbers given where the number on the left is 6 more than the number on the right (e.g., 100 and 94) with reasoning that reflects the relationship between 521 and 527 (difference of 6).

#### ARELS2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	A different and correct pair.

**ARELS3**

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect attempt at describing may be based on previous answers (e.g., <i>add 2 more to both</i> ).
2	Statement regarding the difference of 6 (e.g., <i>number on the left must be six more than the number on the right</i> ) or expression showing the difference (e.g., $a + 6$ , and $a$ )

**ARELS4**

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect response (perhaps due to errors in calculation) but with correct reasoning based on the relationship between 521 and 527 (difference of 6)
2	Two correct numbers given (e.g., 613 and 619) but little/no reasoning, may include some calculations.
3	Two correct numbers given where the number on the right is 6 more than the number on the left (e.g. 600 and 606) with reasoning that reflects the relationship between 521 and 527 (difference of 6).

**ARELS5**

SCORE	DESCRIPTION
0	No response or irrelevant response
1	A different and correct pair

**ARELS6**

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect attempt at describing may be based on previous answers (e.g., <i>add 10 to both</i> ).
2	Statement regarding the difference of 6 (e.g., <i>number on the right must be six more than the number on the left</i> ) or an expression showing the difference (e.g., $a$ and $a + 6$ )

**6. ABBUY1**

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Correct response but no explanation beyond a descriptive statement (e.g., Sensational Songs is more expensive)
2	Correct (Memorable Music) with explanation that uses calculations to show why Memorable Music better

**ABBUY2**

<b>SCORE</b>	<b>DESCRIPTION</b>
<b>0</b>	No response or irrelevant response
<b>1</b>	No comparison made or Indicates one or the other with a simple example or " <i>it depends on how many downloads</i> " with no working out evident or no comparison made
<b>2</b>	Response indicates some comparison (e.g., trial and error calculations) but explanation incomplete or conclusion unjustified
<b>3</b>	Qualified statement (e.g., for less than 50 downloads, Memorable Music is better, but if more than 50 downloads Sensational Songs is better) supported by some form of mathematical reasoning (e.g., calculations, table, graph or algebraic expression)

**ABBUY3**

<b>SCORE</b>	<b>DESCRIPTION</b>
<b>0</b>	No response or irrelevant response
<b>1</b>	Some attempt to explain reasoning using a different approach to the one used for part (b) but incomplete incorrect or no comparison made
<b>2</b>	Different approach to the one used for part (b) (i.e., table, graph, algebraic expression) used correctly to support conclusion

## STUDENT SCORE SHEET ALGEBRA FORM B

Student Name:	Year Level:
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		Score	Comments
1	AHAB1		
	AHAB2		
	AHAB3		
2	ABBEQ		
3	AMUST		
4	AEQB1		
	AEQB2		
5	ARLT2		
	ARELS1		
	ARELS2		
	ARELS3		
	ARELS4		
	ARELS5		
	ARELS6		
6	ABBUY1		
	ABBUY2		
	ABBUY3		
<b>Total Raw Score</b>			

## RAW SCORE TRANSLATOR FOR ALGEBRA FORM B

The following table locates students on the **Learning Progression for Algebraic Reasoning** based on their total score for Algebra Form B. Total scores are obtained by adding the rubric scores assigned to each item on the form. Where a total score is very close to the beginning or end of a score range, teachers are advised to use their knowledge of the student to make a decision about the most appropriate Zone.

Students need to have had an opportunity to attempt all tasks for this process to be meaningful.

Total Score	Zone	Zone Description
38-40	8	Is able to combine a facility with symbolic representation and an understanding of algebraic concepts to represent and explain mathematical situations. Explanations are sophisticated using logical thought and the language of reasoning. Can use multiple representations in a co-ordinated manner to solve, analyse, convince and conclude. Can visualise the form and structure of a function, at least graphically, from a real context. Is able to work in a context free environment using symbolic language and treat algebraic expressions (e.g. $3x + 2$ ) as single entities. Can generalise more complex situations. Is able to establish and describe equivalence involving the four operations explaining relationships in symbolic terms. Can use abstract symbols to solve problems in context with multiple steps.
35-37	7	Is able to use and interpret algebraic conventions for representing generality and relationships between variables. Beginning to use sound logical reasoning with appropriate reasoning language (e.g. if ... then, must) evident. There is more co-ordination of multiplicative thinking and the associated language to notice algebraic structure. Can recognise and use the relationships between multiple entities and connections between and within different representations. Is able to establish and describe equivalence explaining relationships using the distributive property and the inverses of addition and multiplication. Can generalise quite complex situations and in more direct situations is beginning to use simplest form.
29-34	6	Can use and interpret basic algebraic conventions to represent situations involving a variable quantity. Beginning to explain using logical language and to use if ... then reasoning. Uses symbolic language but the need for simplification is still being developed. Able to generalise arithmetic relationships with justification, including simple multiplicative relationships, but are often still context bound. Can show why several expressions are equivalent, typically employing numerical (non-symbolic) justifications.
23-28	5	Able to use multiplicative reasoning in simple situations. Can reason with more complex additive situations involving larger numbers and subtraction but usually by examples. Has moved from algebraic expressions to using equations. Can derive a strategy that maintains equivalence, but cannot

		yet generalise the situation. Able to use symbols to express rules. Can follow, compare and explain rules for linking successive terms in a sequence. Recognises and represents simple functional representations. Can justify an argument using mathematical text. Beginning to generalise using words or using some symbolic generalisations in simple situations, usually building on in context.
20-22	4	Beginning to work multiplicatively and simultaneously co-ordinate variables, although still uses specific examples to convince. Able to reason and generalise in simple situations. Can recognise and interpret the relevance of range from table and/or graphs and to recognise functional relationships. When faced with more complex algebraic situations is unable to use the full range of explanation or handle all of the information simultaneously. Beginning to transition to abstraction by inserting a number for a pronumeral.
12-19	3	Beginning to use symbolic expression and elementary reasoning. While still using arithmetic approaches there is evidence of relational reasoning with the numbers and providing some explanation. Beginning to recognise simple multiplicative relationships. There is some evidence of co-ordination of two ideas. Explanation and justification is limited. Algebraic expressions are used rather than equations. Beginning to recognise equivalent relationships. Can explain simple generalisations by telling stories, manipulating materials and very simple use of symbolic language.
7-11	2	Beginning to recognise patterns and relationships and conjecture about these. Able to identify numbers that vary and numbers that stay the same. Engages with the context, but arithmetic reasoning, typically based on calculations, is still being used. Recognises some multiples and some relationships like 6 more/6 less, while not necessarily recognising equivalence. Can work with simple scales and transfer from a table of values to a graph.
1-6	1	Can continue simple patterns but is likely to build them additively. Reasoning is confined to specific incidences and numerical examples of simple physical situations. Arithmetic thinking is used. Abstraction and generalisation not evident at this stage.