

National Numeracy Tests

REASONING

8ER16MS

Marking the test
and understanding performance



139161



Llywodraeth Cymru
Welsh Government

Marking the reasoning test

This document comprises:

- the markscheme for the National Numeracy Test (Reasoning) for Year 8 together with marking guidance
- additional information to support teachers' understanding of their learners' responses, providing a platform for growth.

For learners using the modified large print or Braille test materials, some questions have been adapted or replaced. When marking a modified large print or Braille test, please use this markscheme alongside the adapted markscheme which is included in the *Notes for teachers* that accompany the modified tests.

All items within this test require numerical reasoning and therefore most are open, allowing the learner to select what they consider to be an appropriate strategy. This means that there may be a range of ways of arriving at a solution.

As a consequence, marking the reasoning tests may not be as straightforward as simply checking whether or not the final answer is correct since the methods used are also of importance.

Understanding the markscheme

To ensure the accessibility of the markscheme, the focus is primarily on key pointers that indicate the learner's understanding. For example, the markscheme may state 'Shows the value **12**' or 'Links **36** to **9**'.

These values generally credit intermediate stages, showing partial understanding.

Alongside this, commentary is provided as appropriate, to enable markers and teachers to understand their learners' responses and also to support marking.

Common errors are also flagged up, as well as explanations as to why certain responses are awarded partial credit.

Exemplars

To help schools not only with marking but also in interpreting their learners' responses, a range of exemplars is provided for each item, as appropriate.

These exemplars are actual responses from learners (taken from a trial of the reasoning tests) so include spelling mistakes and numerical inaccuracies. They have been typed to ensure anonymity.

Assessing and building on test performance

Marking the test gives teachers an overall score for each learner.

However, this score in isolation is unlikely to provide a great deal of information relating to the strengths of individual learners, or evidence of those areas of numerical understanding and reasoning skills that require improvement.

Equally, comparing learners' scores may mask significant differences in their performance. For example, two learners may both score 12. However, within that overall score Learner A may show a clear ability to communicate effectively but need support to review their work, while Learner B may show the exact opposite.

For this reason, the markscheme and the accompanying materials are designed to provide teachers with a deeper assessment of both individual and class performance.

Diagnostic tool

To assist in interpreting and building on test performance, a diagnostic tool is provided.

This can be accessed via gov.wales/learning

At its simplest level, the diagnostic tool provides markers with a check on the total score for that particular learner.

However, completing the full set of data on each learner gives the teacher an overview of class performance, identifying group or individual strengths and problem areas and hence indicating further teaching needs.

Building on the test: classroom activities

Having assessed learners' ability to apply numerical reasoning and identified areas for both individual and class development, teachers may then wish to build on the test experience and materials through accessing gov.wales/learning

This site provides the test items and associated markschemes, but also includes additional materials with suggestions for linked classroom activities to extend the learning.

In addition, further activities supporting the learning and teaching of numerical reasoning can be found on gov.wales/learning

Markscheme

General marking rules

It is essential that you apply this markscheme, the marking guidance and the general marking rules given below to your own marking, in order for the standardised scores to be valid.

- The marking guidance shown within the markscheme should be applied to find the relevant score for each question. No half marks are awarded.
- At the end of each double-page spread of marking, record the total number of marks in the 'total' box in the bottom right-hand corner. Check that the mark recorded does not exceed the maximum number of marks available.
- Once the marking has been completed, add up the total number of marks awarded. This is the total score and should be recorded on the cover of the test booklet and input onto the relevant mark sheet on the school's management information system, together with the details and date of the test taken.
- Markers should record their initials on the cover of the test booklet to assist quality assurance.

This data should then be submitted as part of the Welsh National Tests Data Collection (WNTDC). Further details are available from the *National Reading and Numeracy Tests – Test administration handbook 2016* on the Learning Wales website and in *Welsh National Tests Data Collection and reporting arrangements 2015/16* available on the Welsh Government website.

Marking guidance

It is important that the tests are marked accurately. The questions and answers below help to develop a common understanding of how to mark fairly and consistently.

Must learners use the answer boxes?

Provided there is no ambiguity, learners can respond anywhere on the page. If there is more than one answer, the one in the answer box must be marked, even if incorrect. However, if the incorrect answer is clearly because of a transcription error (e.g. 65 has been copied as 56), mark the answer shown in the working.

Does it matter if the learner writes the answer differently from that shown in the markscheme?

Numerically equivalent answers (e.g. eight for 8, or two-quarters or 0.5 for half) should be marked as correct unless the markscheme states otherwise.

How should I mark answers involving money?

Money can be shown in pounds or pence, but a missing zero, e.g. £4.7, should be marked as incorrect unless the markscheme states otherwise.

How should I mark answers involving time?

In the real world, specific times are shown in a multiplicity of ways so accept, for example, 02:30, 2.30, half past 2, etc. Do not accept 2.3 as this is ambiguous. The same principle should be used for marking time intervals, e.g. for two and a half hours accept 2.5 but not 2.5pm.

What if the method is wrong but the answer is correct?

Unless the markscheme states otherwise, correct responses should be marked as correct even if the working is incorrect as learners may have started again without showing their revised approach.

What if the learner has shown understanding but has misread information in the question?

It is important that learners select the appropriate information and review their work. However, for most questions, method marks can still be obtained.

What should I do about crossed-out work?

Working which has been crossed out and not replaced can be marked if it is still legible.

What is the difference between a numerical error and a conceptual error?

A numerical error is one in which a slip is made, e.g. within 86×67 the learner works out $6 \times 7 = 54$ within an otherwise correct response. A conceptual error is a more serious misunderstanding for which no method marks are available, e.g. if 86×60 is recorded as 516 rather than 5160

What if learners use a method that is not shown within the markscheme?

The markscheme shows the most common methods. However, there can be a wide range of approaches to a question and any correct method, however idiosyncratic, is acceptable.

In all questions, the correct answer should be given full marks, whatever the method used, unless the markscheme states otherwise.

Most questions give partial credit for responses that show a correct method but the answer is incorrect or incomplete: a correct method is one that would lead to a correct answer if there were no numerical errors.

8ER16 Reasoning test: Markscheme

In this question part, there are four correct methods. These are shown below. Mark as follows:

Q	Marks	Answer
1i	5m	4 minutes with all five steps of their method shown or clearly implied, e.g. on the graph
	Or 4m	Any four steps correct or clearly implied
	Or 3m	Any three steps correct or clearly implied
	Or 2m	Any two steps correct or clearly implied
	Or 1m	Any one step correct or clearly implied
		Or Answer 4 minutes with no supportive working

The five steps within each method are shown below, with complete, correct solutions.

Notes: To gain credit, a step must be calculated correctly.

Units need not be shown, and can be ignored even if incorrect.

Use follow-through, i.e. give credit for a step even if a previous step is incorrect.

Rounding within follow-through: accept if rounded, including to the nearest integer, or if truncated to 1 or more decimal place but not to the nearest integer.

Method A (most common)

Read graph	Any one of 10, 12, 13, 15 (joules/sec)
Read graph correctly	All four correct, no others
Total	50 (joules/sec)
$12000 \div \text{total}$	$12000 \div 50 = 240$ (secs)
That answer $\div 60$	$240 \div 60 = 4$ mins

Method B (less common)

Read graph	Any one of 10, 12, 13, 15 (joules/sec)
Read graph correctly	All four correct, no others
Total	50 (joules/sec)
Total $\times 60$	$50 \times 60 = 3000$ (joules/min)
$12000 \div \text{that answer}$	$12000 \div 3000 = 4$ mins

Method C (rare)

Read graph	Any one of 10, 12, 13, 15 (joules/sec)
Read graph correctly	All four correct, no others
Each one $\times 60$	600, 720, 780, 900 (joules/min)
Total	3000 (joules/min)
$12000 \div \text{total}$	$12000 \div 3000 = 4$ mins

Method D (very rarely seen)

Total the weights	$50 + 60 + 65 + 75 = 250$
Read graph correctly for any value	Any correct reading
Read graph correctly for their total	50 (joules/sec)
<i>The next two steps are as for method A or method B</i>	

Question 1i: Exemplars



$$\begin{aligned} 10j &= 50\text{kg} \\ 12j &= 60\text{kg} \\ 13j &= 65\text{kg} \\ 15j &= 75\text{kg} \end{aligned}$$

50 joules per second

$$50j \times 240s = 12000 \text{ joules}$$

$$240s + 60 = 4 \text{ mins}$$

Answer 4 mins.

4 minutes

Method A; 4 minutes, all five correct steps; **5 marks**

- This learner justifies their answer of 4 minutes, using method A. The work is set out clearly and effectively.



$$1 \text{ second} = 10+13+12+15=50$$

$$10 \text{ seconds} = 50 \times 10 = 500$$

$$100 \text{ seconds} = 5000$$

$$1000 \text{ seconds} = 50\,000$$

~~$$5000 + 5000 = 10\,000.$$~~

$$100 + 100 = 200$$

$$500 + 500 + 500 + 500 = 2000$$

$$10 + 10 + 10 + 10 = 40$$

$$10000 + 2000 = 12\,000$$

$$200 + 40 = 240$$

~~$$240 \div 6 = 40$$~~

$$240 + 60 = 4$$

4 minutes

Method A; 4 minutes, all five correct steps; **5 marks**

- This work also shows method A, but to reach 240 ($12000 \div 50$) the learner has used a tortuous adding-on method. Support in understanding (and using!) division would be beneficial.



$$13 + 15 + 10 + 12 = 50$$

$$50 \times 60 = 36000$$

$$12000 \div 36000 = 0.3$$

0.3 minutes

Method B; four correct steps; **4 marks**

- Most learners, once they have reached 50, divide into 12000 before changing into minutes (method A). A few learners do this in reverse order (method B). The first three steps are correct, but the fourth is incorrect as $50 \times 60 \neq 36000$. However, the fifth step shows correct follow-through as rounding is allowed.



$$1 \text{ min} = 600\text{J}$$

$$1 \text{ min} = 720\text{J}$$

$$1 \text{ min} = 780\text{J}$$

$$1 \text{ min} = 900\text{J}$$

$$\frac{3000 \times 4 = 12000}{2}$$

1200 minutes

Method C; four correct steps; **4 marks**

- Although this learner does not show the values 10, 12, 13 and 15 they are clearly implied by 600, 720, 780 and 900 since these values could not otherwise have been derived. The fourth step is correct (3000) and the correct answer, 4 minutes, is embedded but as this has not been selected for the answer, the fifth step is incorrect.

Continued overleaf

Question 1i: Exemplars (continued)

$50 \text{ kg} = \text{per second } 10 \text{ joules}$
 $60 \text{ kg} = \text{per second } 12 \text{ joules}$
 $65 \text{ kg} = 13 \text{ joules}$
 $75 \text{ kg} = 15 \text{ joules}$

15
 13
 12
 10
 $\hline 50$

50 joules per second

$15 \times 60 = 900 \text{ joules}$
 $13 \times 60 = 780 \text{ joules}$
 $12 \times 60 = 720 \text{ joules}$
 $10 \times 60 = 600 \text{ joules}$
 $\hline 8400$
 $\quad 2$

8,400 joules

6 minutes

Method A/B then C; three correct steps; 3 marks

- This learner starts by showing the first three correct steps for method A or B, but then changes to method C where the first three steps are also shown. However, the remaining steps are incorrect: the sum is wrong and 6 minutes does not follow through from values shown.

50
 $\times 10$
 $\hline 500m$

60
 $\times 12$
 $\hline 120$
 60

65
 $\times 13$
 $\hline 195$
 65

75
 $\times 15$
 $\hline 375$
 75

180m 260m 450m

260
 450
 180
 500
 $\hline 1320m$

1320 minutes

Method C; two correct steps; 2 marks

- The graph is read correctly (as shown by $\times 10, \times 12, \times 13, \times 15$) but this learner then multiplies by the number of kg, rather than by 60. The total is incorrect and the fifth step is not shown.

10
 12
 13
 14
 15
 $\hline 60$

60 joules

60
 120
 180
 240
 300
 360
 420
 480
 540
 600
 660
 720
 780

840
 900
 1000
 $1000 \times 12 = 12000$

minutes

Method A; one correct step; 1 mark

- The learner reads the graph but because 14 is included the second step is incorrect. Their total should be 64, so the third step is incorrect, and although they are clearly trying to find $12000 \div 60$ (their total) by counting on, 200 is not found so the fourth step is incorrect. The fifth step is omitted.

4 people
 $12000 \div 4 = 3000$
 $3000 \div 60 = 50$

50 minutes


Method A; one correct step; 1 mark

- The graph has not been read, so the first three steps must be incorrect, and $12000 \div 4 = 3000$ does not imply the correct fourth or earlier steps for methods B or C. However, $3000 \div 60 = 50$ implies a correct follow-through conversion to minutes, so 1 mark can be given for the fifth step of method A.

Q	Marks	Answer
1ii	1m	Half of their answer to part i

Do not accept 2 minutes without 4 minutes shown in part i

Question 1ii: Exemplars

<p>4 minutes</p> <p>Suppose the dancers could double the number of joules per second. Then how many minutes would it take them to charge the phone?</p> <p>2 minutes</p>	<p>Correct; 1 mark</p>
<p>2.5 minutes</p> <p>Suppose the dancers could double the number of joules per second. Then how many minutes would it take them to charge the phone?</p> <p>1.25 minutes</p>	<p>Correct; 1 mark</p> <ul style="list-style-type: none"> As part ii is half of their answer to part i, it scores 1 mark.
<p>4 minutes</p> <p>Suppose the dancers could double the number of joules per second. Then how many minutes would it take them to charge the phone?</p> <p>8 minutes</p>	<p>Incorrect; 0 marks</p> <p> This is a very common error. The learner has not reasoned that an increase in joules will result in less, not more, time taken to charge the phone.</p>
<p>1 minutes</p> <p>Suppose the dancers could double the number of joules per second. Then how many minutes would it take them to charge the phone?</p> <p>2 minutes</p>	<p>Incorrect; 0 marks</p> <ul style="list-style-type: none"> Their part ii is not half of their answer to part i, so no marks can be given.

Q	Marks	Answer
2	2m	Both correct, i.e. 1200 grams and 300 grams, in either order
	Or 1m	Shows or implies the intent to divide 1500 by 5 , e.g. <ul style="list-style-type: none"> • 300 seen

3	2m	18006 years old
	Or 1m	Shows any of the following: <p>2010</p> <p>18000</p> <p>1806</p> <p>180006</p> <p>Or</p> <p>Shows a method that would lead to 18006 if calculated correctly, e.g.</p> <ul style="list-style-type: none"> • 2016 – 2016, then + 6

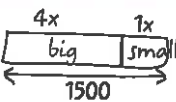
2010: Year of birth

18000: 20016 – 2016

1806 and

180006: Place value errors

Question 2: Exemplars

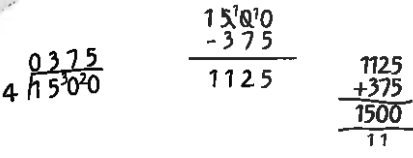


$1500 \div 5 = 300$

300 grams and 1200 grams

Correct; 2 marks

- This learner uses a diagram to support their reasoning that if the big parcel is $4 \times$ the smaller one, there are 5 'lots' altogether.



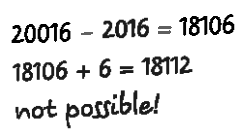
1125 grams and 375 grams

Incorrect; 0 marks

- Dividing by 4 is a very common error, showing a misconception about proportions.

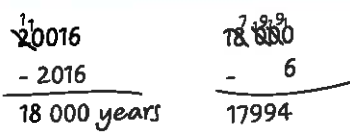


Question 3: Exemplars



years old

Correct method; 1 mark



17,994 years old

Shows 18000; 1 mark

- The learner has subtracted 6 rather than adding it.

Q	Marks	Answer
4	1m	All correct and none incorrect, i.e. 0 1 2 3 4 5 6 7 8 9

5	2m	10.5 kilometres
	Or 1m	<p>Answer 21 kilometres</p> <p>Or</p> <p>Shows 10 500 or the digits 105, e.g.</p> <ul style="list-style-type: none"> • 1050 • 1.05 <p>Or</p> <p>Shows a method, including correct conversion of units, that would lead to 10.5km if calculated correctly, e.g.</p> <ul style="list-style-type: none"> • $14 \times 1500 \div 2 \div 1000$ • 7×1.5

Distance from and to the boat

Depth in metres or conversion error

Question 4: Exemplars

Multiples of 5 have a final digit that is either 0 or 5
 Gareth thinks of a multiple of 4
 What could its final digit be?
 Circle all the possible answers.

0	24	
4	28	40
8	32	
12	36	
16		
20		

0 1 2 3 4 5 6 7 8 9

Correct; 1 mark

- This learner lists the 4-times table in order to find the correct endings. Discussion after the assessment would help establish whether this learner shares the common misconception that multiples stop after 10 x (or 12 x) the number.

Multiples of 5 have a final digit that is either 0 or 5
 Gareth thinks of a multiple of 4
 What could its final digit be?
 Circle all the possible answers.

0 1 2 3 4 5 6 7 8 9

Incorrect; 0 marks

- 2 and 6 are omitted.

Question 5: Exemplars

$1000\text{m} = 1\text{km}$
 $14 \times 1500 = 21,000$
 $21,000 \div 1000 = 21$

21 kilometres

Answer 21 kilometres; 1 mark



Despite the diagram, this learner has made the very common error of ignoring that the signal must travel in both directions.

7 secs to go down
 $1500 + 1500 = 3000$
 $3000 \times 3 = 9000$
 $9000 + 1500 = 11500$

11.5 kilometres

Correct method; 1 mark

- This learner finds 7 lots of 1500 by doubling then tripling, then adding on 1500. The answer shows correct conversion of metres to kilometres, so this is a correct method and 1 mark is scored despite the numerical slip in adding 9000 and 1500

$14 \times 1500 = 21000\text{m}$
 m into km you \div by 100
 $21000 \div 100 = 210000$
 210

210000 kilometres

Incorrect; 0 marks

- In addition to forgetting that the signal goes both ways this learner converts units incorrectly, so no marks can be given.

Q	Marks	Answer
7	4m	112, 124, 136 and 148 , with no other answers shown
	Or 3m	All four correct answers, but numbers outside the range 110 to 150 are also given Or Their answers increase in 12's, no errors other than the starting value, are within the range 110 to 150, all possible values given, e.g. <ul style="list-style-type: none"> • 115, 127, 139
	Or 2m	The pattern of increasing in 12's is shown, or implied by at least three consecutive terms greater than 4 (or at least four if one error), e.g. <ul style="list-style-type: none"> • Blue is every 4, but miss two out • 100, 112, 124, 136, ... Or Both patterns below are correct
	Or 1m	The pattern of increasing in 4's is shown, or implied by at least four consecutive terms greater than 12 (or at least five if one error), e.g. <ul style="list-style-type: none"> • $\div 4$ • 4, 8, 12, 16, 20, 24, 28, ... Or The pattern of increasing in 3's is shown, or implied by at least four consecutive terms greater than 10 (or at least five if one error), e.g. <ul style="list-style-type: none"> • 1 more than multiples of 3 • Miss out every two numbers • 13, 16, 19, 21 (error), 24, ...

If appropriate, accept 150 (or 110) included or excluded, i.e. 'between 110 and 150' can be interpreted as inclusive or exclusive

Condone the incorrect use of 'multiples' or ' $\div 12$ ', e.g. accept

- It is multiples of 12
- $+ 12$

For all patterns, accept starting at an incorrect value but do not count this incorrect value as one of the numbers in the pattern. Do not allow more than one error within each pattern

Condone the incorrect use of 'multiples' or ' $\div 3$ ', e.g. accept

- It is multiples of 3
- $\div 3$

Question 7: Exemplars

114, 126, 138

Answers increase in 12's, and so on; **3 marks**

- All the conditions for 3 marks are met: the only error is that the start value, 114, is incorrect. However, this learner needs support to understand the importance of showing working.

112		4	1
116		8	
120		12	
124		16	2
128		20	
132		24	
136		28	3
140			
144			
148			

152 140 128 116

Pattern of increasing in 12's; **2 marks**

- The start value, 116, is incorrect: it may be that this learner thinks that as 16 is blue and on its own, 116 must also be. As the answer includes the value 152 (outside the range) 3 marks cannot be given.

110=on its own/orange
 114=~~own~~/blue
 150-110=40
 4=blue/own
 8=blue/with
 12=blue/with
 16=blue/own
 20=blue/with
 24=blue/with
 28=blue/own
 32=blue/with
 36=blue/with
 40=blue/own

all multiples of 4 = blue
 pattern = own, with, with

4

Pattern of increasing in 12's; **2 marks**

- The wording on the right identifies the pattern, as does the text on the left.

190	130	131	So on...
170	129	128	150
160	127	126	.
140	124	125	.
130	123		.
110	121	122	.
110	120		.

Incorrect; **0 marks**

- The continuation of the hopscotch pattern on the right gives no indication that the learner understands the significance of the pattern of add 3 (for 'on their own' numbers) so no marks can be given.

114, 117, 126, 129, 138, 141, 150

Incorrect; **0 marks**

- The pattern of add 3 alternates with add 9. This is insufficient to imply add 12 and is also insufficient to imply add 3.

