

REASONING

9ER14

Marking the test
and understanding performance



117628



Llywodraeth Cymru
Welsh Government

Marking the reasoning test

This document comprises:

- the markscheme for the National Numeracy Test (Reasoning) for Year 9 together with marking guidance
- additional information to support teachers' understanding of their learners' responses, providing a platform for growth.

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 learning.wales.gov.uk

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 learning.wales.gov.uk

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 teaching and learning of numerical reasoning can be found on learning.wales.gov.uk

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 National Data Collection (NDC). Further details are available from the *National Reading and Numeracy Tests – 2014 test administration handbook* on the Learning Wales website and in *National Data Collection and reporting arrangements 2013/14* 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, for example 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.

9ER14 Reasoning test: Markscheme

Q	Marks	Answer	
1		<p>Method A considers each section of the route separately.</p> <p>Method B groups sections into up, down and flat.</p> <p>For both methods, use all five categories of this markscheme to give the total score.</p> <p>(Note that for ease of marking, times for only some sections of the route are considered. Errors in the other sections can be ignored.)</p>	
	1m	<p>Method A:</p> <p>For the section 0 to 17 (17km flat) shows a time of 1 to 1.2 hours inclusive (accept units omitted)</p>	<p>Method B:</p> <p>Shows the intent to group the sections into three categories (flat, down, up), even if there are errors</p>
	1m	<p>Method A:</p> <p>For the section 28 to 46 (18km down) shows a time of 0.5 to 0.75 hours inclusive (accept units omitted)</p>	<p>Method B:</p> <p>Shows any one of the following times (accept units omitted, and accept if not linked to flat, down or up but do not accept if incorrectly linked, e.g. 2.5 hours linked to down)</p> <p>Flat: 2 to 3 hours inclusive</p> <p>Down: 1 to 2 hours inclusive</p> <p>Up: 7 to 8 hours inclusive</p>
	1m	<p>Method A:</p> <p>For the section 87 to 112 (25km up) shows a time of 3 to 3.25 hours inclusive (accept units omitted)</p>	<p>Method B:</p> <p>Shows another one of the times above (accept units omitted, and accept if not linked to flat, down or up but do not accept if incorrectly linked)</p>
	1m	<p>Both methods (communication mark):</p> <p>Sets out their work so that all of their distances and times are clearly linked to up, flat or down (or 8, 16 or 32), even if there are errors (all three categories must be present)</p>	
	1m	<p>Both methods:</p> <p>Gives a final time of between 11 and 12 hours inclusive, even if no working, or working that includes errors, is shown.</p>	

Question 1: Exemplars



Wiggins = $4\frac{1}{4}$ hours
143km



$$\text{time} = \frac{d}{s}$$

~~3.125~~

17 km at 16km/h = 1.0625

11km at 8 = 1.375

18km at 32 = 0.56

10km at 16 = 0.63

23 at 16 = 0.44

25 at 8 = 3.125

16 at 32 = 0.500

15 at 8 = 1.875

10.65

10.65 hours

Method A; 4 marks

- First: 1.06 ✓
- Second: 0.56 ✓
- Third: 3.125 ✓
(errors in the other categories can be ignored)
- Fourth: distances, category (8, 16, 32) and times are linked ✓
- Fifth: 10.65 hours ✗



16km perhr
Flat
48km = 3hr

8km per hr
Steep
11km = 6hr
25km
15km

32 km per hr
down
22 km = 1hr
16km

17
41
58

11
25
15
51

$$3 + 6 + 1 = 10$$

10 hours

Method B; 4 marks

- First: groups into flat, steep and down ✓
- Second: flat 3 hours ✓
- Third: down 1 hour is correct ✓
(the error for up can be ignored)
- Fourth: distances, category (flat, steep, down) and times are linked ✓
- Fifth: 10 hours ✗



$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

51 steep mountains

$$\frac{D}{S} = \frac{51}{8} = 6.375$$

17 = 58 fairly flat

$$T = \frac{D}{S} = \frac{58}{16} = 3.625$$

18 = 34 down steep mountains

$$\frac{34}{32} = 1.0625$$

~~11.0625~~

11.1 hours

Method B; 4 marks

- First: groups into steep, flat and down ✓
- Second: down 1.0625 hours ✓
- Third: up and flat categories are incorrect ✗
- Fourth: distances, category (flat, steep, down) and times are linked ✓
- Fifth: 11.1 hours ✓

Exemplars continue on page 8 →

Question 1: Exemplars continued

8km per hour up steep hills
~~4~~ steep hills) 5 steep hills)

1st steep hill = 11^{km} (1 hour and 20mins to clear)
 2nd steep hill = 10^{km} (1 hour and 10mins to clear)
 3rd steep hill = 8^{km} (1 hour to clear)
 4th steep hill = 25^{km} (3 hours and 10 mins to clear)
 5th steep hill = 15^{km} (1 hour and 50mins)

2 Flat areas
 17km 1st flat area = 17^{km} (50mins) (1 hour and 10mins)
 2nd flat area = 23km (1hour and 25mins)
 32

10 $\frac{1}{2}$ hours

Method A; 2 marks

- First: '1st flat area (1 hour and 10 mins)' ✓
- Second: not attempted ✗
- Third: '4th steep hill = 25km (3 hours and 10 mins)' can be assumed to link to section 87 to 112 ✓
- Fourth: only two categories (flat and steep) are considered ✗
- Fifth: 10 $\frac{1}{2}$ hours ✗

Time = $\frac{16}{17} = 0.9$ 0.9
 Time = $\frac{8}{11} = 1.4$ 1.4
 Time = $\frac{32}{18} = 1.8$ 1.8
 Time = $\frac{16}{10} = 1.6$ 1.6
 Time = $\frac{32}{8} = 4$ 4
 Time = $\frac{16}{23} = 0.7$ 0.7
 Time = $\frac{8}{25} = 0.3$ 0.3
 Time = $\frac{32}{16} = 2$ 2
 Time = $\frac{8}{15} = 0.5$ 0.5

12.2 hours

Method A; 1 mark

- First, second, third: this learner has used time = speed ÷ distance; all are incorrect ✗
- Fourth: distances, category (16, 8, 32) and times are linked ✓
- Fifth: 12.2 hours ✗

2 hours 3 hours 6 hours 7 hours 8 hours 10 hours 13 hours 14 hours 19 hours

0 17 28 46 56 64 87 112 128 143

How many times 8 goes in to 29 3s

8
16
24
32
40
48
56
64
72
80
88
96
104
112
120
128
136
144
152
160

19 hours

Method A; 1 mark

- First: 2 hours ✗
- Second: this learner shows cumulative times; 6 – 3 = 3 hours ✗
- Third: as above, the times are cumulative; 13 – 10 = 3 hours ✓
- Fourth: no explicit linking to up, flat or down (or 8, 16 or 32) ✗
- Fifth: 19 hours ✗

32km per hour
 16km
 8km ✗
 8km
 32km
 8km
 16km
 32km
 8km
 8km
 32km
 8km

11.417 hours

Method unknown; 1 mark

- The numerical communication is so poor that it is not clear how this learner has reached the answer of 11.417 hours. However, even though it is an inappropriate degree of accuracy given the context, this is a correct value for the fifth category.

Q	Marks	Answer
2	2m	£90
	Or 1m	Shows a method that would lead to £90 if calculated correctly, e.g. <ul style="list-style-type: none"> • $6 \times 10 + 6 \times 5$

3	1m	10
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Question 2: Exemplars



£5 is half price, so you can get two books for £15

$$15 \times 6 = £120$$

£

Correct method; **1 mark**



half £10 = £5

$$5 \times 12 = £60$$

£

Incorrect; **0 marks**



This learner has reduced all the books to half price.

Question 3: Exemplar



Correct; **1 mark**

- The degree sign that is given alongside their answer can be ignored.


Q	Marks	Answer
4	3m	<p>Gives a correct rule, e.g.</p> <ul style="list-style-type: none"> • Length of wall \times 4.5 = number of blocks • Do length by height, then + half the length
	Or 2m	<p>Shows 6, 4 and 3.5</p> <p>Or</p> <p>Shows 4.5 or equivalent</p>
	Or 1m	<p>States that the length should be multiplied by the height, even if the remaining information is incomplete or incorrect, e.g.</p> <ul style="list-style-type: none"> • $H \times L$ then add on some more <p>Or</p> <p>Implies generality by showing at least two of 12×4 (or 48), 8×4 (or 32) or 7×4 (or 28)</p>

Accept unambiguous use of letters, even if not defined, e.g.

- $L \times H + L \div 2$
- $9L \div 2$

Number of blocks - (length \times height)

Question 4: Exemplars


 The length x height = number of blocks roughly
 Brick height = 4.5
 size
 $4.5 \times \text{length} = \text{Number of blocks}$ foot =


Correct; **3 marks**

Length of wall (feet) $\frac{12}{}$ = $48 + 6 = 54$
 Height of wall (feet) $\frac{4}{}$
 Number of blocks $\frac{54}{}$
 Length of wall (feet) $\frac{8}{}$ = $32 + 4$
 Height of wall (feet) $\frac{4}{}$ = 36
 Number of blocks $\frac{36}{}$
 Length of wall (feet) $\frac{7}{}$ = 28
 Height of wall (feet) $\frac{4}{}$ + 3.5
 Number of blocks $\frac{31.5}{}$

Shows 6, 4 and 3.5; **2 marks**



- The calculations at the top of the page show 6, 4 and 3.5 but this learner has not recognised the relationship between these values and the length of the wall.

 I think the number of blocks are calculated by timesing length of wall and the height of wall together and then getting the answer and then adding more blocks to make it look fair or to fill in any gaps


 The number of blocks are calculated by timesing the 2 numbers together such as
 $8 \times 4 = 36$

Length x height; **1 mark**

- Although the numerical communication is weak 'the 2 numbers' can be assumed to refer to the length and height. The error in the calculation can be ignored.

 $12 \div 4 =$ ~~$12 \times 4 =$~~
 $6 \times 2 =$
 ~~$6 \times 4 =$~~

 $12 \times 4 = 48$ $8 \times 4 = 32$
 $12 \times 2 = 24$ $\frac{16}{16}{32}$

Shows 48 and 32; **1 mark**

 By the lenght and height of the wall

Incomplete; **0 marks**

- There is no reference to multiplication.

Q	Marks	Answer
5	5m	5 or 5.8 or 5.8 followed by any digits
	Or 4m	Shows correct working but rounds up to give the answer 6 Or Shows 100 000 000 ÷ 17 196 300 or equivalent
	Or 3m	Shows 17 196 300
	Or 2m	Shows the digits 171963 , e.g. <ul style="list-style-type: none"> • 1719630.00 Or Shows 521 100 Or Shows the intention to multiply 90 by 60 , and by 5 and by 19.3 and also by 33 (in any order)
	Or 1m	Shows 27 000 (accept 0.027m^3 provided correct units are shown) Or Shows the intention to multiply by 19.3 and also by 33 (in either order) Or Shows the intention to multiply by 636.9


◀ Cost in £ of one paving stone

◀ How much, in grams, one paving stone weighs

◀ Volume, in cm^3 , of one paving stone

Question 5: Exemplars


- 1cm³ of gold weighs 19.3 grams 521.100
- gold costs £33 per gram.

 1 slab = 17, 196, 300

5 paving stones

Correct; **5 marks**

- Although this learner has answered correctly, their numerical communication is disappointing. The importance of showing each step of working could be a useful discussion point after the test.

 $\frac{627}{£637 \text{ per } 1\text{cm}^3}$
 $£637 \times 27,000\text{cm}^3 = £17,199,000$
 for 1 paving stone

$£17,199,000 \times 5 = £85,995,000$

$£17,199,000 \times 5.8 = \cancel{£99,754,200}$
 with

$5.8 \frac{58}{10}$ paving stones

Correct; **5 marks**

- This learner has rounded the cost per cm³ to the nearest £, which is why the values from then on do not match those in the markscheme. However, appropriate rounding at the final stage means that the answer is correct.

 $1,000,000,000 = 33$

$90 \times 60 \times 5 = 27\,000 \text{ cm}^3$

$27\,000 \times 19.3 = 521\,100$


$521\,100 \times 33 = 17\,196\,300$

$5.8 \frac{58}{10}$ rounded to be nearest

~~30 30 300~~ paving stones

Correct method, answer 6; **4 marks**

- The only error is to round up at the final stage, which is not appropriate within the given context.

 stone - 90cm long 60cm wide, 5cm
 1cm³ - 19.3grams
 Gold - £33per gram 100million pound
 $90 \times 60 \times 5 = 2\,7000$
 $19.3 \text{ grams} \times 27000 = 521100 \text{ grams}$

$19.3 \times 33 = £636.90$

1 gram = 193


£33 per gram £86.00

171963.00

6591 paving stones

Shows 521 100 (or the digits 171 963); **2 marks**

- This learner has found how much a paving stone weighs, but may have confused £ and pence to give 171 963.00 rather than 17 196 300

 ~~$33 \times 90 = 4240$~~
 $33 \times 90 = £2970$
 $60 \times 33 = £1980$
 $5 \times 33 = £165$
 $£5115$

$19.3 \times 90 = 1737\text{g}$
 $\times 33$
 5732.1

$19.3 \times 60 = 1158\text{g}$
 $\times 33$
 3821.4


$19.3 \times 5 = 96.50\text{g}$
 $\times 33$
 3184.5

60
 deep 5cm 90

paving stones

Shows $\times 19.3$ and $\times 33$; **1 mark**

- This learner needs support to understand volume since each dimension of the paving stone is multiplied separately.

 $33 \times 19.3 = 636.9$

6369 paving stones

Incorrect; **0 marks**

- Although 636.9 is shown, it is not used to multiply a value so no credit can be given.

Q	Marks	Answer
6i	1m	States or implies that the percentage has been rounded








Accept 'rounding', but do not accept that the number of games has been rounded

6ii	3m	<p>Selects 183 for the number of games and shows a correct trial for 182, i.e.</p> <table border="1"> <thead> <tr> <th>Games</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>182</td> <td>17.6 or 17.5(...)</td> </tr> </tbody> </table> <p>Or</p> <p>Selects 183 for the number of games and links 17.5% to 182.9 or 182.8(...)</p>	Games	%	182	17.6 or 17.5(...)																	
	Games	%																					
182	17.6 or 17.5(...)																						
Or 2m	<p>Selects 183 for the number of games</p> <p>Or</p> <p>Shows 182.9 or 182.8(...) or $32 \div 0.175$, or equivalent</p> <p>Or</p> <p>Shows at least two correct trials from the number of games shown below</p> <table border="1"> <thead> <tr> <th>Games</th> <th>%</th> </tr> </thead> <tbody> <tr><td>179</td><td>17.9 or 17.8(...)</td></tr> <tr><td>180</td><td>17.8 or 17.7(...)</td></tr> <tr><td>181</td><td>17.7 or 17.6(...)</td></tr> <tr><td>182</td><td>17.6 or 17.5(...)</td></tr> <tr><td>183</td><td>17.5 or 17.4(...)</td></tr> <tr><td>184</td><td>17.4 or 17.3(...)</td></tr> <tr><td>185</td><td>17.3 or 17.2(...)</td></tr> <tr><td>186</td><td>17.2(...)</td></tr> <tr><td>187</td><td>17.1(...)</td></tr> <tr><td>188</td><td>17.0(...)</td></tr> </tbody> </table>	Games	%	179	17.9 or 17.8(...)	180	17.8 or 17.7(...)	181	17.7 or 17.6(...)	182	17.6 or 17.5(...)	183	17.5 or 17.4(...)	184	17.4 or 17.3(...)	185	17.3 or 17.2(...)	186	17.2(...)	187	17.1(...)	188	17.0(...)
Games	%																						
179	17.9 or 17.8(...)																						
180	17.8 or 17.7(...)																						
181	17.7 or 17.6(...)																						
182	17.6 or 17.5(...)																						
183	17.5 or 17.4(...)																						
184	17.4 or 17.3(...)																						
185	17.3 or 17.2(...)																						
186	17.2(...)																						
187	17.1(...)																						
188	17.0(...)																						
	Or 1m	Shows one correct trial from the number of games shown above																					





For 3m, 2m or 1m, accept percentages written as decimals

To 3 decimal places the number of games for a success rate of 17.5% is 182.857

Question 6i: Exemplars

 $32 \div 177 = 0.18079096 \approx 18\%$ $32 \div 178 = 0.17977528 \approx 18\%$	<p>Correct; 1 mark</p> <ul style="list-style-type: none"> • Rounding is clearly implied.
 $32 \div 177 = 0.18\% = 18\%$ $32 \div 178 = 0.179\% = 18\% \text{ rounded}$	<p>Correct; 1 mark</p> <ul style="list-style-type: none"> • Despite the incorrect use of the % sign after the decimal, this learner shows good understanding.
 <p>Because it has been rounded</p>	<p>Correct; 1 mark</p>
 <p>because the games are rounded</p>	<p>Incorrect; 0 marks</p>
 <p>because 18% of 178 is 32.04 which rounds to 32</p>	<p>Incorrect; 0 marks</p> <ul style="list-style-type: none"> • This calculation implies that the number of games won has been rounded.
 <p>The percentage is seen the same because the percentage won, is what he has won no what he has lost, so the percentage should only change when he wins the game.</p>	<p> Incorrect; 0 marks This is a common misconception.</p>

Question 6ii: Exemplars

 $32 \div 185 \times 100 \quad 17.21$ $32 \div 182 \times 100 \quad 17.58$ $32 \div 183 \times 100 = 17.48\%$ <p>183 games played</p>	<p>Selects 183 and shows a correct trial for 182; 3 marks</p>
 $32 \div 183 \times 100 = 17.4$ <p>it will be rounded down to 17%</p>	<p>Selects 183; 2 marks</p> <ul style="list-style-type: none"> • Although the number of games selected is not explicit, it is the only value shown so can be assumed to be their answer.
 $32 \div 179 = 0.178$ $32 \div 180 = 0.177$ $32 \div 181 = 0.176$ $32 \div 182 = 0.175$ $32 \div 184 = 0.173$ <p>Games played 184</p>	<p>Five correct trials; 2 marks</p>
 <p>When he plays 184 games because $32 \div 184 \times 100 = 17.3\%$ but you round it down</p>	<p>One correct trial; 1 mark</p>