National Numeracy Tests

REASONING

9ER18MS

Marking the test
and understanding performance

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.

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 sample 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 2018* on the Learning Wales website and in *Welsh National Tests Data Collection and reporting arrangements 2017/18* 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.

9ER18 Reasoning test: Markscheme

Q	Marks	Answer
1i	2m	All three correct, i.e.

20 000	10	4300
40 000	20	8600

Q	Marks	Answer
	Or 1m	Any **two** correct

Q	Marks	Answer
1ii	1m	**200**m by **200**m

Q	Marks	Answer
1iii	1m	**3185** or 3186 or 3185.(...) or 3180 or 3190 or 3200

Question 1i: Exemplar

Area of solar panels (m²)	Power generated (megawatts)	Amount of CO₂ saved each year (tonnes)
2000	1	430
20000	10	4360
40000	20	8600

Two correct; **1 mark**

- 4360 is incorrect. This is likely to be a slip which illustrates the importance of checking.

Question 1ii: Exemplars

40 000m² of solar panels is the same area as

a **square** that is [20,000 m] by [20,000 m]

Incorrect; **0 marks**

Common error

This is a very common error. Had the learner stopped to reflect, they would have realised that $20\,000 \times 20\,000$ is much greater than $40\,000$

40 000m² of solar panels is the same area as

a **square** that is [10,000 ~~m~~ m] by [10,000 m]

Incorrect; **0 marks**

Common error

It is likely that this learner is confusing area and perimeter.

Question 1iii: Exemplars

1 car gives out about 2.7 tonnes of CO₂ each year.

8600 tonnes of CO₂ is the amount of CO₂ that

about [3185.2] cars give out in a year.

Correct; **1 mark**

- A non-integer is condoned even though fractions of a car are not possible.

1 car gives out about 2.7 tonnes of CO₂ each year.

$8600 \div 2.7 = ?$
(× 10)
27
(× 10)
270

8600 tonnes of CO₂ is the amount of CO₂ that

about [302] cars give out in a year.

Incorrect; **0 marks**

Common error

This learner identifies the correct operation $(8600 \div 2.7)$ but does not then use a calculator. Knowing when and why to use calculators is an important numerical skill.

1 car gives out about 2.7 tonnes of CO₂ each year.

1 = 2.7   1000 = 2700
10 = 27   2000 = 5400   135.5 cars
100 = 270   3000 = 8100   ~~200~~ 200
540

8600 tonnes of CO₂ is the amount of CO₂ that

about [1200] cars give out in a year.

Incorrect; **0 marks**

Common error

Multiplying 2.7 in order to try to reach 8600 is inefficient and indicates a lack of confidence with division.

Q	Marks	Answer	
1iv	3m	**12** with no evidence of an incorrect method or **11.7** or **11.6(...)** solar farms	◄ Accept 11 only if a more accurate **value or correct method is seen in the working**
	Or 2m	The only error is incorrect place value, i.e. answer with digits 117 or 116(...) Or Shows **70 000 ÷ 6000** Or Shows the intent to find **5% of 233.(...)** Or Shows a method, including correct place value for 1.4 million, that would lead to 11.6(...) if calculated correctly, e.g. • 1 400 000 × 0.05 ÷ 6000	◄ Accept digits 12 with a correct method, or digits 117 or 116(...) rounded up, or truncated, to the nearest whole number ◄ **233.(...) is from 1 400 000 ÷ 6000**
	Or 1m	Shows **70 000** or **0.07** (million) Or Shows ÷ **6000** or **233.(...)**	◄ **5% of the homes in Wales**

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Question 1iv: Exemplars

1,400,000 ÷ 10 = ~~140000~~ 10% = 140000 5% = 70000 70000 ÷ 6000 = 11.6̇ 12 solar farms (11.6 exact answer)	**Correct; 3 marks** • As both answers are acceptable, full marks can be given.
1.4 ÷ 10 = 0.14 0.14 ÷ 2 = 0.07 ⟶ 70,000 6,000 ÷ 70,000 = 11.6 [ ] solar farms	**Correct; 3 marks** • Although the division is written incorrectly, the answer is correct so scores 3 marks. However, the learner needs to understand the importance of effective numerical communication.
(140000 ÷ 100) × 5 = 7000 $\frac{7000}{6000} = \frac{7}{6} = 1.16̇$ 2 solar farms	**Answer 2 from digits 116(...); 2 marks** • The only error is that there is incorrect place value for 1.4 million.
1400,000 14,000,000 ÷ 10 = ~~1400000~~ ~~140000~~ 1400,000 ÷ 2 = 700,000 700,000 ÷ 6000 = 116.6̇ 116.6̇ × 40,000 = [ ] solar farms	**Shows ÷ 6000; 1 mark** • Had this learner stopped at 116.6̇, 2 marks would have been given as this would have been accepted as their answer. However, it has been multiplied by 40 000. Because of this, the incorrect place value for 1.4 million can no longer be condoned, so only 1 mark can be given for dividing by 6000
100% = 1400000 10% = 140000 5% = 70000 [ ] solar farms	**Shows 70 000; 1 mark** **Common error** It is common to get as far as this but not then know how to progress to the solution.
0.14 = 10% = 1.4 ÷ 10 0.07 = 5% = 1.4 ÷ 20 40000 ÷ 0.07 = 571428.6 571429 solar farms	**Shows 0.07; 1 mark** **Common error** This learner is working in millions so gains 1 mark for 0.07 (5% of 1.4 million). That value is then divided into 40 000 (a number not relevant to the solution) to suggest that over half a million solar farms are needed. Common sense should have led to this solution being rejected.
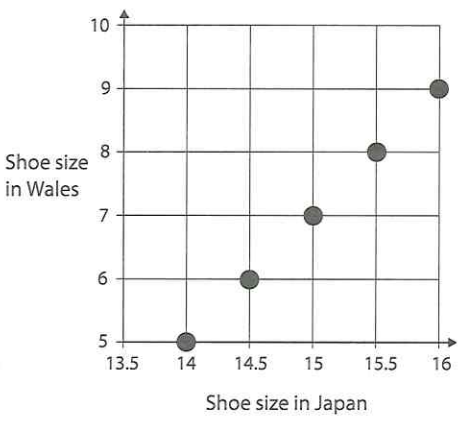
Q	Marks	Answer
2	2m	Gives all **five** correct points and no incorrect points, i.e.

	Or 1m	Not more than **two** points incorrect or omitted

Q	Marks	Answer
3	2m	Both correct, i.e. Beti **69** Ifor **71**
	Or 1m	Incorrect order, i.e. Beti 71 Ifor 69 Or Shows **70** Or Gives two values that sum to 140 and are equidistant from 70, even if Beti is shown to be older than Ifor, e.g. • Beti 73 Ifor 67 • Beti 68 Ifor 72

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Question 2: Exemplars
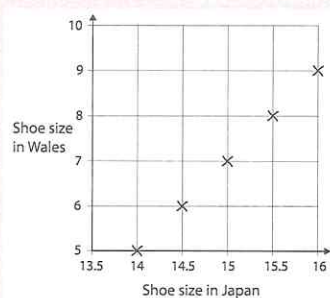
Correct; **2 marks**

- Any unambiguous indication, e.g. crosses, is acceptable.
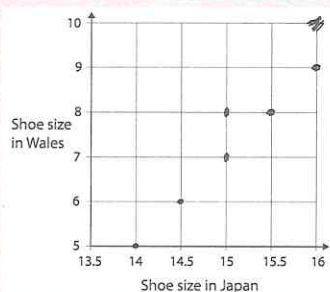
One incorrect; **1 mark**

- (16, 10) has been crossed out but not (15, 8).
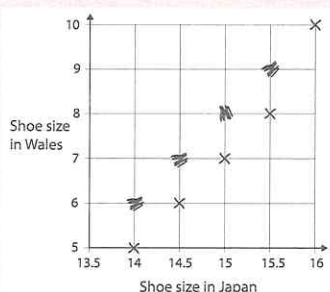
One omitted, one incorrect; **1 mark**

Common error The answers are not in a straight line which should have alerted this learner to their error. Checking answers is an essential part of becoming numerate.

Question 3: Exemplar

140 ÷ 2 = 80

Beti is 79   Ifor is 81

Incorrect; **0 marks**

- Although the method is correct, the error in dividing by 2 leads to incorrect solutions. As these can easily be checked through addition, no marks can be given.

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Q	Marks	Answer
4i	1m	States that 12 is not divisible by 5, e.g. • $12 \div 5 = 2.4$ • It is not possible to divide 12 into 5 (pieces) evenly • It would be 2r2

Q	Marks	Answer
4ii	2m	Gives all five correct unit fractions and no incorrect unit fractions, i.e. $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{6}$ $\frac{1}{12}$
	Or 1m	Gives **three or four** correct unit fractions and no incorrect unit fractions Or Gives **four or five** correct unit fractions and not more than one incorrect unit fraction

Question 4i: Exemplars

|	
5 is not a factor of 12	Correct; **1 mark**
Because $\frac{1}{5}$ of 12 is not a whole number.	Correct; **1 mark** • This response is minimally acceptable. '$\frac{1}{5}$ of 12 is not a whole number of squares' would be a restatement of the information given to the learner, so no marks would be given.
12 ÷ 5 = 2.2 not a whole number	Incorrect statement; **0 marks** **Common error** Although this learner understands what to do, $12 ÷ 5 = 2.4$ not 2.2 so no marks can be given.
Because 5 doesn't fit into 12 exactly, so you would have to shade half squares as well as whole squares.	Incorrect statement; **0 marks** **Common error** '5 doesn't fit into 12 exactly' would gain the mark, but it is not true that half squares would need to be shaded as well. This is a surprisingly common error in which learners may be using 'half squares' to mean 'part squares'.
Because theres only 4 squares across	Incomplete; **0 marks** • 'Only 4 squares across' does not explain why the total number of squares is not a multiple of 5

Question 4ii: Exemplars

factor pairs *1, 12 2, 6 3, ~~8~~ 4* $\frac{1}{12}\ \frac{1}{1}$ $\frac{1}{6}\ \frac{1}{2}$ $\frac{1}{4}\ \frac{1}{3}$	All five correct, none incorrect; **2 marks** • This learner shows good insight into the problem. The fraction $\frac{1}{1}$ can be ignored.
$\frac{1}{12}$ $\frac{1}{6}$ $\frac{1}{2}$ $\frac{1}{3}$	Four correct, none incorrect; **1 mark** • One-quarter is missing.
$\frac{1}{4}$ $\frac{1}{2}$ $\frac{1}{3}$	Three correct, none incorrect; **1 mark** • One-sixth and one-twelfth are missing. The pictures can be ignored.
$\frac{1}{2},\ \frac{1}{4},\ \frac{1}{6},\ \frac{1}{8}$	Three correct, one incorrect; **0 marks** • One-third and one-twelfth are missing and one-eighth is incorrect.

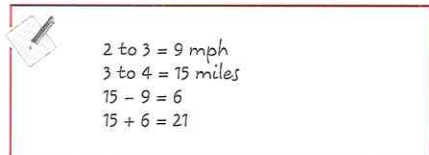| Q	Marks	Answer

5i	1m	Gives a correct justification, e.g.
		• After 2 hours, total 30 miles
		  After 1 hour, 9 miles
		  difference of 21
		• $15 + 15 - 9$

5ii	2m	**12** miles
	Or 1m	Shows or implies that the total distance travelled is **42** (miles) Or Shows a method that would lead to 12 if calculated correctly, e.g. • $14 \times 3 - 21 - 9$

Question 5i: Exemplars
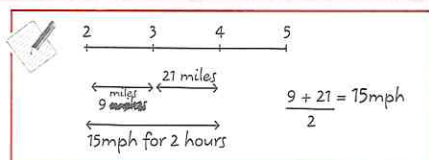
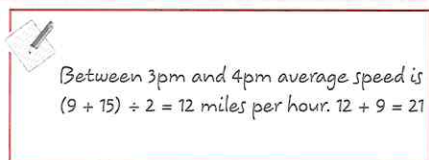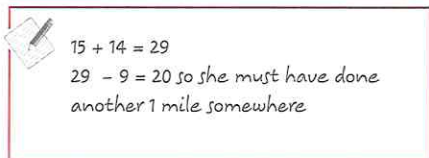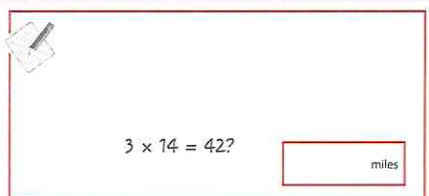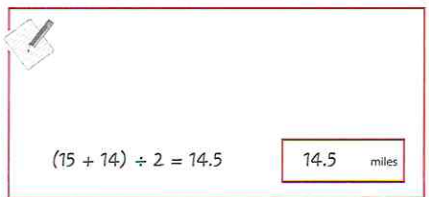|	
2 3 4 5 ← 21 miles → ← miles → 9 miles 15mph for 2 hours $\frac{9 + 21}{2} = 15$mph	**Correct; 1 mark** • The use of a diagram is an effective way of breaking down the problem. The learner uses the information given to show that the average speed over 2 hours is 15 miles per hour.
2 to 3 = 9 mph 3 to 4 = 15 miles 15 – 9 = 6 15 + 6 = 21	**Correct; 1 mark** • This calculation is equivalent to $2 \times 15 - 9$ so gains the mark, but it would be helpful to discuss after the test to what extent the learner understood the underlying numeracy.
Between 3pm and 4pm average speed is $(9 + 15) \div 2 = 12$ miles per hour. $12 + 9 = 21$	**Incorrect; 0 marks** • This calculation is spurious – the average speed between 3pm and 4pm is not 12 miles per hour. No marks can be given.
15 + 14 = 29 29 – 9 = 20 so she must have done another 1 mile somewhere	**Incorrect; 0 marks** **Common error** 14 miles per hour refers to the time after 4pm, so it makes no sense to include it in a calculation that refers to an earlier time period. Trying to do so is a common error.

Question 5ii: Exemplars
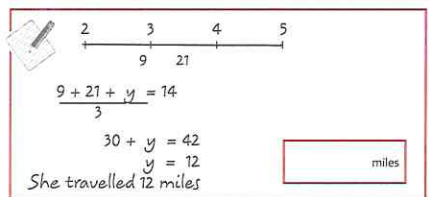
|	
2 3 4 5 9 21 $\frac{9 + 21 + y}{3} = 14$ 30 + y = 42 y = 12 She travelled 12 miles [ ] miles	**Correct; 2 marks** • As above, a simple diagram helps this learner organise their thinking. The answer is clearly shown in the working.
3 × 14 = 42? [ ] miles	**Implies total distance is 42 miles; 1 mark** • The first step is correct but then this learner is unable to continue.
$(15 + 14) \div 2 = 14.5$ [14.5] miles	**Incorrect; 0 marks** **Common error** It is a common error to simply find the mean of the average speeds shown at 4pm and 5pm.

Q	Marks	Answer
6	3m	Both correct, i.e. red **£21.(00)** blue **£16.25**
	Or 2m	Order incorrect, i.e. red £16.25 blue £21.(00) Or **One** correct cost Or Shows a method (but not trial and improvement) that would lead to **both** correct costs if there were no numerical errors
	Or 1m	Shows a method (but not trial and improvement) that would lead to **one** correct cost if there were no numerical errors

Question 6: Exemplars

2 red and 1 blue   58.25
4 red and 2 blue   116.5
3 red   116.5 – 53.50
       = 63
  1 red = 63 ÷ 3 = £21
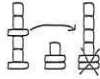
2 red and   1 blue 58.25
    42 + 1 blue = 58.25

    1 blue = 58.25 – 42
          = £16.25

£ 21

£ 16.25

Correct; 3 marks

- This learner uses diagrams as an effective way to structure their thinking by reasoning that doubling 2 red and 1 blue allows the elimination of blue.

Blue ends in 25p I think so red is £1

Red	Blue	2 Red + 1B	2 Blue + 1R
19	20.25	✓	59.50 ✗
20	18.25	✓	56.50 ✗
21	16.25	✓	53.50 ✓

£ 21.00

£ 16.25

Correct; 3 marks

- Trial and improvement is a difficult approach with two unknowns but the learner shows good numerical insight at the beginning by reasoning that the costs given suggest the blue box must end in 25p and the red cost is a whole number of £.

2R + 1B = 58.25
1R + 2B = 53.50
3 of each = 58.25 + 53.50
        = 101.75
1 of each = 101.75 ÷ 3
        = 33.92
1R + 1B = 33.92
1R + 2B = 53.50
  So 1B = 53.50 – 33.92
        = 19.58
  So 1R = 33.92 – 19.58
        = 14.34
    ?

£

£

Correct method for both costs; 2 marks

- The only error is in adding 58.25 and 53.50. The question mark is presumably because the learner recognises that the values obtained do not fit the costs given.

58.25 ÷ 3 = £19.42

Red £19.50   Blue 58.25 – 39 = £19.25
            19.50 + 38.50 = £58

Red £19.40   Blue 58.25 – 38.80 = £19.45
            19.40 + 38.90 = £58.30

£

£

Incomplete; 0 marks

- This learner sets out their trials effectively. However, no marks are available for this method unless it leads to one or both correct solutions.