National Numeracy Tests

REASONING 9ER15MS

Marking the test

and understanding performance

128972

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 learning and teaching 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 Welsh National Tests Data Collection (WNTDC). Further details are available from the *National Reading and Numeracy Tests – Test administration handbook 2015* on the Learning Wales website and in *Welsh National Tests Data Collection and reporting arrangements 2014/15* 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.

9ER15 Reasoning test: Markscheme

Q	Marks	Answer
1i	1m	**13**

Q	Marks	Answer
1ii	2m	All three correct codes, in any order, i.e. ● — — ● ● ● ●
	Or 1m	Any **two** correct codes

◀ **Ignore in-betweens if shown**

Q	Marks	Answer
1iii	3m	Explanation includes all three aspects below: – refers, explicitly or implicitly, to dots, dashes and in-betweens – is clearly intended for all combinations of dots and dashes, of any length – justifies why the code must be odd e.g. • To start it's dot (1) or dash (3). You add on any number of 2's (↑ + dot) or 4's (↑ + dash) or both, and odd + even = odd
	Or 2m	As above, but the length of the code is limited Or Shows that the sequence of **dots** goes up in **2's** (accept 1, 3, 5, ...) and the sequence of **dashes** goes up in in **4's** (accept 3, 7, 11, ...)
	Or 1m	Shows that the sequence of **dots** goes up **in 2's** (accept 1, 3, 5, ...) Or Shows that the sequence of **dashes** goes up **in 4's** (accept 3, 7, 11, ...) Or States that **odd + even = odd**

◀ **Minimally, the code must refer to all combinations of two dots/ dashes**

Question 1iii: Exemplars

Everything goes into evens like this . ↑ = 2, — ↑ = 4. Evens together are even but −1 because the last one doesn't have ↑ and even − 1 = odd	Correct; **3 marks** • This learner shows good understanding including that the rule must apply to all combinations, of any length.
Dots use 1 and dashes use 3 and two odds add to an even but when you add the between so it goes back to odd and when you add another odd it goes even but the between makes it odd again and it goes on the same.	Correct; **3 marks** • This learner also shows good understanding with 'it goes on the same' implying that this applies to codes of any length.
It starts odd and then you add 1 for the inbetween and then you add another odd and an odd + 1 = even but an even + odd = odd.	Correct but length of code limited; **2 marks** • This explanation refers to only the first two parts of a code. There is no reference to what happens beyond.
Because when adding each unit 'in between' it always comes to an odd number e.g 3 ↑1 3 = 7 3 ↑1 3 ↑1 3 = 11	Sequence of dashes goes up in 4's; **1 mark** • This learner works only with dashes. Although the first term (3) is not explicit, it is enough to imply the sequence is 3, 7, 11, ...
• — • 7 • — — 9 • • • — • — • 17 These are all odd so that is how I know.	Incomplete; **0 marks** Common error: This is a common error – examples do not prove a general statement.
Because the finishing dot or dash is an odd number because the dot is 1 unit and the dash is 3 and there both odd	Incomplete; **0 marks** • That the final part of a code is odd does not explain why all terms must be odd.
It can because you have • = 1 and then you have a space so it will be a 2. And — = 3 so a unitof time will be 4 so you can have a unit of time which is a even number	Incorrect; **0 marks** Common error: It is surprisingly common for learners to say they have disproved information given to them, rather than checking to see where they have made a mistake.

Q	Marks	Answer
2	4m	**55** with a correct method shown or implied
	Or 3m	Shows a correct method, with not more than one error. The most common correct methods are: Adding the square numbers 1, 4, 9, 16 and 25 Or Finding the **total** number of cubes (140) then **subtracting** the number of **green** cubes (85)
	Or 2m	Shows at least **four** of the square numbers 1, 4, 9, 16, 25, 36 and 49 Or Shows **140** Or Shows **85**
	Or 1m	Shows at least **three** of the square numbers 1, 4, 9, 16, 25, 36 and 49 Or Shows **1 + 4 + 8 + 12 + 16 + 20 + 24** with not more than one omission or error

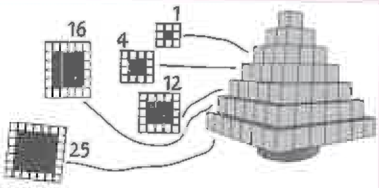
Do not accept an incorrect method, e.g. from miscounting the 56 green faces visible on the diagram

For marker information:

Layer	Total	Green	White
1	1	1	0
2	4	4	0
3	9	8	1
4	16	12	4
5	25	16	9
6	36	20	16
7	49	24	25
	140	85	55

Throughout, accept square numbers shown as powers, e.g. 4^2

Question 2: Exemplars

Inside each one it is square but the first two are all green so then it is 1 + 4 + 9 + 16 + 25 55 white cubes	55 with correct method; **4 marks** Efficient method This learner shows a correct, efficient method.
$1^2 = 2$ $2^2 = 4$ 9 16 25 56 white cubes	Correct method; **3 marks** • All five square numbers, i.e. 1^2, 2^2 (or 4), 9, 16 and 25, are shown and 56 implies addition. The only error is to evaluate 1^2 as 2
 **Altogether**, how many **white cubes** are there? Show how you know. 58 white cubes	Correct method; **3 marks** • This learner should have realised that 12 is not a square number. However, this is the only slip in an otherwise correct method.
24)-4 20)-4 16)-4 12 6 4 1 140 57 white cubes	Correct method; **3 marks** • Had 6 been identified correctly as 8, this learner would have reached the correct solution of 55 white cubes. That the pattern of subtracting 4 was discontinued should have alerted them to their error.
bottom base = 36 2nd base = 20 3rd base = 16 4th base = 9 5th base = 0 6th base = 0 81 81 white cubes	Shows three of the square numbers; **1 mark** • This learner shows the square numbers 9, 16 and 36
55 green cubes white cubes = 55 the white cubes are the same as those are behind the green and all cubes are the same size 55 white cubes	55 but with no correct method; **0 marks** • This learner appears to be (mis)counting the number of green cubes that are visible.

Q	Marks	Answer
3	4m	**60**m, but not from an incorrect method
	Or 3m	Shows a correct method that would lead to 60 if calculated correctly, e.g. • 625 – 40 – 45, then ÷ 9 • 625 – 400, then ÷ 9, then + 35
	Or 2m	Shows or implies that there are **9 lengths** between 10 hurdles, e.g. • ÷ 9 seen Or Within a complete and otherwise correct method, divides by 10 (or 8) rather than 9, e.g. • 625 – 85, then that answer ÷ 10 • Answer 54m Or Shows **25**, but not from an incorrect method
	Or 1m	Shows **540** Or Gives an answer of **54.6875** (accept 54.6 or 54.7 or anything in between) Or Shows that 45 + 9 × 35 + 40 = 400

Additional distance between hurdles in the 625m race (refers to: Shows 25)

Distance between first and last hurdles (refers to: Shows 540)

The error is to use a scale factor of 1.5625, forgetting that start to first and last to end are not scaled (refers to: 54.6875)

Checks the values for the first race (which helps to model the second) (refers to: 45 + 9 × 35 + 40 = 400)

Question 3: Exemplars

400 − 85 = 315 315 ÷ 10 = 31.5 × 45 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 40 625 − 85 = 540 540 ÷ 9 = 60 Answer: 60 m	Correct; **4 marks** • This learner starts by making the common error of ÷ 10 but because they have checked their understanding against the first race they are able to find and correct the error.
440 ÷ 9 = 625 − 45 − 40 = 440 9 ⟌440 −90 (10×) 350 −180 (20×) 260 −180 (30×) 170 Answer: m	Correct method; **3 marks** • Although the method is correct, by not using a calculator this learner has not progressed to the correct solution. Knowing when and why to use a calculator is an important part of becoming numerate.
The distance between the hurdles has gone up by 225m. 10 hurdles have 9 spaces like we did with fence panels so you ÷ 9 and 225 ÷ 9 = 25 Answer: 25 m	Shows ÷ 9 (or 25); **2 marks** • This learner connects the problem to a similar one (fence panels). The only error is to forget that 25 needs to be added to the original distance of 35m – that the distance between the hurdles is less than in the original race should have alerted them to their error.
45 + 40 = 95 625 − 95 = 530 530 ÷ 10 = 53 Answer: 53 m	Correct method, other than ÷ 10; **2 marks** Common error: Although there is a slip when adding 45 and 40, the method is correct other than ÷ 10
It's gone up by 225 so it must be 22.5 + 35 = 57.5 Answer: m	Correct method, other than ÷ 10; **2 marks** • This learner would benefit from showing more working – they are working out the increase in length from the first race, but have divided by 10 rather than 9
625 − 45 = 580 then I did − 40 = 540 but what do I do now ?????? Answer: m	Shows 540; **1 mark**

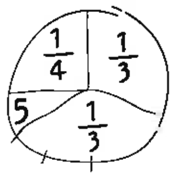
Q	Marks	Answer	
4	2m	Shows or implies that the answer to **365 ÷ 7** includes **remainder 1**, e.g. • 365 ÷ 7 = 52r1 • 365 days = a whole number of weeks and one extra day • 52 × 7 = 364 so one more day is needed Or Shows 365 ÷ 7 = **52.14(...)** and interprets the decimal as **1 day** • 365 ÷ 7 = 52.142857142 That's 52 weeks and 1 day	**For 2m, do not accept .14(...) truncated to .1 then misinterpreted as 1 day**
	Or 1m	Shows or implies **365 ÷ 7** Or States or implies that **365** is not a **multiple of 7** Or Shows **364**	**Given the context, accept '365 won't divide by 7'** **364 is the nearest multiple of 7 to 365**

Question 4: Exemplars

7 days a week 52 week a year 365 ÷ 52 = 7 7 × 52 = 364 so it has 1 more day	Correct; **2 marks** • Although the calculation within the first line is truncated, the next two lines show sufficient understanding.
Peoples birthdays change by a day each year as there are 52 weeks and a day in each year	Correct; **2 marks** • This response is minimally acceptable for 2 marks.
because if it were 364 it would be on the same day every year. So because there is one more day then it will go forward a day every year	Shows 364; **1 mark** • Had this learner explained the relevance of 364, they would have scored 2 marks.
$\left(\frac{365}{7} = 52.1 \text{ to 1dp}\right)$ – There aren't an equal amount of weeks in a year so it changes 1 each year	Shows 365 ÷ 7; **1 mark** • Although it is true that 365 ÷ 7 = 52.1 to 1 d.p. we cannot be sure that this learner does not have the common misconception that .1 is 1 day, so only 1 mark can be given.
365 ÷ 7 = 52 weeks there is an odd number of days in a year	Shows 365 ÷ 7; **1 mark**
because 7 does not fit into 365 exactly	States that 365 is not a multiple of 7; **1 mark**
Because when there is a leap year so you change by 2 days but when there isn't it is only 1 day change	Incomplete; **0 marks** • This learner simply restates information given in the question.

Q	Marks	Answer	
5	2m	**60** people	
	Or 1m	Shows $\frac{11}{12}$ or equivalent	**Accept 0.91(...) or 0.92 or 91.(...)% or 92%**
		Or	
		Shows $\frac{1}{12}$ or equivalent (but not from a computational error)	**Accept 0.08(...) or 8.(...)%**

Question 5: Exemplars

Learner response	Comment
$\frac{2}{3}$ good $\frac{1}{4}$ average $\frac{2}{3} + \frac{1}{4} = \frac{8}{12} + \frac{3}{12} = \frac{11}{12}$ so $\frac{1}{12}$ left over must be the 5 people, $5 \times 12 = 60$ 60 people	Correct; **2 marks** • This learner shows good numerical communication.
 $5 \times 3 = 15$ 60 people	Correct; **2 marks** • The use of a diagram is an effective way of solving the problem. This learner finds that $\frac{1}{12} = 5$, so $\frac{1}{4} = 15$, so 15×4 is the whole.
90 − 60 − 22.5 ✗ 120 − 80 − 30 ✗ 60 − 40 − 15 ✓ 60 people	Correct; **2 marks** • This learner uses repeated trials, subtracting two-thirds and then one-quarter in an attempt to find the 5 people left over. Although inefficient, when other methods fail repeated trials can offer a useful strategy.
$\frac{2}{3} = \frac{8}{12}$ and $\frac{1}{4} = \frac{3}{12}$ so $\frac{11}{12}$??? people	Shows $\frac{11}{12}$; **1 mark** • This learner starts correctly but does not know how to progress to the correct solution.
$\frac{2}{3}$ $\frac{1}{4}$ $5 = \frac{1}{12}$ 70 people	Shows $\frac{1}{12}$; **1 mark** • There is no evidence that $\frac{1}{12}$ has arisen from a computational error.
$\frac{2}{3} \times \frac{1}{4} = \frac{1}{12}$ people	$\frac{1}{12}$ from a computational error; **0 marks** • $\frac{1}{12}$ is the incorrect outcome from multiplying together $\frac{2}{3}$ and $\frac{1}{4}$. No marks can be given.

Q	Marks	Answer
6	2m	States that the smaller cog has turned **270°** or **three-quarters** of a turn, and **justifies why** it has turned that amount, e.g. • The little one goes anti-clockwise. The big one makes half a turn which is 15 teeth so the little one must turn 15 teeth too, but that is $\frac{3}{4}$ of the way round • For every turn of the big cog the small cog turns $1\frac{1}{2}$ times so as the big one has done a half turn the small one has gone 270°
	Or 1m	States that the smaller cog has turned **270°** or **three-quarters** of a turn Or States that **both cogs turn 15 teeth** Or Shows a **correct ratio of turns**, e.g. • When they turn, the little cog turns faster. Big : little is 2 : 3

Question 6: Exemplars

the teeth are 30 : 20 so speed = 20 : 30 = 2 : 3 so when the bigger one moves 2 right angles the smaller one does 3	Correct; **2 marks** • 3 right angles is equivalent to 270° and this amount is justified by the ratio of the speeds.
The small cog is turned 270° anti-clockwise The smaller cog has to turn a larger amount because the larger cog has a larger amount of teeth than the small cog	Smaller cog turns 270°; **1 mark** • The second sentence is incomplete – it does not justify the 270°.
It must be in this position as for every tooth in the larger cog there is 1.5 teeth on the smaller.	Incorrect; **0 marks** • This learner may be attempting to describe the ratio of speeds, but the statement is incorrect (it is the other way round).
Because as the bigger cog turns the smaller cog is a third smaller than the bigger cog so it will go round 1 third less of what the bigger one does.	Incorrect; **0 marks** • This learner appears to think that the smaller cog turns more slowly than the bigger cog.
Because the smaller cog only has 20 teeth, it wont turn all the 180° like the bigger one, it will turn 90°, and because the bigger cog has 30 teeth, it will turn faster	Incorrect; **0 marks** Common error: It is a common error to think that the smaller cog has turned 90° clockwise and that therefore the bigger cog is turning faster because it has more teeth.