Find the nth Term by Matching the Rule

Teacher		**Class**	Year 8
Subject	Maths	**Topic**	Sequences and the nth term
Date		**Room**	
Lesson length	60 minutes	**Country**	United Kingdom

Pupils learn to recognise arithmetic sequences and find the nth term. They match sequences, pictures and rules, then test them.

Curriculum links

- recognise arithmetic sequences and find the nth term

Learning objectives

- Students will recognise arithmetic sequences by checking for a constant difference.
- Students will find the nth term of linear sequences using difference and adjustment.

Success criteria

- I can tell if a sequence is arithmetic and give the common difference.
- I can write the nth term and use it to find any term.

What students already know

Quick chant round the class: count up in 4s from 5, then count back in 5s from 20. Ask what stays the same each step.

Key words

sequence	a list of numbers in order
term	each separate number in a list
common difference	the same amount added each time to get the next number
nth term	a rule that gives any number from its place in the list, so each place maps to exactly one value [1]

Materials

- envelopes of triangle matching cards with colour-coded borders (sequence, picture, rule)
- sugar paper and glue sticks
- Slides 1-4, 6-7, 9, 11-12 projected
- Video clip 1 KS3 nth term worked examples (0:00-5:00) ready to play
- printed Worksheet Task G (Tick true or false) copies
- mini whiteboards and pens

Before the lesson

- Print and cut one envelope of triangle matching cards per group, with colour-coded borders
- Print one copy of Worksheet Task G (Tick true or false) per pupil
- Test Video clip 1 (0:00-5:00) on Slide 6 with sound
- Set projector for Slides 1-4, 6-7, 9, 11-12 and arrange tables for groups of three
- Put sugar paper, glue sticks, whiteboards and pens on tables

Lesson outline

0–8 min **Starter** 8 min · Whole class

To recall equal steps and create curiosity about matching sequences to rules.

YOU DO

1. Show Slide 1 title and keep four sealed envelopes on the desk to build suspense.
2. Say the hook and show Slide 2 photo of cups stacking by the same number each time.
3. Ask pairs where they have seen this kind of steady growth and take two quick answers.
4. Do a 2-minute prior check by counting up in 4s and back in 5s round the class.

STUDENTS DO

1. Discuss with a partner where steady growth happens and join in the counting check.
2. Predict what the matching puzzle will ask them to do.

Say: Four sequences, four pictures, four rules, all mixed up. Sort them before time runs out. Look at these cups stacking up by the same number each time. Where else have you seen a pattern grow like this?

Ask: When we count 5, 9, 13, 17, what are we adding each time? (Adding 4 each time, the gap stays the same.) · How is 20, 15, 10, 5 still a steady pattern? (It goes down by the same amount, subtract 5 each time.)

Check understanding: Hands up for who can say the next two numbers in each count. If unsure, model the gaps on the board number line and repeat once.

Support: Show the two counts on a number line with the jumps marked +4 and -5. **Stretch:** Ask what number would be five jumps ahead without listing every step.

Use: Slides 1-2

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8–20 min **Teaching** 12 min · Whole class

To model how to recognise arithmetic sequences and build the nth term.

YOU DO

1. Show Slide 4 cards with 5, 9, 13, 17 and 20, 15, 10, 5 and 2, 4, 8, 16.
2. Model writing gaps under each sequence to show same gap means arithmetic.
3. Show Slide 3 four steps and model them for 4, 7, 10, 13 on the board.
4. Stress each position maps to exactly one term value, so the rule must fit n = 1, 2, 3 [1].

STUDENTS DO

1. Copy the gaps and four steps into books.
2. Test the rule with n = 2 and n = 3 alongside the teacher.

Say: Arithmetic means the same difference every step. We put that difference in front of n, then fix the start to fit term 1. We always test it on term 2 and term 3 before we trust it.

Worked example: Sequence 4, 7, 10, 13. Step 1 gaps: 7-4=3, 10-7=3, 13-10=3, so arithmetic with difference 3. Step 2 put 3 in front of n to give 3n. Step 3 fix the start: 3 x 1 = 3, need 4, so add 1 to give 3n + 1. Step 4 test: n=2 gives 3x2=6, 6+1=7, n=3 gives 3x3=9, 9+1=10. It works. 20th term: 3x20=60, 60+1=61.

Ask: Why is 2, 4, 8, 16 not arithmetic? (Gaps are 2, then 4, then 8, they double so are not the same.) · For 4, 7, 10, 13, why is the rule not just n + 3? (n + 3 only works for the first term: n = 2 gives 5, not 7. The terms go up by 3 each time, so the rule starts with 3n, and 3n + 1 fits every term.)

Check understanding: Mini whiteboards up to show the gaps for 5, 9, 13, 17. Reteach writing differences if gaps are missing or wrong.

Support: Give a gap template to write first gap, second gap, third gap, same or not. **Stretch:** Ask what the difference would be for 20, 15, 10, 5 and what sign the n-term starts with.

Use: Slides 3-4

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20–32 min **Guided practice** 12 min · Whole class

To practise the method together and secure key vocabulary.

YOU DO

1. Show Slide 6 and play Video clip 1 (0:00-5:00), pausing after the first example.
2. Ask pupils to try the first video example on whiteboards before the answer is shown.
3. Show Slide 7 key words and link sequence, term, common difference and nth term to the example.
4. Model function evaluation for the 20th term with clear substitution.

STUDENTS DO

1. Watch the video, try the example on whiteboards and compare with the video answer.
2. Say the key words aloud and write the 20th-term substitution in books.

Say: Watch how the difference goes in front of n and how they fix the first term. Try the first example with the video before they show you. We will then use the rule to jump straight to the 20th term.

Worked example: Sequence 7, 12, 17, 22. Gaps are 5, 5, 5, so nth term starts 5n. 5x1=5, need 7, so +2 gives 5n+2. Check n=1 gives 7. 20th term: 5x20=100, 100+2=102 [1].

Ask: What do we do after we spot the common difference is 5? (Write 5n, then adjust to fit term 1.) · How do we know 5n + 2 is correct? (Test n = 1 gives 7, n = 2 gives 12, n = 3 gives 17.)

Check understanding: Whiteboards up with nth term for 7, 12, 17, 22. Replay the fixing step if most show 5n or n+5.

Support: Provide a substitution frame with boxes for multiply then add or subtract. **Stretch:** Ask for the 100th term in one line of working and whether 150 could fit.

Use: Video clip 1 (0:00–5:00), Slides 6–7

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32–50 min **Main activity** 18 min · Groups

To match sequences, diagrams and nth terms that describe the same pattern.

YOU DO

1. Show Slide 9 task and hand each group an envelope, sugar paper and glue.
2. Explain they must fit sequence, growing bar diagram and rule together, such as 4, 7, 10, 13 with a bar growing by 3 and 3n + 1.
3. Remind them that addition belongs to arithmetic [3], so keep adding the difference to test each match before gluing.
4. Circulate, ask for checks with n = 4, and stop the class once for a good check.

STUDENTS DO

1. Sort cards by colour border, find gaps, propose nth terms and test with substitution.
2. Glue one complete matched set on sugar paper and write the n = 4 check underneath.

Say: Work in threes to sort your triangles into full sets. Each set needs a sequence, its picture and its nth term rule. Test every match with n = 1, 2, 3 and with n = 4 before you glue it down.

Worked example: One complete set: sequence 4, 7, 10, 13; bar diagram with 4 bars then +3 each time; rule 3n + 1. Check n=4: 3x4=12, 12+1=13, which matches the 4th term, so glue this set and write the check under it.

Ask: How do you know these three cards belong together? (Same difference in numbers and picture, and rule gives 1st to 4th terms.) · What do you do if two rules look close, like 3n + 1 and 3n + 2? (Test n = 1 and n = 2, only one will give both terms.)

Check understanding: Visit each group to see one glued set with n = 4 working. If checks are missing, model one test on the board and send groups back to test.

Support: Use colour-coded borders so sequence cards, picture cards and rule cards are easy to tell apart.
Stretch: Ask groups to make one extra false match that looks close and challenge another group to explain the error.

Use: Slide 9

50–60 min **Plenary** 10 min · Whole class

To apply the nth term to a problem and correct common mistakes.

YOU DO

1. Show Slide 11 mystery about shelves: 6, 9, 12... and solve for shelf 10 together.
2. Show Slide 12 quiz for 7, 12, 17, 22 and take answers on whiteboards.
3. Hand out Worksheet Task G and tick true or false together in 4 minutes, watching for common mistakes.

STUDENTS DO

1. Write nth term 3n + 3 and calculate shelf 10 on whiteboards.
2. Complete Worksheet Task G by ticking true or false.

Say: First shelf holds 6 boxes. Each shelf above holds 3 more. How many on shelf 10? Use the nth term, do not draw ten shelves. Then we will quiz and spot true or false traps.

Worked example: Shelves 6, 9, 12... Gaps 3, 3, so start 3n. 3x1=3 need 6 so +3 gives 3n+3. Shelf 10: 3x10=30, 30+3=33 boxes. Check n=1 gives 6, n=2 gives 9.

Ask: Is 7, 12, 17, 22 arithmetic and what is the nth term? (Yes, +5 each time, nth term 5n + 2.) · Is 12, 12, 12, 12 arithmetic? (Yes, difference 0, because addition of 0 does not change a number [3].)

Check understanding: Collect whiteboards for shelf 10 = 33 and Task G true or false ticks. Re-explain adjustment error if many give 3n or 5n.

Support: Put a word bank on the board: difference, position, term, nth term, not arithmetic. **Stretch:** Ask whether 200 could ever appear in 4n + 3 and how to prove it.

Use: Slides 11–12, Worksheet Task G (Tick true or false)

Common mistakes

Mistake	How to spot it	How to fix it
Calling 2, 4, 8, 16 arithmetic because numbers go up.	Gaps written as 2, 4, 8 are not equal.	Always write all gaps first and keep only the ones with the same gap every time.
Writing n + 3 for 4, 7, 10, 13 instead of 3n + 1.	Test with n = 2 gives 5 not 7.	Multiply the difference by n first, then adjust to fit term 1 and test n = 1, 2, 3 [1].
Saying a constant list like 12, 12, 12 cannot be arithmetic.	Pupil says difference must be positive.	Show difference is 0 and addition of 0 does not change a number, so it is arithmetic [3].

Support

- Use colour-coded borders so sequence cards, picture cards and rule cards are easy to tell apart.
- Provide gap templates, substitution frames and a word bank with difference, position, term and nth term.

Stretch

- Ask groups to make one extra false match that looks close and challenge another group to explain the error.
- Ask whether a given number such as 150 or 200 can belong to a rule and prove it by solving.

For the LSE or teaching assistant

Stay with the two focus groups during the matching task. Point to colour borders, prompt gap writing, and ask them to read the n = 4 check aloud before gluing.

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Check for understanding

Question	Answer
Is 6, 10, 14, 18 arithmetic? What is the common difference?	Yes, common difference +4.
Find the nth term of 6, 10, 14, 18.	4n + 2. Check n = 1 gives 6.
Use the rule to find the 20th term.	4 x 20 + 2 = 82.

Homework

Find the nth term for 2, 7, 12, 17 and use it to find the 30th term.

Sources

1. Function (mathematics) · Wikipedia · https://en.wikipedia.org/wiki/Function_(mathematics)
2. On-Line Encyclopedia of Integer Sequences · Wikipedia · https://en.wikipedia.org/wiki/On-Line_Encyclopedia_of_Integer_Sequences
3. Addition · Wikipedia · https://en.wikipedia.org/wiki/Addition

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