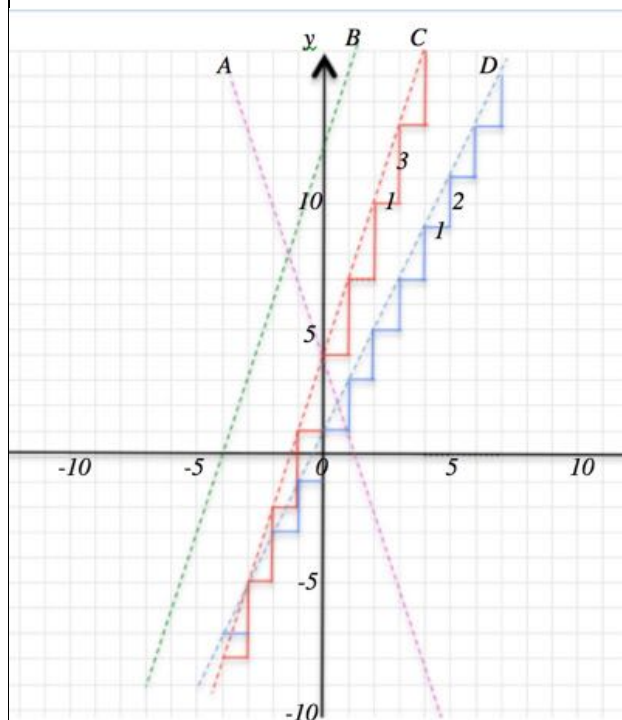


STEPS



Continue these sequences for the next 3 terms and continue the sequences backwards to the previous 3 terms:

7, 10, 13, 16, 19, ...

15, 18, 21, 24, 27, ...

1, -2, -5, -8, -11, ...

The first 2 sequences come from a multiplication table shifted up. Which multiplication table is it? What do you notice about the third sequence? How do the sequences relate to the red steps in the diagram?

How do these sequences relate to the lines A, B and C in the diagram? Which sequence relates to which line?

How does the sequence 3, 5, 7, 9, 11... relate to a multiplication table and to the blue steps in the diagram? How does it relate to the line D in the diagram?

Imagine you are climbing the red steps from the point (-3, -5) to the point (3, 13). Now imagine you climb the same number of the blue steps from the point (-3, -5) to the point (3, 7). Which is the steeper climb? Why? How could you measure the steepness of the climb?

Match the following equations to the lines in the diagram.

$$E_1 : y = 3x + 12$$

$$E_2 : y = 2x + 1$$

$$E_3 : y = -3x + 4$$

$$E_4 : y = 3x + 4$$

HELP

Learners may find that writing down the coordinates of points L, M, N, P, Q, R and S and then of the points T, U, V and W helps them to do this question.

Learners might work in groups and take responsibility for ensuring that everyone in the group understands before the group moves on to the next stage. In that way everyone can develop the skills of maintaining good interpersonal relations while working co-operatively.

NEXT

First draw the graphs of the lines:

through $(0, 7)$ with gradient -2 and

through $(0, -5)$ with gradient 1 and find their equation.

Then draw 3 more straight lines with the same axes and record the intercepts, gradients and equations.

NOTES FOR TEACHERS

SOLUTION

The first two sequences come from the 3 times table and the third one from multiples of -3.

| Line | Sequence | Equation | Multiplication table and shift |
|------|---|---------------------|--------------------------------|
| A | ...10, 7, 4, 1, -2, -5, -8, -11, -14, -17, -20, ... | $E_3 : y = -3x + 4$ | -3 shifted by 4 |
| B | ... 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, ... | $E_1 : y = 3x + 12$ | 3 shifted by 12 |
| C | ...-2, 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, ... | $E_4 : y = 3x + 4$ | 3 shifted by 4 |
| D | -3, -1, 1, 3, 5, 7, 9, 11, 13, 15, 18, ... | $E_2 : y = 2x + 1$ | 2 shifted by 1 |

Lines B and C are parallel and have the same gradient.

The red steps and graph C, gradient 3, are steeper than the blue steps and graph D, gradient 2.

Why do this activity?

This activity connects what learners know about counting in 2s and 3s, and number patterns and sequences, to the important features of straight line graphs, namely the connection between arithmetic series, intercepts, gradients and equations. The activity focuses on identifying lines and their equations through a process that is equivalent to filling in y values in a table for successive x values. It emphasises the 'distances across and up' features of the graph that underpin the concepts and formulas of gradient and the distance between two points.

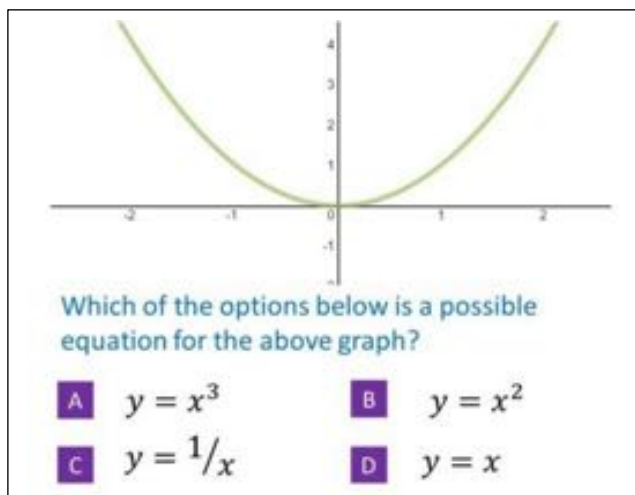
DIAGNOSTIC ASSESSMENT

This should take about 5–10 minutes.

Write the question on the board, say to the class:

"Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 for D".

1. Notice how the learners respond. Ask a learner who gave answer A to explain why he or she gave that answer. DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.
2. It is important for learners to explain the reasons for their answers. Putting thoughts into words may help them to gain better understanding and improve their communication skills.
3. Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.
4. Ask the class to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a change and who gave right and wrong answers.
5. If the concept is needed for the lesson to follow, explain the right answer or give a remedial task.



The correct answer is:

Possible misconceptions:

<https://diagnosticquestions.com>

Learning objectives

In doing this activity students will have an opportunity to develop their understanding:

- of gradients and equations of straight lines;
- of the connections between arithmetic sequences and linear equations.

Generic competences

In doing this activity students will have an opportunity to practise and develop

- independent learning to prepare students for lifelong learning;
- communication, co-operation, interpersonal relations and life skills;
- competence of communication.

Suggestions for teaching

Start with the whole class counting aloud, saying the terms of the sequences and counting on in 3's to give the next few terms of the series. Ask the learners to tell you what they notice. Then count back.

Either give out copies of the worksheet or write the question on the board. It is best to encourage your learners to read questions for themselves and decide for themselves what to do. This helps to develop the **competence of independent learning to prepare students for lifelong learning**.

After some time working individually you could choose to have your learners working in pairs. This helps to develop the **competences of communication, co-operation, interpersonal relations and life skills**.

When most of the learners have done all they can and checked their answers, then ask some learners to explain their answers to the whole class. This helps to develop the **competence of communication**.

Summarise what has been learned and the links between the concepts of sequences, intercepts, gradients and equations of straight line graphs. Make it clear that the sequences give the y coordinates for integer x coordinates (hence the steps) and make it clear that to draw the lines we connect those points to include all the points in between.

Key questions

Here are some prompts that could be used if students get stuck:

- Where does that line cut the y-axis?
- Looking at the equation, what is the value of y when $x=0$?
- Does the line go up or down? Is the gradient positive or negative?
- What can you tell me about the lines B and C?

Follow up

Shifting Times Tables (do this before STEPS)

<https://aiminghigh.aimssec.ac.za/shifting-times-tables/>

Multiple Patterns <https://aiminghigh.aimssec.ac.za/multiple-patterns/>

Mind Reader <https://aiminghigh.aimssec.ac.za/mind-reader>

Building Functions <https://aiminghigh.aimssec.ac.za/building-functions/>

Undoing <https://aiminghigh.aimssec.ac.za/undoing/>

Go to the **AIMSSEC AIMING HIGH** website for lesson ideas, solutions and curriculum

MATHS



links: <http://aiminghigh.aimssec.ac.za>

Subscribe to the **MATHS TOYS YouTube Channel**

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Download the whole AIMSSEC collection of resources to use offline with the **AIMSSEC App** see <https://aimssec.app> or find it on Google Play.

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and school years up to Secondary 5 in East Africa.

New material will be added for Secondary 6.

For resources for teaching A level mathematics (Years 12 and 13) see <https://nrich.maths.org/12339>

Mathematics taught in Year 13 (UK) & Secondary 6 (East Africa) is beyond the SA CAPS curriculum for Grade 12

| | Lower Primary Approx. Age 5 to 8 | Upper Primary Age 8 to 11 | Lower Secondary Age 11 to 15 | Upper Secondary Age 15+ |
|--------------|-------------------------------------|------------------------------|---------------------------------|----------------------------|
| South Africa | Grades R and 1 to 3 | Grades 4 to 6 | Grades 7 to 9 | Grades 10 to 12 |
| East Africa | Nursery and Primary 1 to 3 | Primary 4 to 6 | Secondary 1 to 3 | Secondary 4 to 6 |
| USA | Kindergarten and G1 to 3 | Grades 4 to 6 | Grades 7 to 9 | Grades 10 to 12 |
| UK | Reception and Years 1 to 3 | Years 4 to 6 | Years 7 to 9 | Years 10 to 13 |

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