Angles on straight lines, elevation and depression

Lesson plan and teacher's notes · Form 1 Mathematics · 1 period of 40 minutes

School	(write school name)	**Teacher**	(write name)
Date	(date)	**Class**	Form 1
Subject	Mathematics	**Enrolment**	Boys ___ Girls ___ Total ___
Time	40 minutes	**Topic**	Angles on straight lines, elevation and depression

Learners name acute, obtuse and reflex angles and a full turn, identify complementary, supplementary, adjacent and vertically opposite angles, identify corresponding, alternate and allied angles between parallel lines, and say what the angles of elevation and depression are. Examples come from a flagpole at a Luangwa school, a cliff above Lake Tanganyika and a tall tree.

Specific outcomes

By the end of the lesson, learners should be able to:

1. Name acute, obtuse and reflex angles and a full turn
2. Identify complementary, supplementary, adjacent and vertically opposite angles
3. Identify corresponding, alternate and allied angles between parallel lines
4. Say what the angle of elevation and the angle of depression are

Prior knowledge

- A vertex is where two lines or edges meet
- Addition and subtraction of whole numbers
- Using a ruler to draw straight lines

Teaching and learning materials

- chalk and board
- rulers
- exercise books
- two straight sticks or strips of paper to show crossing lines

References

Ministry of Education (CDC) Form 1 Mathematics syllabus and module; 25Schools learners' note: Angles on straight lines, elevation and depression.

Lesson development

Stage and time	Teacher activities	Learner activities
Introduction 5 min	Ask where learners see angles: two roads crossing, a roof meeting a wall, or the top of a tall tree. Tell them that today they name angles and use them to find unknown angles.	Name examples of angles around the school and copy the title.
Development: kinds of angles 8 min	Draw and name acute, obtuse and reflex angles and a full turn of 360 degrees. Mark the vertex on each.	Draw one of each kind and label its size range.
Development: pairs of angles 12 min	Teach complementary, supplementary, adjacent and vertically opposite angles. Work the example of angles on a straight line step by step. Then show corresponding, alternate and allied angles between parallel lines using a transversal.	Copy each definition and solve the straight-line example in their books.
Development: elevation and depression 12 min	Draw a learner on level ground looking up at the top of a tree. Mark the horizontal line, the line of sight and the angle of elevation. Then draw a person on a hill looking down at a village and mark the angle of depression.	Draw both sketches and mark each angle.
Conclusion 3 min	Ask for the sum of angles on a straight line and the meaning of elevation. Set the homework.	Answer orally and copy the homework.

Teacher's content notes

Read these before the lesson. They are what you need to know, not what to copy onto the board.

Kinds of angles

Angles are named by their size. An acute angle is less than 90 degrees. An obtuse angle is between 90 and 180 degrees. A reflex angle is greater than 180 degrees but less than 360 degrees. A full turn, or full rotation, is 360 degrees. A vertex is the point where two lines or edges meet. Every angle has a vertex.

Pairs of angles

Two angles that add up to 90 degrees are complementary. Two angles that add up to 180 degrees are supplementary, as angles on a straight line are. Adjacent angles share a common side and a vertex. When two straight lines cross, the opposite angles are called vertically opposite angles, and they are always equal.

Angles between parallel lines

When a transversal crosses parallel lines, corresponding angles are in the same relative position at each crossing. Alternate angles form a zig-zag (Z) pattern. Allied angles lie between the parallel lines on the same side of the transversal.

Angles of elevation and depression

Imagine a learner standing on level ground looking at the top of a tree. The horizontal line from the learner's eye is the reference. The angle between this line and the line of sight going up to the top of the tree is the angle of elevation. If a person stands on top of a hill and looks down at a village, the angle between the horizontal line and the line of sight going down is the angle of depression.

Questions to ask during the lesson

Question	Expected answer
A teacher draws three angles on the board for a class in Luangwa: one of 40 degrees, one of 120 degrees and one of 200 degrees. (a) Name the 40 degree angle. (b) Name the 120 degree angle. (c) Name the 200 degree angle.	(a) An acute angle. (b) An obtuse angle. (c) A reflex angle.
A learner reads that two angles can add up to 90 degrees or to 180 degrees and wants to name each pair. (a) What do we call two angles that add up to 90 degrees. (b) What do we call two angles that add up to 180 degrees. (c) Which pair do angles on a straight line belong to.	(a) Complementary angles. (b) Supplementary angles. (c) Supplementary angles.
Two straight roads cross at a junction in a village and the learners look at the opposite angles. (a) What are the opposite angles called. (b) What is true about them. (c) What do we call angles that share a common side and a vertex.	(a) Vertically opposite angles. (b) They are always equal. (c) Adjacent angles.
A learner stands on level ground and looks up at a tall tree, while a person on a hill looks down at a village. (a) Name the angle the learner makes with the horizontal when looking up. (b) Name the angle the person on the hill makes when looking down. (c) What line is the reference for both.	(a) The angle of elevation. (b) The angle of depression. (c) The horizontal line from the eye.

Worked examples for the board

Example 1: angles on a straight line

Two angles on a straight line are x and 65 degrees. Find x. Angles on a straight line add up to 180 degrees. So x + 65 = 180. Then x = 180 - 65. So x = 115 degrees.

Example 2: an equation with 2x

Two angles on a straight line are 2x and 50 degrees. Find x. Angles on a straight line add up to 180 degrees, so 2x + 50 = 180. Then 2x = 130 and x = 65 degrees.

Example 3: elevation to the top of a tree

A learner stands on level ground and looks at the top of a tree. The horizontal line from the learner's eye is the reference. The angle between this line and the line of sight going up to the top of the tree is the angle of elevation.

Board plan

Write the title and key words. Left: kinds of angles with their sizes. Centre: pairs of angles and the straight-line example. Right: two sketches, one of elevation and one of depression, with the horizontal line marked.

Angle	Size
Acute angle	Less than 90 degrees
Obtuse angle	Between 90 and 180 degrees
Reflex angle	Greater than 180 degrees but less than 360 degrees
Full turn	360 degrees

Kinds of angles and their sizes

Mistakes to expect

Learners often think	Put it right
Complementary and supplementary angles are the same thing.	Complementary angles add up to 90 degrees. Supplementary angles add up to 180 degrees, as angles on a straight line do.
Vertically opposite angles are sometimes different.	When two straight lines cross, vertically opposite angles are always equal.
The angle of elevation is measured from the vertical.	It is measured from the horizontal line from the eye up to the line of sight.
The angle of depression is the angle above the horizontal.	The angle of depression is the angle between the horizontal line and the line of sight going down.

Differentiation

Learners who struggle

Give learners a card with the four kinds of angles and their sizes, and let them sort drawn angles into the right group. For the straight-line example, write the three steps on the board and let them copy the pattern for a new number.

Learners who finish early

Ask learners who finish early to solve an equation such as $2x + 50 = 180$ on a straight line, and to explain what happens to the angle of elevation when the observer walks closer to the object.

Hearing or visual impairment

For learners with visual impairment, make raised angles with string or wire so they can feel acute, obtuse and reflex angles. For learners with hearing impairment, draw every angle on the board and label it before explaining.

No projector, no printing

Use two sticks or strips of paper to show crossing lines and vertically opposite angles. Draw all sketches on the board or on the ground with a stick.

If time is short

Teach the kinds of angles, supplementary angles and the straight-line example. Leave the angles between parallel lines for the next lesson.

Evaluation

Question or task	A correct answer shows
A learner at a school in Luangwa stands on level ground and looks up at the top of a flagpole. (a) Draw a sketch showing the horizontal line and the line of sight. (b) Mark the angle of elevation. (c) Say what happens to this angle if the learner walks closer to the pole.	(a) A horizontal line from the eye and a line of sight rising to the top of the pole. (b) The angle between the horizontal line and the line of sight. (c) It becomes bigger as the learner gets closer.
A builder in Lusaka cuts a board so that two angles lie on a straight line. One angle is x and the other is 65 degrees. (a) State what angles on a straight line add up to. (b) Write an equation. (c) Find x.	(a) 180 degrees. (b) x + 65 = 180. (c) x = 180 - 65 = 115 degrees.
Two roads cross in a village near Feira, and one learner says the opposite angles are different while another says they are equal. (a) Name the opposite angles. (b) Say which learner is correct. (c) Name the two angles that add up to 90 degrees.	(a) Vertically opposite angles. (b) The learner who says they are equal. (c) Complementary angles.

Homework

A fisherman stands on a cliff above Lake Tanganyika and looks down at a boat. Two angles on a straight line at the shore are 2x and 50 degrees. (a) Name the angle between the horizontal line and his line of sight down to the boat. (b) Write an equation for the straight-line angles. (c) Find x.

Extra practice with answers

Question	Answer

1. Two angles on a straight line at a road junction near Feira are x and 110 degrees. (a) State what angles on a straight line add up to. (b) Write an equation. (c) Find x.	(a) 180 degrees. (b) x + 110 = 180. (c) x = 180 - 110 = 70 degrees.
2. Two angles on a straight line on a roof beam are 3x and 60 degrees. (a) Write an equation. (b) Find 3x. (c) Find x.	(a) 3x + 60 = 180. (b) 3x = 120. (c) x = 40 degrees.
3. A learner at a school in Luangwa stands on level ground and looks up at the top of a flagpole. (a) Draw a sketch showing the horizontal line and the line of sight. (b) Mark the angle of elevation. (c) Say what happens to this angle if the learner walks closer to the pole.	(a) A horizontal line from the eye and a line of sight rising to the top of the pole. (b) The angle between the horizontal line and the line of sight. (c) It becomes bigger as the learner gets closer.
4. Two parallel lines are crossed by a transversal in a diagram on the board. (a) What name is given to angles in the same relative position at each crossing. (b) What pattern do alternate angles form. (c) Where do allied angles lie.	(a) Corresponding angles. (b) A zig-zag (Z) pattern. (c) Between the parallel lines on the same side of the transversal.

Answers to the learners' check-yourself questions

1. What is an obtuse angle?
   An angle between 90 and 180 degrees.
2. What do complementary angles add up to?
   90 degrees.
3. What do supplementary angles add up to?
   180 degrees.
4. What is true of vertically opposite angles?
   They are always equal.
5. Two angles on a straight line are 2x and 50 degrees. Find x.
   2x + 50 = 180, so 2x = 130 and x = 65 degrees.
6. A learner at a school in Luangwa stands on level ground and looks up at the top of a flagpole. (a) Draw a sketch showing the horizontal line and the line of sight. (b) Mark the angle of elevation. (c) Say what happens to this angle if the learner walks closer to the pole.
   (a) A horizontal line from the eye and a line of sight rising to the top of the pole. (b) The angle between the horizontal line and the line of sight. (c) It becomes bigger as the learner gets closer.
7. A fisherman stands on a cliff above Lake Tanganyika and looks down at a boat. (a) Name the angle between his horizontal line of sight and the line to the boat. (b) Explain how it differs from an angle of elevation. (c) Two angles at the same corner are supplementary and one is 72 degrees; find the o
   (a) The angle of depression. (b) It is measured below the horizontal, while the angle of elevation is measured above it. (c) 180 - 72 = 108 degrees.

Teacher's reflection

What went well:

What I will change next time:

Learners who need follow-up: