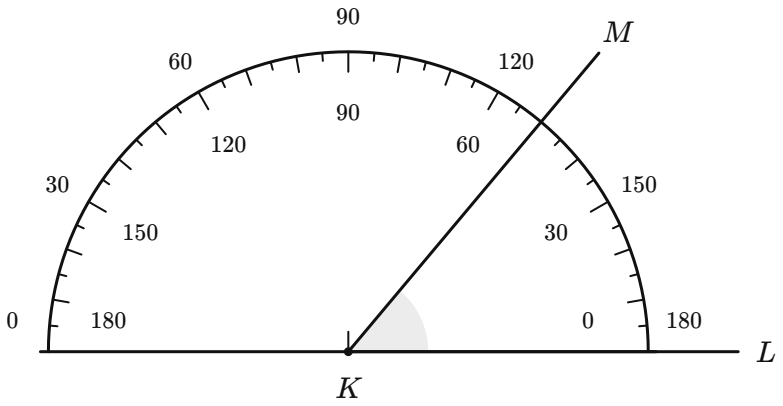
Grade 4 Unit 11 worksheet: Measuring and drawing angles with a protractor (answer key)

ANSWERS AT A GLANCE

1. (a) the inner row (b) $m\angle LKM = 50^\circ$ (c) 130
2. (a) 5° (b) 75° (c) at the third small mark past the 120
3. (a) $m\angle BSF = 130^\circ$ (b) He read the inner row, whose 0 is at the right end, where no arm runs.
4. $m\angle ANB = 80^\circ$, read on the outer row, because that row has its 0 on arm NA.
5. (a) and (b) At A the count is on the row whose 0 is at the right end (the inner row on the lesson's protractor), at 50; at B it is on the row whose 0 is at the left end (the outer row), at 60. (c) $m\angle ACB$ is about 70°, read on the row whose 0 lies on the arm lined up at C.
6. (a) 130° (b) at the 50 on the outer row, the row whose 0 is at the left end (the inner row reads 130 there) (c) 50° is narrower than a square corner, but her angle opens wider than a square corner.

WORKED SOLUTIONS

1. Mason is building a model house. In the figure, arm KL runs along the flat top of a wall and arm KM runs along one slanted edge of the roof. A protractor is laid on the angle with its center mark on K.



(a) Which row of numbers has its 0 on arm KL, the inner row or the outer row?

(b) Find $m\angle LKM$.

(c) What number does the other row show where arm KM crosses the curved edge?

ANSWER

(a) the inner row (b) $m\angle LKM = 50^\circ$ (c) 130

SOLUTION

(a) Arm KL runs to the right end of the base line, and the inner row has its 0 there.

(b) Count up the inner row from that 0 to where arm KM crosses: past the label 30 come 40 and 50 at the first two long marks: 30 + 10 + 10 = 50. So $m\angle LKM = 50^\circ$. Check: the roof edge is narrower than a square corner, so the angle is less than 90°.

(c) The two rows add to 180 at every place: 180 − 50 = 130. The outer row's 0 is at the left end, where no arm runs, so 130 is not the angle.

2. Mei has a toy protractor. Its numbers go 0, 20, 40, and so on up to 180. Between two numbers next to each other there are 3 small marks, evenly spaced.

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(a) How many degrees does each space between two marks stand for?

(b) Mei lines up an angle correctly. Its other arm crosses at the third small mark past the 60, on the row whose 0 is on the first arm. What is the angle?

(c) Mei wants to draw a 135° angle. Past which number, and at which small mark, does her dot go?

ANSWER

(a) 5° (b) 75° (c) at the third small mark past the 120

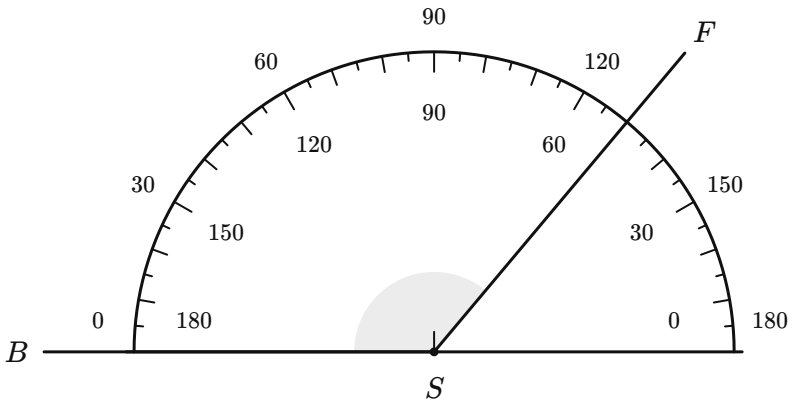
SOLUTION

(a) The 3 small marks cut the 20 degrees between two numbers into 4 equal spaces: 20 ÷ 4 = 5, so each space is 5°.

(b) Three spaces past 60: 60 + 5 + 5 + 5 = 75, so the angle is 75°.

(c) The number just below 135 is 120, and 135 − 120 = 15. That is 15 ÷ 5 = 3 spaces, so the dot goes at the third small mark past the 120.

3. Lucas opens a book and looks at it from one end. The back cover lies flat on the table, along arm SB, and the front cover is arm SF. He lays a protractor on the angle at the spine S, as in the figure.



(a) Find $m\angle BSF$.

(b) Lucas first wrote 50°. What did he do wrong?

ANSWER

(a) $m\angle BSF = 130^\circ$ (b) He read the inner row, whose 0 is at the right end, where no arm runs.

SOLUTION

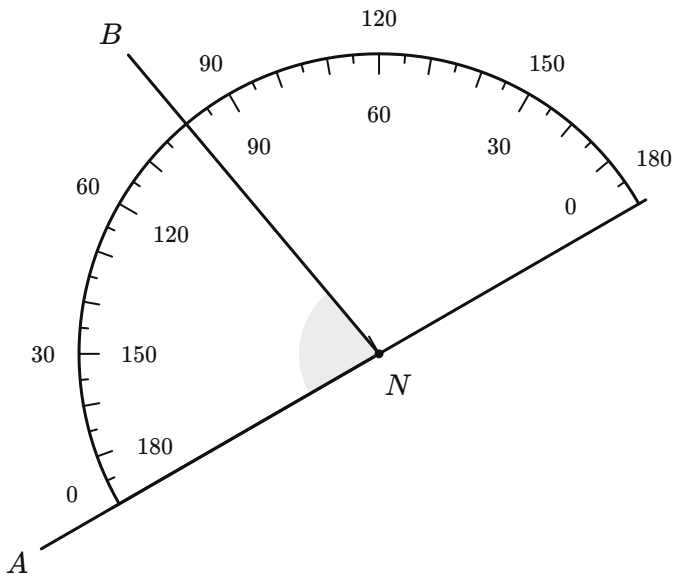
(a) Arm SB runs to the left end of the base line. The row with its 0 at the left end is the outer row, so that row counts the turn from SB. Arm SF crosses the outer row past the label 120, at the first long mark: 120 + 10 = 130. So $m\angle BSF = 130^\circ$.

(b) At the same place the inner row reads 50, and 50 + 130 = 180. The inner row starts at 0 on the right end of the base line, where neither cover lies, so 50 is not the angle. An estimate shows it too: the cover is opened wider than a square corner, so the angle is more than 90°.

4. Zoe sketches her toy crocodile with its mouth wide open. In the figure, N is the hinge at the back of the jaws, arm NA runs along the lower jaw and arm NB along the upper jaw. Neither arm runs

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across the page, so she turns the protractor until its center mark is on N and its base line lies along NA.



Find $m\angle ANB$. Say which row you read, and why.

ANSWER

$m\angle ANB = 80°$, read on the outer row, because that row has its 0 on arm NA.

SOLUTION

Arm NA lies along the base line at the end where the outer row has its 0, so the outer row counts the turn from NA. Counting up that row, arm NB crosses past the label 60 at the second long mark: 60 + 10 + 10 = 80. So $m\angle ANB = 80°$.

The inner row reads 100 at the same place, but its 0 is at the other end of the base line, where no arm runs. Check: the mouth is open a little less than a square corner, so the angle is a little less than 90°.

5. Use a ruler and a protractor.

(a) Draw a segment $\overline{AB}$, 8 centimeters long, across the page, with A on the left.

(b) At A, draw a ray above $\overline{AB}$ that makes a 50° angle with $\overrightarrow{AB}$. At B, draw a ray above $\overline{AB}$ that makes a 60° angle with $\overrightarrow{BA}$. Label the point where the two rays cross C.

(c) Measure $\angle ACB$. Write which row you read.

ANSWER

(a) and (b) At A the count is on the row whose 0 is at the right end (the inner row on the lesson's protractor), at 50; at B it is on the row whose 0 is at the left end (the outer row), at 60. (c) $m\angle ACB$ is about 70°, read on the row whose 0 lies on the arm lined up at C.

SOLUTION

(a) Rule a segment 8 centimeters long and label its left end A and its right end B.

(b) At A: center mark on A, base line along $\overline{AB}$. Ray AB runs to the right end of the base line, so count up the row whose 0 is at that end: past the label 30, two long marks make 40 and 50.

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Dot at 50 and join it to A. At B: center mark on B, base line along $\overline{BA}$. Ray BA runs to the left end, so count up the row whose 0 is at the left end, 0, 30, 60: the 60 is a printed label. Dot at 60 and join it to B. The two rays cross above the segment at C.

(c) At C neither arm runs across the page, so turn the protractor: center mark on C, base line along $\overline{CA}$ (or $\overline{CB}$). Read the row whose 0 is on that arm. A careful drawing reads about 70°. Check: the angle at C is narrower than a square corner but wider than half of one, so it is between 45° and 90°.

6. Layla wants to draw a 50° angle. She draws a ray pointing left, puts the center mark on its endpoint and the base line along the ray. Then she counts up the inner row to 50, makes her dot there, and joins it to the endpoint.

(a) What size is the angle Layla drew?

(b) Where should her dot have gone?

(c) How could an estimate have warned her?

ANSWER

(a) 130° (b) at the 50 on the outer row, the row whose 0 is at the left end (the inner row reads 130 there) (c) 50° is narrower than a square corner, but her angle opens wider than a square corner.

SOLUTION

(a) Her ray runs to the left end of the base line, where the outer row has its 0. Her dot sits where the inner row reads 50, and at every place the two rows add to 180, so the outer row reads 180 − 50 = 130 there. Counted from her ray, the angle is 130°.

(b) She should count up the row whose 0 is on her ray, the outer row, to 50. The inner row reads 180 − 50 = 130 at that spot.

(c) A 50° angle is narrower than a square corner, 90°. Her new arm leans past the top of the protractor, away from her ray, so her angle opens wider than a square corner. It cannot be 50°.

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