Chapter 3: Angles as Turns

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Exercise 3.1 — Introductory Turns Activity — Reema's Turns and Everyday Objects (p. 33)

Q1 Reema takes two half turns in the same direction. It is like a _____ turn.

SOLUTION

Each half turn = 1/2 of a full circle.
Two half turns = 1/2 + 1/2 = 1 full turn.

Answer: full

Q2 What happens if Reema takes 2 quarter turns in the same direction? It is like a _____ turn.

SOLUTION

Each quarter turn = 1/4 of a full circle.
Two quarter turns = 1/4 + 1/4 = 2/4 = 1/2 turn.

Answer: half

Q3 What happens if Reema takes 4 quarter turns in the same direction? It is like a _____ turn.

SOLUTION

Four quarter turns = 1/4 + 1/4 + 1/4 + 1/4 = 4/4 = 1 full turn.

Answer: full

Q4 Write some everyday objects that involve turns (besides taps). What is the maximum possible turn for each object in the table — less than a 1/4 turn, exactly a 1/4 turn, or more than a 1/4 turn?

Objects: Clothes clip, Door with hinge, Tongs, Scissors, File cover.

Also: Do any of these make a half turn? Do any make a full turn?

SOLUTION

Other everyday objects that involve turns: door knobs, wheels, bottle caps, pencil sharpener, hand fan, clock hands.

Maximum turn for each object (check and tick):
Clothes clip: opens and closes — less than a 1/4 turn.
Door with hinge: can swing open up to about a 1/4 turn or a little more — more than a 1/4 turn.
Tongs: the two arms spread apart — less than a 1/4 turn.
Scissors: the two blades open — more than a 1/4 turn (can open quite wide).
File cover: opens flat — up to a 1/2 turn (half turn).

Objects that make a half turn: Door with hinge, File cover (they can open flat = 1/2 turn).
Objects that make a full turn: None of these objects complete a full turn.

Answer: Clothes clip: less than 1/4 turn. Door with hinge: more than 1/4 turn (up to 1/2 turn). Tongs: less than 1/4 turn. Scissors: more than 1/4 turn. File cover: 1/2 turn. Half-turn objects: door with hinge, file cover. Full-turn objects: none.

Exercise 3.2 — Let Us Do — Paper Fan and Angle Types (p. 34–35)

Q1 (a) Making a paper fan: Take a rectangular paper, fold every 2 cm as shown, and paste ice cream sticks to make a fan. Use your paper fan to show different acute angles and obtuse angles.

SOLUTION

This is a hands-on activity. Here is how to do it and what to show:

Fold a rectangular strip of paper in accordion pleats (back and forth) every 2 cm.
Pinch the pleated strip together at one end and paste two ice cream sticks on either side of that end.
Fan out the paper from the sticks.

To show an acute angle: hold one stick fixed; open the fan just a little (less than a 1/4 turn between the sticks). The angle between the sticks is less than a right angle = acute angle.
To show a right angle: open the fan so the sticks form a perfect corner (1/4 turn) = right angle.
To show an obtuse angle: open the fan more than a right angle but less than a straight line (between 1/4 and 1/2 turn) = obtuse angle.
To show a straight angle: open the fan fully flat (1/2 turn) = straight angle.

Answer: Make accordion pleats every 2 cm; attach ice cream sticks. Small opening (< 1/4 turn) = acute angle. 1/4 turn opening = right angle. Between 1/4 and 1/2 turn = obtuse angle. Fully open (1/2 turn) = straight angle.

Q2 Make an acute turn with the straws or fan. Continue to make another acute turn. Can the two acute turns together make another acute turn?

SOLUTION

An acute turn is less than 1/4 turn.
Adding two acute turns: each is less than 1/4, so together they are less than 1/2 turn.
But together they could be more than 1/4 turn (obtuse) or exactly 1/4 turn (right angle) depending on the size.

Example: 1/8 turn + 1/8 turn = 2/8 = 1/4 turn = right angle (not acute).
Example: 1/8 turn + 1/6 turn = 7/24 turn (= 105 degrees) = obtuse angle (not acute).

But if both are very small: 1/16 + 1/16 = 1/8 turn = still acute!

So: sometimes yes (if both turns are very small), but often no — two acute turns together can make a right angle or an obtuse angle.

Answer: Sometimes, but not always. Two very small acute turns together are still acute. But two larger acute turns (each close to 1/4) together can make a right angle or obtuse angle.

Q3 (b) Look at the angles marked in the house made from notebook covers. Write whether each angle A, B, C, D, E, F, G, H is a right angle, acute angle, or obtuse angle.

SOLUTION

Compare each marked corner with a right angle (a square corner): smaller = acute, square = right, wider = obtuse.

A: wide, open corner of the roof peak = obtuse angle.
B: square corner where a wall meets the base = right angle.
C: narrow, sharp corner at the side of the roof = acute angle.
D: narrow, sharp corner at the lower edge = acute angle.
E: narrow, sharp corner at the side = acute angle.
F: square corner where two covers meet = right angle.
G: square corner at the base of the house = right angle.
H: wide corner of a tilted cover = obtuse angle.

Answer: A: obtuse B: right C: acute D: acute E: acute F: right G: right H: obtuse

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Q4 (c) Make a 5-sided shape with 2 right angles, 2 obtuse angles, and 1 acute angle in your notebook.

SOLUTION

This is a drawing activity. Here is a way to make such a shape:

Draw a shape that looks like a house with a cut corner, or an arrow shape.

Example — an L-shape with one pointed corner cut diagonally:
Start at point P1. Go right 4 cm (P1 to P2). Turn down — right angle at P2.
Go down 2 cm (P2 to P3). Turn diagonally up-left — obtuse angle at P3.
Go diagonally 3 cm to P4. Turn sharply — acute angle at P4.
Go up 1 cm (P4 to P5). Turn left — obtuse angle at P5.
Go left back to P1 — right angle at P1.

Check: 2 right angles (P1, P2) + 2 obtuse angles (P3, P5) + 1 acute angle (P4) = 5 angles for a 5-sided shape. ✓

Answer: Draw a 5-sided (pentagon) shape with 2 square corners, 2 wide-opening corners, and 1 sharp corner. Any valid drawing with these 5 angle types is correct.

Q5 (d) Look at the angle formation between the legs of the gymnasts in the picture. Identify whether each angle is acute, obtuse, right, or straight.

SOLUTION

Compare each gymnast's leg-spread with a right angle (a square corner / quarter turn).

Gymnast 1: legs in a narrow V — the opening is small, less than a right angle = acute angle.
Gymnast 2: legs still in a narrow V, opening less than a right angle = acute angle.

Gymnast 3: legs spread wider than a right angle but not flat = obtuse angle.
Gymnast 4: legs spread very wide, close to flat but still bent = obtuse angle.
Gymnast 5: legs in a full split forming a straight line = straight angle.

Answer: Gymnast 1: acute Gymnast 2: acute Gymnast 3: obtuse Gymnast 4: obtuse Gymnast 5: straight

Exercise 3.3 — Angle Measuring Tool — Making and Using the 8-part Circle (p. 36)

Q1 (a) Cut out a circle from tracing paper and fold it into 8 equal parts. Attach a straw to the centre and mark the starting point.
(b) Now try this:
- Show a 1/8 turn of the straw.
- Show a 2/8 turn. Show a 1/4 turn. Show a 3/8 turn.
- What angle have you made with a 2/8 turn? A 1/8 turn is half of a quarter turn.
- What angle have you made with a 4/8 turn?

Continue turning by 5/8, 6/8, 7/8, and 8/8. Check when you have completed a 3/4 turn and a full turn.
Now, cut out 1/8 part and 2/8 parts of the circle and use as angle measuring tools.

SOLUTION

This is a hands-on making activity. Here is what each turn looks like:

The circle is divided into 8 equal slices, each slice = 1/8 turn = 45 degrees.

1/8 turn: straw moves 1 slice from the starting point. Angle = 45 degrees (less than a right angle = acute angle).
2/8 turn = 1/4 turn: straw moves 2 slices = right angle (90 degrees).
3/8 turn: straw moves 3 slices = 135 degrees = obtuse angle.
4/8 turn = 1/2 turn: straw moves 4 slices = straight angle (180 degrees).
5/8 turn: 225 degrees — more than a straight angle.
6/8 turn = 3/4 turn: 270 degrees — this is when you have completed a 3/4 turn.
7/8 turn: 315 degrees.
8/8 turn = full turn: straw returns to the starting point = 360 degrees.

What angle with 2/8 turn? A right angle (90 degrees). A 1/8 turn is half of a quarter turn (half of 90 = 45 degrees).
What angle with 4/8 turn? A straight angle (180 degrees).

Cut the 1/8 piece (45-degree slice) and the 2/8 piece (90-degree slice, a quarter circle) to use as measuring tools.

Answer: 1/8 turn = 45 degrees (acute). 2/8 = 1/4 turn = right angle (90 degrees). 3/8 turn = obtuse angle (135 degrees). 4/8 = 1/2 turn = straight angle (180 degrees). 3/4 turn is completed at 6/8. Full turn at 8/8. The 1/8 and 2/8 pieces become your angle measuring tools.

Q2 Now fold a new circle in half and then into 3 equal parts to make 6 equal slices. Show turns of 1/6, 2/6, and so on until a full circle. Cut out 1/6 and 2/6 parts. Fold one 1/6 part in half — what turn is it equal to? This is the same as a 1/12 turn.

SOLUTION

This is a hands-on activity. Here is what you discover:

Each slice = 1/6 turn = 60 degrees.

1/6 turn: 60 degrees (acute angle).
2/6 turn = 1/3 turn: 120 degrees (obtuse angle).
3/6 turn = 1/2 turn: 180 degrees (straight angle).
4/6 turn = 2/3 turn: 240 degrees.
5/6 turn: 300 degrees.
6/6 turn = full turn: 360 degrees.

Folding one 1/6 piece in half gives a piece that is 1/12 of the full circle.
So half of a 1/6 turn = 1/12 turn = 30 degrees (a small acute angle).

Answer: Each 1/6 turn = 60 degrees. Half of a 1/6 turn = 1/12 turn = 30 degrees. The 1/6 and 2/6 pieces (and the 1/12 piece made by folding) become additional angle measuring tools.

Exercise 3.4 — Let Us Think — Drawing Starting Points on Turn Circles (p. 37)

Q1 In the following circles, the end points of 1/2, 1/4, and 1/8 turns are shown. Draw arrows to show the starting points.

SOLUTION

The arrow in each circle shows where the turn ENDS. To find where it STARTED, go backward by the given turn amount.

For a 1/2 turn (half circle): the starting point is directly opposite the end point (180 degrees away).
Example: if the end arrow points to the right (3 o'clock), the starting arrow points to the left (9 o'clock).

For a 1/4 turn (quarter circle): the starting point is 90 degrees behind the end point.
Example: if the end arrow points down (6 o'clock), the starting arrow points to the right (3 o'clock) — for a clockwise turn.

For a 1/8 turn: the starting point is 45 degrees behind the end point.
Example: if the end arrow points down-right (between 3 and 6 o'clock), the starting arrow points to the right (3 o'clock).

Draw the starting arrow by going backward by the turn amount from the given end arrow.

Answer: Draw the starting arrow 1/2 turn (180 deg) before the end arrow for the 1/2-turn circles; 1/4 turn (90 deg) before for the 1/4-turn circles; 1/8 turn (45 deg) before for the 1/8-turn circles.

Exercise 3.5 — Let Us Do — Measuring Angles with Tools (p. 38–39)

Q1 Guess the measures of each of the angles shown (the dot-grid figure in the book). Then check using your angle measuring tools. Also state whether each angle is acute, right, or obtuse.

SOLUTION

This is a figure-based estimation activity using the home-made tools. Here is guidance:

Compare each angle in the figure with your 1/8-turn (45 deg) and 1/4-turn (90 deg) tools.
If the angle is clearly smaller than your 1/4-turn piece: it is acute (less than 90 deg).
If it matches the 1/4-turn piece exactly: it is a right angle.
If it is larger than the 1/4-turn piece but smaller than a straight line: it is obtuse.

Typical estimates from the dot-grid angles shown in the book:
Angle 1 (top-left): looks about 1/8 turn (45 deg) = acute angle.
Angle 2: looks about 1/4 turn (90 deg) = right angle.
Angle 3: looks about 3/8 turn (135 deg) = obtuse angle.
Angle 4: looks about 1/8 turn (45 deg) = acute angle.
Angle 5: looks about 3/8 turn (135 deg) = obtuse angle.
Angle 6 (bottom-right): looks about 1/8 turn (45 deg) = acute angle.

Place your tool at the vertex of each angle with one side of the tool along one arm of the angle and read off the measurement.

Answer: Use the 1/8-turn (45 deg) and 1/4-turn (90 deg) pieces as tools. Angles smaller than the 1/4 piece are acute; matching = right angle; larger than 1/4 but less than 1/2 = obtuse. Verify each by placing the tool at the vertex.

Q2 Guess the measure of the turns made by the arrow in each of the following cases. Verify with a combination of angle measuring tools.
(a) [given: 1/4 + 1/8 turn or 3/8 turn]
(b) _____ turn
(c) _____ turn
(d) _____ turn

SOLUTION

From the figures in the book (coloured sector diagrams showing the swept area of the arrow turn):

(a) The arrow turns from the top (up) clockwise to the down-right, sweeping 3 sections of the 8-part circle = 3/8 turn. Verified: 1/4 + 1/8 = 2/8 + 1/8 = 3/8 turn. This is given as the example answer.

(b) The arrow turns from the top clockwise to the down-left, sweeping 5 sections = 5/8 turn (more than a straight angle).

(c) The arrow turns from the top clockwise to the up-right, sweeping 1 section = 1/8 turn (an acute angle).

(d) The arrow turns from the top clockwise to the down-left, sweeping 5 sections = 5/8 turn (more than a straight angle).

Answer: (a) 3/8 turn (given) (b) 5/8 turn (c) 1/8 turn (d) 5/8 turn

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Q3 Measure each angle in the given shapes. Write the measure of the angles in terms of turns and describe whether they are acute, obtuse, or right angles.
(a) Triangle with vertices A, A', B', C, B
(b) Diamond/parallelogram with vertices D, E, F, E', D'
(c) Quadrilateral with vertices F, F', G', G

SOLUTION

Use the angle measuring tools (1/8, 1/4, 1/6 pieces) at each marked (coloured) angle of the shapes shown in the book.

Shape (a) — two crossing lines (only two angles are marked):
Angle at B' (top): a narrow, sharp angle = about 1/8 turn = acute angle.
Angle at A (bottom-left): a narrow angle = about 1/8 turn = acute angle.

Shape (b) — a rhombus/diamond (three angles marked: D, E, D'):
Angle at E (top point): a sharp, narrow angle = about 1/6 turn = acute angle.
Angle at D (left point): a wide angle = more than a 1/4 turn = obtuse angle.
Angle at D' (right point): a wide angle = more than a 1/4 turn = obtuse angle.
(Opposite corners of a rhombus are equal, so E' matches E = acute.)

Shape (c) — a four-sided shape (angles marked at F, G, F'):
Angle at F (bottom-left): a small, sharp angle = about 1/8 turn = acute angle.
Angle at G (bottom-right): a wide angle = more than a 1/4 turn = obtuse angle.
Angle at F' (top-right): a square corner (small square mark) = 1/4 turn = right angle.

Answer: Place your tools at each marked angle. (a) both marked angles (A and B') are acute. (b) E is acute (about 1/6 turn); D and D' are obtuse. (c) F is acute, G is obtuse, F' is a right angle (1/4 turn).

Q4 Draw angles for the given measures of turns using the given lines in the box:
1/2 turn, 1/4 turn, 1/8 turn, 1/12 turn, 1/4 turn.

SOLUTION

Use the given line segment in each box as one arm of the angle. Then use your angle measuring tool to draw the second arm.

1/2 turn (180 degrees): the second arm continues straight from the given line in the opposite direction — both arms form one straight line.

1/4 turn (90 degrees): the second arm is perpendicular to the given line — draw a square corner using your 1/4-turn (quarter-circle) piece.

1/8 turn (45 degrees): use your 1/8-turn piece. The second arm is halfway between the given line and the perpendicular direction.

1/12 turn (30 degrees): use your 1/12-turn piece (made by folding the 1/6 piece in half). The second arm is close to the given line, opening only a little.

1/4 turn (second one): same as above — draw a right angle.

Answer: 1/2 turn: straight angle (arms form a straight line). 1/4 turn: right angle (square corner). 1/8 turn: 45-degree angle. 1/12 turn: 30-degree angle. 1/4 turn: right angle.

Q5 Draw the angles formed by the following turns in your notebook:
1/2 turn, 1/4 turn, 2/4 turn, 1/6 turn, 4/6 turn, 3/12 turn, 1/2 + 1/4 turn, and 1/8 + 1/6 turn.

SOLUTION

For each, draw a starting ray, then rotate the second ray by the given turn amount:

1/2 turn = 180 degrees: straight angle (a straight line).

1/4 turn = 90 degrees: right angle (square corner).

2/4 turn = 2/4 = 1/2 turn = 180 degrees: straight angle (same as 1/2 turn).

1/6 turn = 60 degrees: acute angle (use your 1/6-turn piece).

4/6 turn = 240 degrees: a reflex angle — more than a straight angle. The arms point with 240 degrees of turning between them.

3/12 turn = 1/4 turn = 90 degrees: right angle.

1/2 + 1/4 turn = 3/4 turn = 270 degrees: a three-quarter turn angle (reflex — more than straight).

1/8 + 1/6 turn = 3/24 + 4/24 = 7/24 turn = 105 degrees: obtuse angle (between 90 and 180 degrees).

Answer: 1/2 = straight angle (180 deg). 1/4 = right angle (90 deg). 2/4 = straight angle (180 deg). 1/6 = 60 deg (acute). 4/6 = 240 deg (reflex). 3/12 = right angle (90 deg). 1/2+1/4 = 270 deg (reflex). 1/8+1/6 = 7/24 turn = 105 deg (obtuse).

Q6 Guess the measure of turns the minute hand of a clock makes in each of the following cases. The initial position of the minute hand is given. Draw the final position on the clock face.
(a) When the minute hand moves by 15 minutes, it has made a _____ turn.
(b) When the minute hand moves by 30 minutes, it has made a _____ turn.
(c) When the minute hand moves by 45 minutes, it has made a _____ turn.
(d) When the minute hand has turned by 1/12 of a full turn, it has moved by _____ minutes.
(e) When the minute hand has turned a full circle, it has moved by _____ minutes.
(f) When the minute hand has turned by 1/6 of a full turn, it has moved by _____ minutes.
(g) When the minute hand has turned by 4/12 of a full turn, it has moved by _____ minutes.

SOLUTION

The minute hand completes one full turn (360 degrees) in 60 minutes.
So 1 full turn = 60 minutes.

(a) 15 minutes out of 60 = 15/60 = 1/4 turn.
Final position: from 12 (top), the hand moves clockwise to 3 o'clock.

(b) 30 minutes out of 60 = 30/60 = 1/2 turn.
Final position: from 6 (bottom), the hand moves clockwise to 12 o'clock (top).

(c) 45 minutes out of 60 = 45/60 = 3/4 turn.
Final position: from 3 (right side), the hand moves clockwise to 12 o'clock.

(d) 1/12 turn means the hand moves 1/12 of 60 minutes = 60 / 12 = 5 minutes.

(e) Full circle = 1 full turn = 60 minutes.

(f) 1/6 turn: 1/6 of 60 minutes = 60 / 6 = 10 minutes.

(g) 4/12 turn = 1/3 turn: 4/12 of 60 minutes = 4 x 5 = 20 minutes.

Answer: (a) 1/4 turn (b) 1/2 turn (c) 3/4 turn (d) 5 minutes (e) 60 minutes (f) 10 minutes (g) 20 minutes

Exercise 3.6 — Which Direction? — Clockwise and Anti-clockwise (p. 40)

Q1 The creatures below have made a quarter turn once. Tick the direction in which they have moved.
(Clockwise / Anti-clockwise) for each: Ladybug, Snail, Bee, Ant.

SOLUTION

Look at each creature — compare its position before and after the 1/4 turn:

Ladybug (top-left): started facing right; after 1/4 turn it faces down = turned clockwise. Tick: Clockwise.

Snail (top-right): started facing right; after 1/4 turn it faces up = turned anti-clockwise. Tick: Anti-clockwise.

Bee (bottom-left): started facing right; after 1/4 turn it faces down = turned clockwise. Tick: Clockwise.

Ant (bottom-right): started facing right; after 1/4 turn it faces up = turned anti-clockwise. Tick: Anti-clockwise.

Answer: Ladybug: Clockwise. Snail: Anti-clockwise. Bee: Clockwise. Ant: Anti-clockwise.

Exercise 3.7 — Try These — Opening Taps, Lids, Nuts (p. 40)

Q1 Observe the direction of movement while opening a tap, unscrewing a lid, or loosening a nut. Do they move clockwise or anti-clockwise?

SOLUTION

Try opening each one at home or school and notice which way it turns:

Opening a tap: turn anti-clockwise (to the left) to let water flow.
Unscrewing a lid (like a bottle cap): turn anti-clockwise (to the left) to open.
Loosening a nut: turn anti-clockwise (to the left) to loosen.

This is a common rule: 'righty tighty, lefty loosey' — tighten by turning clockwise, loosen by turning anti-clockwise.

Answer: Opening a tap, unscrewing a lid, and loosening a nut all move anti-clockwise.

Exercise 3.8 — Fun with Turns — Compass Directions and Clockwise/Anti-clockwise (p. 40–41)

Q1 The children in a class are playing a game. Complete the table by filling in the ending direction after the given turns. (North, South, East, West; one right angle = 1/4 turn.)

Row 1: Start North, Two right angles clockwise.
Row 2: Start South, Two right angles anti-clockwise.
Row 3: Start East, Four right angles anti-clockwise.
Row 4: Start West, Four right angles clockwise.
Row 5: Start North, 5 right angles clockwise.
Row 6: Start South, 3 right angles clockwise, 1/2 right angle clockwise, 1/2 right angle clockwise.
Row 7: Start West, 2 right angles clockwise, four 1/2 right angles anti-clockwise.

SOLUTION

On the compass: North = top, East = right, South = bottom, West = left.
Each right angle turn clockwise: N -> E -> S -> W -> N (repeats).
Each right angle turn anti-clockwise: N -> W -> S -> E -> N (repeats).

Row 1: North + 2 right angles clockwise.
N -> E (1st) -> S (2nd). Ending direction: South.

Row 2: South + 2 right angles anti-clockwise.
S -> E (1st ACW) -> N (2nd ACW). Ending direction: North.

Row 3: East + 4 right angles anti-clockwise.
E -> N -> W -> S -> E (four quarter turns = full circle). Ending direction: East.

Row 4: West + 4 right angles clockwise.
W -> N -> E -> S -> W (full circle). Ending direction: West.

Row 5: North + 5 right angles clockwise.
N -> E -> S -> W -> N -> E (5 steps). Ending direction: East.

Row 6: South + 3 right angles CW + 1/2 right CW + 1/2 right CW.
1/2 right + 1/2 right = 1 right angle. Total = 3 + 1 = 4 right angles clockwise.
S -> W -> N -> E -> S (4 steps, full circle). Ending direction: South.

Row 7: West + 2 right angles CW + four 1/2 right angles ACW.
Four 1/2 right angles = 4 x 1/2 = 2 right angles ACW.
Net = 2 CW - 2 ACW = 0 net turn. Ending direction: West.

Answer: Row 1: South. Row 2: North. Row 3: East. Row 4: West. Row 5: East. Row 6: South. Row 7: West.

Q2 Padma is facing the toy shop. What place will she face if she takes a half turn clockwise? What other way can she turn to face the same place?

SOLUTION

From the picture in the book, the toy shop is directly in front of Padma.
A half turn (1/2 turn) = 180 degrees — it does not matter if it is clockwise or anti-clockwise, the result is the same: she faces the opposite direction.

Looking at the scene: opposite the toy shop is the ice cream cart/street area.
So after a half turn clockwise, Padma will face the ice cream cart (the area behind her, which is toward the viewer).

Other way to face the same place:
She can also take a half turn anti-clockwise and end up facing the same direction (ice cream cart side).
This is because a 1/2 turn CW and a 1/2 turn ACW both bring you to face exactly opposite your starting direction.

Answer: She will face the ice cream cart (the area directly behind/opposite the toy shop). She can also take a half turn anti-clockwise to face the same place — both a 1/2 turn CW and a 1/2 turn ACW rotate you 180 degrees to face the opposite direction.