

Part 11 Student Workbook

Build an accurate L-shaped autonomous path

TEACHER NOTE

MISSION: Drive 36 inches at heading 0, turn right to -90 degrees, drive 24 inches while holding -90, and stop.

Learning targets

- Assign encoders, IMU yaw, and physical measurements to the jobs they can actually perform.
- Trace the three route segments and their independent stop conditions.
- Explain how heading error changes left and right drive power.
- Measure only after STOP and visible DISABLED confirmation.

Route sketch

Draw the 36-inch first leg, clockwise 90-degree turn, 24-inch second leg, start heading 0, and final heading -90. Mark the full turn sweep and stopping buffer.

Before the video

Prediction: If the robot drifts left of its target heading during a straight leg, how should the motor commands change to steer it back?

Guided Video Notes

Pause, discuss, and record evidence

PAUSE	QUESTION / MY EVIDENCE
0:10	State the complete route. _____
0:21	Which sensor estimates distance? _____
0:32	Which sensor measures direction? _____
0:43	Why does a drive-straight method need distance and heading? _____
0:54	What is the first leg's target heading? _____
1:05	Why use -90 instead of 'turn right some amount'? _____
1:16	What heading should the second leg hold? _____
1:28	Do equal motor powers guarantee a straight path? _____
1:40	How does heading error correct drift? _____
1:49	Which telemetry values prove what happened? _____
1:57	When may the team enter the course? _____

Trace the L Path

Connect each segment to its measurement and exit

SEGMENT	TARGET	PRIMARY EVIDENCE	EXIT / ABORT
Leg 1	36 in, heading 0	Encoder positions + yaw	Distance reached / timeout / STOP
Turn	Heading -90	IMU yaw + error	Tolerance / timeout / STOP
Leg 2	24 in, heading -90	Encoder positions + yaw	Distance reached / timeout / STOP
Final	Zero motor power	Telemetry + physical stop	OpMode complete

Heading-hold reasoning

OBSERVATION	ERROR SIGN / MEANING	CORRECTION IDEA
Yaw on target	Near zero error	Left/right base power nearly equal
Robot drifts left	Calculate target - current	Change sides in opposite directions to steer back
Robot drifts right	Calculate target - current	Reverse the correction sign
Oscillation grows	Gain may be too large or sign wrong	STOP; inspect sign and reduce cautiously

Code order

1. `driveStraight(36, 0)`
2. `turnToHeading(-90)`
3. `driveStraight(24, -90)`
4. `stopDrive()`

Safe L-Path Trial Record

Keep the full course clear; record failed and completed trials

POWERING ON SAFETY GATE						
1. Confirm the Driver Station shows DISABLED . Place and square the robot before the test.						
2. Remove hands, tools, cables, tape measures, and loose objects.						
3. Check the full route or turn sweep, side boundaries, and stopping buffer.						
4. Call POWERING ON! loudly, then pause while everyone steps behind the boundary.						
5. Visually confirm that no one is holding, touching, or reaching toward the robot.						
6. Only then authorize INIT and START. Keep the operator ready to press STOP.						
7. After the run, press STOP and visibly confirm DISABLED before anyone approaches.						

TRIAL	LEG 1	TURN	LEG 2	FINAL X	FINAL YAW	EXIT
1	_____	_____	_____	_____	_____	Complete / Timeout / STOP
2	_____	_____	_____	_____	_____	Complete / Timeout / STOP
3	_____	_____	_____	_____	_____	Complete / Timeout / STOP

Diagnosis

- Distance miss on both legs: inspect wheel diameter, counts per revolution, gear ratio, slip, and repeatability.
- Correct distances but wrong corner/final heading: inspect Hub orientation, yaw sign, reset timing, tolerance, and turn gain.
- Curved straight legs: inspect heading-correction sign/gain, motor direction, traction, and loose hardware.

Exit ticket

Why can accurate encoder counts alone fail to produce an accurate taped L? Explain how the IMU changes the motor commands during each straight leg.
