

Part 12 Teacher Answer Key

Measure repeatability, diagnose a pattern, change one variable, and retest

Guided video answers

PROMPT	EXPECTED RESPONSE / EVIDENCE
0:27 what stays the same?	Start location, start heading, chassis reference point, floor, battery/test procedure, code, and settings.
0:36 one perfect finish?	No. One run cannot show repeatability or reveal the spread of results.
0:54 clear areas	Both legs, complete turn sweep, side boundaries, and stopping buffer.
1:05 authorize START	Only after POWERING ON, a pause, everyone behind the boundary, and visual confirmation that the course is clear.
1:25 enter course	After STOP, visible DISABLED confirmation, and safety-captain permission.
1:45 calibration pattern	A consistent distance miss across repeated, controlled trials; isolate straight travel before changing calibration.

Trial-record calculations

Target endpoint: $x = 36$ inches forward, $y = 24$ inches right, yaw = -90 degrees. For each run:

x error = actual x - 36

y error = actual y - 24

endpoint error = $\sqrt{(x \text{ error})^2 + (y \text{ error})^2}$

heading error = shortest signed difference between final yaw and -90

INTERPRETATION

Signed coordinate errors show direction; endpoint error shows total miss magnitude. Preserve both. A small average endpoint error with a large spread is not the same as repeatable performance.

Strong conclusion examples

- Improved accuracy and consistency: the retest mean endpoint error decreased and the retest spread narrowed.
- Closer but not more consistent: mean error decreased, but results remain widely scattered.
- More consistent but still biased: points cluster tightly on the same side of the target; investigate a repeatable calibration or heading cause.
- No supported improvement: differences are small relative to run-to-run spread or too few retests were completed.

Part 12 Diagnosis and Assessment

Reward controlled evidence, not only the closest finish

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.

Pattern-to-next-check guide

OBSERVED PATTERN	LIKELY CATEGORY	NEXT CONTROLLED CHECK
Both straight legs repeatably long/short	Distance scale	Run an isolated straight-line calibration test.
Corner heading repeatably off	IMU orientation/sign/tolerance/gain	Run an isolated turn test and inspect yaw telemetry.
Curved straight legs	Heading correction / traction	Verify correction sign and compare yaw error with motor adjustments.
Wide scatter	Setup, hardware, traction, power, or sensor instability	Tighten setup controls and inspect loose parts before tuning.
Timeouts	Stall, unreachable target, low power, wrong direction, or poor timeout	Inspect telemetry and mechanical freedom; do not merely lengthen time.

Assessment checklist

- Records all baseline trials, including failures
- Uses one chassis reference point and consistent coordinate convention
- Computes signed x/y errors and endpoint error correctly
- Chooses one justified change and predicts its effect
- Completes at least two retests under comparable conditions
- Compares both accuracy and consistency
- Follows POWERING ON and approach discipline every trial