



AI First Engineering

FUNDAMENTALS OF AI-AUGMENTED ENGINEERING: A Conversational Approach

CHAPTER 2

LAB-2: Engineering Report Template

Reaction Time & Safe Stopping Distance

Can we turn a real measurement into an algorithm — and defend the decision it produces?

Team Information

Team name / number	
Team members	1) 2) 3) 4)
Date	
Section (if applicable)	

How to use this template: *replace every gray italic guide with your team's actual evidence and reasoning, insert your photographs, tables, plots, and code excerpts in the marked places, and delete nothing else. Concise evidence + engineering reasoning beats pages of polished prose. Your AI teammate may help assemble this report from your engineering record — Section 19 is where the humans take responsibility for it.*

1. Problem / Objective

What engineering question did this investigation answer? What does “maximum safe approach speed” mean here — and how does your ruler measurement connect to the stopping-distance problem? Two or three sentences.

2. Models

Reaction-time model — *the Chapter 1 free-fall model, inverted: the ruler's fall distance is the clock.*

$$t_r = \sqrt{(2d / g)}$$

Stopping-distance model — *reaction distance + braking distance.*

$$d_{stop} = v \cdot t_r + v^2 / (2a)$$

Symbol	Meaning	Units
d	catch distance of the falling ruler	cm → m (convert!)
g	gravitational acceleration = 9.81	m/s ²
t _r	reaction time — the model input	s
v	vehicle approach speed	m/s
a	braking deceleration (a _{dry} / a _{wet})	m/s ²
d _{stop}	total stopping distance	m

Symbol	Meaning	Units
d_avail	available stopping distance = 50	m

3. Assumptions

Documented with the problem — before the search. Complete the right column concisely; the last rows are for additional team assumptions.

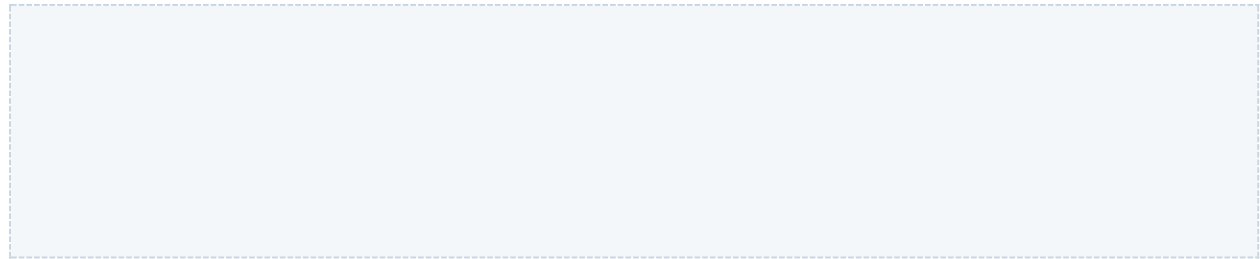
Ruler undergoes free fall after release	
$g = 9.81 \text{ m/s}^2$	
Ruler-catch reaction time is the model input t_r	
Ruler simple reaction stands in for driver response — a MODELING assumption	
Braking deceleration treated as constant	
Level road · simplified stopping model, as used in the lab	
Available stopping distance d_avail = 50 m	
Boundary rule: d_stop = d_avail is SAFE / UNSAFE (circle)	
Additional team assumption:	
Additional team assumption:	

4. Experimental Setup

- Roles for the trial sets — catcher · releaser · recorder — and how you rotated them:
- Ruler type and markings · string release used? · visor blocking the upward view?
- Anything nonstandard at your station, noted for the consistency discussion:

PHOTOGRAPH OF THE STANDARDIZED CATCH SETUP

Insert one photo — catcher seated, visor blocking the upward view, releaser holding the ruler at the 0 mark



Caption: (what does this figure show, in one sentence?)

5. Reaction-Time Data

Five VALID catch distances per student, the invalid tally, and each student's five-trial average. All trials stay — an inconvenient measurement is still a measurement.

Student	T1 (cm)	T2	T3	T4	T5	Invalid	t_r avg (s)

Default team representative t_r = mean of the individual students' five-trial averages.

Team representative t_r = _____ s

Required only if your team deliberately used a different representative value — record the choice and justify it:

Choice / rationale: _____

6. Hand Check / Unit Check

ONE of your own trials, fully shown on paper — the cm → m unit gate must be explicit.

Catch distance: d = _____ cm = _____ m

t_r = $\sqrt{(2 \times \text{_____} / 9.81)}$ = _____ s

Our reaction_time() function returned: _____ s

Agreement / discrepancy: (they should agree within expected rounding — if not, investigate the discrepancy before proceeding.)

7. Engineering Inputs + Boundary Rule

The inputs the search will use — with units. The boundary decision is YOURS; write it down before computing.

Representative t_r [s]	
a_{dry} [m/s²]	7.0

10. Student-Written Pseudocode — Before AI

YOUR PSEUDOCODE — EXACTLY AS IT EXISTED BEFORE THE AI CRITIQUE.

Must contain: inputs with units · the stopping-distance formula · the safety comparison · a WHILE · an explicit stopping criterion · your boundary call · the reported output. A photo of the handwritten page is fine.

```
# copy your pre-AI pseudocode here
```

11. AI Critique + Human Evaluation

At least ONE evaluated suggestion. Quote the AI suggestion concisely — do NOT paste the whole conversation.

AI suggestion (quoted concisely)	Verdict — ACCEPT / MODIFY / REJECT	Why?	What changed, if anything

Critical evaluation does not require disagreement — a correct AI suggestion is ACCEPTED once the team has verified it.

12. Python Implementation — Functions + WHILE

Paste the smallest code excerpts needed to show your implementation — not pages of code.

```
# reaction_time(d_cm, g=9.81) — cm → m inside, seconds out
```

```
# stopping_distance(v, t_r, a) and is_safe(d_stop, d_avail) — encodes YOUR boundary rule
```

```
# the WHILE search — tests the NEXT speed, so v ends as the last safe one
```

Can every team member explain the code used in the submitted analysis? YES / NO

13. Test Battery — Expected vs Actual

Expected values were written BEFORE anything ran — RUNS ≠ CORRECT; running was only level 1 of 4.

Test	Inputs	Expected — BEFORE running	Actual	Verdict	What it probes
Known case	$v=20$, $t_r=1.0$, $a=7$	$d_{\text{stop}} \approx 48.57$ m			implementation slips
Boundary	$d_{\text{stop}} = d_{\text{avail}}$ exactly	per YOUR recorded rule			$\leq$ vs $<$ confusion
Edge	$v=0 \cdot d_{\text{avail}}=0 \cdot \text{step}=10$				hidden assumptions
Nonsense probe	Unit probe: intentionally use 18 instead of 0.18 in the free-fall equation and predict what should happen.				unit discipline
Monotonic check	$v = 10, 20, 30$				broken physics
AI-suggested (optional)					

14. BREAK THE AI + Debugging Evidence

At least THREE deliberate attacks, chosen from the lab list. “Survived the attack” is a finding too — show HOW you verified it. Do not stage a failure.

Attack / test	Expected behavior	What happened	Finding	Action / verdict

Debugging evidence — one bug, end to end (fill in if any test failed):

Failing inputs: _____ Expected: _____ Actual: _____

Hypothesis: _____ Test performed: _____

Fix (if needed): _____ Retest result: _____

A failed test is evidence, not an embarrassment.

15. Validation ×4 + Step Size / Resolution

Four checks — and, for each, what it shares with the others. Independence is not binary.

① Hand-calculated known case

- Evidence:
- What this check supports:
- What it shares (assumptions / methods):

② Excel ↔ Python agreement

- Evidence:
- What this check supports:
- What it shares (assumptions / methods):

③ Analytical limit

- Evidence:
- What this check supports:
- What it shares (assumptions / methods):

④ Physical reasonableness

- Evidence:
- What this check supports:
- What it shares (assumptions / methods):

$$v_{exact} = a \cdot (-t_r + \sqrt{(t_r^2 + 2 \cdot d_{avail} / a)})$$

Provided — use it with YOUR t_r ; no derivation required. The search reports the last safe step below this limit.

Step [m/s]	Search v_{max} [m/s]	Gap to v_{exact} [m/s]	Loop iterations
0.5			
0.1			
0.01			

Smaller step → _____ but requires

16. Wet-Road Parameter Study

Same driver, same road length — one parameter changed.

Condition	a (m/s ²)	v_{max} (m/s)	≈ km/h	Reaction distance at v_{max} (m)	Braking distance at v_{max} (m)
DRY	7.0				
WET	3.5				

Did the wet-road result support P3? YES / NO

Explain physically — concisely — why halving braking deceleration does NOT simply halve maximum safe speed. At the same speed, what happens to braking distance when $|a|$ is halved? What happens to

reaction distance? Why must the new safe speed then be found from the combined stopping-distance model?

17. Final Engineering Decision

“Under the stated assumptions ($t_r = \underline{\hspace{1cm}}$ s from our ruler measurement, $a_{\text{dry}} = 7.0 \text{ m/s}^2$, $a_{\text{wet}} = 3.5 \text{ m/s}^2$, $d_{\text{avail}} = 50 \text{ m}$, boundary rule: $\underline{\hspace{1cm}}$), the maximum safe approach speed is $\underline{\hspace{1cm}}$ m/s ($\approx \underline{\hspace{1cm}}$ km/h) for the dry case and $\underline{\hspace{1cm}}$ m/s ($\approx \underline{\hspace{1cm}}$ km/h) for the wet case.”

One concise line of evidence for each check:

- ① Hand check:
- ② Excel $\leftrightarrow$ Python:
- ③ Analytical limit / step size:
- ④ Physical reasonableness / limitations:

NUMBER + ASSUMPTIONS + EVIDENCE + JUDGMENT. A bare number is a guess wearing a lab coat.

18. Limitations / Improve

- One limitation of using ruler reaction time as the driver-response input:
- One limitation of the simplified stopping-distance model:
- One improvement we would make if this decision mattered in a real engineering application:

19. Human Review & Approval

“Before submission, we reviewed the completed report against our original engineering record — measurements, calculations, observations, code, plots, tests, validation evidence, and conclusions. We accept responsibility for the submitted engineering work.”

Human reviewed and approved.

This approval happens BEFORE FINAL SUBMISSION — after the completed report has actually been reviewed. Would you confidently put your name on this result? Sign only when the answer is yes.

Name · Signature · Date

Name · Signature · Date

Name · Signature · Date

Name · Signature · Date

AI assists. Humans observe. Humans verify. Humans decide. Humans approve.

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