AM-00.06 — Check whether a result is plausible: five tests before believing it

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Course compass

Guiding question: How can you suspect a result is wrong even when the calculator reports no error?

Markers: MEASURED · CONVENTION · CALCULATED · TEACHING ASSUMPTION · APPROXIMATION

• understand the concept

• do a simple calculation

• explain every symbol

• check a result

Essential answer

Check whether a result is plausible: five tests before believing it. The question to solve is: How can you suspect a result is wrong even when the calculator reports no error? Markers: MEASURED · CONVENTION · CALCULATED · TEACHING ASSUMPTION · APPROXIMATION understand the concept do a simple calculation explain every symbol check a result? A speed result should end with speed units. If it ends in joules or kilograms, the chain of operations probably does not answer the question. The rest of the course turns that idea into an auditable line of reasoning: explicit units, stated assumptions, reproducible calculations, order-of-magnitude checks and interpretation limits. A result is useful only when the reader can explain what it measures, where every input came from and which engineering decision it can support.

Starting synthesis: derivations, examples, limitations and sources are developed in the course body.

Key terms before you start

unit · order of magnitude · assumption · approximation · efficiency

1 — Unit check

A speed result should end with speed units. If it ends in joules or kilograms, the chain of operations probably does not answer the question.

This check is independent of the numerical value.

2 — Sign check

Distance travelled in a simple example should not become negative, but a velocity component can be negative if the direction convention allows it.

A sign is not good or bad without a defined reference frame.

3 — Bound check

An efficiency defined as a simple fraction between 0 and 1 cannot become 1.4 unless the definition changes. A simple probability cannot be 230%.

Known bounds are powerful error detectors.

4 — Limiting-case comparison

If a force goes to zero, should the predicted effect vanish? If distance doubles, should the quantity rise or fall?

Mentally testing extreme cases can reveal a transcribed equation error.

Three complete examples: change one assumption to understand

Before each calculation, identify where every number comes from and whether it is measured, conventional, assumed, or calculated.

Example A — efficiency

98% = 0.98. A calculated 1.08 = 108% should trigger a question: are we still using the same efficiency definition?

A bound check does not prove 98% is correct; it reveals a possible inconsistency.

Example B — speed

120 km in 2 h gives 60 km/h. A result of 0.06 km/h would be three orders of magnitude too small.

Order of magnitude plus unit makes the problem visible.

Example C — pressure

If $p = F/A$, doubling F at constant area should double p. If your calculation predicts the opposite, check the relationship.

Sensitivity check before detailed calculation.

Inverse calculation

If p and A are known, recover $F = p \times A$ and substitute it back into $p=F/A$. Returning to p is a simple algebraic check.

Common trap and result check

Trap: “the result looks precise” is not a check. A number with six decimals can be precisely wrong.

Always check units, order of magnitude, and physical meaning before accepting a result.

Exercises and answers

Understand

Explain the relationship in your own words.

Change an assumption

Modify one input and predict the direction of change before calculating.

Verify

Name two checks after a calculation.

Primary and educational sources

• NIST SP 811 - Guide for the Use of the SI

• NASA Glenn - Guide to Rockets