Constant-acceleration equations: choosing a model

Student activity • observation and reasoning

YEAR 10 / LESSON 16 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

When is a constant-acceleration equation an appropriate model?

Use labelled practice journeys to select known quantities, calculate an unknown and test the assumptions.

Equipment

- Booklet, calculator, ruler and graph paper

Written modelling only. No ball drops, raised platforms or moving-vehicle experiments are needed.

Course coverage: Shared Physics / Double Award: 1.6, 1.10. Acceleration and $v^2 = u^2 + 2as$.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

YEAR 10 / LESSON 16 / PHYSICS + SCIENCE (DOUBLE AWARD)

1. Define u, v, a, s and t, and choose one positive direction before substituting values. Use SI units.

2. For a cart changing from 2 to 8 m s^{-1} in 3 s, calculate acceleration from (v − u)/t. State the assumption needed to treat this as a constant acceleration.

3. For a cart starting at 2 m s^{-1} with constant acceleration 3 m s^{-2} over 10 m, use $v^2 = u^2 + 2as$ and choose the physically relevant speed.

4. For a vehicle slowing from 12 m s^{-1} to rest at −3 m s^{-2}, calculate stopping distance with the same equation. Interpret the signs.

5. Compare the predictions with a velocity–time sketch. Explain why a ping-pong ball falling through air may not maintain constant acceleration.

6. Check whether each answer has a sensible unit and magnitude. Keep invented practice values separate from any earlier trolley measurements.

Cleanup

- Keep corrected calculations and return rulers.

Record your evidence

Blank spaces are for your own work

YEAR 10 / LESSON 16 / PHYSICS + SCIENCE (DOUBLE AWARD)

Reference and task data

These are mathematical practice cases, not measured trials. The equations used here assume constant acceleration along a straight line. $v^2 = u^2 + 2as$ is useful when time is not given. Squaring velocity removes its sign, so a square root needs physical interpretation. Air resistance can make a falling ball's acceleration change.

Practice case	Known / unknown quantities	Equation / result
Changing velocity		
Final speed		
Stopping distance		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

YEAR 10 / LESSON 16 / PHYSICS + SCIENCE (DOUBLE AWARD)

1. Find acceleration from 2 to 8 m s^{-1} in 3 s.

2. Find final speed for u = 2, a = 3 and s = 10 in SI units.

3. Find stopping distance for u = 12 m s^{-1} and a = −3 m s^{-2}.

4. Why is the braking acceleration negative here?

5. Can these equations always model a falling ping-pong ball?

6. What check is needed before selecting an equation?