GCSE ONLINE TUTORING

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OCR GCSE (9-1) GATEWAY SCIENCE PHYSICS A J249

FOUNDATION + HIGHER

COMMON MISTAKES & DIAGNOSTIC REPAIR HANDBOOK

Examiner-evidenced misconceptions + specification-derived diagnostic risks

INDEPENDENT PUBLICATION NOTICE

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Evidence key

ER = directly supported by OCR examiner-report commentary. SPEC = independently authored diagnostic risk derived from the J249 specification/common-misconceptions sections. No percentages are invented.

01. Particle hierarchy

Tier	Evidence
Both	[SPEC]

Typical error: Atoms, molecules and subatomic particles are used interchangeably.

Repair routine: Classify the object first: proton/electron/neutron -> atom -> molecule/material.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

02. Volume conversion

Tier	Evidence
Both	[SPEC]

Typical error: cm^3 or mm^3 are converted with a linear rather than cubic factor.

Repair routine: Write the conversion factor and cube it before density calculations.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

03. Specific heat capacity vs latent heat

Tier	Evidence
Both	[ER25H3]

Typical error: The wrong thermal equation is selected.

Repair routine: Ask whether temperature changes. If yes use mcDeltaT; if state changes at constant temperature use mL.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

04. Velocity sign

Tier	Evidence
Both	[SPEC]

Typical error: A reverse direction is treated as a positive speed in a vector calculation.

Repair routine: Choose a positive direction before any motion/momentum calculation.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

05. Distance-time vs velocity-time graphs

Tier	Evidence
Both	[ER25F1, ER25H3]

Typical error: Gradient/area rules are transferred between graph types.

Repair routine: Write axes and units first; derive what gradient/area means from units.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

06. Zero resultant force

Tier	Evidence
Both	[SPEC]

Typical error: Zero resultant force is interpreted as zero speed.

Repair routine: Newton I: zero resultant means zero acceleration; velocity can be constant and non-zero.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

07. Extension

Tier	Evidence
Both	[ER25F1]

Typical error: Total spring length is used instead of change in length.

Repair routine: extension = stretched length - original length.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

08. Equation rearrangement

Tier	Evidence
Both	[ER25F1, ER25H4]

Typical error: A correct equation is selected but rearranged incorrectly.

Repair routine: Rearrange symbolically before inserting numbers; show every step.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

09. Standard form / prefixes

Tier	Evidence
Both	[ER25F1, ER25H4]

Typical error: Powers of ten, micro, kilo or mega are mishandled.

Repair routine: Write the prefix multiplier explicitly before calculating.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

10. Significant figures

Tier	Evidence
Both	[ER25F1, ER25H3, ER25H4]

Typical error: Final answer ignores requested precision.

Repair routine: Carry guard digits and round only once at the end.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

11. Positive charge movement

Tier	Evidence
Both	[SPEC]

Typical error: Protons are said to move between materials in static charging.

Repair routine: Only electrons transfer in ordinary charging of solids.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

12. Electron vs conventional current

Tier	Evidence
Higher	[ER25H3]

Typical error: Electron flow direction is confused with conventional current.

Repair routine: State explicitly which direction the question requests.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

13. Current / charge units

Tier	Evidence
Both	[ER25H3]

Typical error: A/s, Q or other incorrect units are given for current.

Repair routine: Current is A; charge is C; 1 A = 1 C/s.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

14. Magnetic field diagrams

Tier	Evidence
Both	[ER25F1, ER25H3]

Typical error: Lines cross or are disconnected; direction is wrong.

Repair routine: Field lines never cross; outside a bar magnet they run N to S.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

15. Induced magnetism

Tier	Evidence
Both	[ER25F1]

Typical error: A temporary induced magnet is described without linking it to an external field.

Repair routine: State that magnetic material is magnetised by being placed in a magnetic field.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

16. Transformer induction

Tier	Evidence
Higher	[ER25H3]

Typical error: Students say a.c. is needed without explaining changing field/flux.

Repair routine: Link alternating current -> changing magnetic field -> changing flux -> induced p.d. in secondary.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

17. Wavelength

Tier	Evidence
Both	[SPEC]

Typical error: Crest-to-trough is taken as one wavelength.

Repair routine: Measure identical phase points, e.g. crest-to-crest.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

18. Echo / pulse timing

Tier	Evidence
Both	[ER25H4]

Typical error: Round-trip time is used directly as one-way travel time.

Repair routine: For echo/pulse distance, halve the send-return time before d=vt where appropriate.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

19. Sound speed in denser material

Tier	Evidence
Both	[ER25H4]

Typical error: Students assume sound always travels more slowly in a denser medium.

Repair routine: Use the particle/interactions model and context; do not transfer light-refraction rules to sound.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

20. Irradiation vs contamination

Tier	Evidence
Both	[ER25H4, SPEC]

Typical error: The terms are treated as synonyms.

Repair routine: Contamination = radioactive material present; irradiation = exposure to radiation.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

21. Half-life

Tier	Evidence
Both	[SPEC]

Typical error: Half-life is treated as a fixed number of nuclei decaying each interval.

Repair routine: The same fraction/proportion decays over each half-life.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

22. Fission vs fusion

Tier	Evidence
Both	[ER25H4]

Typical error: The two nuclear processes are reversed or described vaguely.

Repair routine: Fission splits a heavy nucleus; fusion combines light nuclei.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

23. Energy stores

Tier	Evidence
Both	[ER25H4, SPEC]

Typical error: Energy is said to be “used up” or gravity itself is said to remove energy.

Repair routine: Track stores and transfers; dissipation transfers energy to thermal stores of surroundings.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

24. Thinking vs braking distance

Tier	Evidence
Both	[SPEC]

Typical error: Alcohol/tiredness is assigned to braking rather than thinking distance.

Repair routine: Separate human reaction factors from vehicle/road braking factors.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

25. Practical improvement

Tier	Evidence
Both	[ER25H4]

Typical error: “Repeat and average” is offered for every accuracy problem.

Repair routine: First identify the actual limitation: resolution, parallax, uncontrolled variable, calibration or random scatter.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

26. Vague practical methods

Tier	Evidence
Both	[ER25H4]

Typical error: Methods omit measurements, controls, repeat strategy or processing.

Repair routine: Write apparatus + variable changed + measured quantities + controls + repeats + graph/calculation.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

27. Proportionality language

Tier	Evidence
Higher	[ER25H3]

Typical error: Any upward graph is called directly proportional or exponential.

Repair routine: Direct proportionality requires a straight line through the origin.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

28. Orbital motion

Tier	Evidence
Both	[ER25H4]

Typical error: Objects in orbit are described as having no gravity or “floating away”.

Repair routine: Gravity provides centripetal acceleration; orbital motion is continuous free fall.

Retest rule: Attempt a fresh question in a different context and explain the reasoning aloud/in writing before checking the answer. Mark the issue secure only after two correct unseen attempts.

2025 examiner-report themes to build into revision

- Foundation Paper 1: showing working enabled partial credit; rearranging equations and standard form separated stronger responses; candidates needed familiarity with practical suggestions.
- Higher Paper 3: longer explanations needed precise language; common issues included proportionality language, atom/particle confusion, field diagrams, electron-current direction, transformer induction, motion-graph interpretation, SHC versus latent heat, unit conversion and significant figures.
- Higher Paper 4: weaker responses struggled with four-term equation rearrangement, vague scientific procedures, contamination versus irradiation, micro-prefix conversion, pendulum/energy reasoning, identifying real measurement limitations, fission/fusion and sound-wave behaviour in denser media.

Diagnostic log

ID	Issue	Found	Repaired	Retested
01	Particle hierarchy	☐	☐	☐
02	Volume conversion	☐	☐	☐
03	Specific heat capacity vs latent heat	☐	☐	☐
04	Velocity sign	☐	☐	☐
05	Distance-time vs velocity-time graphs	☐	☐	☐
06	Zero resultant force	☐	☐	☐
07	Extension	☐	☐	☐
08	Equation rearrangement	☐	☐	☐
09	Standard form / prefixes	☐	☐	☐
10	Significant figures	☐	☐	☐
11	Positive charge movement	☐	☐	☐
12	Electron vs conventional current	☐	☐	☐
13	Current / charge units	☐	☐	☐
14	Magnetic field diagrams	☐	☐	☐
15	Induced magnetism	☐	☐	☐
16	Transformer induction	☐	☐	☐
17	Wavelength	☐	☐	☐
18	Echo / pulse timing	☐	☐	☐
19	Sound speed in denser material	☐	☐	☐
20	Irradiation vs contamination	☐	☐	☐
21	Half-life	☐	☐	☐
22	Fission vs fusion	☐	☐	☐
23	Energy stores	☐	☐	☐
24	Thinking vs braking distance	☐	☐	☐
25	Practical improvement	☐	☐	☐
26	Vague practical methods	☐	☐	☐
27	Proportionality language	☐	☐	☐
28	Orbital motion	☐	☐	☐

References and evidence base

Accessed 12 November 2026. Specification mappings, boundaries, results statistics, equation-sheet policy and examiner-evidence labels were checked against the sources below. The diagnostic handbook does not invent error-frequency percentages where OCR has not published them.

[SPEC] OCR GCSE (9-1) Gateway Science Physics A J249 Specification, Version 4.2 (February 2024)
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[ER25F2] OCR J249/02 Examiners Report, Summer 2025
https://www.ocr.org.uk/Images/753198-examiners-report-paper-2.pdf

[ER25H3] OCR J249/03 Examiners Report, Summer 2025
https://www.ocr.org.uk/Images/753197-examiners-report-paper-3.pdf

[ER25H4] OCR J249/04 Examiners Report, Summer 2025
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