

Paper 1: explanations and practical methods

AQA GCSE Combined Science Trilogy 8464 and Separate Physics 8463 | Both tiers | Paper 1

20 parts / 42 marks per route | Estimated/untrialled 35–40 min independent +15–20 review

Specification points covered

8463 4.1.1.3 / 8464 6.1.1.3: specific heat capacity and a valid heating investigation
8463 4.1.3 / 8464 6.1.3: renewable resources, reliability and environmental comparisons
8463 4.2.1.3–4.2.1.4 / 8464 6.2.1.3–6.2.1.4: resistance, meters and component behaviour
8463 4.3.1.1 / 8464 6.3.1.1: density and displacement measurements
8463 4.4.2.1, 4.4.2.4 / 8464 6.4.2.1, 6.4.2.4: radiation properties; irradiation versus contamination

A food-inspection laboratory audits a heated processing line, its electrical sensors and radiation-monitoring records. Use the evidence to repair weak scientific explanations and design valid tests.

Complete Sections 1–6, then ONE task in Section 7, as directed by your teacher. Do not answer both final alternatives. Show calculations; explain links rather than listing keywords. Use $\Delta E = mc\Delta\theta$, $R = V / I$ and density = mass / volume as needed.

1 Case A: heating the processing line

The laboratory tests two heater inserts of equal mass. Each receives the same increase in thermal energy. Neither changes state.

1(a) State what is meant by the specific heat capacity of the insert material. **[1 mark]**

1(b) Insert A has a lower specific heat capacity than insert B. Explain why A has the larger temperature rise in this test. **[2 marks]**

1(c) A 0.80 kg insert warms from 20 °C to 35 °C when it receives 6000 J of thermal energy. Calculate its specific heat capacity. **[2 marks]**



1 Case A: heating the processing line continued

1(d) A different test uses the total electrical energy input to calculate specific heat capacity, but some energy heats the surroundings. Explain why this makes the calculated value too high. [2 marks]

2 Case A: an energy-supply decision

The line must operate after sunset. Table 1 is the laboratory's simplified evidence for two energy resources; there is no battery storage.

Table 1

Resource	Availability	Carbon dioxide during operation
Solar electricity	Varies with sunlight; zero after sunset	No fuel burning in generation
Natural gas heating	On demand while fuel is supplied	Carbon dioxide released when burned

2(a) Identify the renewable resource in Table 1 and state what renewable means. [1 mark]

2(b) Compare the two resources for the laboratory's evening operation and its aim to reduce carbon dioxide emissions. Use the evidence to recommend a supply arrangement. [3 marks]

2(c) A manager claims: "Renewable means reliable at every time, so solar alone will always power the line." Evaluate the claim. [2 marks]



3 Case A: identifying a loose insert

An irregular, non-porous insert sinks in water and does not react with it. Its mass is 156 g. Water in a measuring cylinder rises from 40 cm³ to 60 cm³ when it is fully submerged.

3(a) Calculate the insert's density in g cm⁻³. The replacement specification accepts densities from 7.5 to 8.0 g cm⁻³ inclusive. Decide whether this result meets it. **[2 marks]**

3(b) Describe how to obtain the mass and displaced volume for another irregular insert. Include a reading precaution and explain how to avoid counting air as part of its volume. **[3 marks]**

3(c) A bubble remains attached to the submerged insert. Explain how this affects the measured volume and calculated density. **[2 marks]**



4 Case B: testing the indicator circuit

Figure 1 shows a low-voltage test circuit for a filament lamp. P and Q are meter positions. Table 2 gives steady readings from two separate component tests. The fixed resistor is kept at constant temperature.

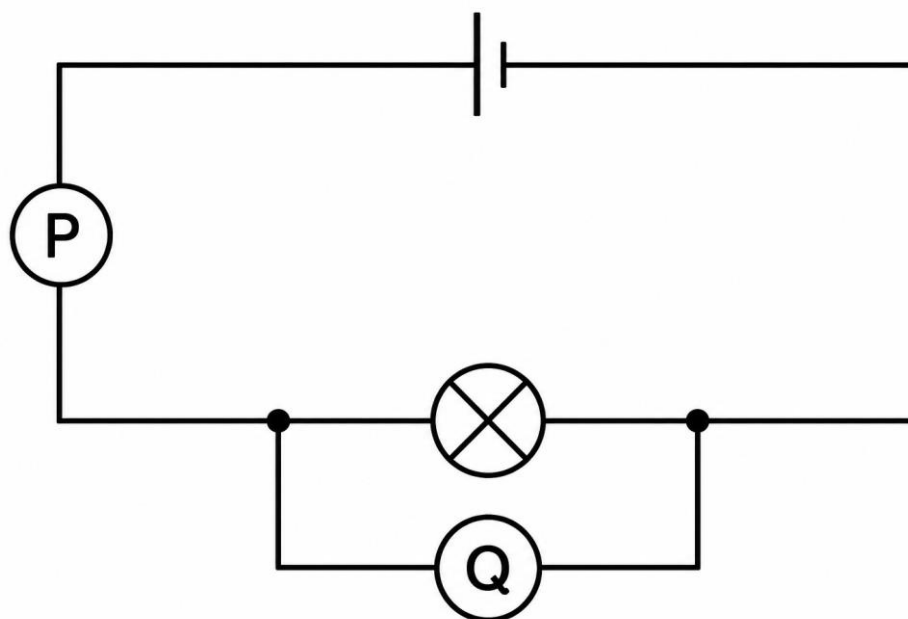


Figure 1

4(a) Name the meters required at P and Q, and state why each connection is suitable. [2 marks]

Table 2

Component	Potential difference / V	Current / A
Fixed resistor	2.0	0.20
Fixed resistor	4.0	0.40
Filament lamp	2.0	0.25
Filament lamp	4.0	0.40

4(b) Use both readings in Table 2 to compare how the resistance of the fixed resistor and the lamp changes. Support your comparison with calculated values. [2 marks]

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4 Case B: testing the indicator circuit continued

4(c) The trainee writes: "The lamp current doubles when the potential difference doubles." Correct this statement using Table 2 and explain the lamp's behaviour. **[2 marks]**

4(d) In a separate sensor-wire test, the technician changes the length of one wire. Explain why using a low current and disconnecting between readings makes the length comparison more valid. **[2 marks]**

5 Case C: checking the irradiation record

A sealed source exposes packaged food to gamma radiation in a controlled industrial facility. No radioactive material is transferred to the food. These are supplied records, not instructions to carry out a radiation experiment.

5(a) A trainee says the food must be radioactively contaminated because it was irradiated. Explain why this conclusion is wrong in the stated case. **[2 marks]**

5(b) The radiation must reach food inside thick packaging. Explain why gamma is more suitable than alpha radiation for this requirement. **[2 marks]**

5(c) In another incident, radioactive powder actually lands on an item. Explain why moving the item away from the external source does not remove this hazard. **[2 marks]**

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