# Mains safety: matching protections to faults

Student activity • observation and reasoning

YEAR 10 / LESSON 49 / PHYSICS + SCIENCE (DOUBLE AWARD)

## The question

**Which protection addresses which electrical fault?**

Analyse labelled appliance diagrams and fault scenarios without opening or energising mains equipment.

## Equipment

- Original appliance diagrams, fault cards and booklet

Paper activity only. Do not open plugs or appliances, connect to mains, burn wire wool, melt fuse wire or deliberately create electrical faults. Report damaged classroom equipment to staff.

Course coverage: Shared Physics / Double Award: 2.2. Insulation, earthing and protective devices.

## 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

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**1.** Identify insulation around live parts and distinguish basic insulation from double or reinforced insulation in a labelled Class II diagram.

**2.** Trace a fault in a Class I metal-cased appliance where a live conductor contacts the case. Show the protective-earth path and explain how a suitable protective device can disconnect the supply.

**3.** Explain a fuse melting under sufficient overcurrent and a circuit breaker opening the circuit. Distinguish these from an RCD responding to an imbalance between live and neutral currents.

**4.** Compare fault scenarios: damaged insulation, overload, missing protective earth and a Class II appliance. Match each to a relevant protection and limitation.

**5.** Explain why an earth conductor is not the normal return path for load current and why a fuse does not make all electric shocks impossible.

**6.** Write an action statement for damaged equipment: stop using it, isolate safely and report it for competent repair. Do not propose pupil repairs or a live test.

## Cleanup

- Return cards and retain corrected fault explanations.

# Record your evidence

Blank spaces are for your own work

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## Reference and task data

This is conceptual safety education, not wiring or repair training. Class I equipment uses protective earthing; Class II equipment uses double or reinforced insulation and is not identified merely by having a plastic case. Protective devices address different fault conditions.

| Fault / design | Relevant protection | Explanation / limitation |
|---|---|---|
| Damaged insulation | | |
| Overcurrent | | |
| Live contact with metal case | | |
| Class II design | | |

**Show your calculations, labelled model or correction here.**

# Explain and evaluate

Use evidence and show calculation steps where relevant

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**1.** What does insulation do?

**2.** Why earth an exposed conductive case in a Class I appliance?

**3.** What causes a fuse to operate?

**4.** Is a fuse an all-purpose shock detector?

**5.** What does an RCD detect?

**6.** What should a pupil do with damaged electrical equipment?