On mains electricity

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Warm-up problems

1. Draw a labelled diagram of a plug. Make sure you include the materials used and the colours of the three wires.
2. 'Mains electricity is at 230 V a.c., 50 Hz in the UK.' Explain this statement as fully as you can.
3. What is the difference between alternating current (a.c.) and direct current (d.c.)?

Regular problems

4. Electrical fires have metal cases and three wires connected to the plug. Two of the wires are the live and the neutral.
   (a) What is the third wire called?
   (b) To what part of the electric fire should this be connected?
   (c) If a fault develops, explain how this protects the user from a shock.
5. (a) What is the purpose of the fuse in a plug?
   (b) What happens to the fuse when too much current flows through it? (Avoid using the word *blows*)
   (c) How is the rating of the fuse decided?
   (d) To which pin of the plug is fuse connected? Why is this?
   (e) How would the thickness of a wire in a 13 A fuse compare to that in a 3 A fuse?
6. A hairdryer usually has a moulded plastic casing.
   (a) The hairdryer has only two wires. Which two?
   (b) Which of the usual wires is missing?
   (c) It is still safe without this third wire? Explain why.
   (d) The following information is found on the hairdryer

230 V 50 Hz
Maximum Power 1000 W

i. What is the maximum current in the hair dryer?

ii. What would be a suitable fuse?

(e) During a fault, a current of 30 A flows down the live wire.

i. Suggest a possible reason for this fault.

ii. What happens to the fuse?

iii. How does this protect the wiring to the hair dryer?

7. Find out an advantage of using a Residual Current Circuit Breaker (RCCB) rather than a fuse to protect the user of an electrical appliance.

8. (a) Calculate the current that the following appliances operate at, when connected to the 230 V mains:

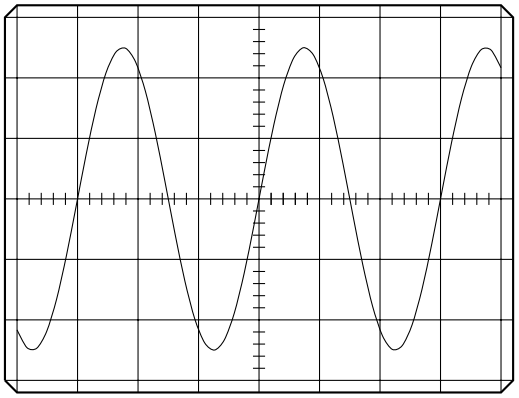
i. a 100 W table lamp,

ii. a 2.5 kW kettle,

iii. a 1kW fire.

(b) Given the choice of the following fuses: 3 A, 5 A, and 13 A, which would be the most suitable for fitting in the plugs of the appliances?

9. A diagram of an oscilloscope trace is shown below. The timebase control is set to 20 ms/cm and the Y-gain control is set to 5 V/cm.



Calculate the supply's

(a) peak potential difference,

(b) frequency.

Extension problems

10. 'RCCBs operate by detecting a difference between the live and the neutral wires'. Find out how the devices do this, and explain in detail what happens when a surge of current flows.