Electrical Power

1. The 12V heated rear window of a car takes a current of 15A. Calculate the power of the heater. *(180W)*

2. A torch bulb is labelled 3V, 0.5A.
   (a) Calculate the power of the bulb in normal use. *(1.5W)*
   (b) The life of the bulb is approximately 10 hours. How much energy will it dissipate in its lifetime? *(5.4×10^4J)*

3. The table shows the power rating and voltage as marked on a number of appliances. Calculate the operating current of each appliance. Suggest a suitable fuse value for each appliance choosing from the fuse values given.

Appliance	Power rating	voltage/V	Operating current/A	Suggested fuse values choosing from 3A, 5A, 13A
Iron	1200W	230		
Vacuum cleaner	900W	230		
Headlamp	60W	12		
Jug kettle	2.4kW	230		
Radio	100W	230		
Travel kettle	340W	120		

(5.2, 3.9, 5, 10.4, 0.43, 2.8)

4. What is the power loss in a copper connecting lead 50cm long with a resistance of 0.005Ω per metre when it carries a current of 1.5A? *(5.6mW)*

5. What power is supplied to the heater of an electric bar fire with a resistance of 50Ω connected to the mains 230V supply? *(1.06kW)*

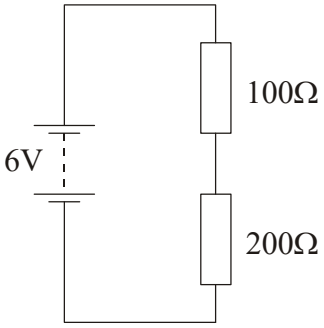
6. Calculate the resistance of:
   (i) a 2.0kW kettle element connected to 230V mains? *(26Ω)*
   (ii) a 40W mains bulb connected to 230V mains? *(1.3kΩ)*

7. A 10kΩ resistor has a maximum dissipation of 0.25W. What is the maximum voltage that can be across it? *(50V)*

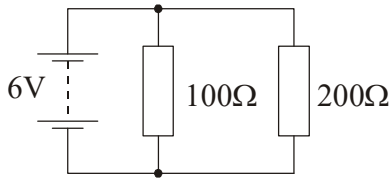
8. Calculate the power loss in an electrical transmission cable, 15km long, carrying a current of 100A. The resistance per km of the cable is 0.20Ω. *(30kW)*

9. A 100m mains extension lead has two wires, each of cross-sectional area 1.5mm^2. (Current flows out along one and back along the other.) The lead is used to supply an electric fire, needing a current of 5.0A.
A copper conductor of area 1.5mm^2 has a resistance of 12.1 mΩ per metre.
   (a) Calculate the power dissipated in the cable. *(61W)*
   (b) The lead has a warning label: 'do not operate unless lead is fully uncoiled' written on it. Explain the danger.

10. This question is about the effect of resistance on power dissipation in a series circuit and in a parallel circuit.



   (a) A 100Ω resistor and a 200Ω resistor are connected in series to a 6.0V battery.
      (i) What is the current through the resistors? *(0.02A)*
      (ii) What is the power dissipated in each resistor? *(0.04W; 0.08W)*



   (b) The same 100Ω and 200Ω resistors are now connected in parallel to the 6.0V battery.
      (i) What is the voltage across each resistor?
      (ii) What is the power dissipated in each resistor? *(0.36W; 0.18W)*
   (c) A 1.0m length of thin copper wire and a 1.0m length of thick copper wire are joined in series to a power supply. Explain which wire gets hotter.
   (d) A bicycle dynamo is connected to a high power headlamp bulb and a lower power rear lamp bulb in parallel. Both bulbs have filaments of the same material and a similar length. Explain which filament is thicker.

11. The 'third rail' suburban electric railway system uses a nominal 750V dc supply. A suburban train uses 1.5MW under acceleration.

   (a) What current is taken by the motors? *(2000A)*
   (b) The third rail supplying the train has a resistance of $2.06\times10^{-5}\Omega m^{-1}$. If the trackside power supply is 1.5km from the train, calculate the power lost in the third rail supplying this current. *(124kW)*