Year 9 Science: Electric circuits: insulators, resistors, energy and efficiency

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Why is the inside of a cable copper and the outside plastic?

2. A student puts a voltmeter in the loop of a series circuit and the lamp goes out. Explain what went wrong.

3. A kettle element on 230 V draws 8 A for 120 s. How much energy is transferred?

4. A motor receives 500 J of electrical energy and gives 350 J of movement energy. How much is wasted, and what is its efficiency?

5. Give one advantage and one disadvantage of relying on hydro for most of New Zealand's electricity.

Fix the mistake

6. Correct this statement: "A voltmeter goes in the loop, the same as an ammeter."

7. Correct this statement: "The lamp uses up the energy, so it no longer exists."

8. Correct this statement: "A lamp on 6 V drawing 0.5 A for one minute uses 6 × 0.5 × 1 = 3 J."

9. Correct this statement: "A lamp with 100 J in and 40 J of light out is 250% efficient, from 100 ÷ 40."

Answer key (for parents and tutors)

1. Why is the inside of a cable copper and the outside plastic?
   Copper is a conductor, so it carries the current; plastic is an insulator, so the charge cannot reach whoever holds the cable.

2. A student puts a voltmeter in the loop of a series circuit and the lamp goes out. Explain what went wrong.
   A voltmeter has a very high resistance, so in the loop it almost stops the current. It should be connected across the lamp.

3. A kettle element on 230 V draws 8 A for 120 s. How much energy is transferred?
   220 800 J (about 221 kJ), from $E = V \times I \times t = 230 \times 8 \times 120$.

4. A motor receives 500 J of electrical energy and gives 350 J of movement energy. How much is wasted, and what is its efficiency?
   150 J is wasted, mostly as heat, and the efficiency is $350 \div 500 \times 100\% = 70\%$.

5. Give one advantage and one disadvantage of relying on hydro for most of New Zealand's electricity.
   Advantage: renewable, with no carbon dioxide while running, and it can be turned up quickly when demand rises. Disadvantage: dry years leave the lakes low, so fossil fuel stations like Huntly have to make up the shortfall.

6. Correct this statement: "A voltmeter goes in the loop, the same as an ammeter."
   A voltmeter goes across the component; in the loop its very high resistance almost stops the current.

7. Correct this statement: "The lamp uses up the energy, so it no longer exists."
   Energy is conserved: the lamp changes electrical energy into light and heat, and the heat spreads into the room rather than disappearing.

8. Correct this statement: "A lamp on 6 V drawing 0.5 A for one minute uses $6 \times 0.5 \times 1 = 3$ J."
   Time must be in seconds for joules, so $E = 6 \times 0.5 \times 60 = 180$ J.

9. Correct this statement: "A lamp with 100 J in and 40 J of light out is 250% efficient, from $100 \div 40$."
   Efficiency is useful out ÷ total in × 100%, so $40 \div 100 \times 100\% = 40\%$; it can never pass 100%, because no device makes energy.