Year 7

Physics Friend

Electric Circuits

ANSWERS

Fundamentals of Electric Circuits

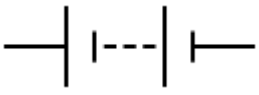
Page 6 questions:

1. What two things are needed for an electric circuit to work?
    - A complete circuit / a conductor **(1 mark)**
    - An energy source **(1 mark)**
2. What happens in an electrical circuit when charge flows?
    - Energy is transferred from one place to another **(1 mark)**
3. Explain why high voltage can be dangerous.
    - High voltage gives the current more energy **(1 mark)**
    - This can be enough energy to travel through your body, causing burns / stop your heart **(1 mark)**
4. Describe two safety precautions you should take when using electric circuits.
    - Circuits should be disconnected when not in use **(1 mark)**
    - You should not touch them when they are working **(1 mark)**
    - Take care not to short-circuit the battery **(1 mark)**
    - *(Any two of the above)*
5. What is a short-circuit, and why is it dangerous?
    - A short-circuit is when a wire (or conductor) connects both terminals of a battery **(1 mark)**
    - The battery discharges rapidly **(1 mark)**
    - This can cause a fire **(1 mark)**

Making Electric Circuits

Page 10 questions:

1. Draw the circuit symbols for a battery and a bulb.

Battery:  Bulb:  **(1 mark)**

2. What is the difference between a series and a parallel circuit?
    - Series circuit has one path for current **(1 mark)**
    - Parallel circuit has more than one path/separate branches **(1 mark)**

3. Describe how to connect a voltmeter and an ammeter in a circuit and what each measures.
    - Voltmeter: Connected in parallel, measure voltage/potential difference **(1 mark)**
    - Ammeter: Connected in series, measure current **(1 mark)**
4. Aside from wires not being plugged in correctly, explain one reason why a circuit might not work. How could this be fixed?
    - Component (e.g. bulb) is broken, component connected wrong (e.g. voltmeter connected in series) **(1 mark for 1 reason)**
    - Swap to a different component, check circuit is wired as per the diagram (e.g. voltmeter connected in parallel) **(1 mark for 1 fix)**

Models of Electric Circuits

Page 13 questions:

1. What is a scientific model?
    - A representation of an object or system **(1 mark)**
2. Why are scientific models useful?
    - They help us to visualise and understand how things work **(1 mark)**
3. Give an example of a limitation of an electric circuit model.
    - The objects representing charge might 'bunch up', or not move at the same time in the model, which is not realistic
    - OR, The charge objects may leave the circuit, which is not realistic **(1 mark)**
4. Describe a model for an electric circuit, using a different analogy to the ones given in the notes.
    - Any example where objects representing **charge** move from a component representing a battery **through a circuit** back to the battery, delivering **energy** along the way. A good example would be skiers on a ski-lift. **(3 marks – 1 mark per explanation in bold)**

Charge & Current

Page 15 questions:

1. What is electric current?
    - The amount of charge that flows past a point every second **(1 mark)**
2. What is the formula used to calculate electric current?
    - $I = Q/t$ **(1 mark)**
3. Describe the direction of conventional current flow in an electric circuit.
    - Positive to negative / positive terminal to negative terminal **(1 mark)**
4. How should an ammeter be connected in a circuit to measure current?
    - In series **(1 mark)**
5. If a charge of 10 Coulombs flows past a point in 2 seconds, calculate the current.
    - $I = 10\ C / 2\ s$ **(1 mark)**
    - $I = 5\ A$ **(1 mark)**

Potential Difference & Energy

Page 17 questions:

1. What is potential difference?
    - A measure of the energy transferred to a component per coulomb of charge (that flows through it) **(1 mark)**
2. How is a voltmeter connected in a circuit?
    - In parallel (with the component to be measured) **(1 mark)**
3. In a series circuit, how is the potential difference of the battery related to the potential difference across the components?
    - The p.d. across the battery is shared out by the components **(1 mark)**
    - *or* The p.d. across the components adds up to the p.d. across the battery
4. In a series circuit with a 9V battery and three bulbs, the voltage across two of the bulbs is 3V and 2V. Calculate the voltage across the third bulb.
    - (Battery voltage = Sum of bulb voltages) $9V = 3V + 2V + X$ **(1 mark)**
    - $X = 9 - 3 - 2 = \underline{4V}$ **(1 mark)**

5. If a component transfers 20 Joules of energy when 4 Coulombs of charge flow through it, calculate the potential difference across the component.
    - V = 20 J / 4 C **(1 mark)**
    - V = 5 V **(1 mark)**

Parallel Circuits

Page 20 questions:

1. How can you relate the behaviour of series and parallel circuits to the models of electricity?
    - *An explanation of how the models show **series** and **parallel** behaviour* **(2 marks)**
    - For example, a series circuit is like a delivery van going to one house and then another, giving some packages to each house.
    - A parallel circuit is like separate pipes for water, where the water flows through either one pipe or the other, but not both.
2. Decide if each of the following statements is true or false and circle the correct answer. If they are false, write a corrected statement at the bottom of the page.

1. Series means that the components follow on one after another.	True
2. In a parallel circuit, the electrons go through only 1 branch.	false
3. Adding more bulbs to a series circuit makes the bulbs dimmer.	false
4. Adding more bulbs to a parallel circuit doesn't affect the bulbs' brightness.	false
5. In a series circuit, a bulb breaking will cause all the bulbs to go out.	True
6. In a parallel circuit, a bulb breaking won't affect the other bulbs.	false
7. In a circuit with two bulbs and a battery, the battery will last longer if the bulbs are in series.	True
8. The current is the same everywhere as you go around a series circuit.	false

Resistance

Page 21 questions:

1. What is electrical resistance, and what is its unit of measurement?
    - Electrical resistance is the opposition to the flow of electric charge (current) in a circuit. **(1 mark)**
    - It is measured in ohms (Ω). **(1 mark)**
2. Write down the formula for calculating resistance in a circuit. What do each of the symbols represent?
    - The formula is: R = V / I **(1 mark)**
    - Where:
        R = Resistance, measured in ohms (Ω)
        V = Potential difference (voltage), measured in volts (V)
        I = Current, measured in amperes (A) **(1 mark)**
3. How does resistance affect the flow of current in a circuit? What happens if there's a higher resistance in one path compared to another?
    - Resistance slows down the flow of current in a circuit. **(1 mark)**
    - If one path has a higher resistance than another, less current will flow through the path with higher resistance, and more will flow through the path with lower resistance. **(1 mark)**
4. In the water circuit model, how could you represent electrical resistance?
    - In the water circuit model, resistance can be represented by a narrower pipe, or an obstruction within a pipe. **(1 mark)**
5. A bulb has a potential difference of 6V across it, and a current of 0.5A flows through it. Calculate the resistance of the bulb.
    - R = V / I = 6 / 0.5 **(1 mark)**
    - R = 12 Ω **(1 mark)**

PD, Current & Resistance

Page 23 questions:

1. What is the relationship between potential difference (voltage) and current in a circuit?
    - As the potential difference increases, the current also increases. **(1 mark)**

2. How does adding more bulbs in series to a circuit affect the resistance and current?
    - Adding more bulbs in series increases the total resistance of the circuit. **(1 mark)**
    - This makes it harder for current to flow, so the current decreases as more bulbs are added. **(1 mark)**

3. What happens to the total current in a circuit when you add more bulbs in parallel? Why?
    - When you add more bulbs in parallel, the total current increases. **(1 mark)**
    - This happens because there are more paths for the current to flow through, making it easier for current to move around the circuit and lowering the total resistance. **(1 mark)**

4. Explain what potential difference is and how it is measured in a circuit.
    - Potential difference (voltage) is the amount of energy transferred per coulomb of charge as it moves through a component in a circuit. **(1 mark)**
    - It is measured in volts (V) using a voltmeter, which must be connected in parallel with the component being measured. **(1 mark)**

5. If a circuit has a potential difference of 9V and a resistance of 3Ω, what is the current in the circuit?
    - $I = V / R = 9 / 3$ **(1 mark)**
    - $I = 3$ A **(1 mark)**

Revision Questions

Page 23-25 questions:

1. Which two things are essential for any functional electric circuit?

   b) A complete circuit made of a conductor and an energy source

2. What happens when electrical charge flows through a functioning circuit?

   b) Energy is transferred from one place to another.

3. Which of the following is a safety precaution when using electric circuits?

   c) Disconnecting circuits when not in use.

4. How are components connected in a series circuit?

   c) One after another, in a single path for the current.

5. What does an ammeter measure, and how is it connected in a circuit?

   b) Current, in series.

6. Why are scientific models useful when studying electric circuits?

   b) They help to visualise and understand things we cannot see.

7. If 15 Coulombs of charge flow past a point in a circuit in 3 seconds, what is the current?

   a) 5 Amperes (Calculation: Current = Charge / Time = 15 C / 3 s = 5 A)

8. What is potential difference (voltage)?

   c) The energy transferred to a component per coulomb of charge.

9. According to the Current Law, what is true about current at any point in a circuit?

   b) The total current flowing into the point is equal to the total current flowing out.

10. If the resistance in a circuit increases, what happens to the current (assuming voltage stays the same)?

b) The current decreases.