WEEK: 15

Week Beginning: 29-6-20

Subject: SCIENCE

Year: 9

Lesson Objective:

- Go over homework
- Circuit and resistance practical
- Electricity in the home

Keywords/ Concepts

- Current, resistance, home

Class Worksheets

- Questions below

Homework

- Notes

Additional Notes

- Attach all the classroom worksheets and homework worksheets to this lesson plan and email together.
- Assume the students don't have revision guides and workbooks. Attach all the pages you want them to have.

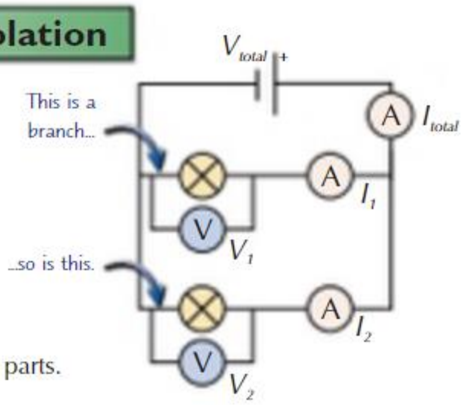
Homework from last week

Parallel Circuits

Parallel circuits can be a little bit trickier to wrap your head around, but they're much more useful than series circuits. Most electronics use a combination of series and parallel circuitry.

Parallel Circuits — Independence and Isolation

1) In parallel circuits, each component is separately connected to the +ve and –ve of the supply (except ammeters, which are always connected in series).
2) If you remove or disconnect one of them, it will hardly affect the others at all.
3) This is obviously how most things must be connected, for example in cars and in household electrics. You have to be able to switch everything on and off separately.
4) Everyday circuits often include a mixture of series and parallel parts.



Potential Difference is the Same Across All Components

1) In parallel circuits all components get the full source pd, so the voltage is the same across all components: $V_1 = V_2 = V_3 = ...$
2) This means that identical bulbs connected in parallel will all be at the same brightness.

Current is Shared Between Branches

1) In parallel circuits the total current flowing around the circuit is equal to the total of all the currents through the separate components: $I_{total} = I_1 + I_2 + ...$
2) In a parallel circuit, there are junctions where the current either splits or rejoins. The total current going into a junction has to equal the total current leaving it.
3) If two identical components are connected in parallel then the same current will flow through each component.

Adding a Resistor in Parallel Reduces the Total Resistance

1) If you have two resistors in parallel, their total resistance is less than the resistance of the smallest of the two resistors.
2) This can be tough to get your head around, but think about it like this:

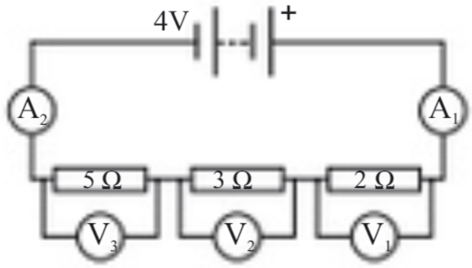
- In parallel, both resistors have the same potential difference across them as the source.
- This means the 'pushing force' making the current flow is the same as the source potential difference for each resistor that you add.
- But by adding another loop, the current has more than one direction to go in.
- This increases the total current that can flow around the circuit. Using $V = IR$, an increase in current means a decrease in the total resistance of the circuit.

Classwork

1. Which has higher resistance, two resistors in a series circuit or the two same resistors in a parallel circuit?

1 **Figure 1** shows a series circuit.

Figure 1



1.1 Calculate the total resistance in the circuit.

[2 marks]

1.2 The current through A_1 is 0.4 A.
What is the current through A_2? Explain your answer.

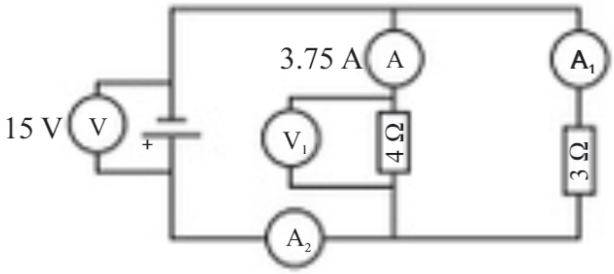
[2 marks]

1.3 V_1 reads 0.8 V and V_2 reads 1.2 V.
Calculate the reading on V_3.

[2 marks]

2 A parallel circuit is connected as shown in **Figure 2**.

Figure 2



2.1 Give the reading on voltmeter V_1.

[1 mark]

2.2 Calculate the reading on ammeter A_1.

[3 marks]

2.3 Calculate the reading on ammeter A_2.

[2 marks]

Power of Electrical Appliances

You can think about electrical circuits in terms of energy transfer — the charge carriers take energy around the circuit. When they go through an electrical component energy is transferred to make the component work.

Energy is Transferred from Cells and Other Sources

1) You know from page 17 that a moving charge transfers energy. This is because the charge does work against the resistance of the circuit. (Work done is the same as energy transferred, p.18.)
2) Electrical appliances are designed to transfer energy to components in the circuit when a current flows.

Kettles transfer energy electrically from the mains ac supply to the thermal energy store of the heating element inside the kettle.

Energy is transferred electrically from the battery of a handheld fan to the kinetic energy store of the fan's motor.

3) Of course, no appliance transfers all energy completely usefully. The higher the current, the more energy is transferred to the thermal energy stores of the components (and then the surroundings). You can calculate the efficiency of any electrical appliance — see p.28.

Energy Transferred Depends on the Power

1) The total energy transferred by an appliance depends on how long the appliance is on for and its power.
2) The power of an appliance is the energy that it transfers per second. So the more energy it transfers in a given time, the higher its power.
3) The amount of energy transferred by electrical work is given by:

Energy transferred (J) = Power (W) × Time (s) **$E = Pt$**

This equation should be familiar from page 23.

EXAMPLE:

A 600 W microwave is used for 5 minutes. How long (in minutes) would a 750 W microwave take to do the same amount of work?

1) Calculate the energy transferred by the 600 W microwave in five minutes. $E = Pt = 600 \times (5 \times 60)$ $= 180\ 000$ J
2) Rearrange $E = Pt$ and sub in the energy you calculated and the power of the 750 W microwave. $t = E \div P$ $= 180\ 000 \div 750 = 240$ s
3) Convert the time back to minutes. $240 \div 60 = 4$ minutes

Remember that the time must be in seconds.

So the 750 W microwave would take 4 minutes to do the same amount of work.

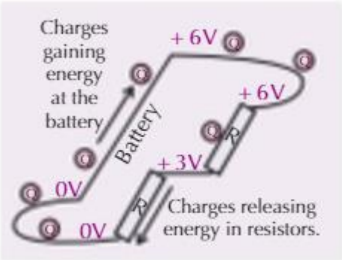
4) Appliances are often given a power rating — they're labelled with the maximum safe power that they can operate at. You can usually take this to be their maximum operating power.
5) The power rating tells you the maximum amount of energy transferred between stores per second when the appliance is in use.
6) This helps customers choose between models — the lower the power rating, the less electricity an appliance uses in a given time and so the cheaper it is to run.
7) But a higher power doesn't necessarily mean that it transfers more energy usefully. An appliance may be more powerful than another, but less efficient, meaning that it might still only transfer the same amount of energy (or even less) to useful stores (see p.28).

More on Power

As you've seen, the power of a device tells you how much energy it transfers per second.
In electrical systems, there are a load of useful formulas you can use to calculate energy and power.

Potential Difference is **Energy Transferred** per **Charge Passed**

1) When an electrical charge goes through a change in potential difference, energy is transferred.
2) Energy is supplied to the charge at the power source to 'raise' it through a potential.
3) The charge gives up this energy when it 'falls' through any potential drop in components elsewhere in the circuit.
4) The formula is really simple:



$$E = QV$$

Energy transferred (J), Charge flow (C), Potential difference (V)

5) That means that a battery with a bigger pd will supply more energy to the circuit for every coulomb of charge which flows round it, because the charge is raised up "higher" at the start.

EXAMPLE:

The motor in an electric toothbrush is attached to a 3 V battery. 140 C of charge passes through the circuit as it is used. Calculate the energy transferred.

$E = QV = 140 \times 3 = 420$ J

This energy is transferred to the kinetic energy store of the motor, as well as to the thermal energy stores of the surroundings.

Power Also Depends on **Current** and **Potential Difference**

1) As well as energy transferred in a given time, the power of an appliance can be found with:

Power (W) = Potential difference (V) × Current (A) $P = VI$

EXAMPLE:

A 1.0 kW hair dryer is connected to a 230 V supply. Calculate the current through the hair dryer. Give your answer to two significant figures.

1) Rearrange the equation for current. $I = P \div V$
2) Make sure your units are correct. 1.0 kW = 1000 W
3) Then just stick in the numbers that you have. $I = 1000 \div 230 = 4.34... = 4.3$ A (to 2 s.f.)

2) You can also find the power if you don't know the potential difference. To do this, stick $V = IR$ from page 41 into $P = VI$, which gives you:

$$P = I^2R$$

Resistance (Ω)