CHURCH STRETTON SCHOOL

# Triple Science - Physics

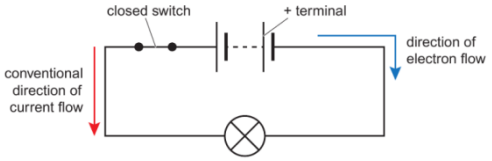
SP10-11 Knowledge organiser

## P10-11: Electricity and Static Electricity

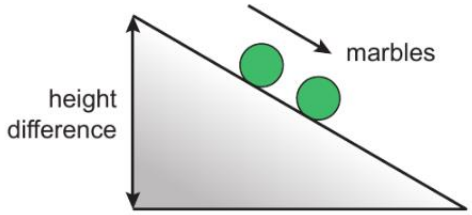
### Lesson sequence

1. Electrical circuits
2. Current and potential difference
3. Current, charge and energy
4. Current, resistance and potential difference
5. More about resistance (Resistors)
6. More about resistance (controlling resistance)
7. Core practical – investigating resistance
8. Transferring Energy
9. Electrical power
10. Transferring energy by electricity
11. Electrical safety
12. Charges and static electricity
13. Dangers and uses of static electricity
14. Electric fields

| 1. Electrical circuits | |
|---|---|
| **Delocalised electrons** | Electrons that are free to move between many different atoms. |
| **Conventional current** | The flow of positive charge from the positive terminal towards the negative terminal (goes in the opposite direction to electrons). |
| **Electron flow** | Electrons flow from the negative terminal towards the positive terminal. |
| **Series circuit** | A circuit in which there is only one path for the current to flow. |
| **Parallel circuit** | A circuit with multiple paths for the current to flow. |



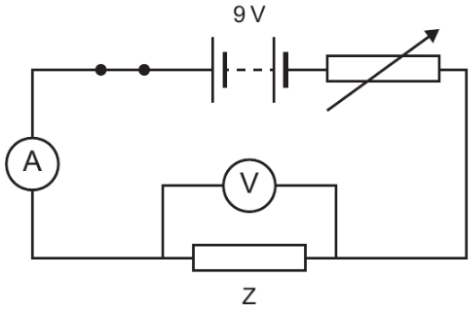

| 2. Current and potential difference | |
|---|---|
| **Amperes, A** | The unit of measurement for current. Amps for short. |
| **Ammeter** | Used for measuring current. Connected in series. |
| **Potential difference** | Aka voltage. This is what pushes electrons around a circuit. |
| **Volts, V** | The unit of measurement for potential difference. |
| **Voltmeter** | Used for measuring potential difference. Connected in parallel. |
| **Current in series circuits** | The same at all points in the circuit. |
| **Current in parallel circuits** | Less on the branches than at the battery. Current on branches adds up to that at the battery. |
| **Potential difference in series circuits** | Potential difference is shared between the components on a circuit. It adds up to be the same as the battery. |
| **Potential difference in parallel circuits** | The same across each branch as it is across the battery. |



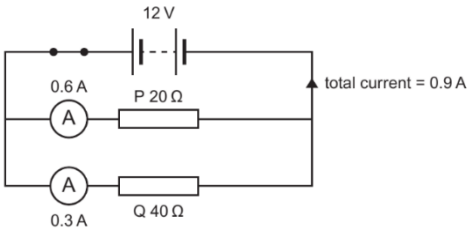

| 3. Current, charge and energy | |
|---|---|
| **Charge** | The amount electricity that has flowed through a circuit. |
| **Coulombs, C** | The unit of measurement for charge. |
| **Current** | The number of coulombs of charge that flows past a point each second. |
| **Calculating charge** | Charge = current x time<br>Q = I x t<br><br>Charge = coulombs<br>Current = amps<br>Time = seconds |
| **The meaning of volts** | The amount of energy transferred by each coulomb of charge. One volt = 1 joule per coulomb. |
| **Calculating energy** | Energy = charge x potential difference<br>E = Q x V<br><br>Energy = joules<br>Charge = coulombs<br>Potential difference = volts |

| 4. Current, resistance and potential difference | |
|---|---|
| **Resistance** | The difficulty with which current passes through materials. |
| **Ohms, Ω** | The unit of measurement for resistance. |
| **High/low resistance** | Higher resistance → better insulator<br>Lower resistance →better conductor |
| **Calculating current** | Current = potential diff / resistance<br>I = V / R<br><br>Current = amps, A<br>Potential diff = volts, V<br>Resistance = ohms, Ω<br><br>Note: This equation is normally written as V = IR. |

| | |
|---|---|
| **Changing current** | Higher voltage → higher current<br>Higher resistance → lower current |




| 5. More about resistance (Resistors) | |
|---|---|
| **Resistors** | Circuit components with differing resistance to control how much current flows to parts of a circuit. |
| **Resistors in series** | Total resistance is the sum of each of the resistors. |
| **Voltage and resistors in series** | Voltage is shared in proportion to the resistance. The resistor with more resistances takes more of the voltage. Calculate this using V=IR. |
| **Resistors in parallel** | Think about each branch of the circuit as a different series circuit. Resistors on different branches do not affect each other. |
| **Variable resistors** | Resistors where you can change the resistance to adjust the current. |

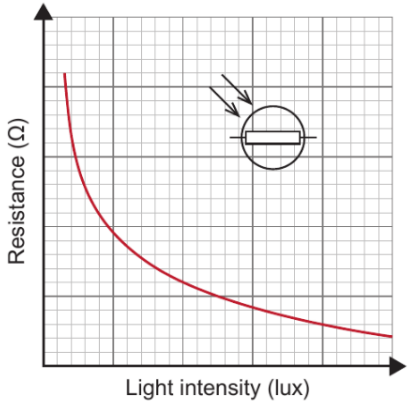


CHURCH STRETTON SCHOOL

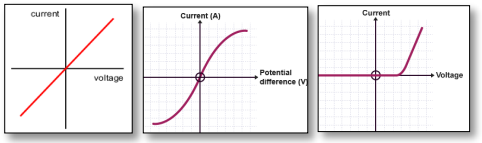
# Triple Science - Physics

SP10-11 Knowledge organiser

How resistance changes with light intensity for a light dependent resistor



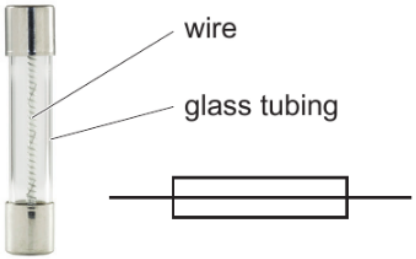

| 6. More about resistance (Controlling resistance) | |
|---|---|
| **LDR** | Light-dependent resistor. High resistance in dark, low resistance in light. |
| **Thermistor** | High resistance when cold, low resistance when hot. |
| **Diode** | High resistance in one direction, low resistance in the other. |
| **Filament lamp** | High resistance causes the filament to heat up, producing light. |
| **Resistor graph** | Current increases in direct proportion to voltage (straight line going through (0,0)). |
| **Filament lamp graph** | Current increases as voltage increases, but levels out eventually. |
| **Diode graph** | Graph slopes up with a positive voltage but stays at 0 with a negative voltage. |




| 7. Core practical – investigating resistance | |
|---|---|
| **Aim** | To explore how resistance changes in different circuits. |
| **Investigating resistance** | Set up a circuit with an ammeter, resistor and voltmeter across the resistor. Vary the voltage and record voltage and current. |
| **Investigating series circuits** | Set up a series circuit with an ammeter, two bulbs and voltmeters across each bulb and the power supply. Vary the voltage and record all readings |
| **Investigating parallel circuits** | Set up a parallel circuit with two bulbs and ammeters on each branch and by the power supply, and voltmeters across each bulb and the powers supply. Vary voltage, record all readings. |
| **Results** | Resistor – doubling voltage doubles current<br><br>Series circuit – voltage at bulbs half of that at power supply<br><br>Parallel circuit – voltage at bulbs equal to power supply, current half that at power supply |

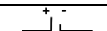
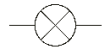
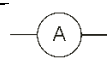
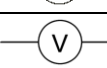
| 8. Transferring Energy | |
|---|---|
| **Calculating energy transfer** | Energy = current x potential difference x time<br>E = I x V x t<br><br>Energy = joules<br>Current = amps<br>Potential difference = volts<br>Time = seconds |
| **Resistance and energy transfer** | Electrons flowing through wires collide with atoms and lose energy. This energy is transferred to heat. |
| **Electrical energy dissipation** | When electrical energy is transferred to wasted heat energy by resistance. |
| **Reducing resistance** | Use thicker wires, use shorter wires, use lower-resistance metals, reduce the temperature. |

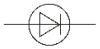
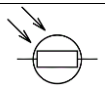
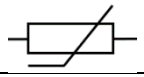
| 9. Electrical power | |
|---|---|
| **Power** | The rate of energy transfer. |
| **Watts, W** | The unit of power: 1 W = 1 joule per second |
| **Power and work done** | $P = \frac{E}{t}$<br>Where 'P' is power in W, 'E' is work done in J, 't' is time in s. |
| **Power, current and voltage** | $P = I \times V$<br>Where 'P' is the power in W, 'I' is the current in A, V is the potential difference in V. |
| **Power, current and resistance** | $P = I^2 \times R$<br>Where 'P' is the power in W, 'I' is the current in A, 'R' is the resistance in Ω. |

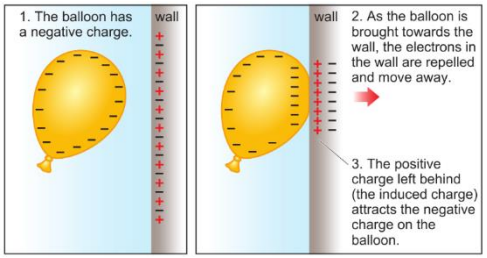



| 10. Transferring energy by electricity | |
|---|---|
| **Mains electricity** | The electricity supplied from wall sockets. |
| **National grid** | The systems of power lines and sub-stations that distributes electricity from power stations to homes and businesses. |
| **Heaters** | Transfer energy from electrical to thermal. |
| **Motors** | Transfer energy from electrical to kinetic. |
| **Direct current** | Current that flows in one direction. |
| **Alternating current** | Current that switches direction many times each second. |
| **Frequency of mains current** | Mains current alternates (switches direction) 50 times each second. The frequency is 50 Hz. |

| 11. Electrical safety | |
|---|---|
| **Live wire** | Brown, 230 V, connects the appliance to the power station. |
| **Neutral wire** | Blue, 0 V, completes the circuit. |
| **Earth wire** | Green and yellow, 0 V. Connects the appliance to the ground so current can flow there in the event of a short circuit. |
| **Fuse** | A thin metal wire that melts and breaks the circuit if there is too much current. |
| **Circuit breaker** | Breaks the circuit if too much current flows. |
| **Advantages of circuit breakers** | Quicker than fuses, just need switching rather than replacing. |

| Circuit symbols | |
|---|---|
| Switch |  |
| Cell |  |
| Battery |  |
| Lamp |  |
| Ammeter |  |
| Voltmeter |  |

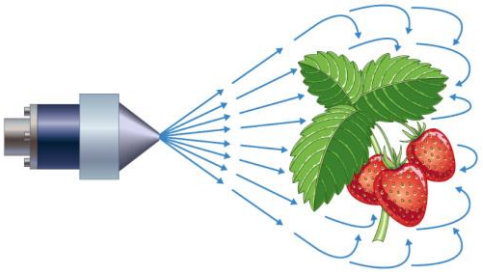
| | |
|---|---|
| Resistor |  |
| Variable resistor |  |
| Diode |  |
| LDR |  |
| Thermistor |  |



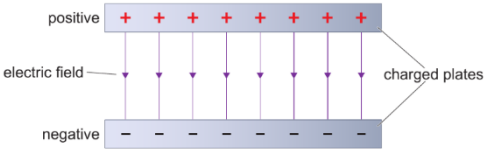

| 12. Charges and static electricity | |
|---|---|
| **Insulators** | A substance or device which does not readily conduct electricity. |
| **Static electricity** | An imbalance of electric charges within or on the surface of a material. |
| **Charging by induction** | a charged object is brought near but not touched to a neutral conducting object. The presence of a charged object near a neutral conductor will induce (force) electrons within the conductor to move. |

| 13. Danger and uses of static electricity | |
|---|---|
| **Discharged** | Allow (a liquid, gas, or other substance) to flow out from where it has been confined. |
| **Earthed** | Connect (an electrical device) with the ground. |

| | |
|---|---|
| **Electrostatic** | Relating to stationary electric charges or fields as opposed to electric currents. |



| 14. Electric fields | |
|---|---|
| **Force field** | Is a volume of space around an object in which another object can experience a force. |
| **Electric field** | A charged object with a force field around it. |
| **Point charge** | A charge that is at a single point. |
| **Field lines** | Is a graphical visual aid for visualizing vector fields. |
| **Uniform** | Remaining the same in all cases and at all times; unchanging in form or character. |




**Exam-style question**

A positively charged balloon is held above a small piece of paper. Explain the effect of the balloon's electric field on the piece of paper. *(3 marks)*