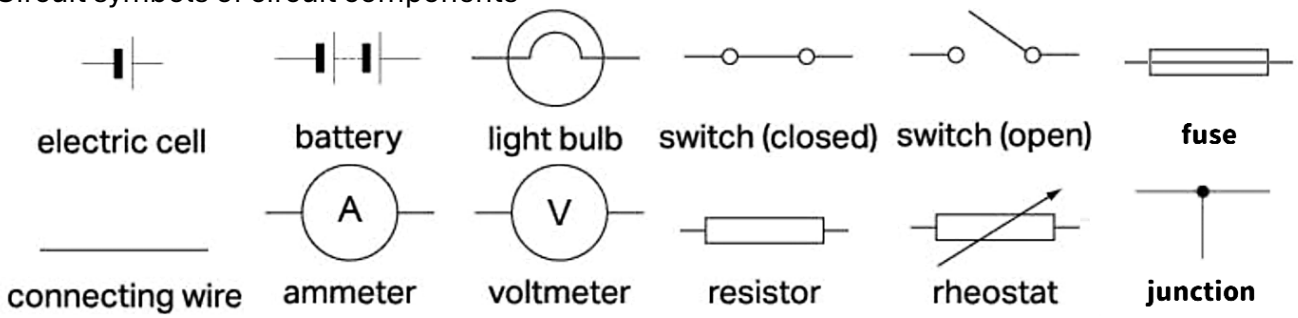
F.2 UT Science Revision Worksheet

8.1 Introducing electricity and simple circuits

- Three basic components of an electric circuit
  - Source of electricity and electrical energy
    - Electric cell (Dry/Wet cell), Mains socket
  - Device Using electrical energy
    - Lightbulb, Fan, Buzzer
  - Wire connecting different parts of the circuit together
    - Electric wire (Copper [Household], Aluminium [Overhead Wires], Nichrome)
- Open/Closed circuit
  - A closed circuit is a circuit that has:
    - A complete path for electricity to flow from one end of the electric cell to the other.
  - A closed circuit with a source of electrical energy is required for electricity to flow.
- Electrical conductors
  - Materials that allow electricity to flow through them are electrical conductors.
  - Metals such as copper, aluminium and iron are usually good electrical conductors.
  - Other materials like graphite can also conduct electricity.
- Electrical insulators
  - Electrical insulators are materials that do not allow electricity to flow through them.
  - Plastic, glass and wood are examples of electrical insulators.
- Switch
  - A switch is used to open or close a circuit.
  - When a switch is closed, it completes a circuit and becomes a closed circuit.
  - When the switch is open, there is a gap in the circuit so electricity cannot flow.

8.2 Circuit diagrams

- A circuit diagram is drawn to represent an actual circuit.
- Circuit symbols of circuit components



- Tips on drawing circuit diagrams (For more, refer to Book 2A P.178-179)
  - Draw the connecting wires as straight lines using a ruler.
  - The straight lines should be either vertical or horizontal.
  - The circuit is drawn with right-angled corners.
  - Draw a dot at each junction.

8.3 Electric current

- Basic concepts of electric current
  - Each atom has a nucleus surrounded by tiny electrons.
  - The nucleus：(+) positive charge；Electrons：(-) negative charge.
- Free electrons
  - Some electrons can escape from atoms and move freely.
  - These electrons are called free electrons.
- Flow of free electrons
  - When a metal is connected to an electric cell to form a closed circuit, the free electrons will flow from the negative (-) pole to the positive (+) pole.
  - This "flow of free electrons" forms an electric current.
- "Conventional current" (Not strictly true)
  - Electric current is a flow of positive charges from the positive (+) to the negative (-) pole.
  - Scientists still use this convention.

- Measuring Electrical energy
  - The size of an electric current is related to:
    - The number of free electrons that flow through a point in the circuit every second.
  - The more free electrons flowing through it, the larger the electric current.
  - We can use an ammeter to measure the size of an electric current.
  - The unit of an electric current is ampere (A).
- The heating effect of electric current
  - When an electric current flows through：
    - Some electrical energy is converted into thermal energy.
  - The heating effect is larger if the electric current is larger.
- Magnetic effect of electric current
  - A current-carrying coil can form a magnetic field like a magnet.
    - This coil is called an electromagnet.
  - The magnetic effect is larger if the electric current is larger.
  - An electromagnet is useful because it acts like a magnet that can be switched on or off.
  - It produces a magnetic effect only when current flows through it.
  - Electromagnets are commonly used in electric door locks, electric bells, etc.

8.4 Voltage

- Basic ideas of voltage
  - Voltage is a measure of the amount of energy supplied to the free electrons.
  - Voltage is also related to the 'electrical push' that makes free electrons flow in a circuit.
  - The higher the voltage, the greater the 'electrical push'.
- Measuring voltage
  - We can use a voltmeter to measure voltage.
  - The unit of voltage is volt (V).
  - The total voltage across connected cells is sum of the voltages of all the electric cells.
- The higher the voltage, the larger the current.

8.5 Resistance

- Basic ideas of resistance
  - Resistance measures the opposition of a material to the flow of electric current.
  - It is measured in ohms (Ω).
- Effect of resistance on current
  - When resistance increases, the electric current decreases.
- Factors affecting resistance
  - Material of the wire
    - Different materials have different resistance.
    - Conductors have low resistance while insulators have very high resistance.
    - Also, some conductors (copper), have lower resistance than others (graphite).
    - Thickness of the wire (The thinner a wire, the higher its resistance.)
    - Length of the wire (The longer a wire, the higher its resistance.)
- Resistor
  - A resistor is a circuit component with a fixed resistance.
- Rheostat
  - A rheostat is a circuit component whose resistance can be changed.
  - Two types of Rheostat
    - Sliding rheostat
      1. Has a coil of resistance wire (nichrome), a metal bar and a sliding contact.
      2. When we move the sliding contact, we change the length of the resistance wire that the current flows through.
      3. This changes the resistance of the rheostat and thus the current in the circuit.
    - Rotary-type rheostat
      1. Has 3 terminals, a coil of resistance wire (nichrome) and a sliding contact.
      2. When the sliding contact of the rheostat is rotated, we change the length of the resistance wire that the current flows through.
      3. As a result, the resistance of the rheostat changes.
  - Applications of Rheostats (Examples)
    - Dimmer switches to adjust the current and thus the brightness of lamps.
    - Volume controls of hi-fi systems.

8.6 Series circuits and parallel circuits

- Basic ideas of series circuits and parallel circuits
  - Series circuits
    - Single-path circuits - There is only one path for current to flow through.
    - If a gap appears in the circuit, there is no current flow in the circuit.
      - If the circuit is open at any point, the circuit will be incomplete.
  - Parallel circuits
    - With branches - There is more than one branch for current to flow through.
    - If one of the branches is open, the current can still flow through the other branch.
    - The electrical appliances in our homes are connected in parallel.
- Current and voltage in series and parallel circuits
  - Series circuits
    - The current is the same at every point in the circuit.
    - The voltage is not the same across different circuit components.
  - Parallel circuits
    - A larger current flows in the branch with lower resistance.
    - The current in the main loop = the sum of the currents in the branches.
    - The voltage is the same across every branch.
    - The voltage across each branch = the voltage across the electric cells.

8.7 Our household electricity

- How do electrical appliances work?
  - Using the heating effect of electric current
    - Electric kettles is an example of electrical appliances that works on it.
    - These appliances have heating elements, which are usually nichrome wires.
    - Most of the electrical energy is converted into thermal energy for use.
  - Making Light - Using the heating effect of electric current
    - A filament light bulb also uses the heating effect of electric current to work.
    - It contains a long thin tungsten filament.
    - The current-carrying filament becomes so hot that it glows and produces light.
  - Using the magnetic effect of electric current
    - Electromagnets is an application of the magnetic effect of electric current.
    - When a current-carrying conductor is placed near a magnet,
      - A force is produced and this force can cause the conductor to move.
    - This effect is used in electric motors.
    - Electric motors can convert electrical energy into kinetic energy.
    - They are used to drive the moving parts in many electrical appliances.
    - Electric fans, vacuum cleaners and washing machines are examples of it.
  - Electrical appliances are energy converters useful for different purposes.
- Mains electricity and domestic circuits
  - Mains electricity
    - The mains electricity in Hong Kong has a voltage of 220 V.
    - This voltage is called the mains voltage.
    - The mains voltage varies from countries to countries.
    - Therefore, electrical appliances may not be cross-country suitable.
  - Connecting to the mains electricity
    - To connect an electrical appliance to mains electricity;
      - We need to insert its plug into a mains socket.
    - The plug used in Hong Kong is called a three-pin plug as it has three pins.
      - The live pin (Brown), the neutral pin (Blue) and the earth pin (Yellow/Green).
    - They fit into the live hole, the neutral hole and the earth hole of the mains socket.
    - The live wire (Brown) carries the voltage that drives the current.
    - The neutral wire (Blue) provides a return path for the current to complete the circuit.
    - The earth wire (Yellow/Green) is a safety device only.
  - Domestic circuits
    - Mains electricity is transmitted from power plants to our home through an electric cable (Aluminium).
    - Domestic circuits are parallel circuits so that appliances can operate independently.