3 Extra Circuit Practice Worksheets

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6.5 Circuit diagrams (Reading)

A map of a town shows the roads as a series of lines, and has symbols for important buildings such as hospitals. A map of a rail system shows the railway stations and the railway lines that join them. The distances between them are not accurate, but you can use the map to work out how to travel anywhere in the network.

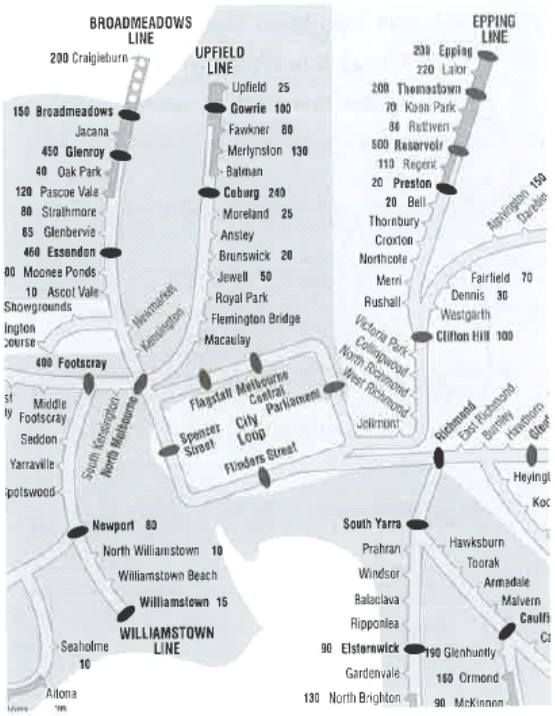


Figure 6.5.1 A map of Melbourne's rail network

A map of an electric circuit is called a circuit diagram. The wires are shown as a line and symbols are used for globes, ammeters and batteries. The symbols on a map of a town or on a map of the rail network are used all over the world. So are the symbols for electric circuits. Some electric circuit symbols are shown in the following diagram.

A **resistor** is any device that has electrical resistance. A **cell** is a chemical device that makes electricity, such as an electrochemical cell. A **battery** is a series of cells joined together. The arrow on some symbols shows that the output is variable (= can change).

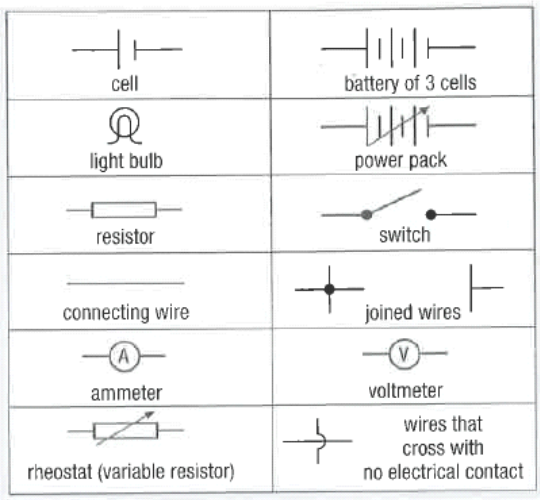


Figure 6.5.2 Some symbols used in circuit diagrams

Circuit diagrams are a stylised way of drawing a circuit. The wires are drawn as straight lines that makes it easier to follow the wires. Circuit diagrams are used to study real circuits and to design new circuits. If wires cross and they are joined, we draw a dot at the intersection. If they are not joined, then one wire has a half-circle drawn in it.

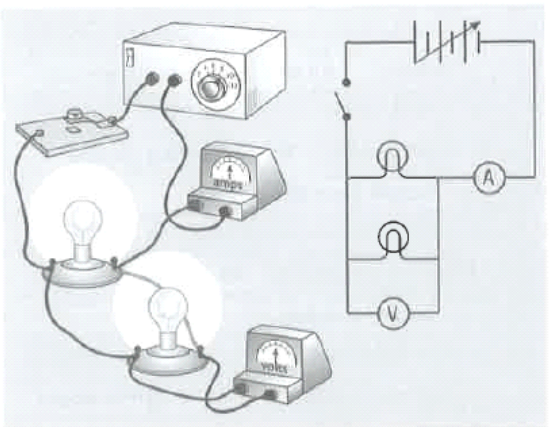


Figure 6.5.3 A circuit and its circuit diagram

Questions

1 Why are circuit diagrams drawn? Circuit diagrams are used to study real circuits and to design new circuits.

2 What is the difference between a cell and a battery? A cell is a chemical device that makes electricity, such as an electrochemical cell. A battery is a series of cells joined together.

3 Draw the circuit diagram symbols for the following.

resistor		ammeter	A
switch		voltmeter	V
cell		power pack	
battery		wire	

4 How do you show on a circuit diagram that the output on an electrical device can be varied or changed?

This is done by drawing an arrow through the symbol for the device.

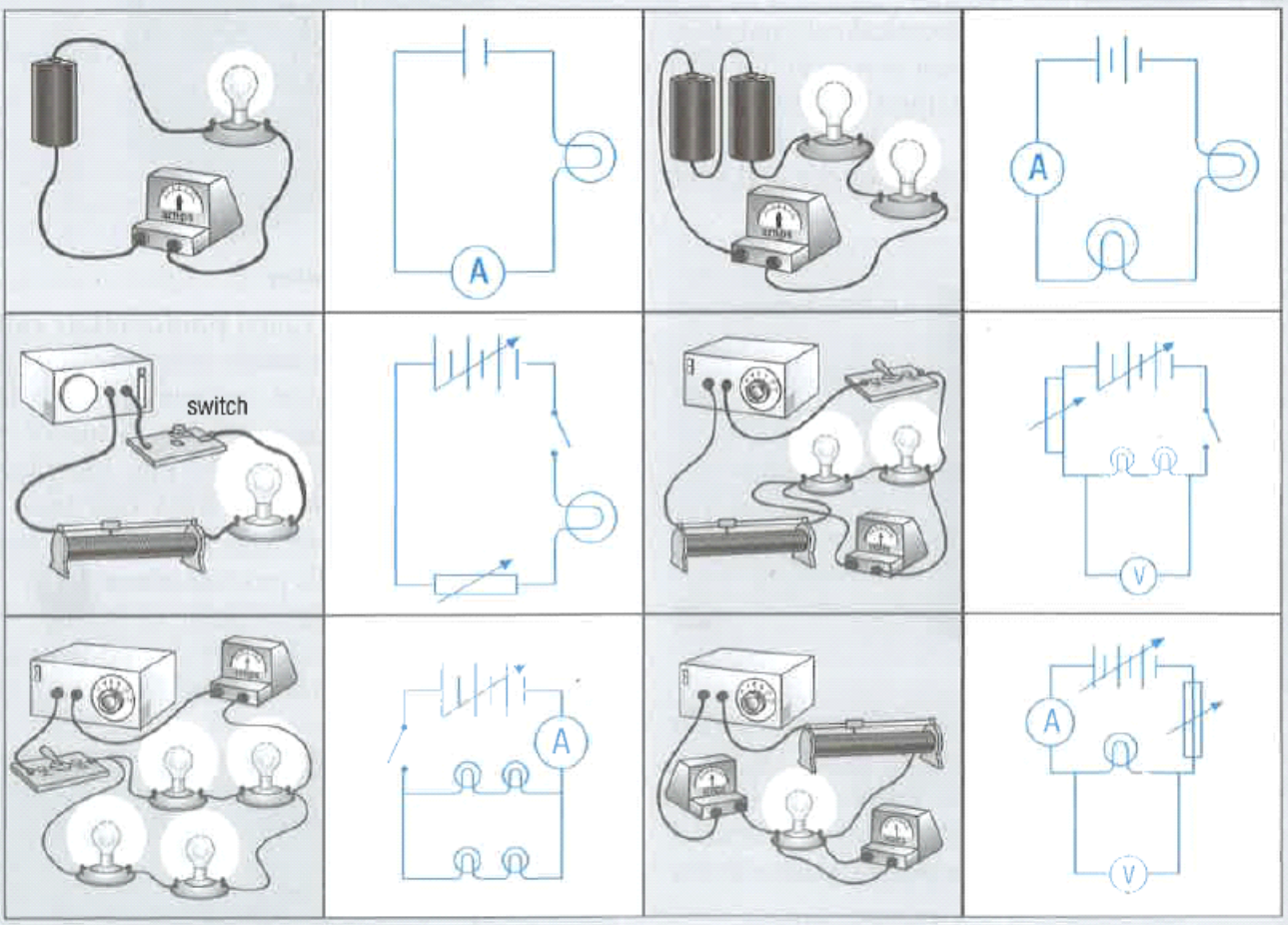
5 The wires in circuit diagrams are drawn straight and are often parallel or at right angles. Why are they drawn like this?

This makes it easier to follow the wires on the diagram.

6 How do you draw wires that cross over but do not connect with each other?

7 An example of a rheostat is a light dimmer. It reduces the voltage so the light becomes dimmer. What is the symbol for a rheostat?

8 Draw circuit diagrams of the circuits illustrated below.



6.7 AC and DC

In Activity 6.1, when we made electricity in an electrochemical cell, the electrons moved from one metal to the other metal. Electric current that flows in one direction only is called **direct current**, or DC. Direct current is made by electrochemical cells, fuel cells, accumulators and photovoltaic cells.

Electricity can be made by a generator or **dynamo**. The electricity that is made goes forwards and then backwards. This is called **alternating current**, or AC. It reverses its direction each time the generator rotates.

An **oscilloscope** lets us see how the voltage in electricity changes. We can see alternating current as a pattern on the screen. Some oscilloscopes can display two voltages on the screen at the one time.

The electricity supply to our homes is alternating current. The current flows forwards and then backwards 50 times per second. We say that its frequency is 50 cycles per second, or 50 hertz. One **hertz** is one cycle per second. The abbreviation for hertz is Hz.

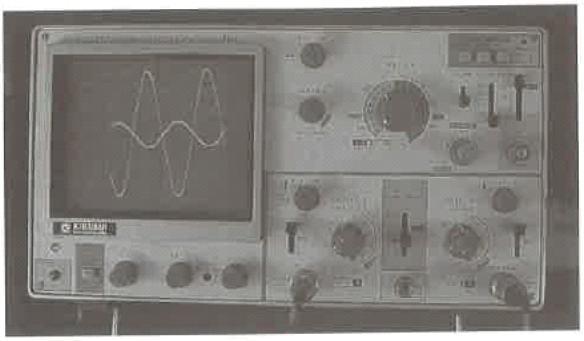


Figure 6.7.1 An oscilloscope

For many years scientists argued about what was best—alternating current or direct current. There are advantages for both, but in the end alternating current was adopted in all countries. This is because alternating current is easily made in generators and can be changed into different voltages by **transformers**. There is the same amount of electrical energy in 240 V alternating current as there is in 240 V direct current.

In Australia the voltage used for houses is 240 V 50 Hz AC. In some countries 110 V 50 Hz AC is used.

Questions

1 What do these letters mean?

a AC Alternating current.

b DC Direct current.

c Hz Hertz, one cycle per second.

2 What does an oscilloscope show us? It lets us see how the voltage in electricity changes. We can see this as a pattern on the screen.

3 Why do most countries use alternating current and not direct current? AC is easily made (by generators) and can be changed into different voltages (by transformers).

4 Our mains supply of electricity is 240 V 50 Hz AC. What does all this mean? 240 V is a measure of the potential difference. 50 Hz means that it is alternating current that flows forwards and then backwards 50 times per second.

5 What is an electrical generator? A device that makes alternating current as it rotates.

6 What is the main difference between direct current and alternating current? In direct current the electricity flows in the one direction. In alternating current the electricity flows frontwards and then backwards quickly.

7 Which electricity has the most energy: direct current or alternating current? Neither. Both have the same energy if the volts are the same.

Drawing electrical circuits

Skills: Understanding, Knowledge

When drawing electrical circuits, symbols are used to show the components and how they are connected. This makes it easier to understand how the circuit should be constructed.

1 **Describe** the four features that are required to construct a simple, working circuit.

① source (battery, cell, power pack)
② conducting wires
③ load ④ switch.

2 **Define** each electrical component by drawing its symbol:

a fixed resistor 

b globe 

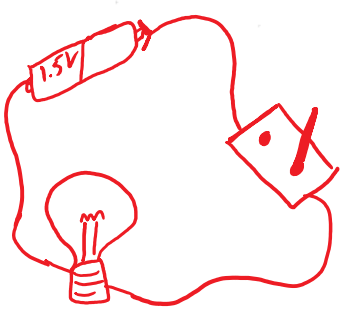
c open switch 

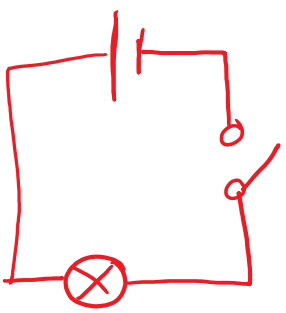
d conductor

e ammeter 

f voltmeter 

3 **Construct** a simple circuit that can switch on a light using a 1.5 V cell, a globe, an open switch and connecting wires. Draw an accurate 3D diagram, then a matching 2D circuit, using symbols only.





4 Explain which was the easiest to draw, and why.

The circuit symbol diagram is MUCH easier to draw as drawing 3D requires some artistic ability.

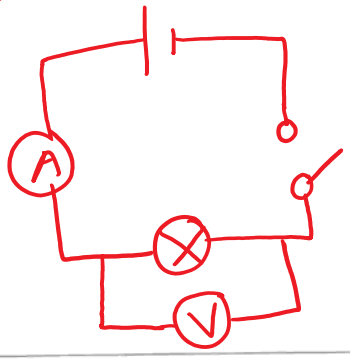
7.2 Circuit symbols

Drawing electrical circuits

Skills: Understanding, Knowledge

5 **Describe** how you would connect an ammeter and voltmeter in the circuit in Question 3. Redraw the 3D circuit diagram, showing the ammeter and voltmeter connected correctly.

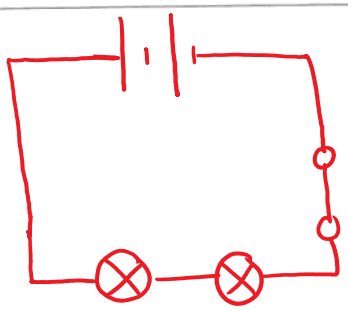
the ammeter must be connected within the circuit, and the voltmeter should be placed across a load.



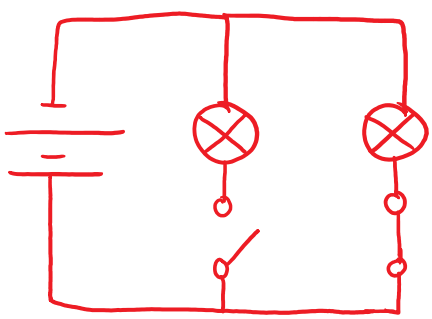
6 Draw and **construct** a circuit diagram for a circuit that has

a two lights, two cells and a switch.

2cells = battery



b two lights. Each light must be able to be turned off separately.

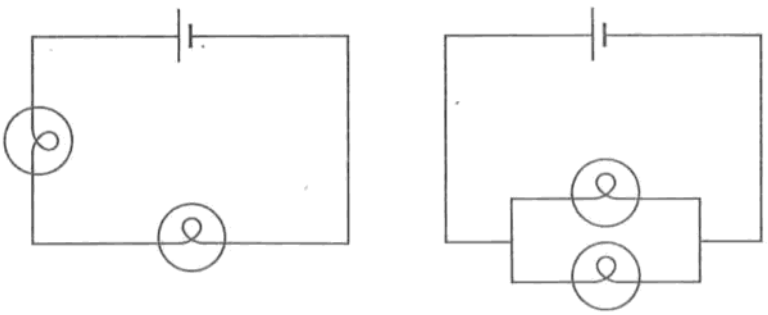


switches must be separate in order to be able to turn on/off each light.

A footy analogy

Skill: Understanding

Look at the two circuits shown here. Twice as much current flows in circuit B as in circuit A. This is because there are two ways for the current to flow.



A B

Here is a model that might help you to understand more about parallel circuits.

Imagine a single queue going through one gate only to enter an NRL match between the Knights and the Panthers. With only one gate, five people can enter and pay every minute.

1 **Identify** which circuit (A or B) this is like. A

2 **Predict** what would happen if another gate was opened.

if another gate is opened, 5 people can get through each gate. so 10 people total /min.

3 **Calculate** how many people would enter every minute once two gates are open.

1 gate = 5/min ∴ 2 (5/min) = 10 people/min
2 gates

4 **Identify** which circuit (A or B) this is like. B

5 **Explain** why the total current in circuit B is higher than in circuit A.

The total current in circuit B is higher bc the current has 2 conducting wires to go through.

Each gate is like a *resistor* in a circuit. It controls the flow. Imagine now that the second gate is twice as wide as the first gate.

6 **Calculate** how many people could now flow through this gate in one minute.

1st gate = 5 ppl/min 2nd gate = 10 ppl/min ≡ Total 15pp/min

7 **State** whether this gate has high or low resistance.

if the gate allows more ppl through (more current to flow) then this gate has lower resistance.