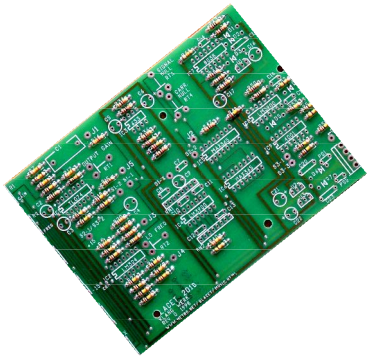


Nat 4 Electricity & Energy

Self Checks

Self check 1 : Revision

1. Name the eight different forms of energy.

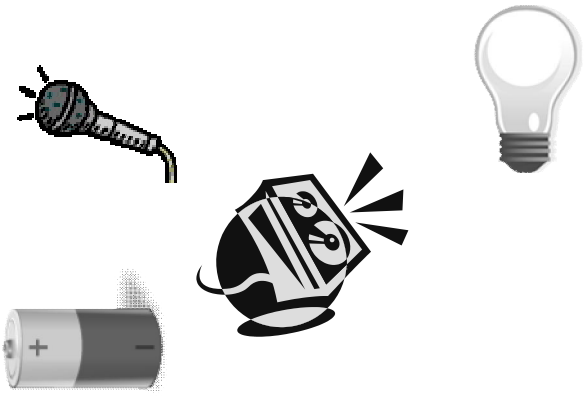
2. For each energy changer below, write down the main energy change:

   (a) bulb.

   (b) microphone.

   (c) loudspeaker.

   (d) battery.



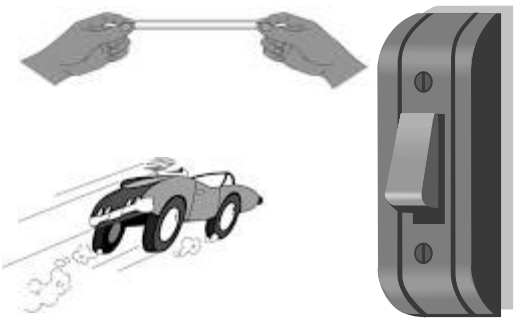
3. Which form of energy is described as stored energy ?

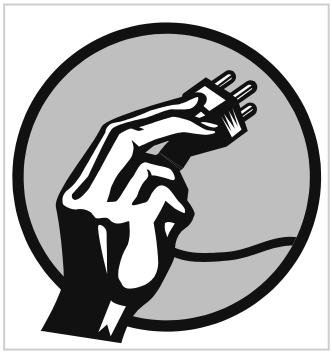
4. Which form of energy do the following objects have:

   (a) a stretched elastic band.

   (b) a ringing doorbell.

   (c) a speeding car.





5. Write down four appliances in the home which:

   (a) use electrical energy.

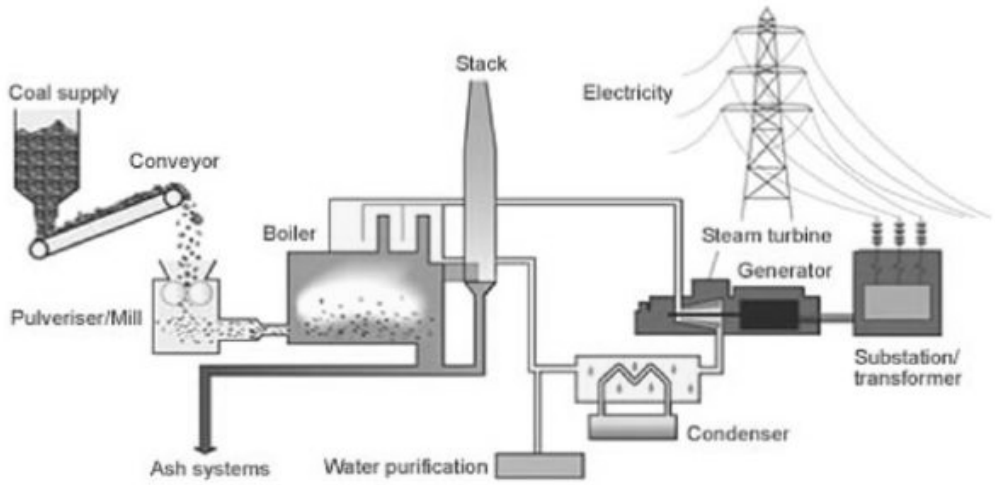
   (b) produce heat energy.

Self check 2 : Non-renewables

1. Name the three fossil fuels.

2. Name another non-renewable source which is commonly used to generate electricity.

3. In the thermal power station shown below coal is being burned to generate electricity.



(a) What energy change occurs when coal is burned?

(b) In which part of the power station does the water turn to steam?

(c) What energy change occurs when the generator is working?

4. (a) In which part of a nuclear power station is heat created?

(b) Describe two advantages of generating electricity in a nuclear power station?

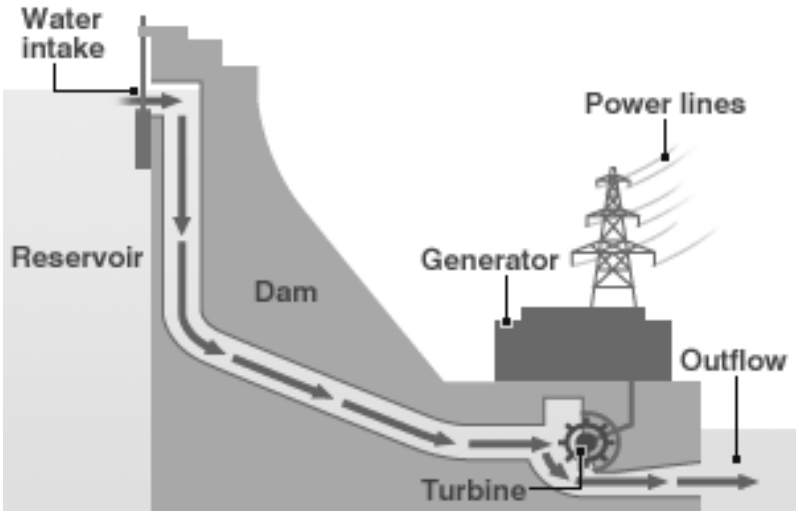
(c) State one disadvantage of generating electricity in a nuclear power station?

5. Why are alternatives to the non-renewable sources of energy being sought?

Self check 3 : Renewables

1. Power companies are investing in the renewable sources of energy.
Name **three** renewable sources.

2. The diagram below shows a hydroelectric power station.



(a) What form of energy does the water behind the dam have?

(b) What form of energy does flowing water have?

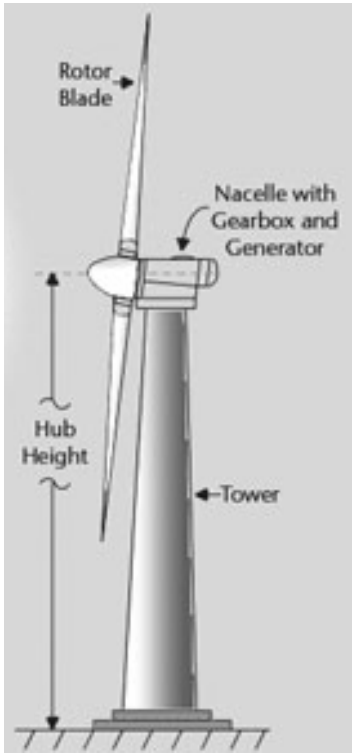
(c) In which part of the power station does kinetic energy change to electrical energy?

3. Wind turbines generate electricity by harnessing the energy of the wind.

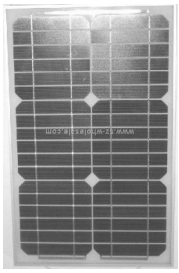
(a) What are the advantages of generating electricity in this way?

(b) What are the disadvantages of generating electricity this way?

(c) Wind turbines may be grouped together to form wind farms. The amount of energy generated depends upon the location of the wind farm. Describe where you would position a wind farm and why.



Self check 3 continued



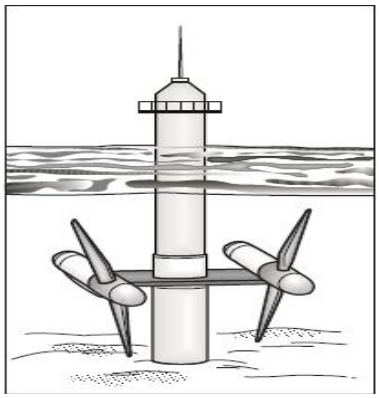
4. What is the energy change in a solar cell?

5. Explain the difference between photovoltaic cells and thermal solar panels.

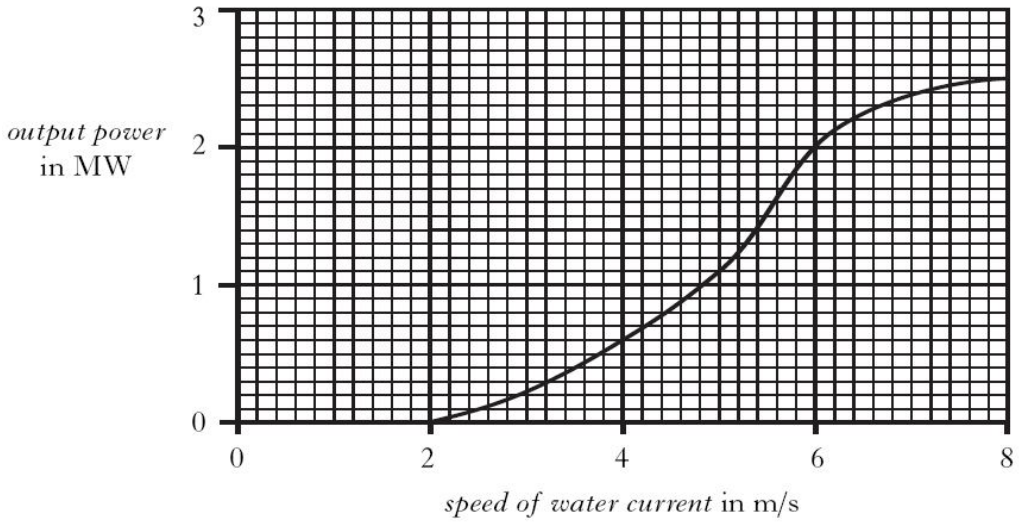
6. Explain why solar panels are placed on the roofs of buildings or in wide open spaces?

7. What are the advantages and disadvantages of generating electricity using solar cells?

8. An underwater generator is designed to produce electricity from water currents in the sea.



The output power of the generator depends upon the speed of the water current as shown in the graph below.



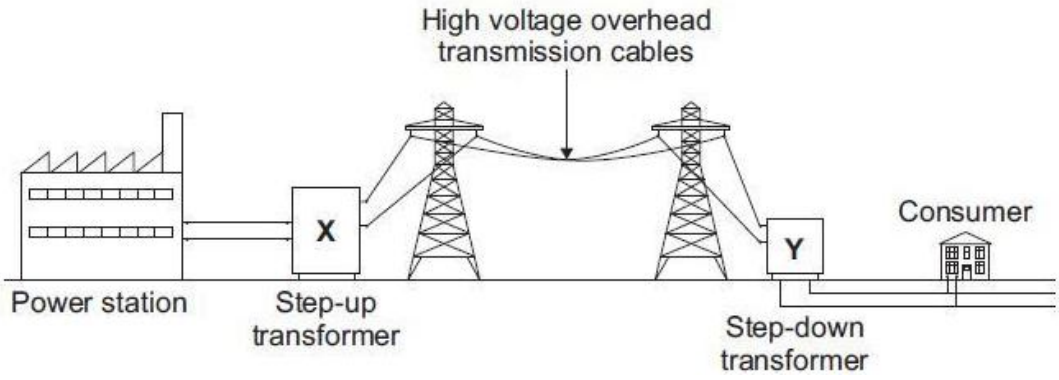
State the output power when the speed of water is (i) 6 m/s
(ii) 4 m/s.

9. Explain why some people think that biomass is a form of solar energy.

Self check 4 : Energy Efficiency

1. What is energy conservation?

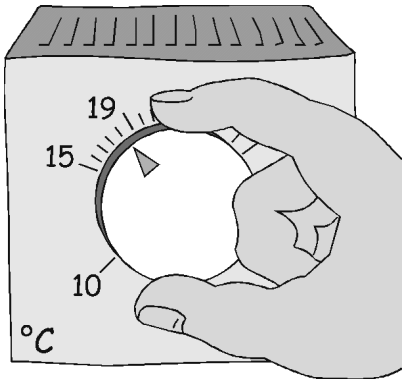
2. The power companies save energy by transferring the electricity efficiently from the power station to the consumer through the national grid as shown below.



(a) Which part saves the energy?

(b) What does the part do to save the energy?

3. Name four ways in which energy waste be reduced in our homes.
Use the clues below.



Self check 4 continued

4. The table below shows the percentage of heat lost from different parts of a house.

Part of house	*Percentage of heat lost (%)*
Roof	25
Walls and Floor	45
Windows	20
Door	10

(a) Present the information in the table as a **bar graph**.

(b) In one second, the heat lost from a house is 10 000 Joules. How much of this heat is lost through the roof ?

(c) If you were the owner of this house and you could afford to buy double glazing or loft insulation (but not both), which would you choose ?
Explain your choice.

5. Use the information in the passage to answer the questions.

Loft insulation is an effective way of keeping houses warmer and reducing heating costs. Up to 20% of heating costs can be saved by installing effective loft insulation.
The three main types of loft insulation are blown insulation, blanket insulation and loose-fill insulation. Blanket and loose-fill insulation can be easily installed, but blown insulation must be installed by a specialist contractor.
Most houses have blanket insulation. Blanket insulation can be made from mineral fibre or rock fibre and is supplied in rolls. Mineral fibre and rock fibre are non-flammable but must be treated to protect them from rot, vermin and dampness. When installing blanket insulation, protective clothing including gloves and a face mask must be worn to prevent fibres damaging skin and lungs.
Loose-fill insulation can be made from cork granules, vermiculite or cellulose fibre. This type of insulation is not advised for use in a draughty loft because the material can blow about.

(a) How much can heating costs be reduced by installing effective loft insulation?

(b) Which type of insulation must be installed by a specialist contractor?

(c) Why must protective clothing be worn when installing blanket insulation?

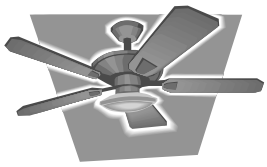
(d) Why should loose-fill insulation **not** be used in a draughty loft?

Self check 5 : Energy and Power

1. (a) If an electric current is passed through a conducting wire, what energy change takes place?
   (b) Many electrical appliances in the home are designed to make use of this energy change. Name four of these appliances.

2. A light bulb has a power rating of 60 W.
   (a) How much electrical energy is transformed by the bulb in 1 s?
   (b) State the energy change in the lamp when it is switched on.

3. The electric motor of a ceiling fan uses 207 kJ of electrical energy in 30 minutes.
   (a) Calculate the power rating of the motor in the fan.
   (b) State the energy change in the ceiling fan when it is switched on.



4. What is the power rating of an appliance which transforms:
   (a) 500 J in 5 s
   (b) 1200 J in 20 s
   (c) 1.8 kJ in 10 minutes?

5. How much electrical energy is used by the following appliances?
   (a) A 400 W drill used for 45 s
   (b) A 300 W food processor used for 20 s
   (c) An 800 W iron used for 40 minutes
   (d) A 2.4 kW kettle that takes 5 minutes to boil the water inside it.

6. How long would a 2 kW electric kettle take to boil the water inside if it uses 100 kJ of electrical energy?

7. How long does it take to completely discharge a battery which stores 200 000 kJ and is used to power a 6 kW heater?

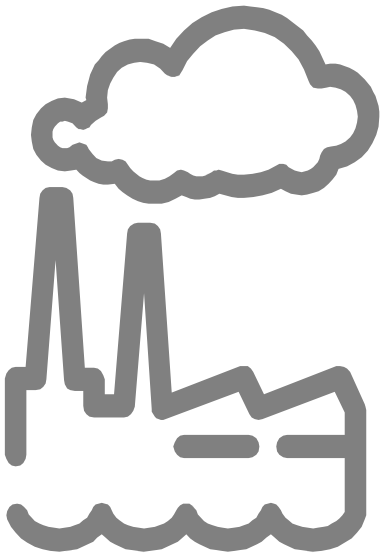
8. In general, which type of devices have the highest power rating?

9. Describe three ways in which energy can be saved in the home.

Self check 6 : Efficiency

1. A turbine converts 65 000 J of heat energy into 13 000 J of kinetic energy.
   What is the efficiency of the turbine?

2. A power station produces 1 600 000 kW of heat, which gives 600 000 kW of electrical power.
   Calculate its efficiency.



3. What is the efficiency of a machine which has a power input of 800 W and a power output of 600 W?

4. A power station uses up 250 000 kJ of chemical energy to produce 105 000 kJ of electrical energy.
   How efficient is the power station?

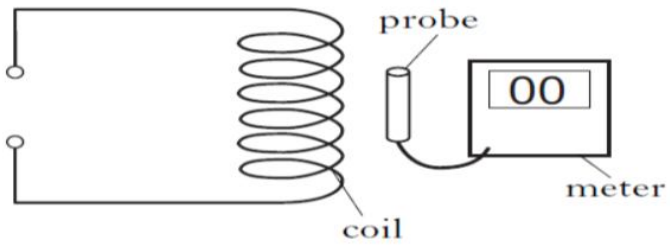
5. Students are investigating the efficiency of an electric kettle. They find that every second the kettle uses 2500 J of electrical energy. 1750 J of this energy is converted to heat energy.
   Calculate the energy efficiency of the kettle.

6. The boiler of a thermal power station releases $2{\cdot}8 \times 10^8$ J of heat energy for each kilogram of coal burned. The generator of the power station produces $1{\cdot}26 \times 10^8$ J of electrical energy for each kilogram of coal burned.
   What is the efficiency of this power station?

7. An electric motor rated at 500 W runs for 2 minutes and does 45 kJ of work.
   (a) What is its input energy?
   (b) What is its efficiency?

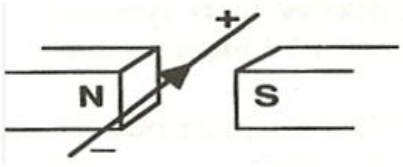
Self check 7 : Electromagnetism

1. A student uses a probe connected to an ammeter to detect the magnetic field close to a coil of wire. The meter reads zero as shown below.



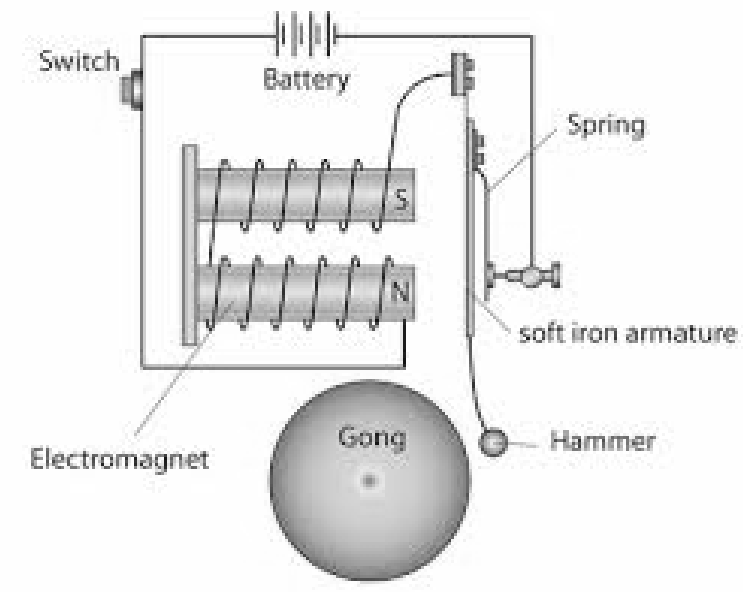
What must pass through the coil in order for the meter to register a reading?

2. Consider the diagram shown below.



What happens to the wire when current passes as shown?

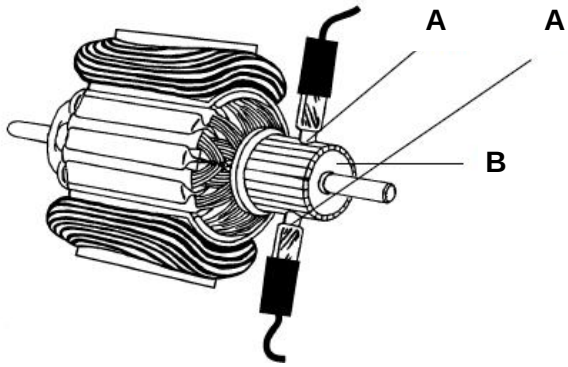
3. The circuit diagram of an electric bell is shown below.



When the switch is pushed, explain fully what happens.

Self Check 7 continued

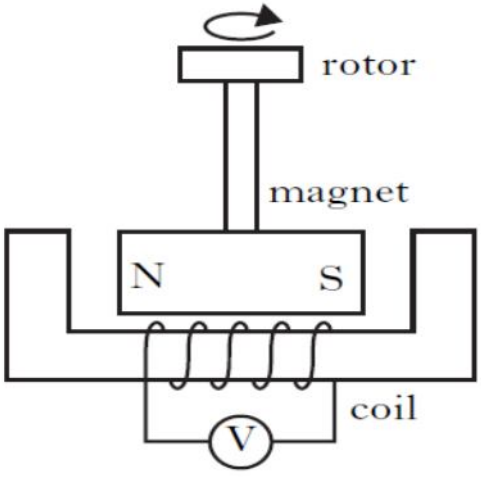
4. A diagram of an electric motor is shown .
Identify labels **A** and **B** on the diagram.



5. In which of the following would a voltage **not** be induced in a coil of wire?

A Rotating the coil of wire near to a magnet
B Rotating a magnet near to the coil of wire
C Holding a magnet stationary within the coil of wire
D Moving a magnet in and out of the coil of wire
E Moving the coil of wire between the poles of a magnet

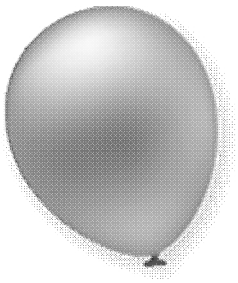
6. The diagram shows a model bicycle dynamo.



When the rotor is turned the magnet rotates, inducing a voltage in the coil.
State the three changes which would reduce the induced voltage.

Self Check 8 : Charge

1. Paul wants to charge a balloon and stick it to a wall.



   (a) What should he do to give the balloon a charge ?

   (b) What are the two types of electrical charge ?

2. Katie does some experiments with plastic strips.

   (a) In the first experiment she gives one strip a positive charge and leaves the other uncharged. What will happen ?

   (b) In the second experiment she gives one strip a positive charge and the other strip a negative charge. What will happen ?

3. Two charged acetate rods repel each other. Suggest a reason for this.

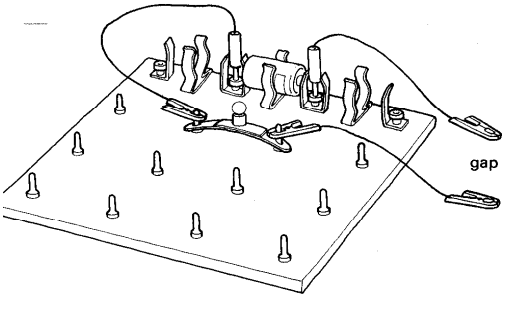
4. When connected to a battery, a bulb allows an electrical current to flow.

   (a) What is meant by the term “electrical current”?

   (b) Why does the bulb not light when a wire is removed?

   (c) What does the battery provide in this example?

5. John sets up the circuit below to test if a substance is a conductor or an insulator of electricity.



   (a) What is the difference between a conductor and an insulator.

   (b) Describe how the circuit is used to show that a substance is a conductor of electricity.

   (c) What particles flow in a wire when electricity flows ?

6. Why are electrical cables :

   (a) made of copper
   (b) coated with plastic ?

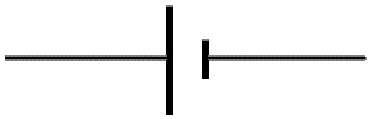
Self Check 9 : Circuit Symbols

1. Why are circuit symbols used rather than drawing or pictures ?

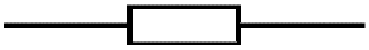
2. Copy and identify the following symbols.

(a)

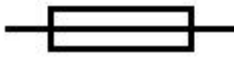
(b)



(c)

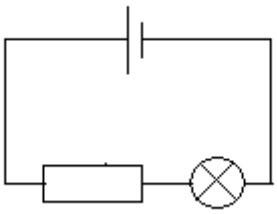


(d)

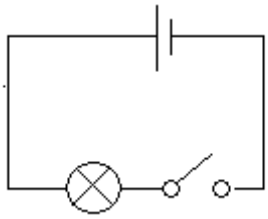


3. Describe the circuits below.

(a)



(b)

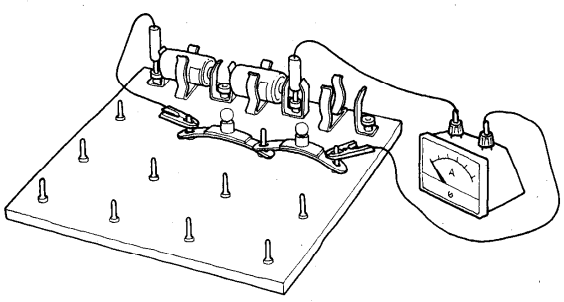


4. In the circuit to the right the bulbs are identical.

   (a) Draw a circuit diagram for this circuit.

   (b) What can you say about the brightness of each bulb ?

   (c) What piece of apparatus measures current ?

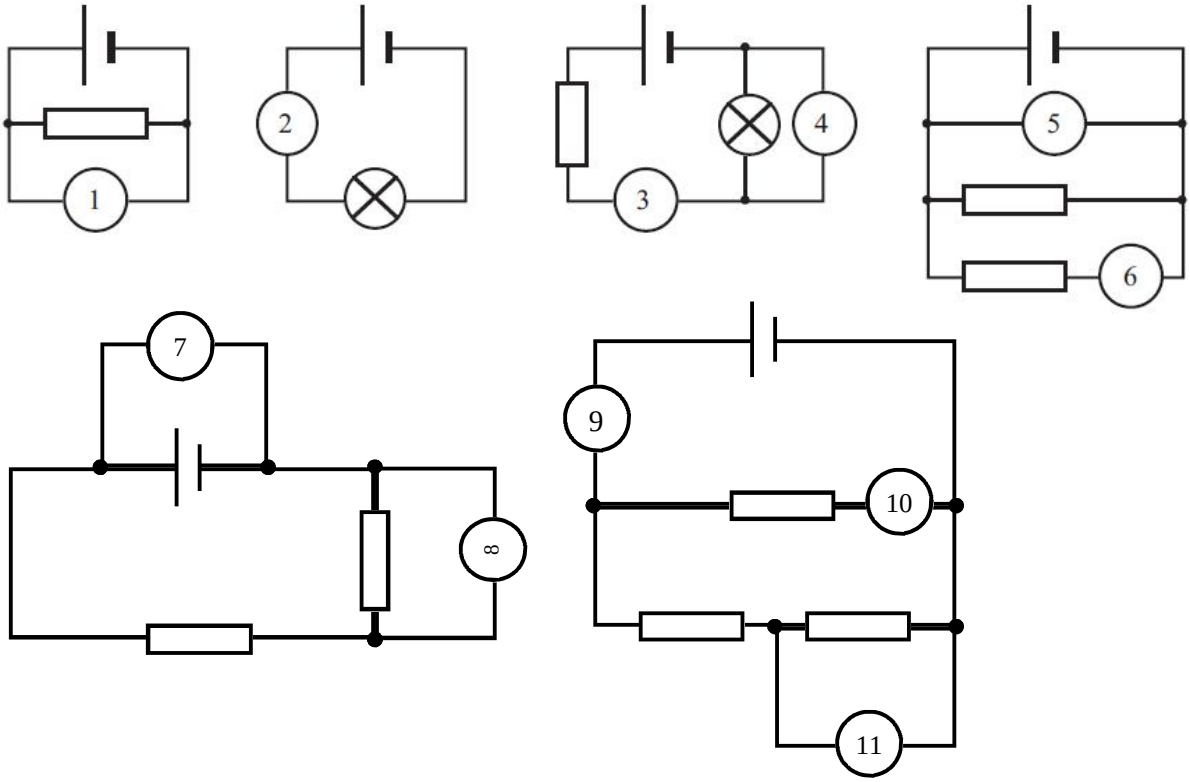


5. Electrical current is the movement of charges called electrons. What are the units of current ?

Self Check 10 : Meters

1. (a) What is meant by voltage ?
   (b) What are the units of voltage ?
   (c) What piece of apparatus would you use to measure voltage ?

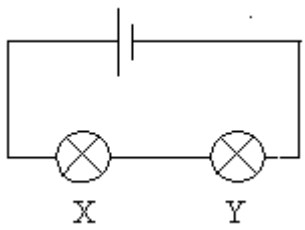
2. In the circuits below, identify the meters 1 to 11.

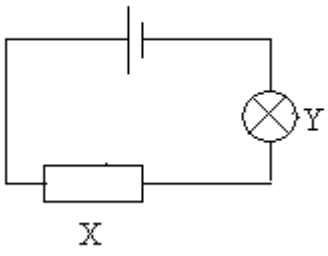


3. Redraw each of the following circuit diagrams to show how to measure :

   (a) the voltage across component X

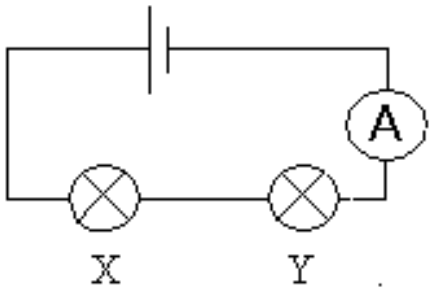
   (b) the current through component Y.





Self Check 11 : Series Circuits

1. Look at the circuit diagram below, X and Y are identical bulbs :



(a) What can you say about the brightness of the bulbs?

(b) What can you say about the current flowing through each of the bulbs?

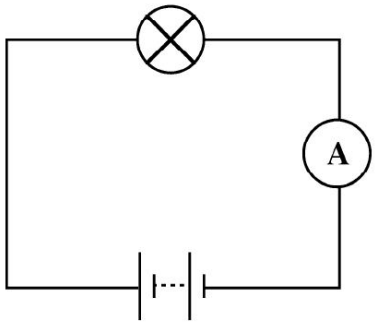
(c) How many paths are there for the current to take in this circuit?

(d) What name is given to this type of circuit ?

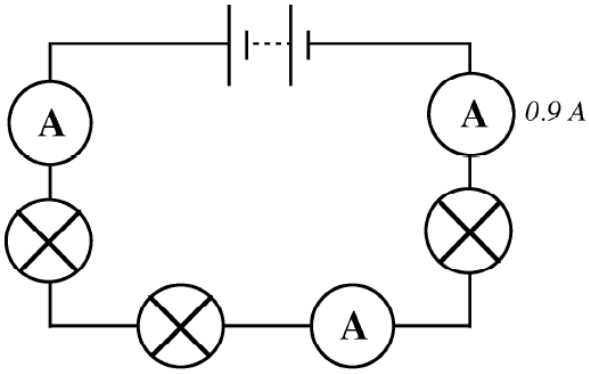
2. (a) In a series circuit is the current at the negative terminal of the supply greater than, less than or equal to the current at the positive terminal ?

   (b) What can you say about the current at all points in a series circuit ?

3. In the circuit below the ammeter reads 0.6 amperes.
   What is the current through the lamp?



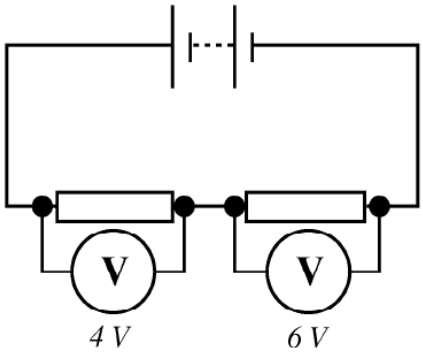
4. Redraw the circuit below and write the reading beside each ammeter symbol.



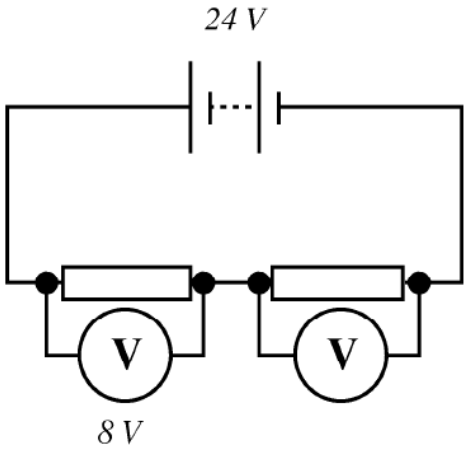
5. State the rule for voltage in a series circuit.

Self Check 11continued

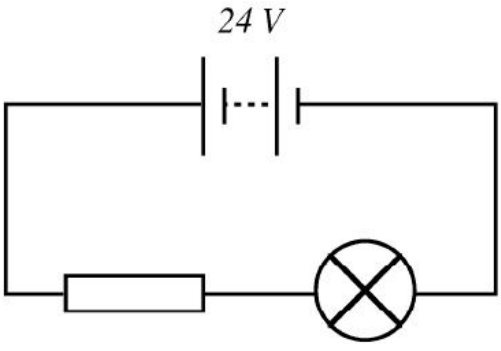
6. In the circuit below, the voltages are as shown. What is the voltage of the supply?



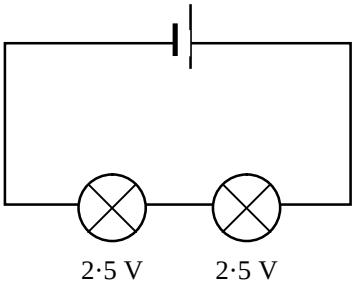
7. In the circuit below, the voltages are as shown. What is the voltage across the second resistor?



8. The diagram shows a 6 V bulb working correctly off a 24 V supply.
What must be the voltage across the resistor?



9. Two identical 2·5 V bulbs are connected to a supply as shown.
What is the voltage of the supply?

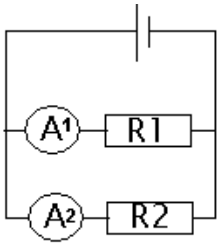


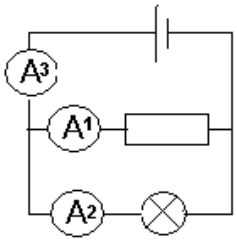
Self Check 12 : Parallel Circuits

1. Which of the following statements is/are true for **parallel** circuits.
   A There is only one pathway round the circuit.
   B There is more than one pathway around the circuit.
   C The potential differences around the circuit add up to the supply voltage.
   D The potential difference (voltage) is the same across all components.
   E The current is the same at all points in the circuit.
   F The current through each component adds up to the supply current.

2. In the circuit opposite, ammeter A_1 reads 0.2 A and A_2 reads 0.3 A.

   What is the supply current in the circuit ?



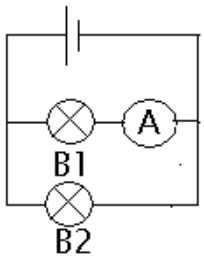


3. In the circuit, ammeter A_1 reads 0.2 A and A_3 reads 1.5 A.

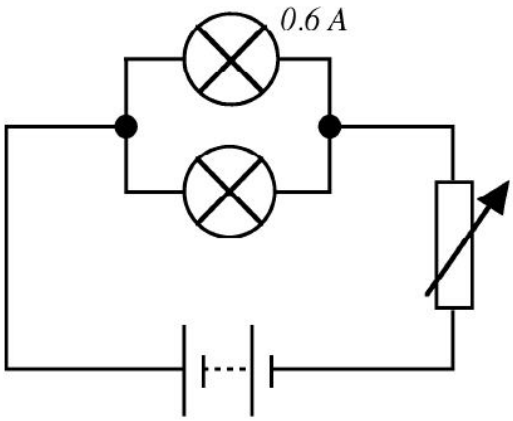
   What current passes through A_2 ?

4. In the circuit opposite, bulbs B1 and B2 are identical. The ammeter next to B1 reads 0.5 A.

   What is the current (i) flowing through bulb B2 ?
   (ii) at the supply ?

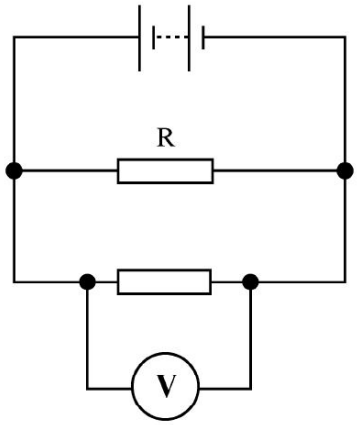


5. In the circuit below, the lamps are identical and the current through each lamp is 0.6 A. Redraw the circuit and mark beside each component the value of the current through it.

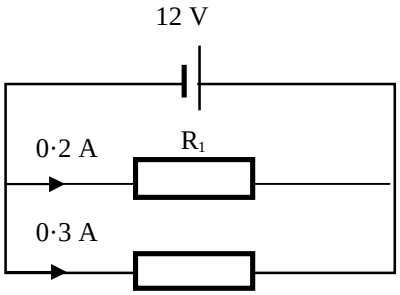


Self Check 12 continued

6. In the circuit below, the voltmeter reads 4 volts.
What is the voltage across the resistor R?



7. Two resistors are connected in parallel to a 12 V battery as shown below.



(a) What is the voltage across R1?

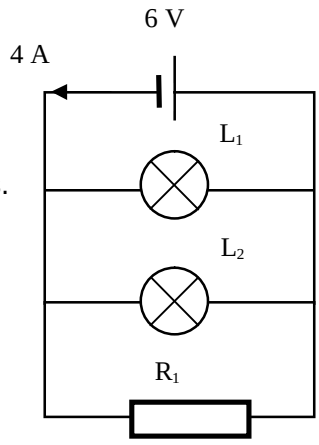
(b) What is the voltage across R2?

(c) What size of current is drawn from the battery?

8. Two identical bulbs and a resistor are connected in parallel to a 6 V supply as shown opposite.

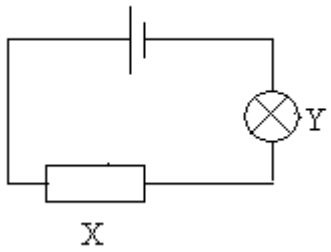
(a) What is the voltage across L_2 ?

(b) A current of 1·8 A flows through each of the bulbs.
What is the current flowing through the resistor?



Self Check 13 : Resistance

1. Resistor X is added to the circuit on the right.



   (a) What happens to the brightness of bulb Y when the resistor is added to the circuit?

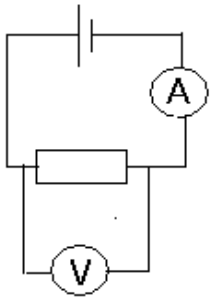
   (b) Explain the change in brightness of the bulb.

2. In a series circuit, the ammeter reading was noted for different values of resistor in the circuit.
   (a) Which electrical quantity does the ammeter measure?
   (b) Copy and complete the table below, placing the ammeter readings in the correct order.

0.6 A, 2.4 mA, 1.2 A, 0.24 A.

Resistor (Ω)	Current
5	
10	
20	
2.5 k	

3. The circuit below is set up to determine the value of the resistor.



   (a) What quantities are being measured in the circuit?

   (b) How are these quantities used to calculate resistance?

   (c) The ammeter reads 0.2 amperes and the voltmeter reads to 12 volts. What is the value of the resistor?

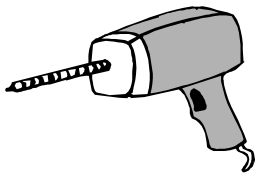
4. The heating element of a kettle is connected to a 230 volt supply. If the current in the element is 4 amperes, calculate the resistance of the element.

5. What size of resistance is in a circuit which has a supply of 12 volts and a current of 0.6 amperes?

6. A hairdryer connected to a 230 volt supply has a current of 5 amperes passing through it. What is the resistance of the hairdryer?

Self Check 13 continued

7. The current in a bulb was 2 A when connected to a 12 V battery. Calculate the resistance of the bulb.



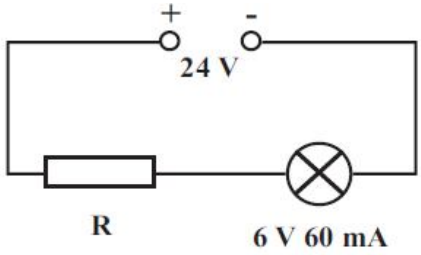
8. A power drill is operated at mains voltage and has a resistance of 1 500 Ω. Calculate the current through the drill.

9. A 20 Ω resistor is connected across a 2 V supply. What is the current in the resistor?

10. The maximum current an electric motor can safely handle is 0.01 A and it has a resistance of 360 W. Calculate its safe operating voltage.

11. A cooker draws a maximum current of 28·75 A and has a resistance of 8 Ω. At what voltage should it operate?

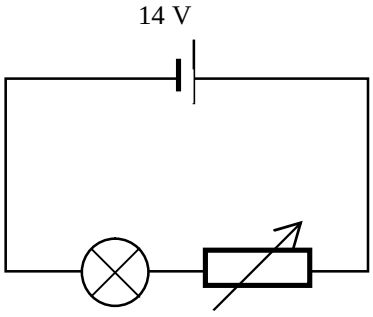
12. The diagram opposite shows a 6 V, 60 mA lamp working off a 24 V supply.



(a) What must be the potential difference across the resistor if the lamp is operating correctly?

(b) Calculate the value of resistor R.

13. A variable resistor is used as a dimmer switch in a simple series circuit as shown. The variable resistor is adjusted until the bulb is shining brightly. The voltage across the bulb is 13·8 V and the current through the variable resistor at this setting is 1·7 A.



(a) Calculate the voltage across the variable resistor.

(b) What is the current flowing in the bulb?

(c) Calculate the resistance of the variable resistor.

Self Check 14 : Input Devices

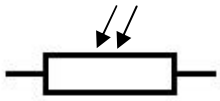
1. What is the energy change in the following input devices ?
   (a) themocouple
   (b) microphone
   (c) solar cell

2. What is sensed by the following input devices ?
   (a) thermistor
   (b) LDR

3. Copy and identify the following symbols.

(a)

(b)



(c)

(d)

4. The table below shows the results of an experiment involving a LDR.

Light Level (Units)	Resistance (Ω)
2.5	1800
5	800
10	500
20	400

   (a) Draw a line graph of resistance against light level.
   (b) State how the resistance of a light dependent resistor (LDR) changes with light level.
   (c) Use your graph to estimate the resistance when the light level is 15 units.

5. For each application listed below identify the most suitable input device.
   (a) a light meter for a camera
   (b) a karaoke machine
   (c) a temperature control for an aquarium
   (d) a circuit that turns on street lights automatically when it is dark
   (e) a thermometer that measures the temperature of a furnace

Self Check 15 : Output Devices

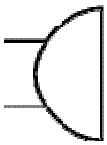
1. What is the energy change in the following output devices ?
   (a) loudspeaker
   (b) bulb
   (c) solenoid

2. Copy and identify the following symbols.

(a)

(b)

(c)



(d)

3. For each application listed below identify the most suitable output device.

   (a) A baby alarm.

   (b) A doorbell indicator for the deaf.

   (c) A standby indicator on a computer.

   (d) A smoke alarm.

   (e) A central locking system in a car.

4. Some electronic devices are listed below:

Microphone	Motor	Switch	Thermistor
Loudspeaker	Lamp	LED	LDR

Copy and complete the table below by putting each device in the correct column.

Input Device	*Output Device*

Self Check 16 : Logic Gates

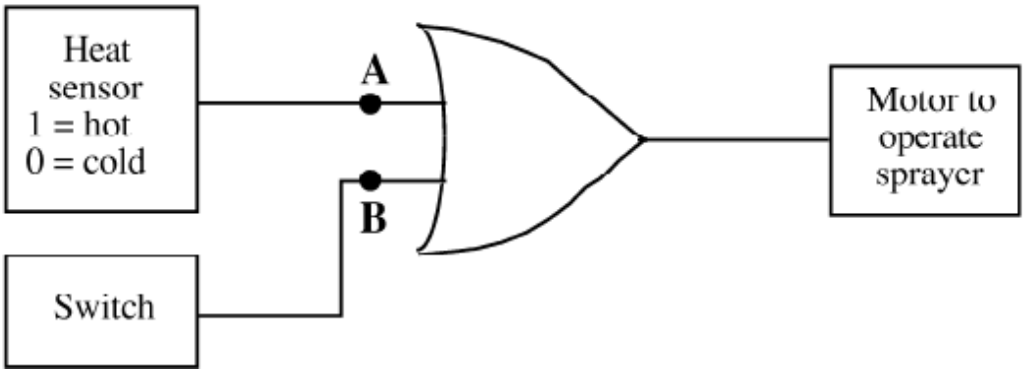
1. Draw the symbol for the following logic gates:
   (a) NOT gate
   (b) AND gate
   (c) OR gate.

2. The following is a truth table for a logic gate.

Input	Output
0	1
1	0

   (a) Name the logic gate.
   (b) Explain in terms of voltage levels, what is meant by the “1”s and “0”s.

3. The system below is designed to allow water to be sprayed on to plants if the air becomes too hot or the gardener switches the sprayer on.



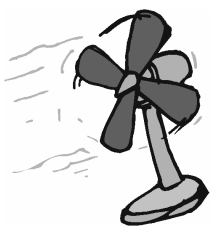
   (a) Identify the logic gate used in the system.
   (b) The gardener switches the sprayer on. What is the logic level at B?
   (c) What input device could be used as the heat sensor?

4. Mr Smith wants to design an electric fan that will come on when it gets too warm or when he switches it on.

   (a) Suggest the two input devices that he should use for this system.

   (b) Suggest a possible output device.

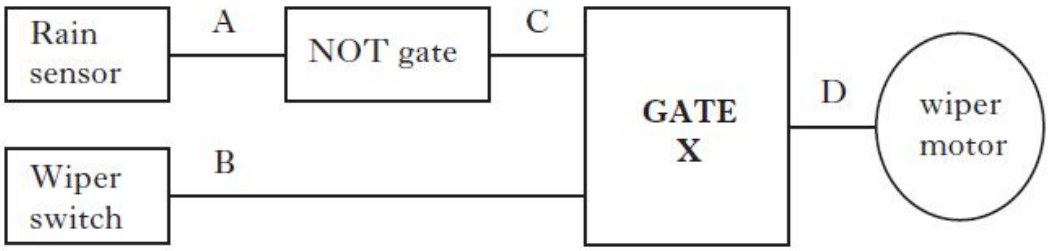
   (c) What logic gate should Mr Smith use? Explain your answer.



Self Check 16 continued

5. Some cars have “smart windscreen wipers” that operate whenever rain lands on the windscreen.

An electronic system diagram for the “smart wipers” is shown.



The wipers switch must be on for the “smart wipers” to work.

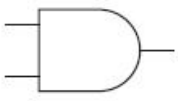
The sensor outputs logic 1 when there is no rain and logic 0 when rain lands on the windscreen.

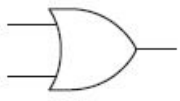
(a) Identify gate X.

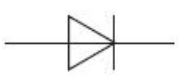
(b) Copy and complete the table to show the logic levels at C and D.

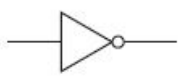
A	B	C	D
0	0		
0	1		
1	0		
1	1		

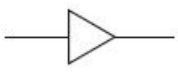
6. Which of the following is the symbol for a NOT gate?

A 

B 

C 

D 

E 

Self Check 17 : Pressure

1. What is the meaning of the term ‘pressure’ in terms of force and area?

2. What are the units of pressure?

3. Find the pressure exerted in each of the following cases;

   (a) a force of 240 N acting on an area of 4.0 m^2.
   (b) a force of 500 kN acting on an area of 1.25 m^2.
   (c) a force of 125 N acting on an area measuring 40 cm by 25 cm.
   (d) a force of 64 N acting on an area 16 m^2.

4. Explain why the use of large tyres helps prevent a tractor from sinking into soft ground.

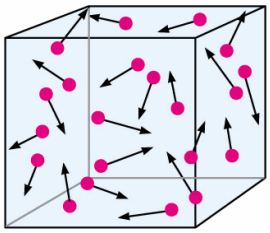
5. What is the purpose of snow shoes?

6. By measuring your weight and the area of your feet, calculate the pressure that you exert on the floor when:
   (a) You are standing normally.
   (b) You are standing on one foot.

7. Are you more likely to fall through an icy lake if you are on your tip toes or lying flat on your back with your arms and legs stretched out? Explain your answer.

Self Check 18 : Kinetic Theory

1. What is kinetic energy?



2. Name five objects which have kinetic energy.

3. Gas particles in the air have kinetic energy.

   (a) What causes the particles to move with greater kinetic energy?
   (b) How do particles with greater kinetic energy move?

4. Air pressure is produced by air particles bouncing off a surface.

   (a) What causes air pressure inside an inflated balloon?

   (b) What is greater the air pressure inside the balloon or outside?

   (c) How would you increase air pressure inside the balloon?

   (d) How would you decrease air pressure in a balloon?

5. A boy goes on a long bicycle ride. Why does the pressure of the tyres of his bicycle increase?

6. A motorist checks the air pressure of his car tyres before a long journey.

   (a) If he checks them again after the journey, how would the pressure compare with pressure before?

   (b) Explain what causes the change in tyre pressure.

7. Why are aeroplanes designed to withstand changes in air pressure?

Self Check 19

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