Name: Form:

MYP 2
Year 8

Energy Production and Climate Change

Statement of Inquiry:	Exploring **changes** in the **environment** brought about by **energy** production and investigating the **consequences** on **humankind**.
Key Concept:	Change
Related Concepts:	Energy and Consequences

2022

8C MYP Command Terms

Term	Definition
Analyse	Break down in order to bring out the essential elements or structure. To identify parts and relationships, and to interpret information to reach conclusions.
Apply	Use knowledge and understanding in response to a given situation or real circumstances
Describe	Give a detailed account or picture of a situation, event, pattern or process
Design	Produce a plan, simulation or model
Discuss	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence
Document	Credit sources of information used by referencing (or citing), following one recognized referencing system. References should be included in the text and also at the end of the piece of work in a reference list or bibliography
Evaluate	Make an appraisal by weighing up the strengths and limitations
Explain	Give a detailed account
Formulate	Express precisely and systematically the relevant concept(s) or argument(s)
Interpret	Use knowledge and understanding to recognize trends and draw conclusions from given information
Outline	Give a brief account
Present	Offer for display, observation, examination or consideration
Recall	Remember or recognize from prior learning experiences
Select	Choose from a list or group
Solve	Obtain the answer(s) using appropriate methods
State	Give a specific name, value or other brief answer without explanation or calculation
Suggest	Propose a solution, hypothesis or other possible answer
Summarize	Abstract a general theme or major point(s)

Glossary: Energy Production & Climate Change

Word	Meaning
atomic energy	Another name for nuclear energy.
cell	It contains a store of chemical energy that can produce electricity (the scientific name for a battery).
chemical energy	The kind of energy stored in chemicals. Food, fuel and cells (batteries) all contain chemical energy.
electrical energy	The kind of energy carried by electricity.
energy flow diagram (Sankey)	A way of showing energy changes as a flow chart.
gravitational	The kind of energy stored by anything that can fall down.
heat energy	The hotter something is the more heat energy it has.
joule (J)	The unit for measuring energy.
kilojoule (kJ)	There are 1000 joules (J) in 1 kilojoule (kJ).
kinetic energy	The kind of energy in moving things.
light energy	The kind of energy given out by light bulbs, candles, etc.
machine	Something that changes energy from one form to another.
nuclear energy	Energy stored inside atoms.
potential energy	The scientific word for ‘stored’ energy.
sound energy	The kind of energy that is made by anything that is making a noise.
strain energy	The kind of energy stored in stretched or squashed things which can change back to their original shapes.
transfer	When energy is changed from one form into another we say it is transferred.
coal	A fossil fuel formed from the remains of plants and trees.
fossil fuels	Coal, oil and natural gas – all fuels that were formed over millions of years from the remains of dead plants and animals.
oil	Fossil fuel formed from the remains of dead animals that lived in the sea.
natural gas	Fossil fuel formed from the remains of animals that lived in the sea.
non-renewable energy resource	Any energy resource that will run out and we cannot renew our supplies of it (e.g. oil).
solar panels	Flat plates that use the Sun's energy to heat water.

Word	Meaning
Non-renewable energy resource	An energy resource that is NOT easily replaced and will run out (e.g. oil).
hydroelectric power	Making electricity by letting falling water (usually from a reservoir) turn turbines and generators.
geothermal power	Making electricity using heat from hot rocks underground.
biomass	Any fuel that comes from plants, animals, or their wastes (e.g. wood, methane from rotting plants, etc.).
solar cells	Flat plates that convert light energy into electrical energy.
wind turbine	A kind of windmill that generates electricity using energy from the wind.
turbine	The machine in a power station that is pushed round by water or steam and turns the generator.
nuclear power	Making electricity by using the nuclear energy stored inside uranium.
tidal power	Making electricity using the moving (kinetic) energy from the tides.
conduction	The way heat travels through solids.
insulator	A material which does not let energy flow through it easily.
absorb	To take in energy.
convection	The transfer of heat in fluids.
convection current	A current created by heat causing changes in the density of a fluid.
emit	To give out (radiate) energy.
infrared radiation	A type of wave in the electromagnetic spectrum. It can travel through transparent things and a vacuum (empty space).
medium	Any substance (that a wave is travelling through).
transfer	When energy is changed from one form into another we say it is transferred.
ammeter	Measures how much electricity is flowing around a circuit.
current	The flow of electrons around a circuit.
in parallel	When the current divides, a part going through each component, then joins up to complete the circuit.
voltage	A measure of how much energy is transferred by electricity.
voltmeter	A component that measures voltage.
volt (V)	The unit for voltage.
rechargeable resource	Cells that can have more energy stored in them after they have been used are said to be rechargeable.

8P 1a Energy – What I already know!

Please answer the questions below. If you are not sure of the answer just do your best and write what you think you know about the question. You will keep this questionnaire and it will help you see how much you have learnt over this topic.

Question	Answer at the start of the energy topic	Answer at the end of the energy topic
How would you describe the term energy?		
List as many types of energy as you can think of.		
What is electricity?		
What does the term conduction mean?		

What are fossil fuels?		
What are renewable and non-renewable resources?		
What is climate change?		

8P 1b Introduction to Energy Types

Introduction:

- **ENERGY** is

_____

_____

_____

- The unit for energy is

_____

- There are **nine types of energy**.

List the nine types of energy below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

- These different types of energy can be categorized into two main forms:
    - **Kinetic** energy – 'movement' energy ('energies in action')
    - **Potential** energy – 'stored' energy

Can you identify and highlight the types of energy that fall under the **kinetic energy** category and also the ones that fall under the **potential energy** category in your list?

What **type(s) of energy** does the following have?

1. Moving car
2. Battery
3. Diver at the top of the cliff
4. A torch switched on
5. Stretched spring
6. Fire
7. Loudspeaker playing music
8. Nuclear power plant
9. Book on the edge of a table
10. Wind turbine

For each type of energy, can you think of your own example(s)? Write them down below.

8P 2a Energy Circus

Law of Conservation of Energy

In 1842, Julius Robert Mayer discovered the Law of Conservation of Energy.

This important law states that **energy can be transferred from one type to another, but it can never be made or destroyed.**

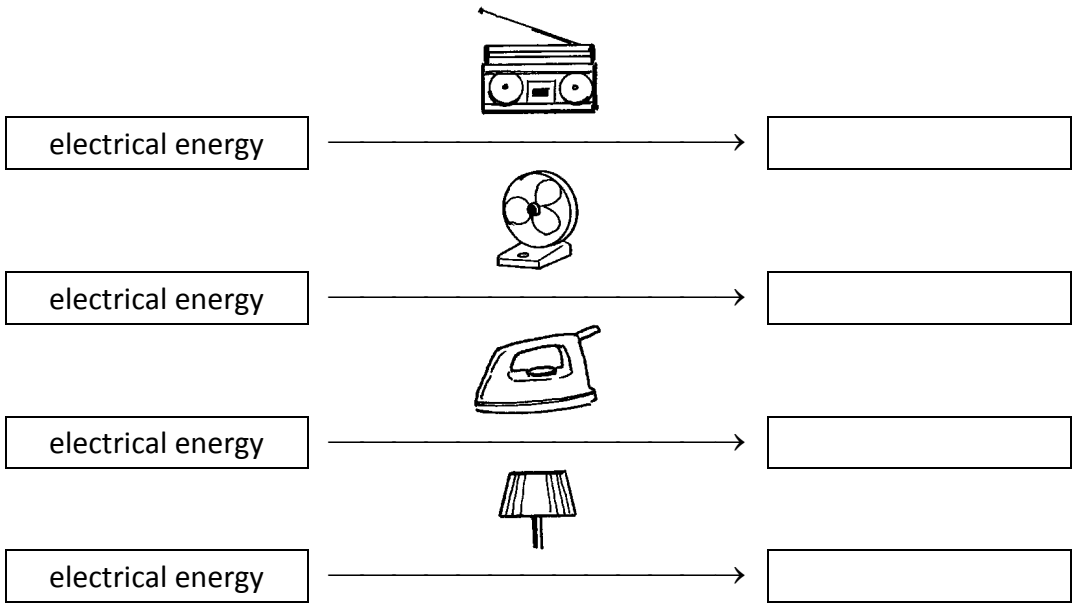
So this means that the total amount of energy in the Universe stays the same!

Energy Transfers

We can write energy flow diagrams to show the energy transfers that occur in objects and also in given situations. For instance,

- Objects:

The pictures below show some objects that need electrical energy to work.
Write the useful energy each object produces in the boxes.



Notice that the electrical energy is transferred to a different type of energy. The transfer of energy or flow of energy is illustrated by the arrow.

- Situation:

When a car brakes…

Chemical ⟶ Kinetic ⟶ Heat/thermal

When a rocket launches…

Chemical ⟶ Kinetic + Sound + Heat ⟶ Gravitational

Practical - Energy Circus

In this practical, you have about 3 mins to think and write down the **energy transfer(s)** for each of the stations set up around the lab. Please write down the energy transfers below.

1) Solar Cell powered light or fan

2) Pendulum set up and/or yoyo

3) Wind-up toy.

4) "Bungee sheep" or similar.

5) Electric bell

6) Electric light

7) Simple pendulum

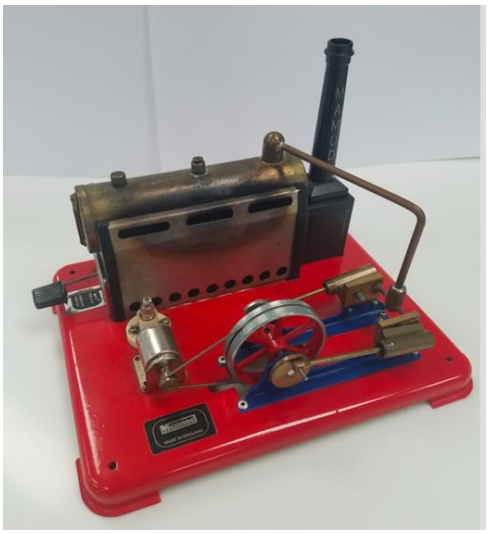
8) Water turbine powering a LED

9) Signal Generator and Speaker

10) Hairdryer

8P 2b Energy Circus

Teacher Demo – Steam Engine



What are the energy transfers for this steam engine?

_____

_____

_____

_____

_____

_____

Sankey Diagram

- We can represent **energy transfers** in a Sankey diagram.

- A Sankey diagram shows:
    - **energy input**
    - **useful output**
    - **energy wasted (non-useful)**.

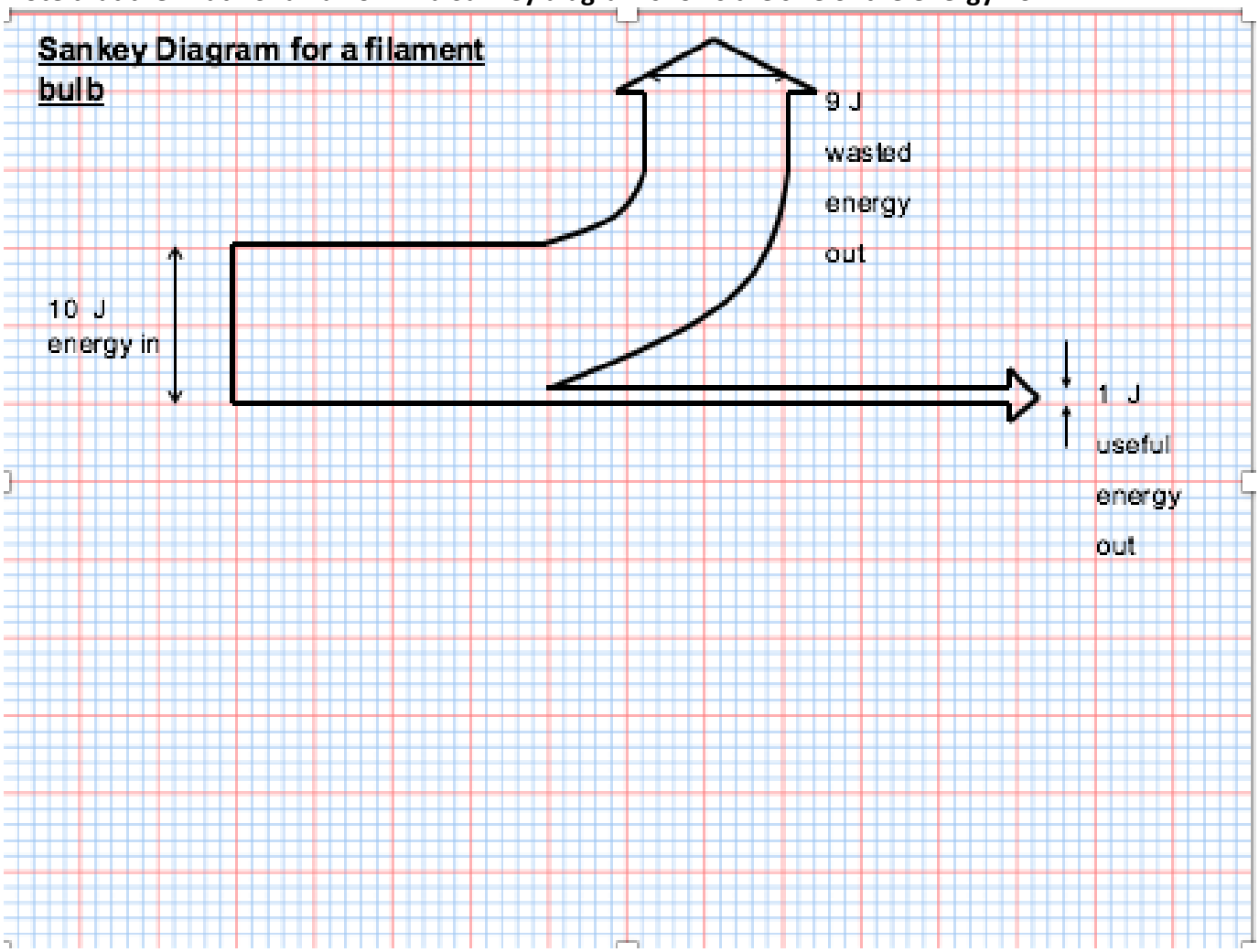
It's called a Sankey diagram as it was named after the engineer Captain Henry Sankey. He created a diagram showing energy flow in a real steam engine compared to a 'perfect' engine in 1898.

Example: A **filament bulb** transfers electrical energy into heat and light energy.

What is useful energy in this example?

What is wasted energy in this example?

Note that the width of an arrow in a Sankey diagram shows the size of the energy flow.



Use the squares on the previous page to help you draw a Sankey diagram for an **energy efficient bulb**, which has the following:

- Energy input 10J
- Wasted energy 6J
- Useful energy 4J

Calculate the efficiency for the filament bulb and the energy efficient bulb using:

$$\text{Efficiency (\%)} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100$$

Extension

1. An energy efficient bulb transfers 40% of the energy as useful light energy.

    a. How much energy is transferred as heat?

    _____

    b. Draw a Sankey Diagram in the space below

Remember to label it with: INPUT ENERGY, USEFUL OUTPUT ENERGY, and WASTED OUTPUT ENERGY

2. A team of scientists test an "old banger" car. They find out that only 10% of the energy is transferred as kinetic energy (useful) and 70% is transferred as heat energy (wasted).

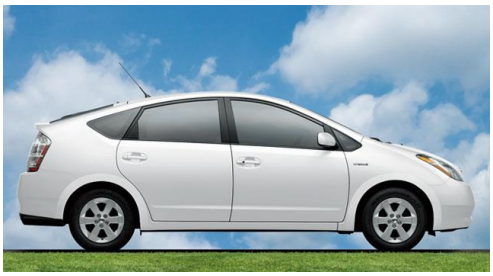
    a. How much energy is wasted as sound?

    _____

    b. Draw a Sankey Diagram in the space below

Label the arrows with input energy, useful output energy (kinetic), wasted output energy (heat), wasted output energy (sound)

3. A team of scientists test a brand new hybrid car. They find out that 40% of the energy is transferred as kinetic energy (useful) and 55% is transferred as heat energy (wasted).



   a. How much energy is wasted as sound?

      _____

   b. Draw a Sankey Diagram in the space below

Remember to label each of the arrows!!!

4. Explain why driving a newer car is 'greener' than driving a very old car.

……

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8P 3a Heat

Introduction:
Different types of energy can be converted into **thermal energy** (heat).

- **HEAT** can be transferred from one place to another.
- Heat always travels FROM hotter places/substances TO cooler places/substances.
- **Thermal or heat energy** is produced when an increase in temperature causes atoms and molecules to move faster and collide with each other.

Make a sketch of particles arranged in a solid, liquid and gas.

SOLID	LIQUID	GAS

Can you predict and sketch what the particles would look like when heated to a warm temperature? Use red and blue to represent hot and cold particles respectively.

SOLID	LIQUID	GAS



8P 3b Heat Transfer in Solids: Conduction

Introduction:
Heat transfer can happen by **conduction**. Conduction typically occurs in solids and it happens because of the vibration of atoms.

Materials which let heat travel along them are good conductors. Some materials are better conductors than others.

Practical: Conduction Experiment

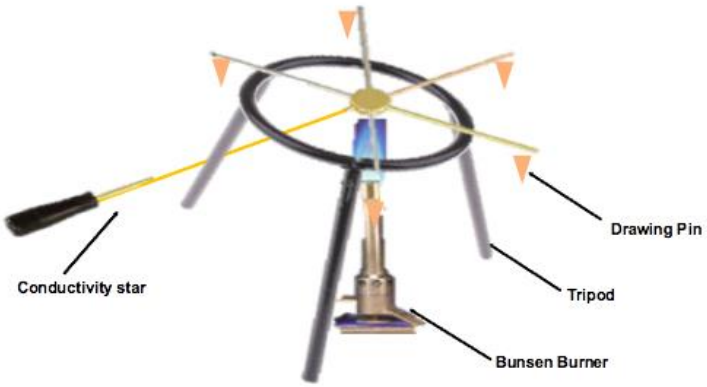
Your teacher will demonstrate this practical. You must record your results.

SAFETY:

- **You must wear SAFETY GLASSES and if you have long hair, please tie it back.**
- **The rods will get very hot! Let them cool down before you touch them.**

Apparatus:

- Bunsen burner
- Lighter
- Tripod stand
- Conductivity star (copper, aluminium, brass, steel and iron)
- Vaseline
- 5 drawing pins
- Stopwatch



Method

1. Place the conductivity star carefully onto the tripod stand.
1. Attach a drawing pin to the outer end of each metal using a small blob of Vaseline.
2. Heat the middle of the conductivity star with a blue Bunsen flame.
3. Record how long it takes for each metal to lose its drawing pin using the stopwatch.

Results

Metal	Time taken for the drawing pin to fall (seconds)
Copper	
Aluminium	
Brass	
Steel	
Iron	

Analysis

1. Explain why the drawing pin/ piece of metal falls.

_____

_____

_____

_____

_____

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_____

2. Rank the metals in order of conductivity.

_____

_____

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_____

_____

3. Explain why this experiment would not work if we used plastic or glass.

_____

_____

_____

_____

_____

8P 3c Heat Transfer in Liquids and Gases: Convection

Introduction:

Heat transfer can happen by **convection**. Convection can only happen in **fluids (liquids and gases)** because the molecules are free to move.

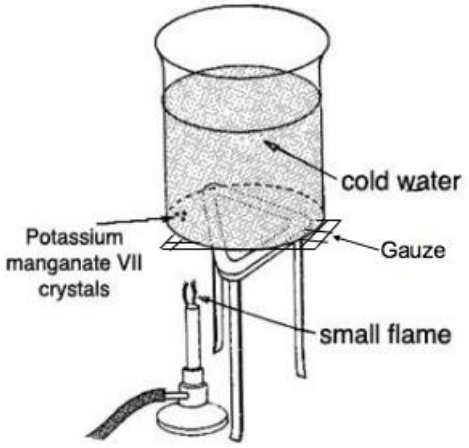
Practical: Convection current in a beaker

SAFETY:

- **You must wear SAFETY GLASSES and if you have long hair, please tie it back.**
- **Potassium permanganate, also known as potassium manganate VII, is harmful if swallowed. It also stains skin and will leave permanent stains on clothing. So please take extra care when handling this chemical.**

Apparatus

- Bunsen burner
- Lighter
- Tripod
- Gauze
- Beaker 600ml
- Glass tube
- Forceps
- Potassium permanganate crystals



Method

1. Fill a beaker with water.
2. As shown in the diagram, place the beaker of water on top of the gauze and tripod.
3. Then place a glass tube inside the beaker of water so that the end of the glass tube touches the inside corner of the beaker.
4. Using forceps, carefully place a potassium permanganate crystal through the glass tube so that the potassium permanganate crystal slides down to the corner of the beaker into the water.
5. Slowly remove the glass tube from the beaker. DO NOT TOUCH OR MOVE THE BEAKER!
6. Place the Bunsen burner directly underneath the crystal and heat it with a small flame.
7. Record your observations.

Observations

- Describe what you see.

_____

_____

_____

_____

_____

_____

_____

_____

_____

- Sketch what you see. Use arrows to depict the direction in which the fluid moves.

8P 3d Heat Transfer: Radiation

Research about heat transfer by radiation.

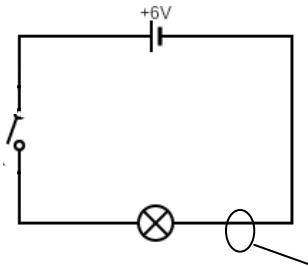
- *Questions to answer or think about:*

What is heat transfer by radiation mean?
What's the difference between this type of heat transfer compared with conduction and convection?
Can you give examples of heat transfer by radiation?

8P 4a Introduction to Electric Circuits

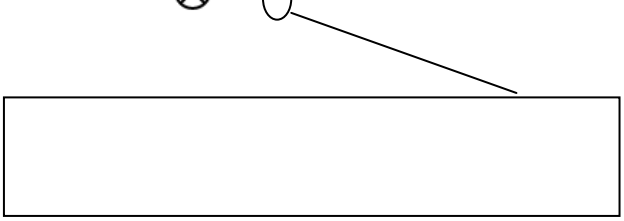
What is Electricity?

Here is a circuit diagram of a circuit containing a cell, switch and bulb:



Imagine you can see inside the wire. How does the electricity look as it flows through the wire?

Draw what you think the electricity looks like as it flows through the wire.



Enlarged View of Wire

Explain what you have drawn above. Try to reference some scientific concepts and ideas.

_____

_____

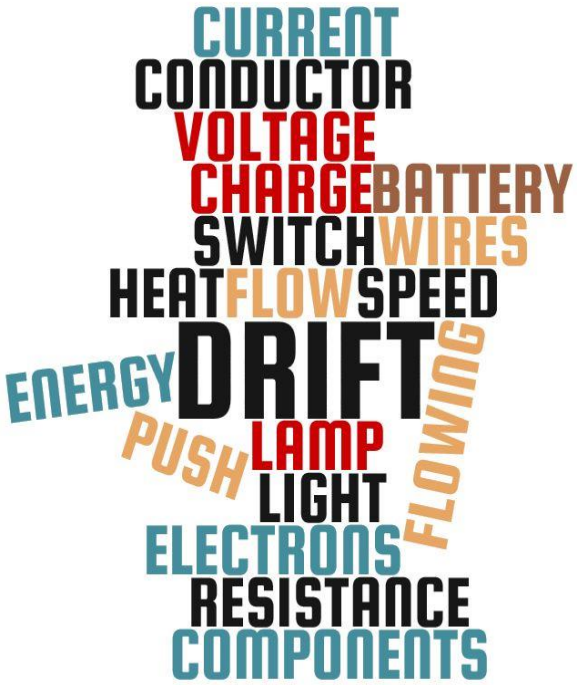
_____

_____

Modelling:

Your teacher will now show you a few ways to model the flow of electricity through a wire, and some simulations. Please add some notes and diagrams to describe them in the space below.

Here are some words that you may wish to include in your notes:



8P 4b Investigating Voltage and Current

Research Question:

To investigate the relationship between the current in a resistor and the voltage across it.

Hypothesis:

As the current in the resistor increases, the voltage across it will increase/decrease.

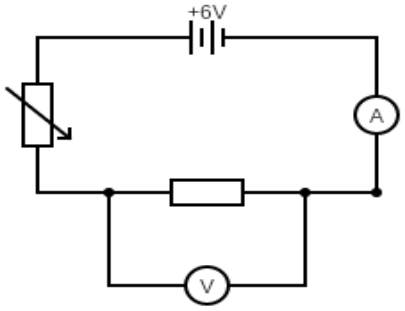
I think this because…

_____

_____

_____

Apparatus:



Method:

1. Set up the circuit as above.
2. Set the supply voltage to 6V by adjusting the dial on the power pack.
3. Set the current to the lowest value by adjusting the variable resistor. This can be identified by looking at the ammeter.
4. Measure the corresponding voltage by reading the voltmeter.
5. Repeat steps 3 and 4 for up to 7 values if the circuit setup allowed in increments of 0.1A.

Results:

Take initial current reading then take readings in increments of 0.1A and record in the following table.

Current (A)	Voltage 1 (V)	Voltage 2 (V)	Average Voltage (V)

Graph:

Construct a graph to show the relationship between the voltage across the resistor and the current in the resistor. This should be done on graph paper and the following *criteria addressed*:

- *Title of graph included*
- *Label on x and y axis with correct units*
- *Scales should be appropriate. Equal divisions and occupy minimum 2/3 to ¾ of axis*
- *Points plots accurately*
- *Add a curve/straight line of best fit*

Conclusion:

1. What is the relationship between the current in a resistor and the voltage across it?

_____

_____

2. Does your conclusion agree with your hypothesis? If it does not, try to suggest reasons why.

_____

_____

3. Explain your conclusion using scientific principles and ideas.

_____

_____

_____

_____

Evaluation:

1. Suggest ways in which the accuracy, precision and reliability of the experiment can be improved.

_____

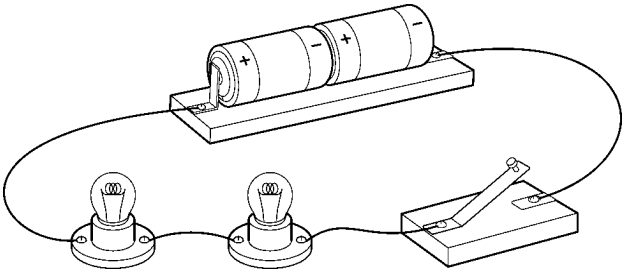
_____

_____

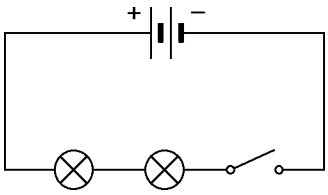
_____

_____

8P 4c Circuit Diagrams



This is a circuit.

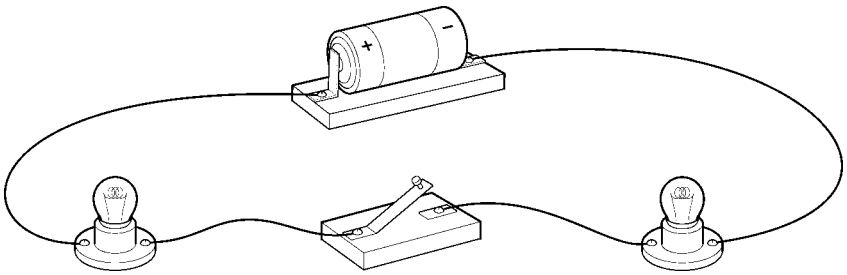


And this is the circuit diagram.

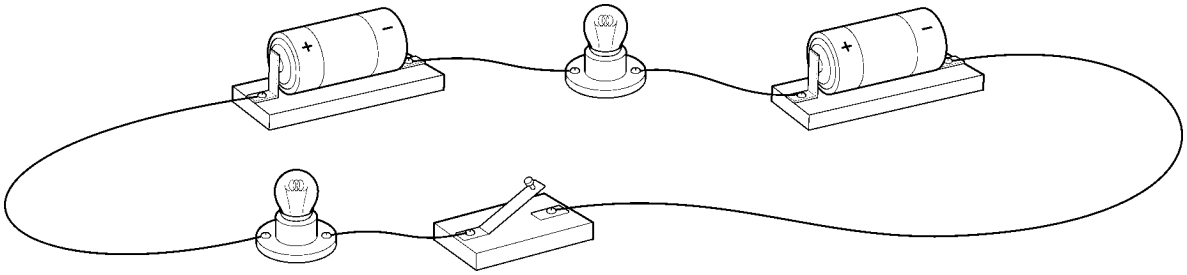
1 Make a neat copy of the circuit diagram above.

2 Draw circuit diagrams for these circuits. Make sure that you show the cells the right way around.

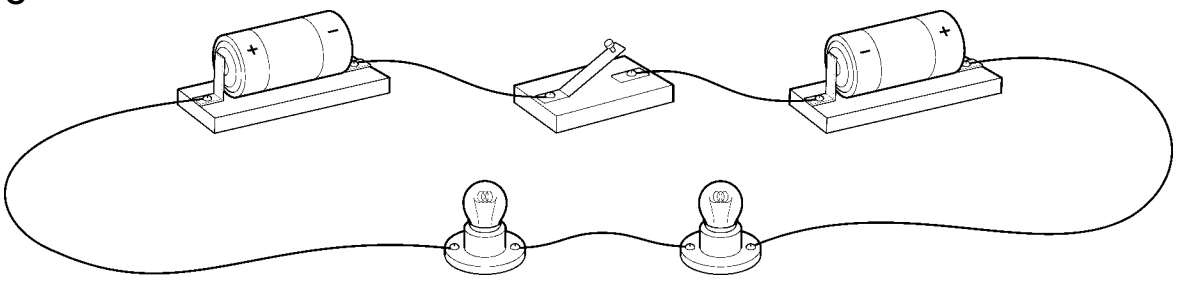
A



B



C



3 What is wrong with the cells in circuit **C**?

8P 5a Series and Parallel Circuits

Introduction:

There are 2 main types of electric circuit:

1. Series
2. Parallel

You teacher will show you an example of each type of circuit and simulation. Draw the circuit diagram for each type of circuit in the space below.

SERIES **PARALLEL**

Describe the difference between a series and parallel circuit. Include diagrams if it helps.

_____

_____

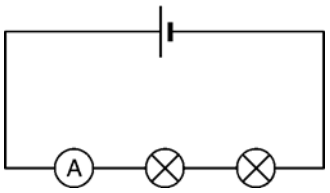
_____

8P 5b Current in Series Circuits

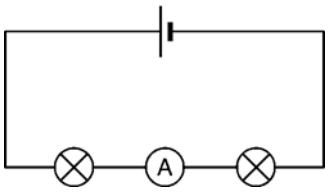
Apparatus:
Cells, Bulbs, Ammeter, Connecting wires

Method:

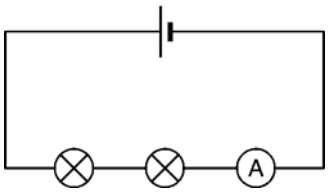
1. Build this circuit. Show it to your teacher before you switch on. Write down the reading on the ammeter.



2. Now build this circuit. Write down the reading on the ammeter.



3. Build this circuit and write down the ammeter reading.



4. Now attach another cell into your circuit. Write down the new current value. Does the current increase or decrease? What happens to the brightness of the bulbs?

5. Finally attach a third bulb in series. Write down the current. Does adding an extra bulb increase or decrease the current? What does this do to the brightness of the bulbs?

Conclusion:

1. What did you find out about the current in a series circuit?

_____

_____

2. What effect does increasing the number of cells have on the current? Try to explain this.

_____

_____

3. What effect does increasing the number of bulbs have on the current? Try to explain.

_____

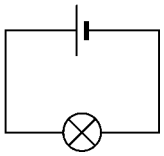
_____

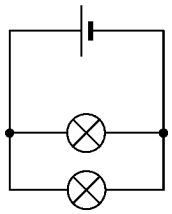
8P 5c Current in Series and Parallel

Apparatus:
Cells, Bulbs, Ammeter, Connecting wires

A. Bright Bulbs:

1. Build a simple series circuit below. Add an extra cell. Then add an extra bulb.
2. Build the simple parallel circuit below. Add an extra cell. Add an extra bulb in parallel.





Conclusions:

1. What happens to the brightness of bulbs in either circuit if you add more cells?

   _____

2. What happens to the brightness of the bulbs in a **series** circuit if you add more bulbs?

   _____

3. What happens to the brightness of the bulbs in a **parallel** circuit if you add more bulbs?

   _____

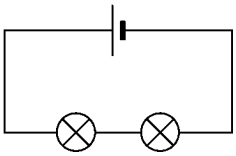
4. Can you explain why you think this happens?

   _____

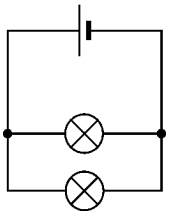
   _____

   _____

B. Missing Bulbs



This is a series circuit. If I take out one bulb it leaves a gap in the circuit. The other bulb _____ (goes off/stays on).



This is a parallel circuit. If I take out one bulb the other bulb _____ (goes off/stays on). There is still a complete circuit for the current to flow around through the other bulb.

Conclusion:

Which circuit is more useful and why?

_____

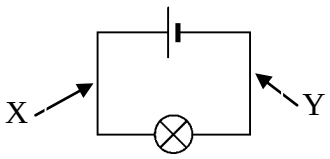
_____

_____

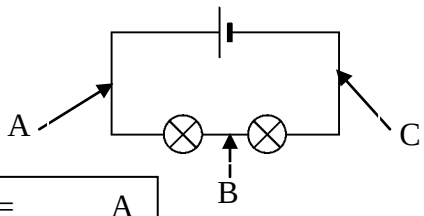
_____

C. Current in Series

Use an ammeter to measure the current in each of these circuits.



Current X = _____ A, Current Y = _____ A



Current A = _____ A

Current B = _____ A

Current C = _____A

If you have time, put and extra cell into your series circuit and measure the current in positions A, B and C.

Conclusions:

1. What is the circuit symbol for an ammeter?
2. What unit is current measured in?
3. What do you notice about the **current** in all parts of a series circuit?

_____

4. What happens to the size of the current if more cells are added to the circuit?

_____

5. What happens to the size of the current if more bulbs are added?

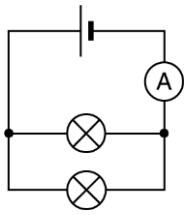
_____

Extension: Can you explain any of this?

D. Current in Parallel

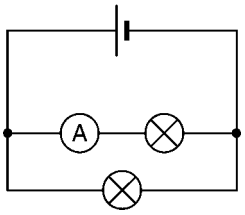
Construct these parallel circuits and measure the current in the positions indicated.

A



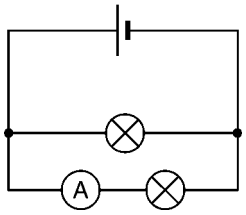
Current = _____ amps

B



Current = _____ amps

C



Current = _____ amps

Current A = _____ A	Current B = _____ A	Current C = _____ A

If you have time, add an extra cell to your circuit and measure the currents again.

If you have further time, add an extra bulb in parallel and measure the currents again. This time you will need to make a fourth measurement Current D.

Conclusions:

1. In a parallel circuit, what is the relationship between the current in the branches and the current in the main circuit?

_____

_____

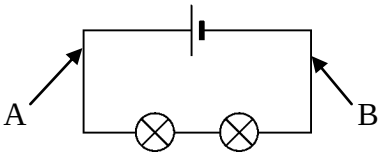
2. How does this help explain how we think current works in a parallel circuit?

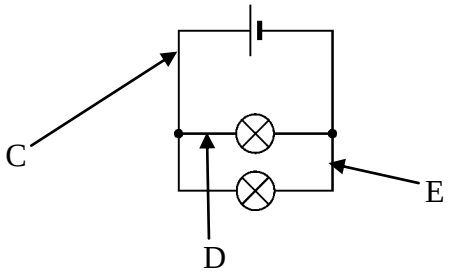
_____

_____

_____

E. Switches in Series and Parallel circuits





Put some switches into the various positions shown in these series and parallel circuits.

Conclusion:

What happens when the switch is closed in a series circuit? In a parallel circuit, explain why the position of the switch is important?

_____

_____

_____

Extension:

If you were wiring the lights in a house, would you use a series or parallel circuit? Why?

_____

_____

_____

Describe some advantages and disadvantages of series compared to parallel circuits.

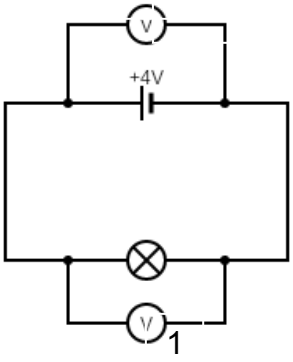
8P 5d Voltage in Series and Parallel Circuits

Apparatus:
Cells, Bulbs, Voltmeter, Connecting wires

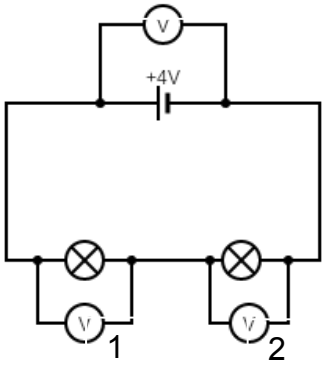
A. Voltage in Series

Build the following circuits. Connect the voltmeter across each component in turn and record the voltage.

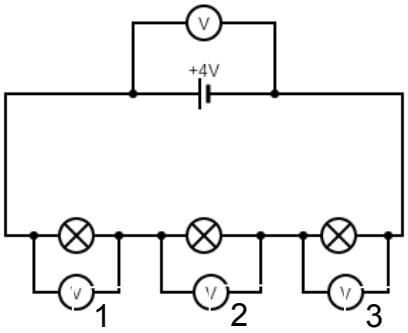
Circuit 1



Circuit 2



Circuit 3



Results:

Circuit	Cell Voltage (V)	Lamp 1 Voltage (V)	Lamp 2 Voltage (V)	Lamp 3 Voltage (V)
1				
2				
3				

Put an extra cell into your series circuit and measure the voltage across each. You will have to draw another table.

Conclusions:

1. What is the circuit symbol for a voltmeter?
2. What unit is voltage measured in?
3. What do you notice about the **voltage** across the cell and each of the components in the circuit?

4. What happens to the voltage across each component if more cells are added to the circuit?

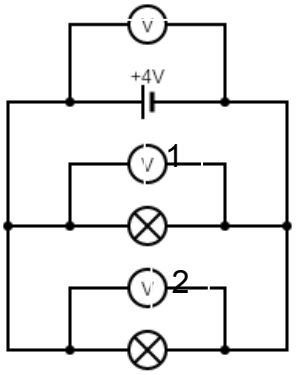
5. What happens to the voltage across each component if more bulbs are added?

_____

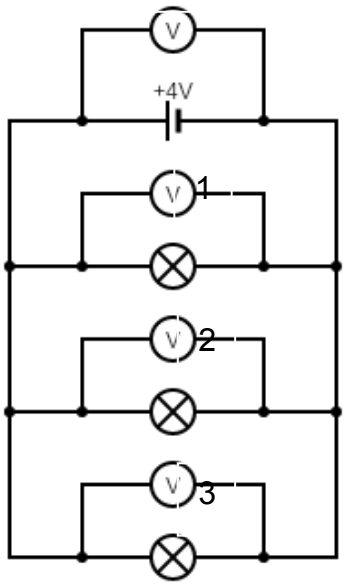
A. Voltage in Parallel

Build the following circuits. Connect the voltmeter across each component in turn and record the voltage.

Circuit 1



Circuit 2



Circuit	Cell Voltage (V)	Lamp 1 Voltage (V)	Lamp 2 Voltage (V)	Lamp 3 Voltage (V)
1				
2				

If you have time, add an extra cell to your circuit and measure the voltages again. You will have to draw another table.

Conclusion:

In a parallel circuit, what is the relationship between the voltage across each 'branch' and the voltage across the in the cell?

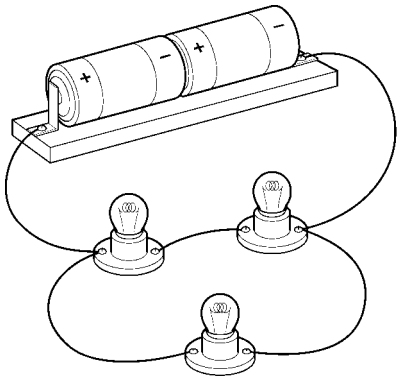
_____

_____

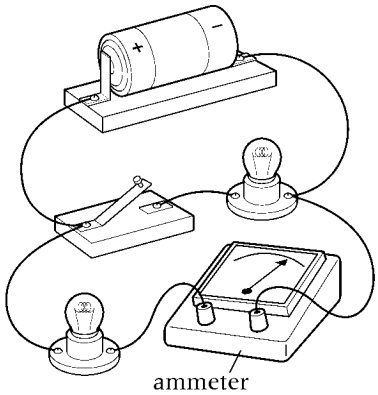
8P 5e - Review Circuit Diagrams and Current (optional)

1 Draw neat circuit diagrams to show these circuits in the space below.

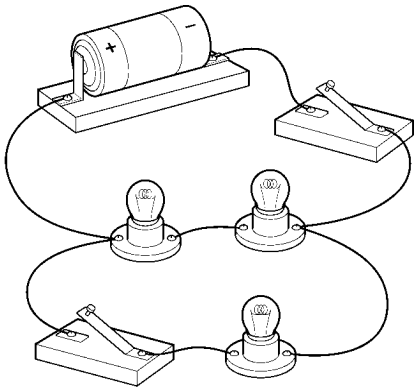
A



B

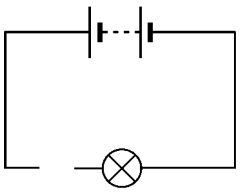


C

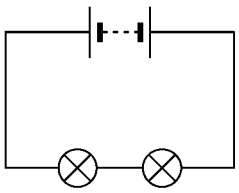


2 There is something wrong in each of these circuits. Write down what is wrong with each one.

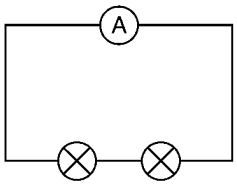
D



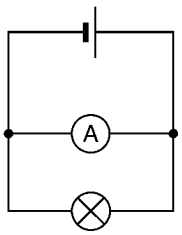
E



F

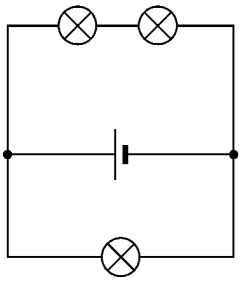


G

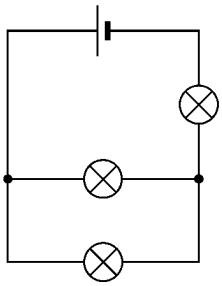


3 Which circuit is the odd one out? Explain your answer. (Tip: Redraw the circuits a different way)

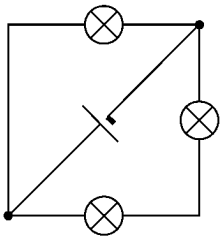
H



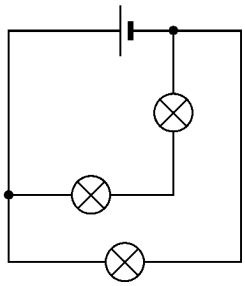
I



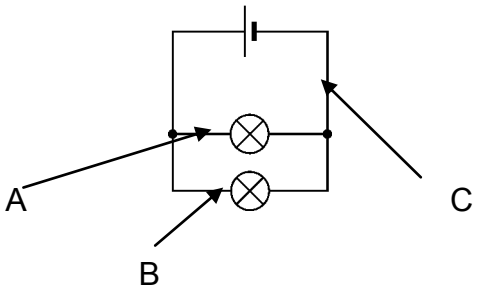
J



K



4.



If current A = 0.75 Amps and current B = 0.5 Amps, what should current C measure?

8P 5f - Voltage and Current in Series and Parallel - Problems

Key Points:

Series Circuits:

- The supply voltage **divides** between the components in the circuit.
- The current is the **same** everywhere in the circuit.

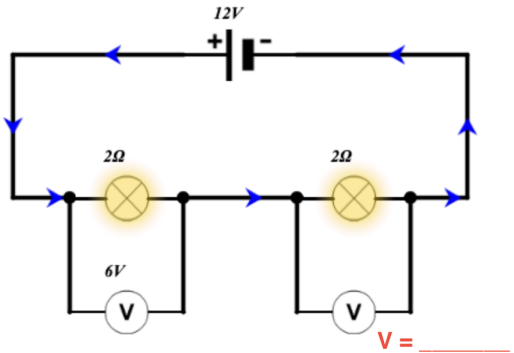
Parallel Circuits:

- The voltage across each branch is the **same** as the supply voltage.
- The current **divides** at each junction.

Example Problems:

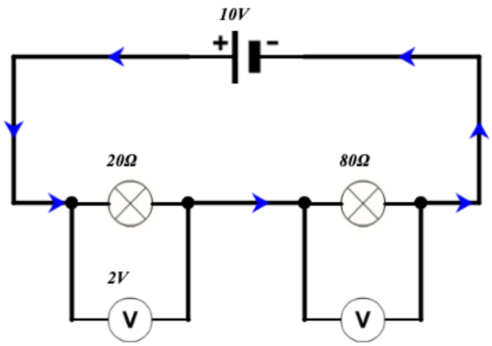
1. Find the unknown voltage for each circuit:

a.



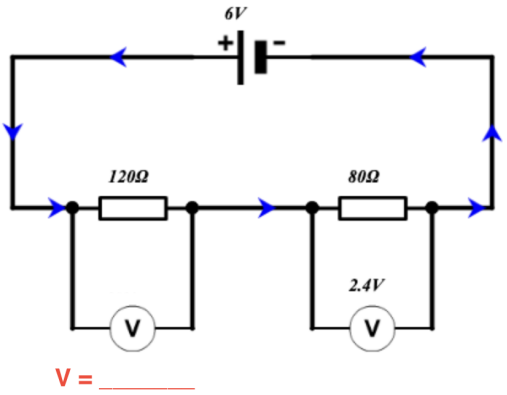
V = _____

b.

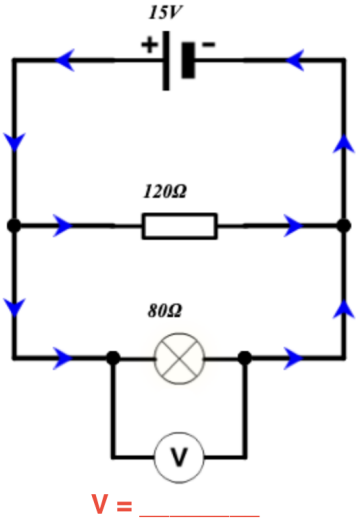


V = _____

c.

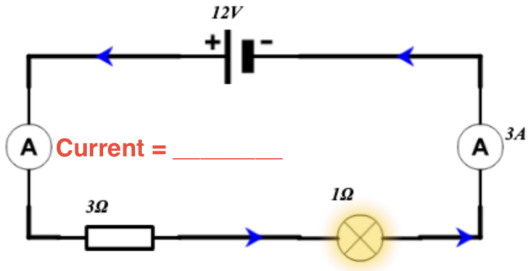


d.

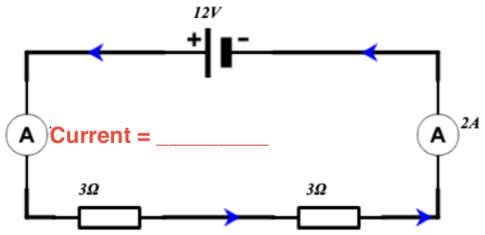


2. Find the unknown current values in each circuit:

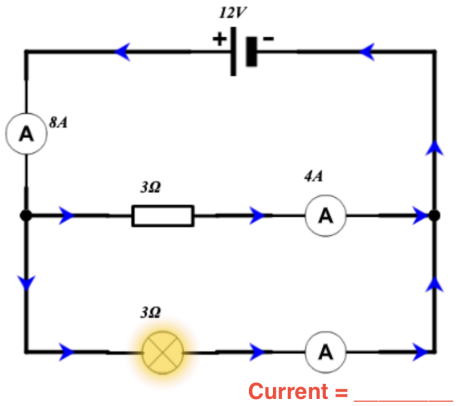
a.



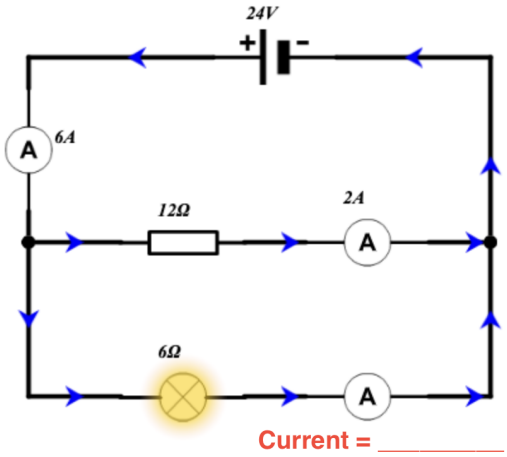
b.


12V
A
Current = _____
A
2A
3Ω
3Ω

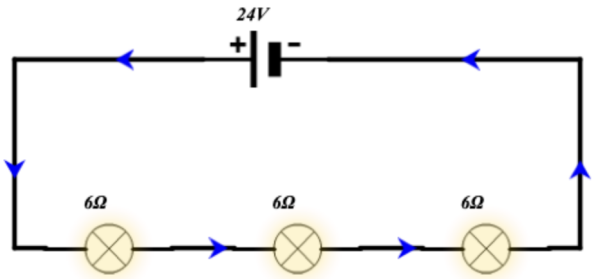
c.


12V
A
8A
3Ω
4A
A
3Ω
A
Current = _____

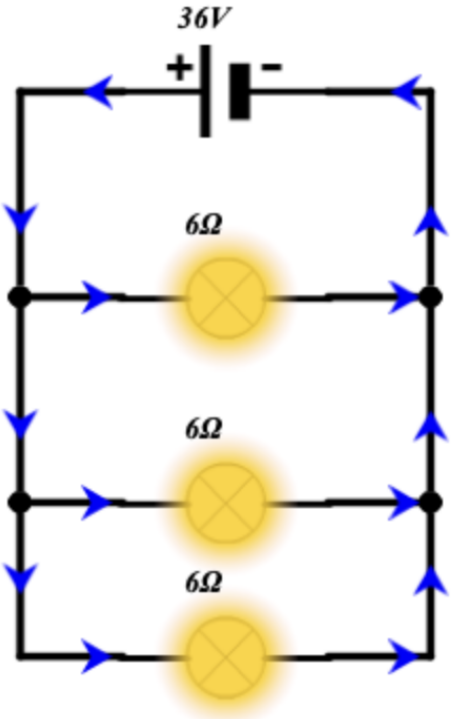
d.


24V
A
6A
12Ω
2A
A
6Ω
A
Current = _____

3. What happens in this circuit if a bulb breaks?



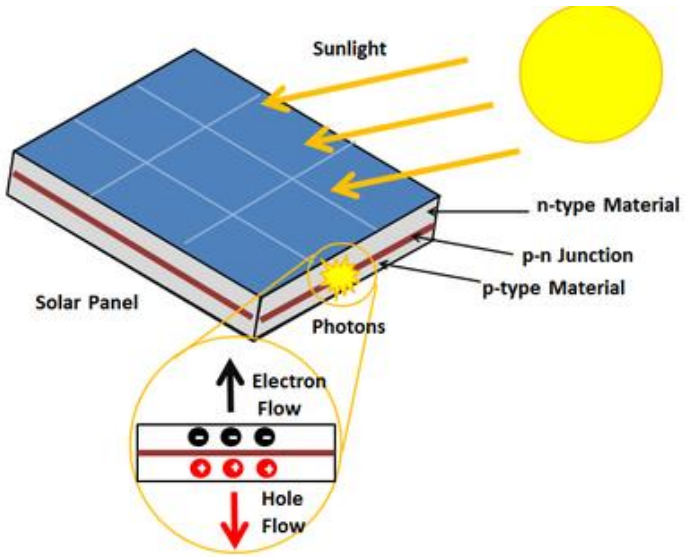
4. What happens in this circuit if a bulb breaks?



8P 6a Solar Cell Investigation

Introduction:

A solar cell is a device that converts **light energy** into **electrical energy**.
The voltage across the solar cell can be measured by a voltmeter.



Research Question:

How does changing the distance between a light source and solar cell affect the output voltage across the solar cell?

Control Variables:

Identify all appropriate control variables and write them down in the table below. Describe how they will be controlled in the experiment.

Control Variable	How will it be controlled /measured?
e.g. area of the solar cell	By using the same solar cell of a fixed area. It can be measured by using a ruler to measure the length and breadth and calculating using: area = length x breadth.

Hypothesis:

Predict what will happen to the output voltage across the solar cell as you change distance between the solar cell and the light source? ***Explain your prediction*** by referring to scientific concepts and ideas. Include a diagram if that helps to aid your explanation.

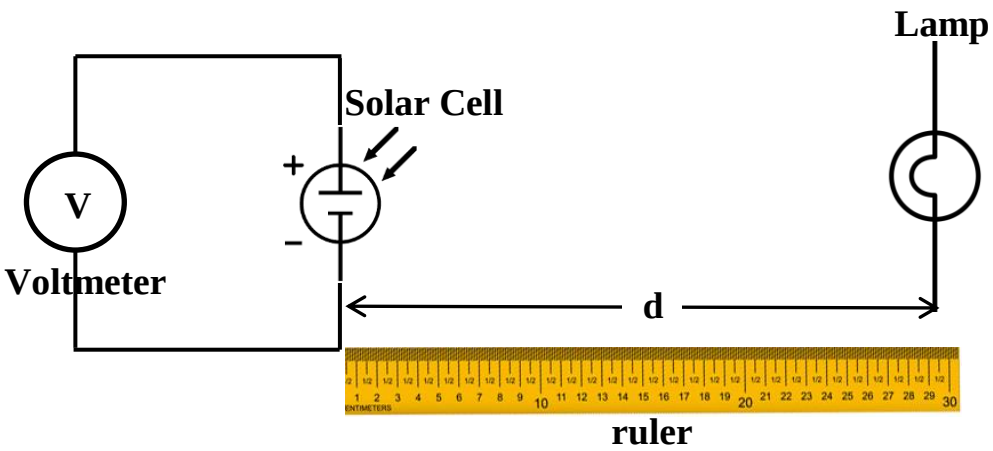
_____

_____

_____

Apparatus:

Solar cell, clamp, voltmeter, 6 electrical wires, power pack, bulb, meter stick



Method:

1. Set up the apparatus as above.
2. Decide on a suitable distance values to use, and add them to the table below. Ensure the range and increments are sufficient. You may to do a quick trial to check this.
3. Use the clamp to ensure that the solar cell is perpendicular to the surface.
4. Move the lamp to the first specified distance by placing it at the appropriate place along the meter stick. Ensure that the distance is measure accurately.
5. Turn on the bench lamp
6. Measure the output voltage across the solar cell from the voltmeter and record the data in the table below.
7. Turn off the bench lamp.
8. Move the bench lamp to the next distance and repeat steps 3-6.
9. Repeat the experiment 2 more times, and write the results in the table. Calculate the mean (average) output voltage across the solar cell.

Safety:

Describe the safely precautions that you should take during the experiment:

1. _____
2. _____
3. _____
4. _____
5. _____

Results:

Distance (cm)	Output voltage across solar cell (V)			Average Voltage (V)
	Voltage 1	Voltage 2	Voltage 3	

Analysing Your Results:

Find the mean (average) by adding up all three results and then divide your answer by 3.
Show your results in a **line graph** and ensure that you address the following criteria:

- *Title of graph included*
- *Label on x and y axis with correct units*
- *Scales should be appropriate*
- *Points plots accurately and connect using curve/straight line of best fit*

Conclusions

What was the correlation between the distance between a light source and solar cell and the output voltage across the solar cell?

_____

_____

Was your original hypothesis correct? If not, try to explain why and modify your explanation.

_____

_____

_____

Evaluation

A few points to consider:

- Was this a fair test? (refer back to the section on control variables)
- Was it reliable?
- Were there any problems carrying out the experiment?
- How could this experiment be improved?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

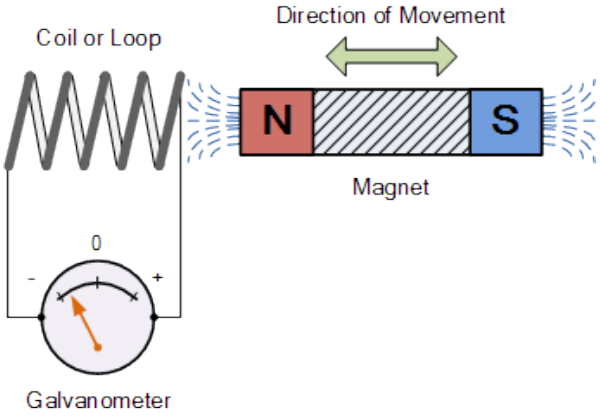
8P 7a Making Electricity

Introduction:

Making electricity is easy! Only 3 things are required:

1. A magnet
2. A coil of wire
3. Movement

When we make electricity this way, we say that we have induced a voltage in the coil.

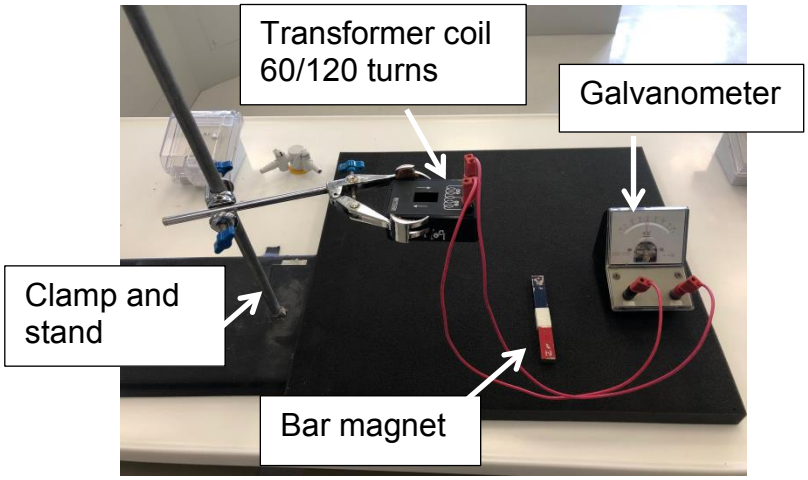


Aim:

To investigate the factors which affect the size of the induced voltage.

Apparatus:

- Transformer coil 60/120 turns
- Clamp
- Stand
- 2 wires
- Bar magnet
- Analogue milli-voltmeter
- Soft padding



Method:

1. Set up the apparatus as above.
2. Ensure that you are using 60 turns.
3. Place the magnet in the coil of wire and hold it stationary. What do you notice about the reading on the millivolt meter? Record your observation in the table below.
4. Place the north pole of the magnet above the coil of wire and drop it through the coil. Observe the direction the voltmeter needle moves. Repeat this, but position the south pole of the magnet above the coil. Compare the direction of the needle and record this in the table below.
5. Place the north pole of the magnet above the coil of wire. Drop it and observe the voltage. Repeat this, but start with the magnet further in the coil of the wire. This means the wire is moving slower past the coil. Observe the induced voltage and compare with the voltage when the magnet was moving more quickly. Record your results in the table below.
6. Change the number of coils to 120 turns. Drop the North Pole through first from the same height. Compare the size of the induced voltage between 60 and 120 turns.

Observations:

Change	Observation
Hold the magnet stationary in the coil.	
North pole or south pole first.	
Move the magnet quickly then slowly through the coil.	The induced voltage is (greater/smaller) if the coil is moving faster.
60 turns or 120 turns at the same speed.	The induced voltage is (greater/smaller) if more turns are used.

Conclusions:

List the ways that you can increase the size of the induced voltage.

_____

_____

_____

_____

Extension:

As the magnet passes through the coil, you should observe the millivolt meter needle move in one direction before swinging back in the opposite direction. In other words, the induced voltage values are positive then become negative.

Using you knowledge of electromagnetic induction, explain what causes this to happen?

_____

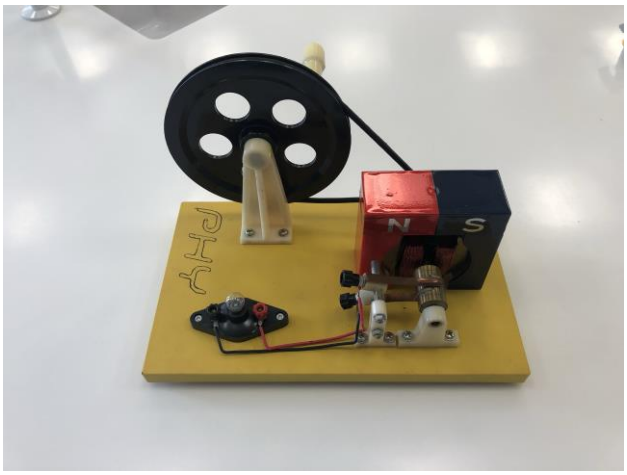
_____

_____

_____

8P 7b Dynamos and Generators

Dynamos



Your teacher will demonstrate a dynamo in action.

Describe how it works in the space below:

_____

_____

_____

_____

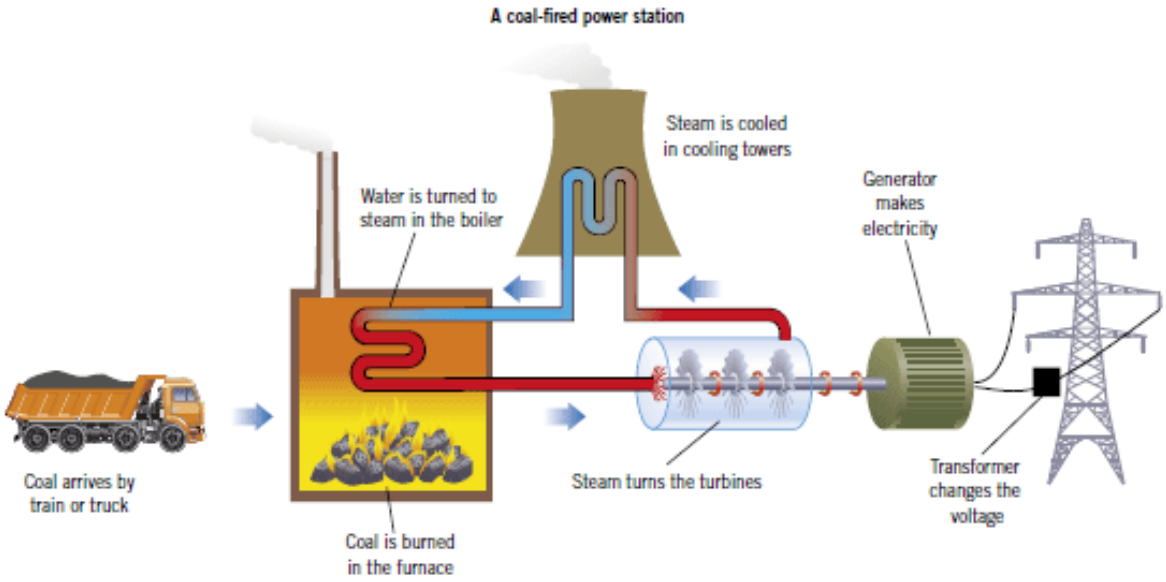
Generators and Power Stations

We can take the principles of making electricity and apply them to make electricity on a larger scale in power stations. It is important to remember that the same three ingredients are required:

- A magnet
- A coil of wire
- Motion

Here is a diagram of coal-fired power station.

Your teacher will explain how it works.



Here is a link that also explains:

https://www.bbc.com/bitesize/guides/zbsdmp3/revision/1

Write a description of how it works below. Try to include the energy transfers that happen. Using bullet points will be helpful:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Extension:

The voltage induced in dynamos and generators is alternating current (a.c.). Find out what this means and why is produced in generators and dynamos.

_____

_____

_____

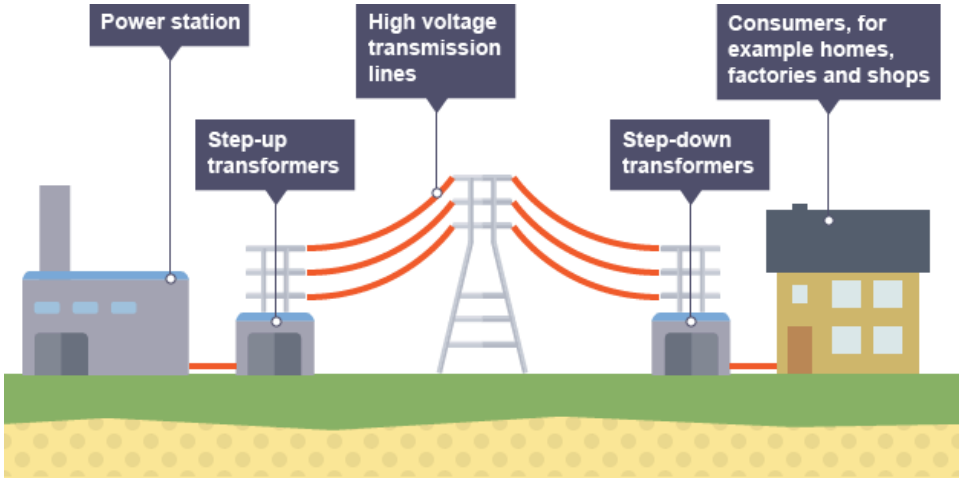
8P 7c Power Transmission

Introduction:

Once electricity has been generated in a power station, it needs to be transmitted from the power station or generator to our homes. This is done using a system of pylons and cables and transformers. In HK a lot of our transmission cables are underground as well.

Model Transmission Line:

Your teacher will show you a model transmission line. It should look similar to the diagram below:



How it Works

Some energy is 'lost' in the transmission lines as heat, due to resistance in the cables and a small amount of sound energy. If you have ever stood near a pylon you may have heard a faint buzzing noise, as some energy is transferred to sound.

We can reduce the loss of energy as heat by ensuring that the electricity in the transmission lines has a lower current. When there is a low enough current, less electrical energy is lost as heat. This is done by using a step-up transformer to reduce the current and therefore the energy lost as heat. The step-up transformer does however increase the voltage to very high voltages (up to 500,000V) which makes it very dangerous. Before the voltage can be safely used by consumers, a step-down transformer is used to reduce the voltage to make it safe.

Questions:

Having seen the model power line and read the description above, answer the following questions in full sentences:

1. How does electricity get transported from power stations to homes?

_____

_____

2. How is energy 'lost' in the transmission lines?

_____

_____

_____

_____

3. Describe how the energy loss can be reduced.

_____

_____

_____

_____

4. Describe the role of the step-up transformer.

_____

_____

_____

5. Why must a step-down transformer be used before?

_____

_____

8P 8a Energy – Identifying Fossil Fuels

Hydro (water) - electric

Wind turbines

Coal

Oil

Solar

Gas

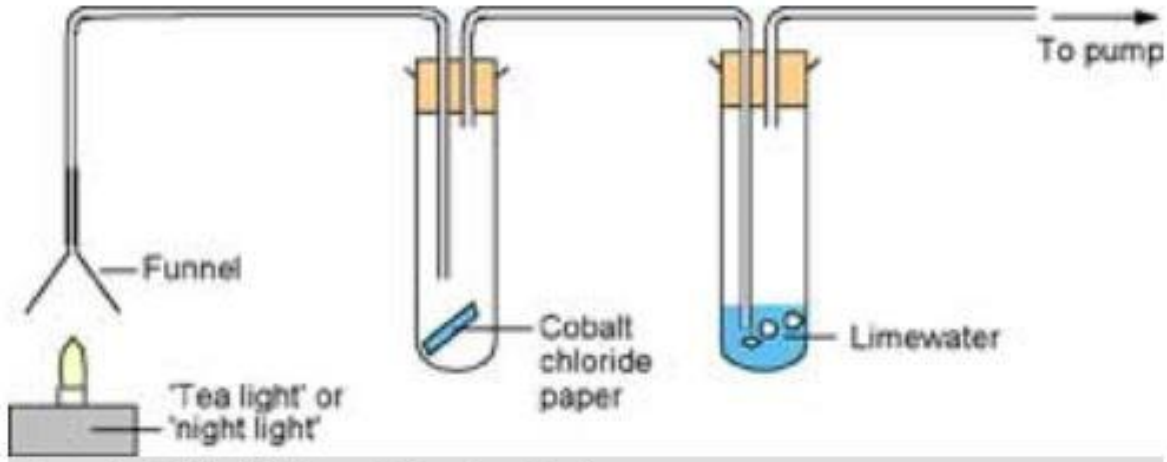
Which picture above is an example of a fossil fuel? Circle your answers.

Explain why those that you have circled are fossil fuels.

8P 8b Production of carbon Dioxide

Your teacher will demonstrate the following experiment that shows how fossil fuels release carbon dioxide gas when burned.

Website Resource:http://www.rsc.org/learn-chemistry/resource/res00000707/identifying-the-products-of-combustion?cmpid=CMP00005148



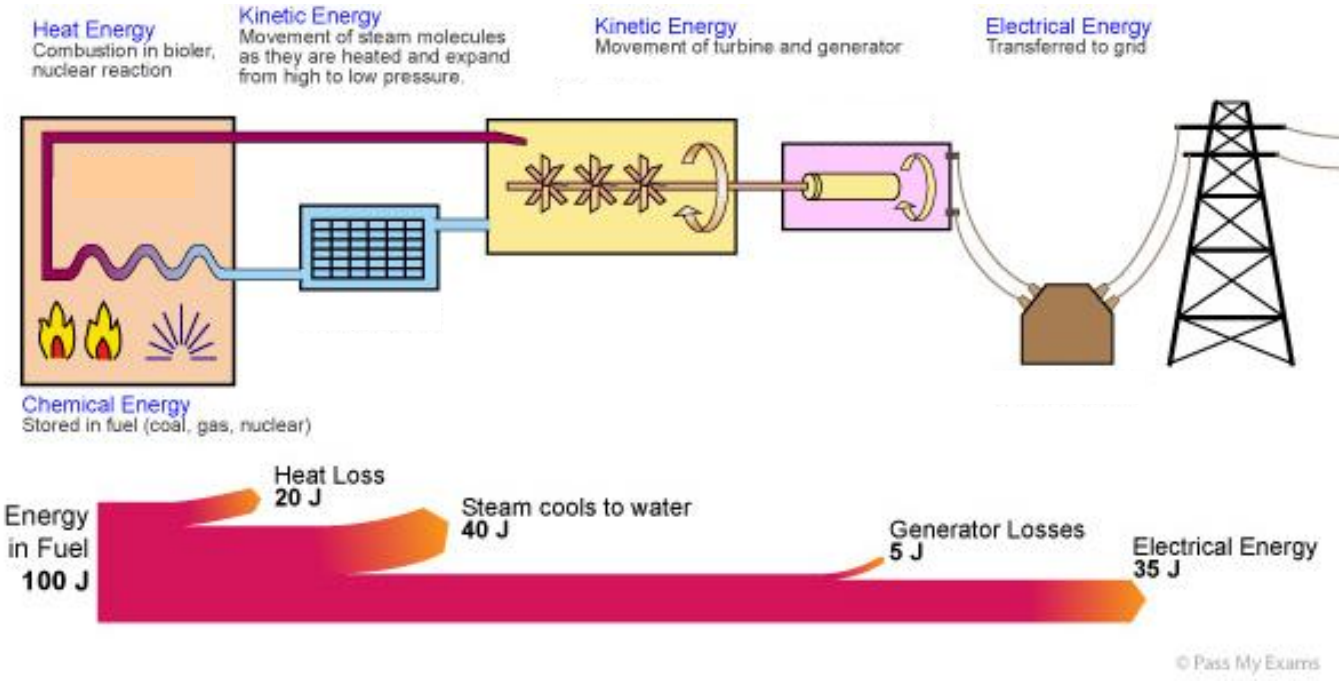
Apparatus to identify the products of combustion

Describe your observations as the fuel is burned. State what fuel is being used.

8P 8c Power Stations

1. Add the following labels to this powerstation diagram. Write them next to the part of the power station that does this.

Turbine **Boiler** **Transformer** **Generator** **Cooler**



2. Calculate the efficiency of the power station in turning Energy in Fuel to Electrical Energy.

3. The table below has information about 5 different types of power station. Draw lines to link up the information about each type of power station.

Type of Power Station	**Advantage**	**Disadvantage**
Coal, Oil and Gas	Produces no CO_2, even in construction.	Very expensive to construct, and potentially very dangerous.
Nuclear	Energy source is totally free and available daily.	Damages very large areas of beautiful countryside.
Wind	Power stations can also provide leisure facilities.	Sometimes considered ugly and not available every day.
Solar	Quick to construct and operates all the time.	Not available 24 hours a day.
Hydroelectric Dam	Very small quantities of waste are made, and no CO2.	Produces large amounts of CO2 which increases global warming.

Extension (optional)

Write a letter to the government explaining why we should use renewable resources, rather than coal, gas or oil to generate electricity.

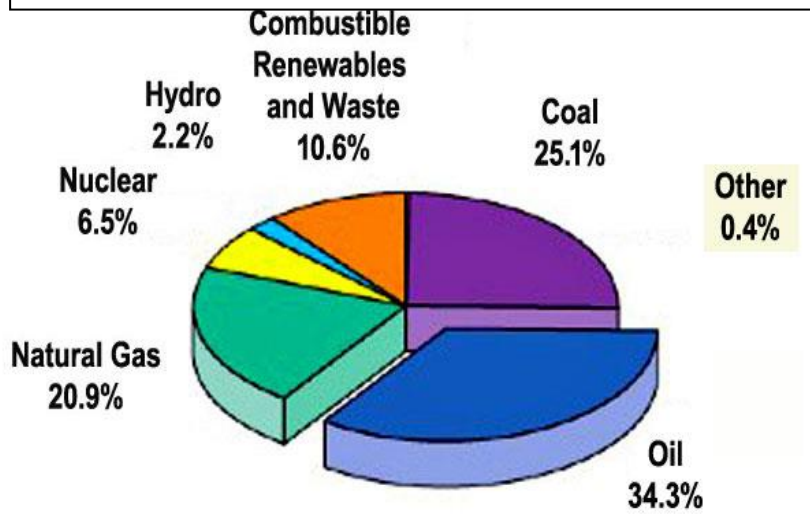
8P 8d Problems with Fossil Fuels

A fossil fuel is_____

_____

_____

A pie chart to show world energy consumption by type



The pie chart shows that_____

_____

_____

_____

There are several reasons for the trend such as_____

_____

_____

_____

_____

_____

The pie chart shows that the world needs to use alternative sources of energy because_____

_____

_____

_____

8P 9a Consequences of Global Warming

Consider the following:

Oceans absorb more heat than the land, and water expands when it is heated so this could cause sea levels to rise.

Glaciers (big 'rivers' of ice) and sea ice could also melt leading to sea level rise.

Coastal cities could flood destroying valuable land.

The climate of places could change. Places which usually get lots of rain may get hotter and drier.

Beaches could disappear because of sea level rises.

Many animals would be threatened with extinction (dying out) because of the heat and the loss of their habitats (homes).

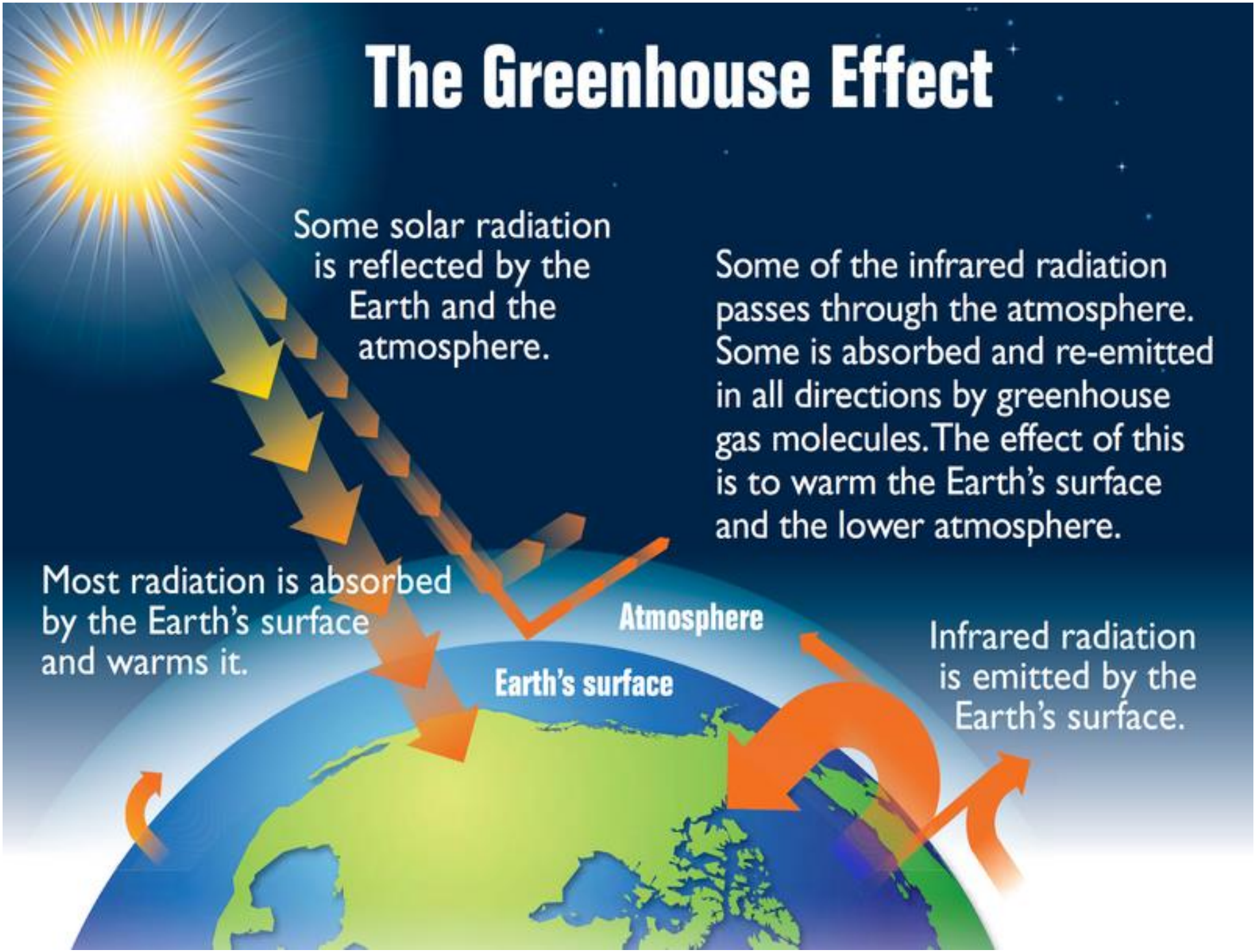
There would be a greater risk of forest fires due to the increase in temperature.

There would be more droughts (Lack of rainfall) making it hard to grow crops in particular places.

There could be an increase in the number of storms and extreme weather events because of the changes in heat.

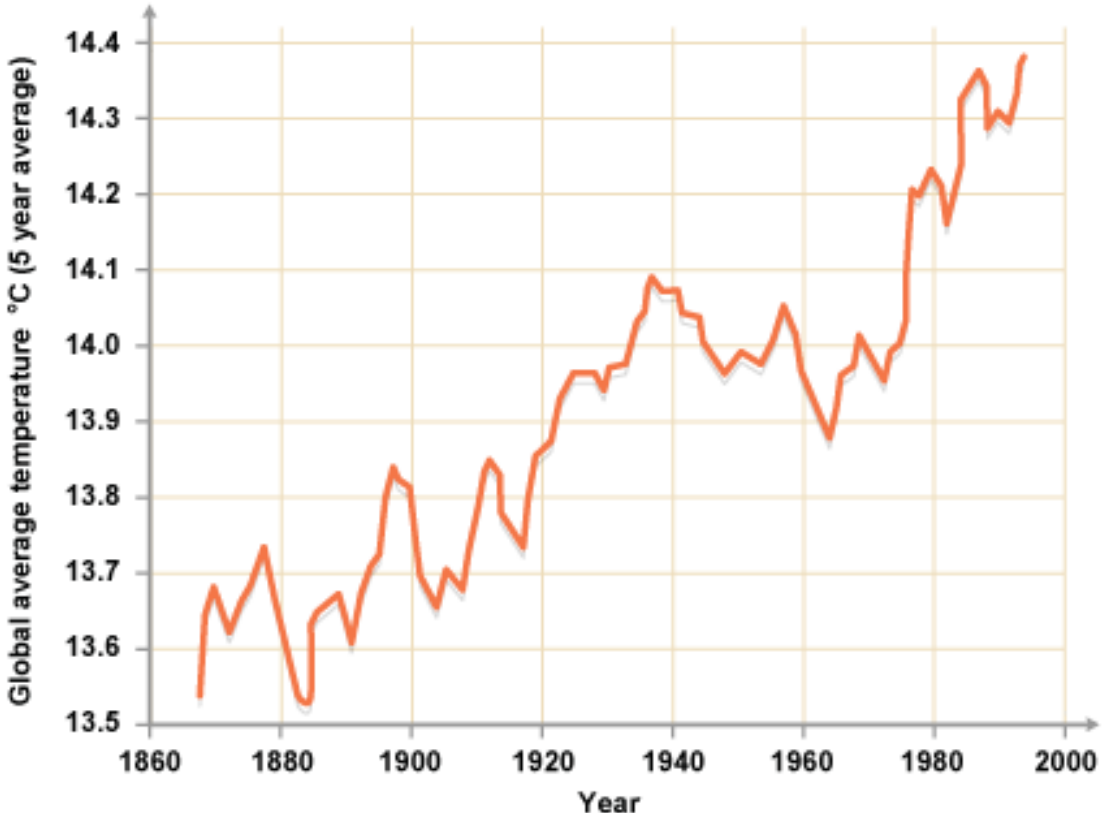
Your task:

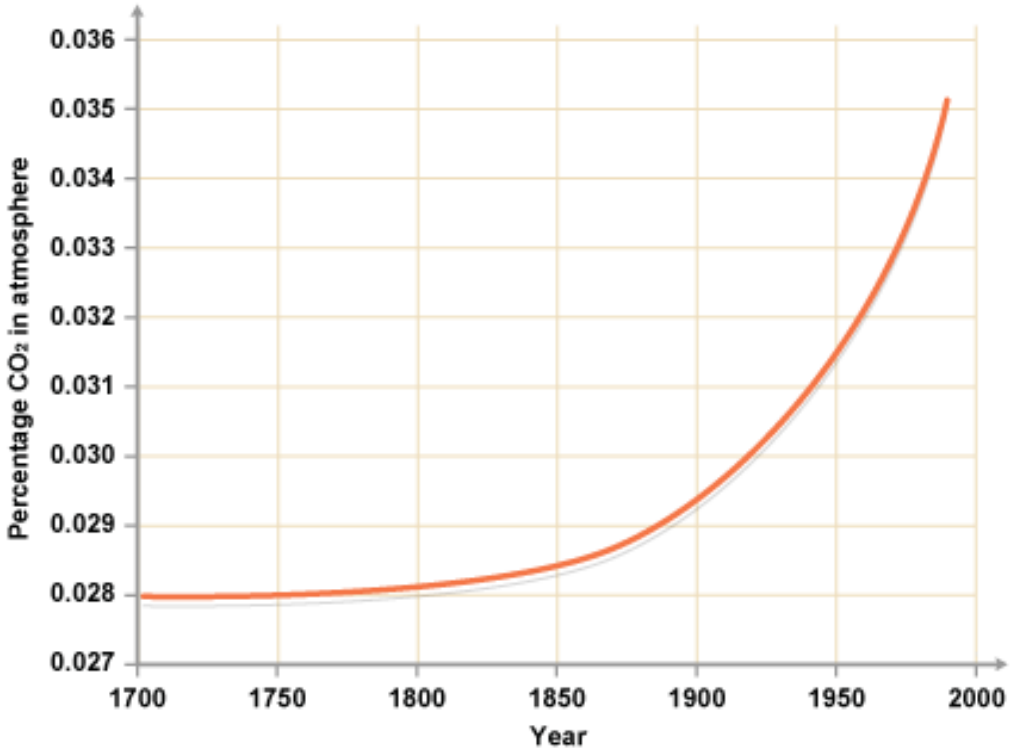
- Divide your file worksheet into 2 – one column for **human impacts** and one for **environmental impacts.**
- Take each point above in turn and decide if it would affect humans, the environment or both.
- Summarise the point in your chosen column as to why the impact would occur.
- You may work in groups of two or three to complete this task.


The Greenhouse Effect
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Most radiation is absorbed by the Earth's surface and warms it.
Atmosphere
Earth's surface
Infrared radiation is emitted by the Earth's surface.

8P 9b Global Temperature and Carbon Dioxide

Examine the graphical data below lined to Global Warming.





Using the graphs answer the questions below:

Explain:

- What trend does the first graph show?

- What has been the overall increase in temperature?

- What trend does the second graph show?

Extension

Do the two graphs have any relationship? How could they be connected? Discuss.

8P 9c Renewable Energy Resources

Type of energy	Where it is from	Advantages	Disadvantages
Solar	Energy from sunlight is captured in solar panels and converted into electricity.	Potentially infinite energy supply. Single dwellings can have own electricity supply.	Manufacture and implementation of solar panels can be costly.
Wind	Wind turbines (modern windmills) turn wind energy into electricity.	Can be found singularly, but usually many together in wind farms. Potentially infinite energy supply.	Manufacture and implementation of wind farms can be costly. Some local people object to on-shore wind farms, arguing that it spoils the countryside.
Tidal	The movement of tides drives turbines. A tidal barrage (a kind of dam) is built across estuaries, forcing water through gaps. In future underwater turbines may be possible out at sea and without dams.	Ideal for an island such as the UK. Potential to generate a lot of energy. Tidal barrage can double as a bridge, and help prevent flooding.	Construction of barrage is very costly. Only a few estuaries are suitable. Opposed by some environmental groups as having a negative impact on wildlife. May reduce tidal flow and impede flow of sewage out to sea.
Wave	The movement of seawater in and out of a cavity on the shore compresses trapped air, driving a turbine.	Ideal for an island country. More likely to be small local operations, rather than done on a national scale.	Construction can be costly. May be opposed by local or environmental groups.
Geothermal	In volcanic regions it is possible to use the natural heat of the earth. Cold water is pumped under ground and comes out as steam. Steam can be used for heating or to power turbines creating electricity.	Potentially infinite energy supply. Used successfully in some countries, such as New Zealand and Iceland.	Can be expensive to set up and only works in areas of volcanic activity. Geothermal and volcanic activity might calm down, leaving power stations redundant. Dangerous elements found underground must be disposed of carefully.

Type of energy	Where it is from	Advantages	Disadvantages
Hydrological or Hydroelectric Power (HEP)	Energy harnessed from the movement of water through rivers, lakes and dams.	Creates water reserves as well as energy supplies.	Costly to build. Can cause the flooding of surrounding communities and landscapes. Dams have major ecological impacts on local hydrology.
Biomass	Decaying plant or animal waste. An organic material, which can be burned to provide energy, eg heat, or electricity. An example of biomass energy is oilseed rape (the fields of yellow flowers you see in the UK in summer), which produces oil. After treatment with chemicals it can be used as a fuel in diesel engines.	It is a cheap and readily available source of energy. If replaced, biomass can be a long-term, sustainable energy source.	When burned, it gives off atmospheric pollutants, including greenhouse gases. Biomass is only a renewable resource if crops are replanted.
Wood	Obtained from felling trees, burned to generate heat and light.	A cheap and readily available source of energy. If the trees are replaced, wood burning can be a long-term, sustainable energy source	When burned it gives off atmospheric pollutants, including greenhouse gases. If trees are not **replanted** then wood is a non-renewable resource.

Research Points – Renewable Energy Technology

MYP 2: Year 8 Science

Criterion D Assessment - Reflecting the Impacts of Science

UNIT:	Energy Production and Climate Change
ASSESSMENT TITLE:	Renewable Energy Technology
Inquiry Statement	Exploring **changes** in the **environment** brought about by **energy** production and investigating the **consequences** on **humankind**.
Key Concept:	Change
Related Concepts:	Energy and Consequences

Assignment Instructions (GRASPS)

Goal	Produce a persuasive Powerpoint presentation or Video providing information on a renewable energy source and highlighting the pros and cons of this energy source compared with burning fossil fuels.
Role	You are part of an environmental group who wishes to persuade the government to introduce legislation for using a renewable source of energy to replace fossil fuels.
Audience	The Government and the local population of your country.
Situation	You are campaigning for renewable energy to replace fossil fuels where you live.
Product	Powerpoint or video presentation.
Success Criteria for Assessment	You will clearly explain the advantages of the renewable energy source compared with fossil fuels and you will have data to support your argument. Presentation will be easy to read, well-illustrated and contain clear and relevant data explained using good scientific vocabulary.

Other Information:

You MUST provide a Bibliography and cite all your sources.
Due Date: this will be set by your teacher.

Level Descriptors and Task Specific Clarifications for Criterion D:

Level	Level Descriptor	Task Specific Clarification
0	The student does not reach a standard described by any of the descriptors below.	No data or clear evidence provided.
1-2	The student is able to, **with limited success**: i. **state** the ways in which science is used to address a specific problem or issue ii. **state** the implications of using science to solve a specific problem or issue, interacting with a factor iii. **apply** scientific language to communicate understanding iv. document sources.	ii. Student simply states the problem of using fossil fuels ii. Simply state that the renewable energy source is better. No explanation or relevant data given. iii. Little evidence of scientific vocabulary being used. iv. Source of information given, but not correctly referenced.
3-4	The student is able to: i. **Outline** the ways in which science is used to address a specific problem or issue ii. **Outline** the implications of using science to solve a specific problem or issue, interacting with a factor iii. **sometimes apply** scientific language to communicate understanding iv. **sometimes** document sources correctly.	i. At least one problem associated with burning fossil fuels is outlined. Some data is given, but source may not be referenced. ii. Student provides at least 1 reason to explain why the renewable source is an improvement. iii. Some scientific vocabulary is used. iv. Bibliography has only one source referenced, but this may not be accurately formatted.
5-6	The student is able to: i. **Summarize** the ways in which science is used to address a specific problem or issue ii. **Describe** the implications of using science to solve a specific problem or issue, interacting with a factor iii. **usually apply** scientific language to communicate understanding **clearly and precisely** **iv. usually** document sources correctly.	i. Problems associated with burning fossil fuels are summarized, but not explained fully. Some data that supports the argument is given. ii. The advantages of the renewable source are described, but not fully explained. There is some mention of energy types. iii. Some good scientific vocabulary is used. iv. At least 3 sources are referenced in APA format
7-8	The student is able to: i. **Describe** the ways in which science is applied and used to address a specific problem or issue ii. **Describe and summarize** the implications of using science and its application to solve a specific problem or issue, interacting with a factor iii. **consistently apply** scientific language to communicate understanding **clearly and precisely** iv. document sources **completely**	i. The student presents a clear explanation of the problems associated with fossil fuels. Equations are given to explain the problems burning fossil fuels cause. Include 1 piece of verifiable data to support the argument for changing from fossil fuels to the renewable source. ii. Contrast these with the advantages of the renewable source, describing and summarising how this works (eg energy transfers) iii. Explanations involve excellent scientific vocabulary. iv. Correct bibliography is provided citing at least 5 reputable and relevant sources, in APA format.

8P10a Renewable Energy Sources - Research Template

Questions	Notes
What are the problems associated with burning fossil fuel? 1. Describe in detail the problems associated with burning fossil fuels. 2. What evidence is there to substantiate the problems you have described?	
Renewable Solution 3. Choose a renewable energy technology. 4. Describe in detail how it works. Be sure to describe the energy transfers taking place.	
Impact 5. What are the benefits of using this renewable technology compared to burning fossil fuels? 6. Are there any other advantages to society or the environment? 7. What are the disadvantages of using this renewable solution? Hint: Think about the impact that it has on the environment, wildlife the economy and society in general.	
Additional notes/diagrams	

References

8P 11a Renewable Energy Solutions

Wind? **Wave?** **Solar?** **Hydro?**

YOU DECIDE!

Task:

Communities are concerned about climate change and future energy supplies. They have decided to develop renewable energy for your town.

Your task is to choose suitable forms of renewable energy for your area. You should try to provide the greatest possible number of homes with 'clean' electricity, at the lowest possible cost.

However - it is not quite that simple! Different types of renewable energy have their advantages and disadvantages.

They may also have strict requirements to make them work. You should carefully study the 'Power Facts' and your map to decide from the PowerPoint you teacher has shown you which sites would be suitable for the different types of energy.

Other points you need to consider include:

- **Visual impact** – will it be a 'blot on the landscape'?
- **Natural heritage** – how might it affect plants and animals?
- **Human activity** – will it cause difficulties for people? Who will you need to consult?
- **Archaeology** – are there important historic sites nearby?
- **Road access** – is your proposed site accessible?
- **Electricity transport** – if your site is remote, you will need more power lines to take the electricity to peoples' homes

Remember – there are no right or wrong answers. Discuss the issues carefully among your group – you may need to make compromises!

To start, it is sensible to consider as many feasible solutions as possible before you choose. Combinations of different types of renewable energy solutions are permitted.

You need to justify your choice and explain why you haven't selected other options.

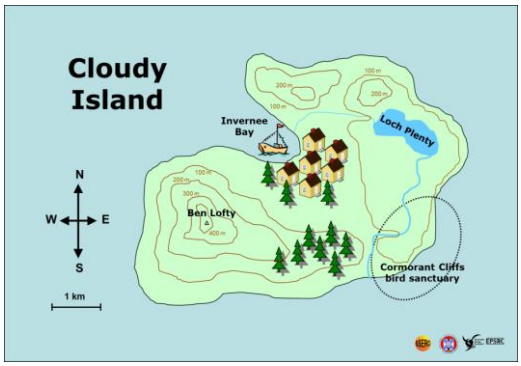
Use the space below to make notes.

8P 11b Renewable Energy Solutions

Presentation:

Your group now needs to present your renewable energy solution.

The presentation should contain the following:



1. Your location map with the renewable energy solution(s) drawn on it.
2. The total cost of your solution. Are there any additional cost such as roads and electricity transmission lines?
3. A justification of why you have chosen that particular solution. Why is it best?
4. An explanation as to why you didn't choose other possible solutions.

For points 3 and 4 above, you should also discuss the following:

- **Visual impact** – will it be a 'blot on the landscape'?
- **Natural heritage** – how might it affect plants and animals?
- **Human activity** – will it cause difficulties for people? Who will you need to consult?
- **Archaeology** – are there important historic sites nearby?
- **Road access** – is your proposed site accessible?
- **Electricity transport** – if your site is remote, you will need more power lines to take the electricity to peoples' homes

8P 12a Presentation Skills Self Assessment Rubric

Complete the following self-evaluation by ticking the boxes.
Reflect on your/your partner's performance on this task and try to set some targets to improve.

N = Novice **R= Reasonable** **G = Good** **E = Expert**

	N	R	G	E
1. **Structure**: Your project or presentation is really well organized and structured. This helps you communicate your understanding to others.				
2. Knowledge and understanding: You really understand the concepts that you are presenting or discussing.				
3. Application of Science: You apply what you have learnt to explain the **uses of science** to solve a problem or an issue.				
4. Implications of Science: You consider the positive and negative effects of Science on this problem or issue.				
5. **Use of Scientific Words & Terminology:** You use lots of important and relevant scientific terms & words. This helps others understand your work.				
6. **Use of Scientific Diagrams, Photo's, Video clips, and Simulations:** You use relevant digital media to help explain concepts and ideas.				
7. Clarity of Communication: Your written, oral or digital media presentation is really clear and easy for others to follow. For oral presentations, your tone, speed and volume of voice is confident and appropriate for your audience.				
8. **Engaging and Interesting**: You make your presentation interesting and show lots of enthusiasm and passion. You use words, phrases, pictures or media applications that really capture the imagination of your audience.				
9. Reading and use of Sources: You have done lots of background reading to help you make your presentation. You quote at least 2 or 3 sources of information at the end of your presentation.				
10. Summarizing: You are able to sum up concisely, so that your audience is clear what your final thoughts, opinions or conclusions are.				
11. **Quality of final product:** Your presentation or project is of a really high standard. Your audience, either reading or listening, seems to really understand what you are trying to communicate.				

Highlight a few of these skills as targets for your future development. If you want, give yourself a grade and discuss these targets with your teacher/tutor/parent or a friend.

Mainly Expert = (8)
Mainly Expert/Good = (7)
Mainly Good = (6)
Mainly Good/Reasonable = (5)
Mainly Reasonable = (4)
Mainly Novice/Reasonable = (3)
Mainly Novice = (1 or 2)

Grade =

(if appropriate)

Student/peer Targets:
The most important thing I learnt was…….

This could be better if……..

8P 13a Summary Notes

Energies in action

- heat energy
- light energy
- sound energy
- electrical energy
- kinetic (movement) energy.

Stored energy

Some energy has to be stored so that it is ready for use when we need it.

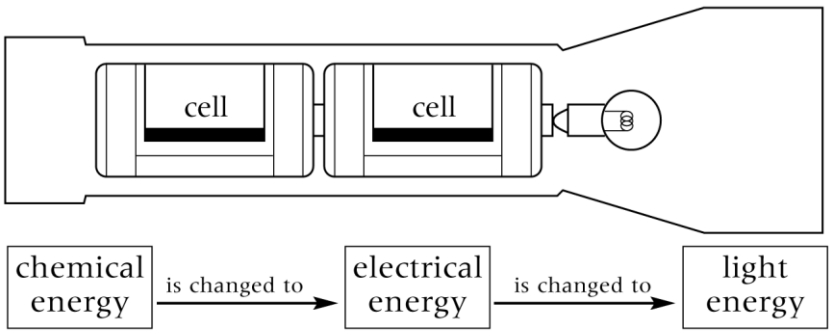
- Chemical energy is stored in food, fuels and cells.
- Gravitational potential energy is stored in high up things.
- Strain energy is stored in stretched or squashed things.
- Nuclear energy is stored inside atoms.

How is energy measured?

Energy is measured in **joules** (**J**) or **kilojoules** (**kJ**). A kilojoule is 1000 joules.

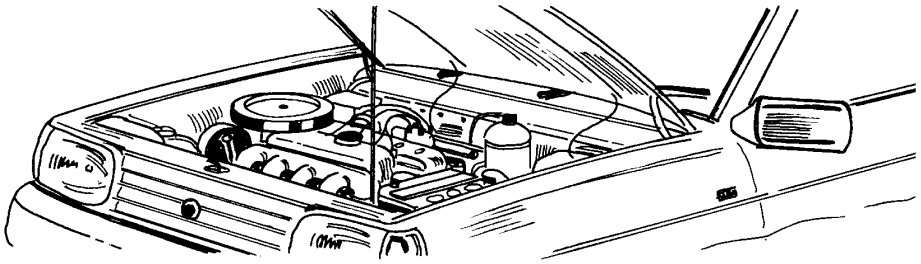
Energy changes

Energy needs to be changed to be useful.



An energy flow diagram.

Many energy changes take place in everyday life. Often wasted energy is produced in the forms of **heat** or **sound**.



A car engine produces kinetic energy, which is useful. It also produces heat and sound

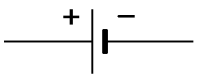
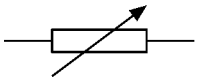
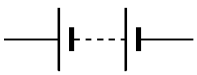
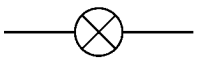
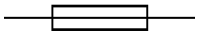
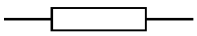
Energy cannot be made or destroyed, but can only be changed from one form to another. This is the **law of conservation of energy**.

Circuits

Electricity is a flow of **electrons**. Electricity can flow through **conductors** but not through **insulators**. **Metals** are good conductors of electricity.

A complete **circuit** is needed for electricity to flow.

We use symbols when we draw circuits:

Component	Symbol	Component	Symbol
cell		variable resistor	
battery of cells		motor	
bulb		ammeter	
switch		fuse	
resistor		Voltmeter	Draw here:

Current

The **current** is the amount of electricity flowing in the circuit. The units for current are **amps** (**A**). Current is measured using an **ammeter**.

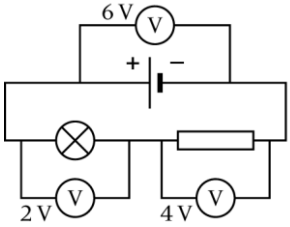
Resistance

The **resistance** of a circuit is a way of saying how easy or difficult it is for electricity to flow.

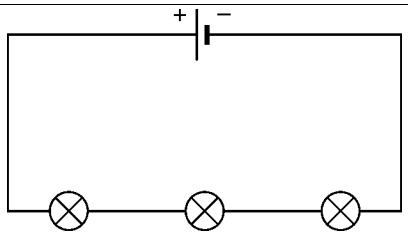
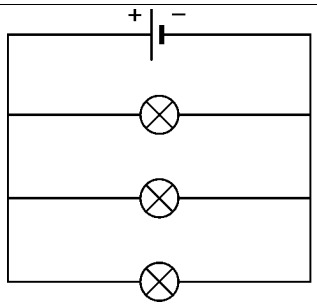
- high resistance = hard for electricity to flow = small current
- low resistance = easy for electricity to flow = large current

Voltage

A circuit must have a cell or power supply to provide a **voltage**. The voltage pushes the **electrons** around the circuit and gives them energy. This electrical energy is **transferred** to other components in the circuit, which convert it to other forms of energy. For instance, a light bulb transfers electrical energy to heat and light energy.
The voltage of a cell can be measured using a **voltmeter**. The units for voltage are **volts** (**V**).The voltage across a component is a way of measuring how much energy the component is transferring. The voltage across all the components in a series circuit adds up to the voltage across the cell.

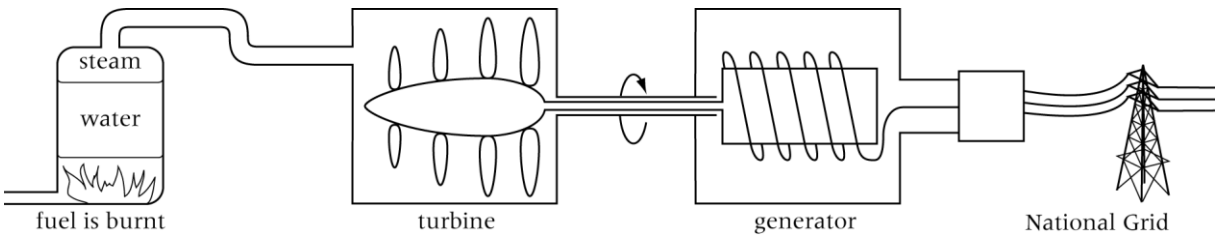


Circuits can be **series** or **parallel** circuits.

Series circuit	Parallel circuit
	
• If one bulb breaks, all the others go off. • The current is the same everywhere. • If you put more bulbs in they will be dimmer, because it is harder for the electricity to get through. The resistance of the circuit is higher. • The voltage from the cell or power pack is divided between the components.	• If one bulb breaks, the bulbs in the other branches stay on. • The current splits up when it comes to a branch. The current in all the branches adds up to the current in the main part of a circuit. • If you add more bulbs they stay bright. It is easier for the current to flow with more branches, because there are more ways for the electrons to go. • The voltage is the same across all the branches of the circuit.

Generating electricity

Fossil fuels are transported to power stations where they are burnt to release heat energy. This heats water, turning it to steam. The steam drives **turbines** which turn **generators**. The electricity generated flows along cables into the National Grid.



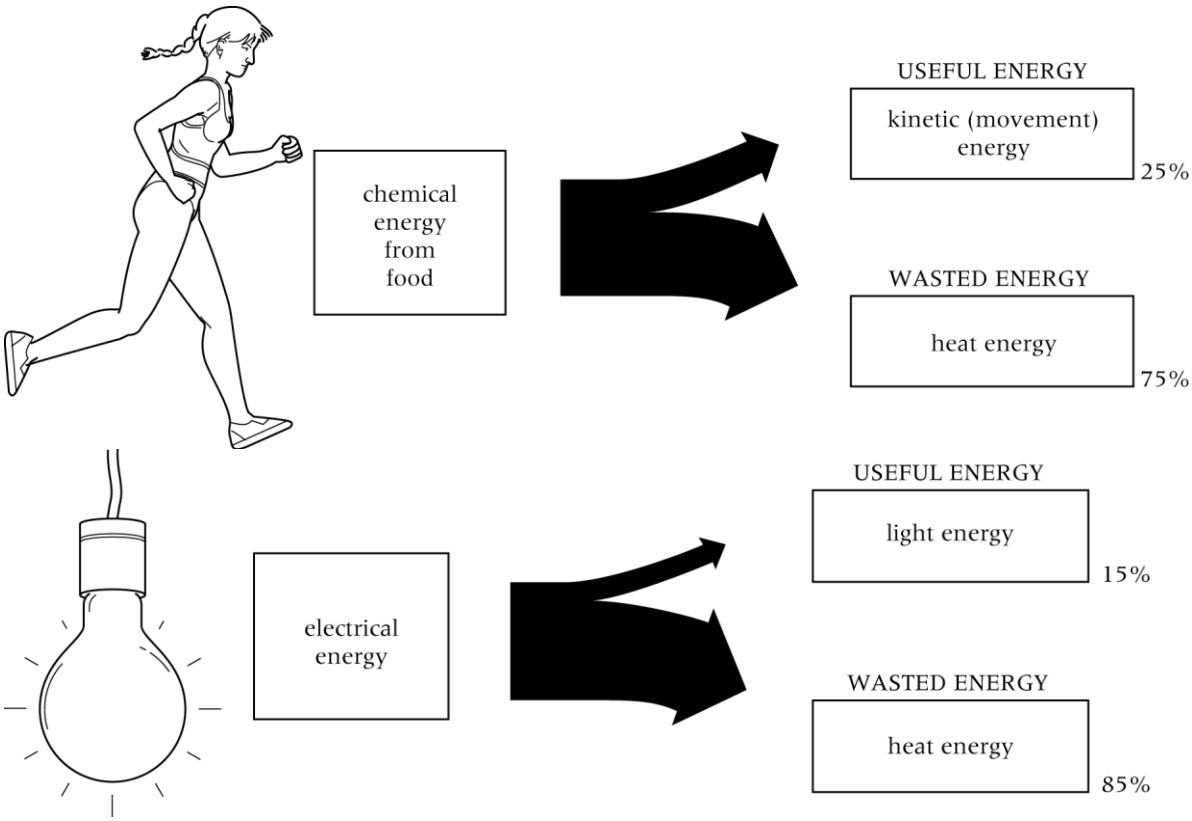
Nuclear fuel is made from a radioactive metal called uranium. The energy in nuclear fuel did not come from the Sun.
Electricity can be generated from renewable resources such as wind and moving water. These will become more important as fossil fuels run out.

Sometimes we need a source of portable electricity when we are not close to the mains. This can be supplied by **cells** (sometimes called **batteries**). These store chemical energy which can be changed to electrical energy. Cells go flat when they run out of chemical energy. Some cells can be **recharged**.

Wasting energy

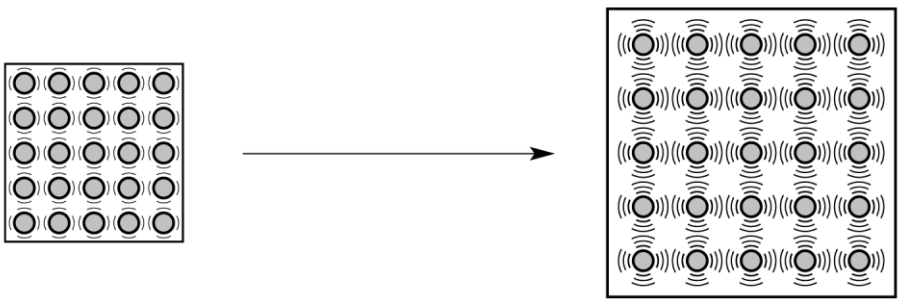
Energy cannot be made or destroyed, but it can be changed to different forms. Not all energy is turned into a form that we want. Often it is turned into heat that we do not need. This is wasted energy. A car engine produces kinetic energy, which is useful. It also produces heat and sound which are wasted forms of energy.

The percentage of useful energy produced by something is known as its **efficiency**. The human body is 25% efficient.

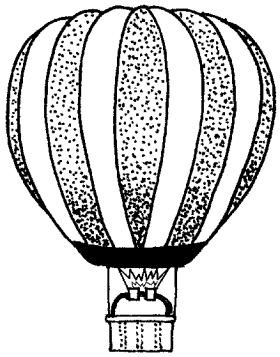


Travelling heat

The **kinetic theory** or **particle model of matter** helps to explain how some forms of heat energy travel. The theory suggests that everything is made of moving or vibrating particles. When these particles are heated they move faster.



When the particles vibrate faster the material expands.



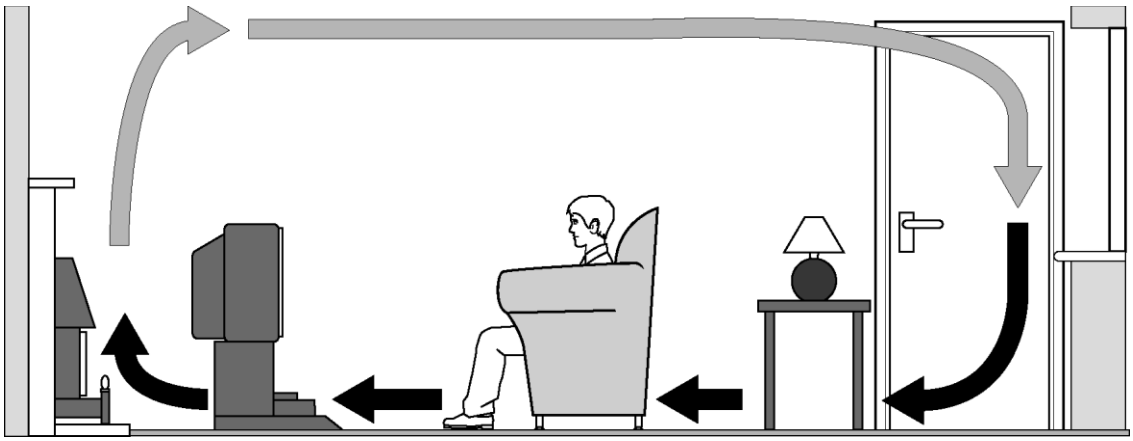
When the air particles in the balloon are heated, they move apart and the air expands and becomes less dense. This causes the hot air to rise, and the balloon rises too.

Thermal energy can travel in three different ways.

Conduction takes place in solids and can also happen in liquids (although not very well). The particles in a solid are held together tightly. When they gain energy they vibrate faster and the vibrations are passed on. Particles are not as close in a liquid, so conduction is not very good. Metals are the best conductors. Most other solids are poor conductors.

Something which does not conduct heat very well is an **insulator**. Liquids, gases, and solids which contain a lot of trapped air are insulators.

Convection takes place in liquids and gases.



When the air near the fire is heated, the particles spread further apart and the air becomes less dense and rises. As it rises it meets cooler air and passes the energy on. Having passed on the energy, it cools and becomes denser. The denser air sinks, setting up a cycle or **convection current**.

Heat can be transferred through empty space by **infrared radiation**. Radiation does not require the movement of particles. Any hot or warm object gives off or **emits** radiation. When something takes in heat energy from radiation, it is said to **absorb** it.

Infrared radiation travels as waves. It can be reflected and it can also be focused.

Energy resources

Energy is needed to make things happen. There are different kinds of energy, such as **light energy** and **heat energy** that we get from the Sun, and **electrical energy**.

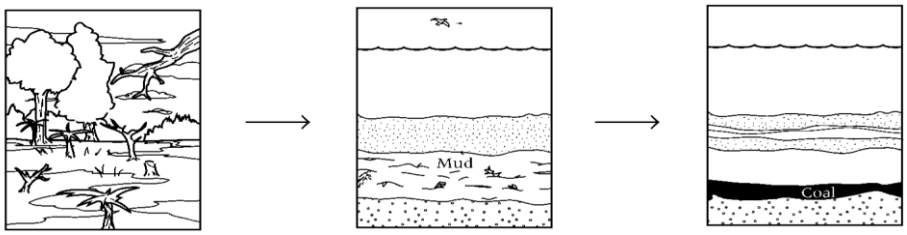
We need **fuels** to provide energy in our homes, factories and for transport. A fuel is something which can release heat energy.

Fossil fuels

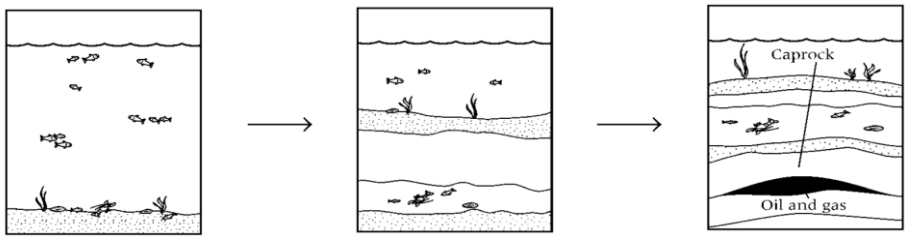
Fossil fuels:

- are made from plants and animals which were trapped in mud and rocks millions of years ago
- include coal, oil and natural gas
- are **non-renewable** (they take millions of years to form, and so our supplies will run out)
- produce gases which cause pollution when they are burnt
- are relatively cheap to obtain
- contain **chemical energy** which changes to heat energy when they are burnt
- originally got their energy from the Sun. The plants that became coal got their energy from the Sun, and the animals that became oil got their energy from plants which got their energy from the Sun.

Electricity is not a fuel. It has to be generated using other energy resources.



How coal is formed.



How oil and natural gas are formed.

Making fossil fuels last longer

We can make fossil fuels last longer by using less energy. We could walk or cycle whenever we can, or use a bus instead of using a car. Walking and cycling would make us fitter and healthier, and there would be less pollution if there were not as many cars on the roads. We could also save energy by keeping our houses cooler and wearing more clothes.

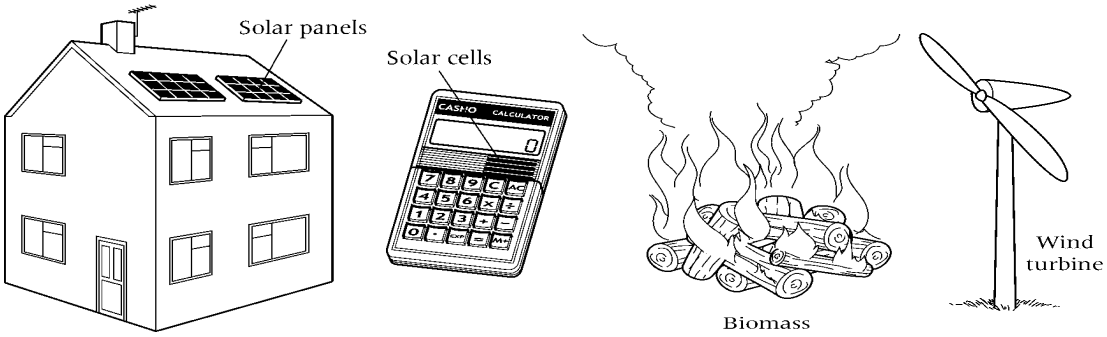
Renewable energy resources

Renewable energy resources:

Biomass – plant or animal material is used to produce heat energy.
Geothermal – hot rocks beneath the Earth's surface provide heat energy.
Solar – light energy from the Sun is absorbed by photovoltaic cells to generate electricity
Wind – kinetic energy from the wind is used to generate electricity.
Tidal – kinetic energy from tides moving in and out is converted to electricity.
Hydroelectric – water flows downhill, converting gravitational potential energy into electricity.

Wave - kinetic energy from moving waves generates electricity.

- do not produce harmful gases
- can be expensive
- will not run out.



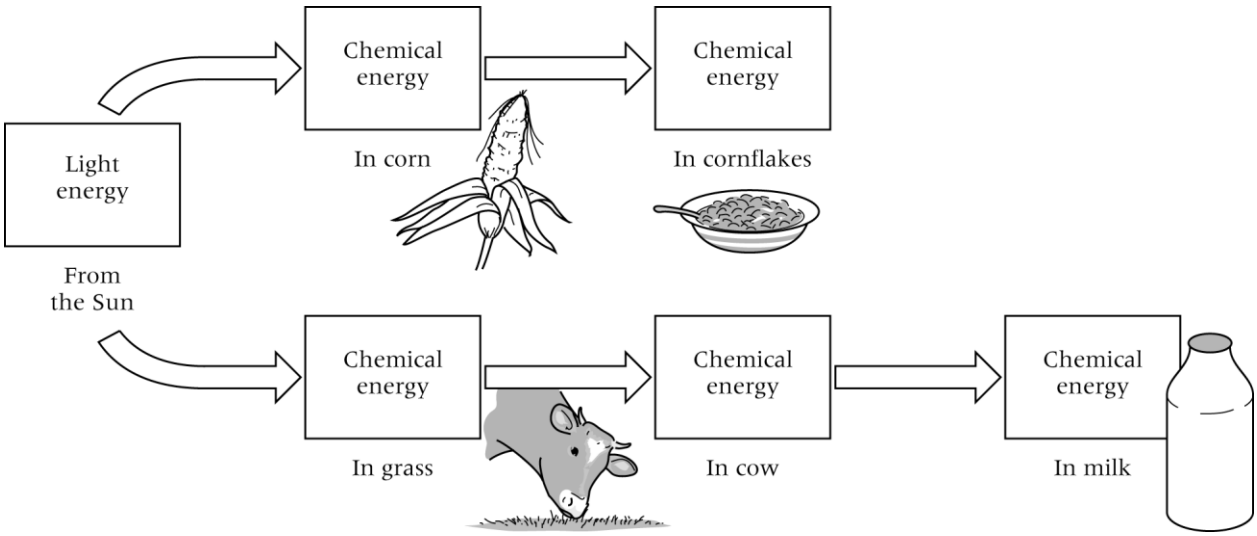
Energy in food

Humans and other animals need energy to live. We get our energy from chemical energy stored in food. We need to choose our food so that we get the right amount of energy. If we eat too much we could get fat and become unhealthy. If we do not eat enough we will get thinner and may become ill.

The unit for measuring energy is the **joule** (**J**). There is a lot of energy stored in food, so we usually measure the energy in food using **kilojoules** (**kJ**). 1kJ = 1000J.

Energy from the Sun

Most of the energy resources we use originally came from the Sun. Only geothermal energy, nuclear power and tidal power do not depend on energy from the Sun.



8P 13b Quick Quiz

On your answer sheet, write in or circle the correct letter for each question.

1 Which of these statements is true?

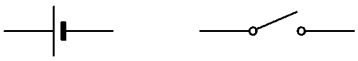
A Plastic is a conductor because it lets electricity flow through it.

B Plastic is an insulator because it lets electricity flow through it.

C Metals are conductors because they let electricity flow through them.

D Metals are insulators because they let electricity flow through them.

2 What do these symbols show?



A a cell and a bulb

B a cell and a switch

C a bulb and a switch

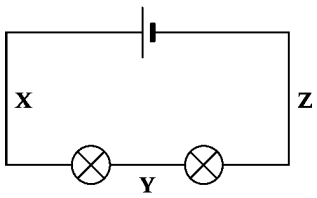
D a switch and a motor

3 Which instrument would you use to measure current?

A an ammeter B a cell

C a motor D a voltmeter

4 How big would the current be at X, Y and Z?



A It would be biggest at X and smallest at Z.

B It would be biggest at Z and smallest at X.

C There would be no current at Y.

D It would be the same at all three places.

5 You can make the current in a circuit smaller by:

A putting a switch in the circuit.

B putting more bulbs in the circuit.

C taking some bulbs out of the circuit.

D putting more cells in the circuit.

6 Resistance is a way of saying:

A how much electricity is flowing.

B how hard it is for electricity to flow.

C how many cells are in a circuit.

D how many switches are in a circuit.

7 Electricity is:

A a source of energy.

B a kind of liquid inside the wires.

C tiny particles called electrons flowing through the wires.

D tiny particles called atoms flowing through the wires.

8 A long wire:

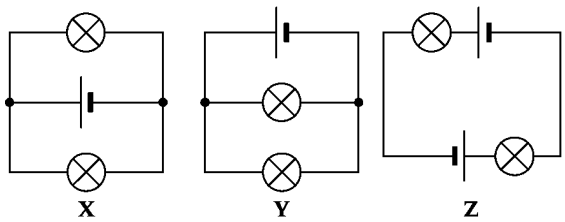
A has a smaller resistance than a short wire.

B has the same resistance as a short wire.

C has a bigger resistance than a short wire.

D does not have resistance.

9 Which of these circuits are parallel circuits?



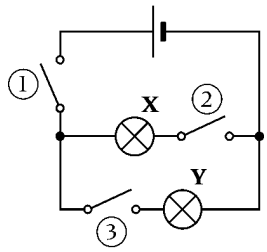
A X and Y only

B X and Z only

C Y and Z only

D all of them

10 Which switches must be pressed to make bulb X come on?



A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D all three of them

11 Parallel circuits are used for house lights:

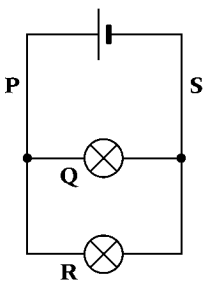
A so they can all be switched on and off together.

B so you know when one breaks, because all the others go off.

C so they use a bigger current.

D so they can all be switched on and off separately.

12 Which of these statements is **not** true?



A The currents at Q and R add up to give the current at S.

B The current is the same at P and S.

C The current is the same at Q and R.

D The current is the same at P and Q.

13 Which of these is **not** a form of energy?

A kinetic **B** petrol

C light **D** sound

14 Which of these has the most gravitational potential energy?

A a parachutist standing on a runway

B a parachutist going into a plane

C a parachutist jumping out of a plane

D a parachutist after landing

15 What are the energy changes in a candle?

A heat to light

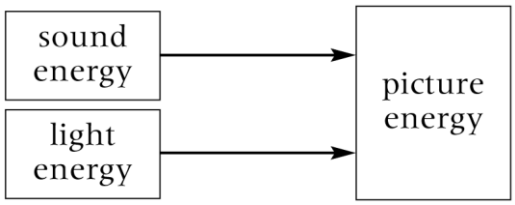
B heat to sound

C light to heat

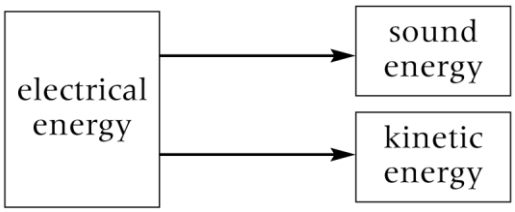
D chemical to heat and light

16 Which is the correct energy flow diagram for a television?

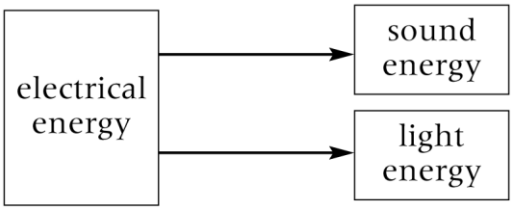
A



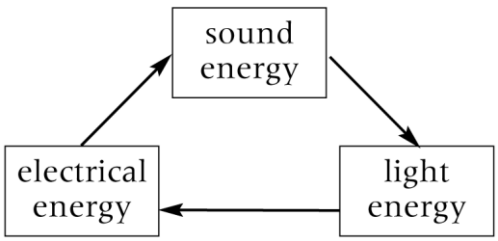
B



C



D



17 The units for voltage are:

A amps.

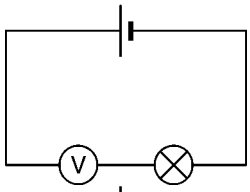
B ohms.

C volts.

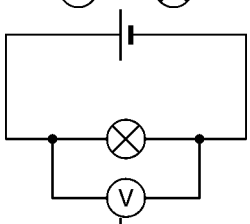
D metres.

18 Voltage is measured:

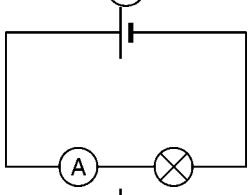
A using a voltmeter in the circuit like this.



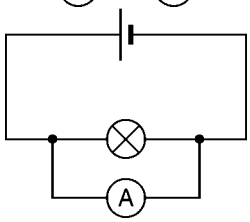
B using a voltmeter in the circuit like this.



C using an ammeter in the circuit like this.



D using an ammeter in the circuit like this.



19 Voltage is:

A another name for current.

B a way of counting how many cells there are in a circuit.

C a way of saying how much energy the electricity is carrying.

D something that makes it difficult for electricity to flow.

20 Which statement is **not** true for a series circuit?

A The voltage is always the same for all the components.

B The voltage across each component depends on how much energy it uses.

C The voltage across all the components adds up to the voltage across the cell.

D The voltage can be measured using a voltmeter.

21 Which is true?

A Renewable energy resources will run out one day.

B Renewable energy resources will not run out.

C Non-renewable energy resources will not run out.

D None of our energy resources will run out.

22 Which of these is a non-renewable energy resource?

A solar

B wind

C natural gas

D moving water

23 Which statement is true?

A Solar panels are used to generate electricity.

B Solar cells and solar panels are the same.

C Solar cells are used to generate electricity.

D Solar cells are used to heat water.

24 Biomass is:

A a heavy weight.

B any fuel made from plant or animal material.

C a fuel made from plant material only.

D a fuel made from animal material only.

25 Which of these materials is a good conductor of heat?

A copper **B** air

C water **D** glass

26 When one end of a piece of metal is heated:

A the particles get closer together.

B the particles vibrate more and the vibrations are passed from particle to particle.

C the heat does not move through the metal.

D the particles get bigger.

27 Solids are better conductors than liquids or gases because:

A the particles are closer together in gases.

B the particles are closer together in liquids.

C the particles are closer together in solids.

D the particles in a solid cannot move.

28 Feathers are good insulators because:

A they are solid.

B birds have them.

C they trap pockets of air.

D they are waterproof.

29 Why do materials expand when they are heated?

A The particles get bigger.

B The particles move around more and take up more space.

C The particles get closer together.

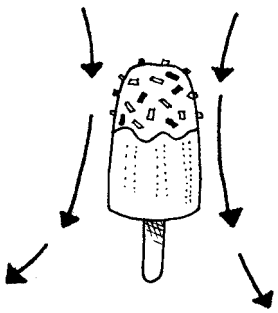
D The particles stick together.

30 Which substances can heat travel through by convection?

A solids and liquids **B** solids and gases

C only liquids **D** liquids and gases

31 Why does the cold air near the ice lolly move downwards?



A It is colder and denser than the surrounding air.

B It is warmer and denser than the surrounding air.

C It is colder and less dense than the surrounding air.

D It is warmer and less dense than the surrounding air.

32 Infrared radiation can travel through:

A transparent objects only.

B opaque objects only.

C empty space only.

D empty space and transparent objects.

33 Which forms of energy are often produced as wasted energy?

A heat and light

B heat and sound

C sound and light

D sound and kinetic

34 Kinetic Energy is:

A Measured in Newtons

B A type of fuel

C A form of energy in moving things

D Stored energy

8P 13c Reflection on Inquiry

Aim: Reflect on the Knowledge and Skills acquired in the Energy Production and Climate Change Unit through Inquiry

Questions asked	Answers found, and how we found them	Any further questions?
Factual - What technologies are available to produce sufficient energy to meet the needs of the human population? - What are the advantages and disadvantages of different sources of energy?		
Conceptual - How is electrical energy made and transferred? - How will the continued use of fossil fuels affect the environment and humankind? - How can the different sources of energy production be best utilised to minimise environmental change?		
Debatable - Is global collaboration required to minimise or prevent the consequences of climate change? - Is the use of nuclear power safe?		
Reflection on ALT (approaches to learning) used: - *Communication* - *Collaboration* - *Organisation* - *Research* - *Critical Thinking* - *Creative Thinking*		

8P 15a Welcome to Nimby

Newspaper Extract:

What kind of Power - Nimby must decide.
Village meeting next week.

Lynne Clarke reports.

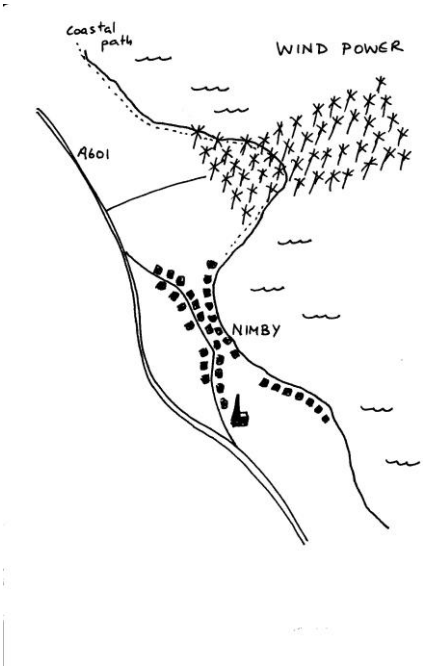
Next week the residents of Nimby will be consulted about how energy is provided for their growing population. The old coal power station at Nimby Ness is to close down and be dismantled. Two plans have been put to Nimby Council for a new way of providing energy. The first is for a nuclear power station to be built on the site of the old coal station. The second is for a wind farm of 100 wind turbines to be placed on Nimby Ness, extending 5km out to sea. The location at Nimby Ness is ideal for power generation as there is a water supply which could be used for cooling in the nuclear plant, as well as adequate wind speed from shoreline breezes.

A nuclear power station would also be able to supply energy to Benwick, the nearest small city. The wind generators would be able to supply a number of small towns like Nimby, but only part of the city.

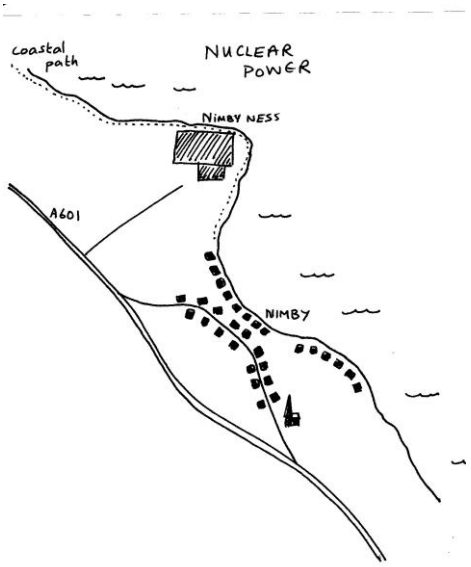
While the new installation is being built, which is estimated to take around 5 years, Nimby will import energy from Norway along cables laid under the North Sea. This is an expensive way of buying energy and isn't affordable in the long term. If the wind farm is chosen, there will still be a need for Nimby to take energy from other sources across the country, including nuclear stations.

At the crucial meeting, which will be held in Nimby village hall, representatives from Scottish Nuclear Power and Northern Wind will each present their case. Farmers and shopkeepers will be present alongside village residents and local councilors, who will have to take the final decision on the type of power station to be built. Planned locations for the rival stations are outlined on the next page.

Wind Power Solution



Nuclear Power Solution



Energy and Nimby – your views for the future.

We will be joined by experts on nuclear power and wind power. You will have a chance to say what you think and listen to others. We need to make decisions on how to supply the extra energy that Nimby needs. Your voice counts.

<u>Questions for you to address:</u>

- What role will I play? How can I get into the role?
- What do I need to find out in advance about nuclear power and about wind power?
- What might the perspectives of the other represented groups be?
- What questions might I need to prepare in advance – what would I like to know?

8P 15b Meeting Planning

You will be allocated one of the following roles:

- Nuclear Power Expert
- Wind Power Expert
- Farmer
- Local Councilor
- Shopkeeper
- Villager

You must carefully read the information about your role. Pay close attention to what you need to do to prepare for the meeting.

Role:

My role in the meeting is _____

How can I get into the role?

_____

_____

Research:

What do I need to find out in advance about nuclear power and wind power?

Here is some space for your research:

Perspectives:

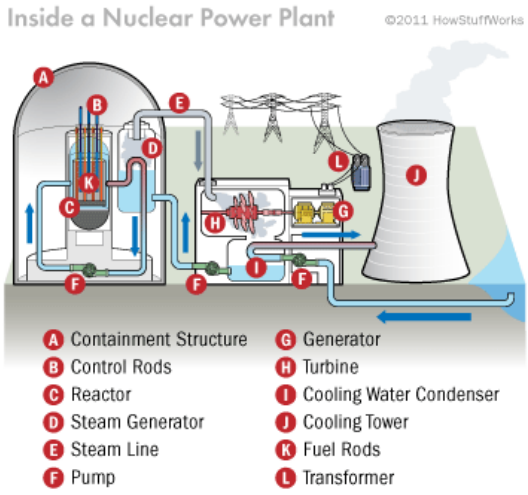
What might the perspectives of the other represented groups be? Try to come up with counterarguments if they agree with your views, or supporting arguments if they agree.

Questions:

What questions might I need to prepare in advance – what would I like to know?
Who will you ask these questions to?

Other Considerations / Additional Notes:

8P 16a Nuclear Power



How does it work?

Nuclear power stations use the energy released during **nuclear fission** reactions. The most common fuel used is uranium.

There are 3 parts of a nuclear power station:

1. Reactor
2. Turbine
3. Generator

In the table below, identify the energy transformations that take place in each part.

Part	Energy Transformation
reactor	nuclear energy → heat energy
turbine	heat energy → kinetic energy
generator	kinetic → electrical

Advantages and Disadvantages:

Write down 3 advantages and 3 disadvantages of using nuclear power.

Advantages:

1. _____
2. _____
3. _____

Disdvantages:

1. _____
2. _____
3. _____

So…..

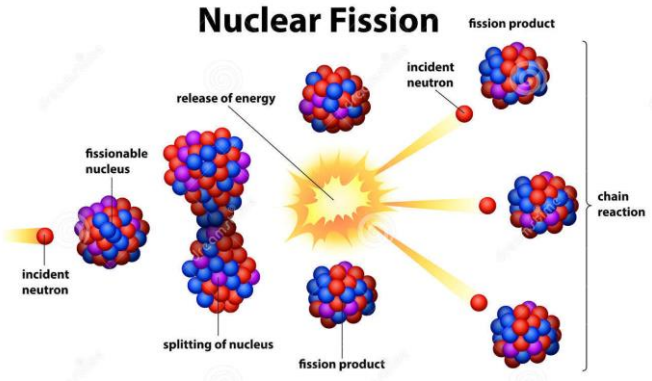
What is your opinion on Nuclear Power?

8P 16b Nuclear Power Extension Work

Nuclear Fission

A nuclear reactor uses a nuclear fission reaction to produce energy. Here is a diagram to illustrate a nuclear fission chain reaction:

Use this diagram to explain what happened in nuclear fission reaction:



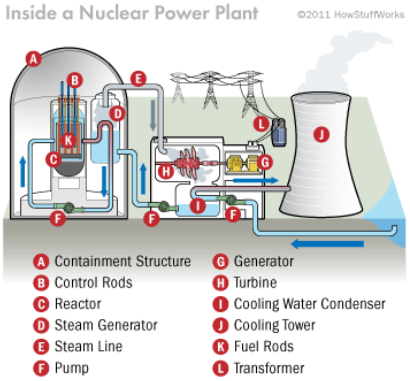
Parts of a Nuclear Power Station

You should know that a nuclear power station is comprised of 3 parts:

1. Reactor
2. Turbine
3. Generator

You should also know the energy transformations that take place in each part. There are however more parts that play an important role in ensuring safety and efficiency.

For each part listed in the table, research what it does then describe its function:

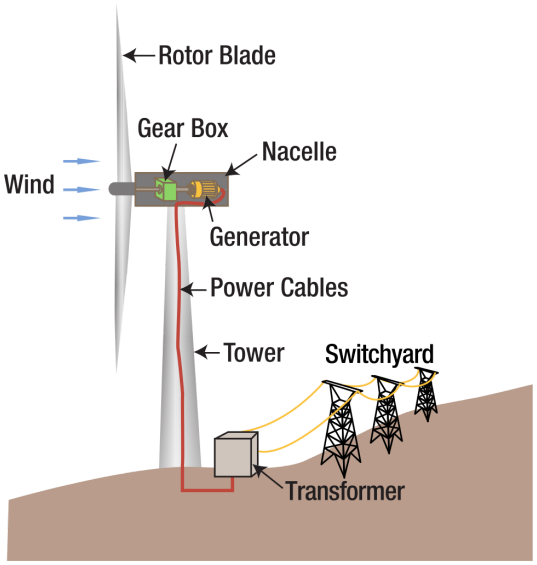


Part	Function
Containment Structure	
Control Rods	
Pump	
Condenser	
Cooling Tower	
Steam Line	
Transformer	
Fuel Rods	
Moderator	

8P 16c Wind Power

How does it work?

The kinetic energy of the wind turns the rotor. This then spins the dynamo which converts the KE into electrical energy.



There are 3 parts of a wind power turbine:

1. Rotor
2. Generator
3. Gearing systems

In the table below, identify the energy transformations that take place in each part.

Part	Energy Transformation
rotor	kinetic energy from wind → rotational kinetic energy
dynamo or electrical generator	kinetic energy → electrical energy

The gearing systems ensure that the turbine is always facing into the wind to maximize the available wind energy

Advantages and Disadvantages:

Write down 3 advantages and 3 disadvantages of using wind power.

Advantages:
1.

2.

3.

Disadvantages:

1.

2.

3.

So…..

What is your opinion on Wind Power?