

# Revision Placemats

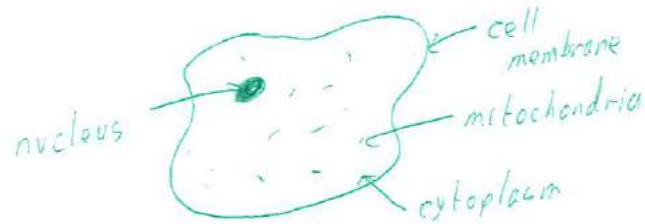
## CE13+ Science



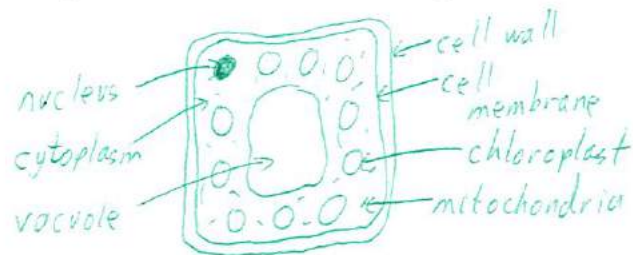
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## Cells and organisation

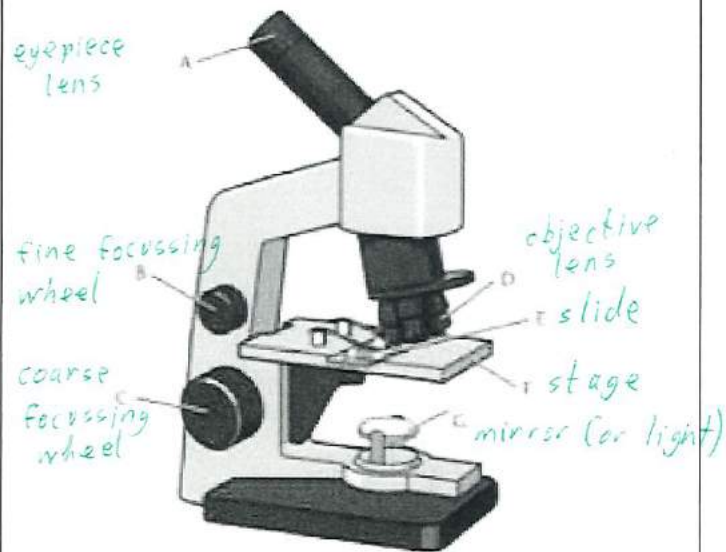
Draw an animal cell and label the 4 organelles.



Draw a plant cell and label the 7 organelles.



Label the diagram of the light microscope:



What are the functions of the following:  
(Underline the organelles only found in plants)

**Chloroplasts**

contain chlorophyll  
↳ absorbs light for photosynthesis

**Nucleus**

contains genetic information which codes for the production of proteins

**Mitochondria**

site of aerobic respiration

**Cell wall**

provides structure for the cell

**Vacuole**

stores cell sap

**Cell membrane**

controls what enters and leaves the cell

**Cytoplasm**

a jelly-like substance where most of the chemical reactions take place

Which organelle, usually found in plant cells, would you not expect to see in an onion skin cell (or a root hair cell)?

chloroplasts

Why?

No light for photosynthesis

Write a method for preparing a microscope slide for observing onion cells. You should include a stain.

1. Take a thin piece of onion skin  
and place on a slide
2. Add 1 drop iodine solution
3. Place a cover slip on top
4. Place slide on stage and  
focus microscope

What is a stain used for?

Highlighting certain  
organelles

Which stain is commonly used for animal cells?

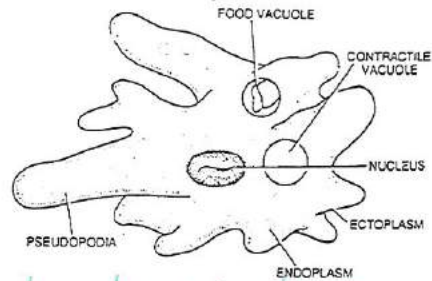
methylene blue

Which stain is commonly used for plant cells?

Iodine solution

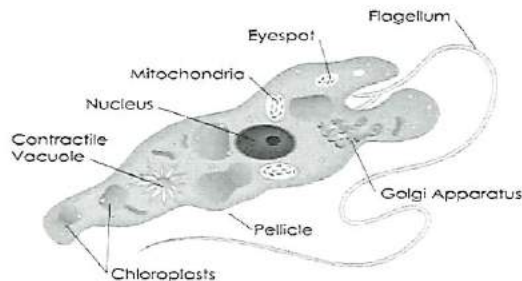


How are amoeba adapted to move and feed?



Pseudopods extend for movement  
and surround prey which can  
then be digested

How are euglena adapted to move and feed?

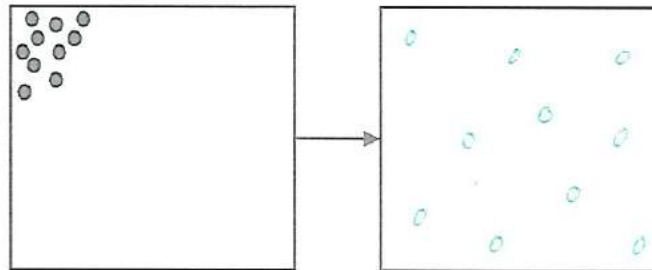


Movement - Flagellum  
Feeding - chloroplasts for  
photosynthesis

What is the definition for diffusion?

movement of particles from an  
area of higher concentration to  
an area of lower concentration

Complete the diagram below to show diffusion taking place.



Explain why only fluids can diffuse.

particles can move around each  
other

Which substances would you expect to diffuse into a cell?

1. glucose
2. oxygen

Which substances would you expect to diffuse out of a cell?

1. water
2. carbon dioxide

Write a definition for each of the words below and give an example:

Tissue

cells of the same type joined  
together

Example: muscle

Organ

TISSUES of different types joined  
together

Example in animals: heart, lungs etc.

Example in plants: roots, leaves etc.

Organ system

A number of organs working  
together

Example in animals: digestive, reproductive etc.

Example in plants: shoots, roots.

Organism

made of cells, can carry out >  
life processes

Example: humans

Complete each word to give the seven characteristics of life:

Movement  
Reproduction  
Sensitivity  
Growth  
Respiration  
Excretion  
Nutrition

## Gas exchange system

Put these stages in order:

- 1 Air is inhaled through the mouth and nose and enters the lungs
- 3 Oxygen is transported in the bloodstream to respiring cells
- 6 Carbon dioxide diffuses out of respiring cells into the bloodstream
- 2 Oxygen diffuses through the alveoli into the bloodstream
- 5 Oxygen is used in aerobic respiration
- 8 Carbon dioxide diffuses out of the bloodstream into the alveoli and is exhaled
- 4 Oxygen diffuses out of the bloodstream into respiring cells
- 7 Carbon dioxide is transported in the bloodstream to the lungs

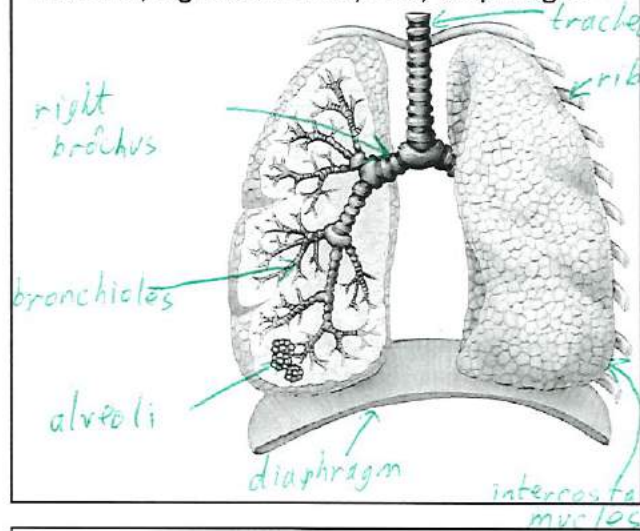
What is the difference between breathing and respiration?

Breathing: the inhalation/expiration of gases

Respiration: the release of energy from glucose (a chemical reaction)

Label the diagram below using these words:

Alveoli, trachea, bronchioles, intercostal muscles, right bronchus, ribs, diaphragm



Complete the sentences by filling in the gaps:

When we breathe in, the diaphragm contracts and moves down.

This decreases the pressure in the chest, causing air to be drawn into the lungs.

The intercostal muscles also contract, causing the ribs to move up and out.

This is important, as the lungs need more space when they are inflated.

By what process do gases pass through the walls of the alveoli? diffusion

Oxygen moves from the alveoli to the capillaries.

Carbon dioxide moves from the capillaries to the alveoli.

What are three ways in which the lungs are adapted for efficient gas exchange?

1. Large surface area -  
increases rate of diffusion
2. Wall of alveoli 1 cell thick -  
short diffusion distance
3. Good blood supply -  
maintains the concentration gradient



Write a method for measuring vital capacity.

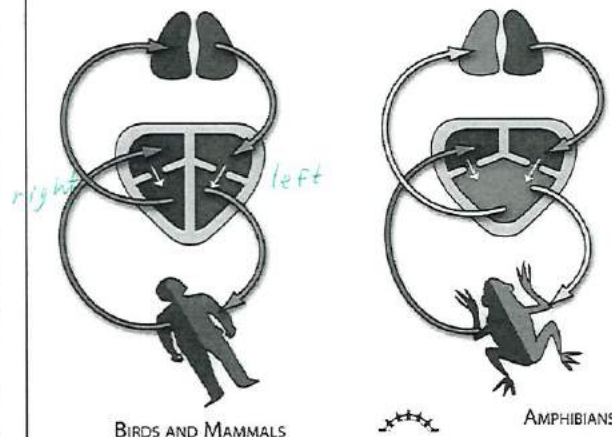
1. Take a deep breath in
2. Exhale into a lung volume bag
3. squeeze the air down to one end
4. Record the volume

From which type of tissue is the heart mostly made? muscle

What is the name for the type of blood vessel which transports blood away from the heart? arteries

What is the name for the type of blood vessel which transports blood towards the heart? veins

This is a simple diagram of the heart in mammals, and in amphibians:



What is the difference between the blood in the right side of the heart, and the left side of the heart in mammals?

Left = oxygenated (contains oxygen)  
Right = deoxygenated (doesn't contain oxygen)

A frog's heart allows blood on the left and right side to mix. Why is this less efficient than a human heart?

oxygenated and deoxygenated blood mix, so some deoxygenated blood will be carried back around the body.

Which three harmful chemicals can be found in cigarette smoke?

1. Nicotine  
Harmful because... Addictive + raises blood pressure
2. Tar  
Harmful because... sticks cilia together  
allows dust/bacteria to enter lungs
3. Carbon monoxide  
Harmful because... binds to red blood cells  
which prevents oxygen from being transported around the body.

Underline the false statements and edit them to make the statement true.

During exercise...

...the heart rate increases

...more oxygen is required for anaerobic respiration <sup>aerobic</sup>

...breathing rate decreases <sup>increases</sup>

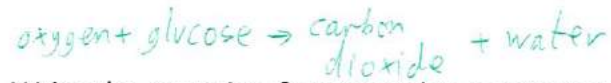
Following exercise...

...the heart rate returns to zero <sup>normal (resting)</sup>

...we continue to breathe heavily to repay an oxygen debt

## Respiration

Write the word equation for aerobic respiration in animals.



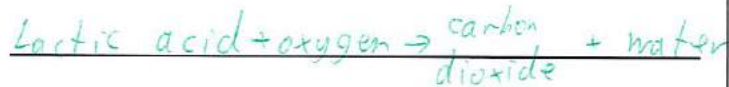
Write the equation for anaerobic respiration in animals.



Explain why, after strenuous exercise, a person's heart rate remains high. You should include a chemical equation in your answer.

Lactic acid must be broken down.

this requires oxygen.



In which organelle does aerobic respiration take place?

mitochondria

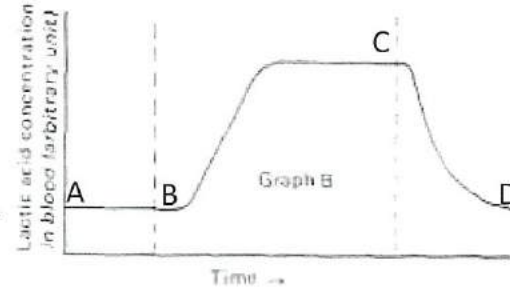
In which organelle does anaerobic respiration take place?

cytoplasm

Which type of respiration releases more energy from glucose?

aerobic

Explain the shape of the graph for this 100 m runner. Suggest what the athlete may be doing at each point.



A → B - resting

B → C - increase in lactic acid due to anaerobic respiration

C → D - decrease in lactic acid as it is broken down after exercise

Complete the table below comparing aerobic and anaerobic respiration in animals.

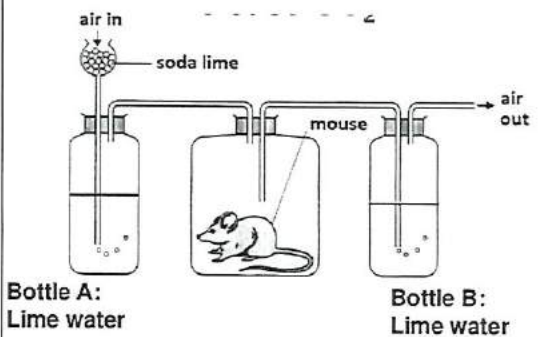
Similarities	Differences
Both release energy	Aerobic requires oxygen Anaerobic doesn't
Both require glucose	Aerobic releases more energy
	Aerobic produces $\text{CO}_2$ + $\text{H}_2\text{O}$ Anaerobic produces lactic acid

What is the chemical test for carbon dioxide?

Test: Bubble through limewater

Result: Colourless → cloudy white

Explain what will happen to the limewater in Bottle A and Bottle B.



Bottle A: stays colourless

↳ Not enough  $\text{CO}_2$  in air

Bottle B: Goes cloudy white

↳ mouse respires and exhales  $\text{CO}_2$



Write the word equation for anaerobic respiration in yeast (and other fungi).

Glucose  $\rightarrow$  ethanol + carbon dioxide

What are two uses for yeast?

1. Baking
2. Brewing beer

Explain why adding yeast to bread dough causes it to rise.

Yeast respire and produces carbon dioxide. This makes bubbles causing bread to rise.

A group of students investigated how the mass of glucose added to some yeast affected the mass of carbon dioxide which was given off.

Use the graph on the right to answer these questions:

Independent variable

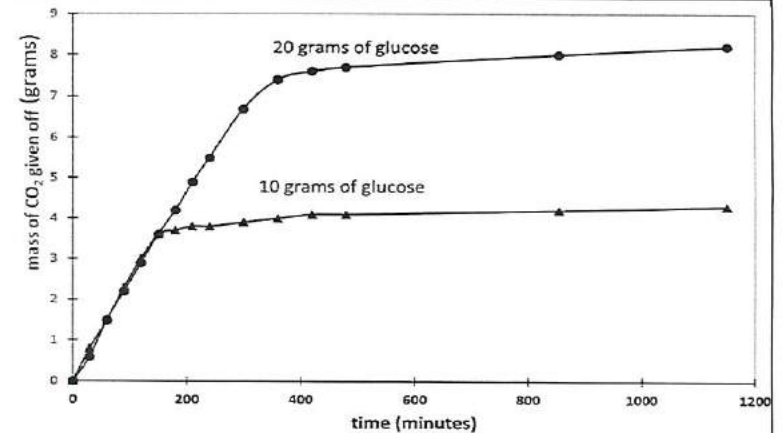
Mass of glucose added

Dependent variable

mass of  $\text{CO}_2$  given off

Control variables

- mass of yeast
- temperature



Describe the difference between the lines.

Why did both lines reach a maximum?

- The more glucose used, the larger the mass of  $\text{CO}_2$  produced.
- Both reach a maximum because all of the glucose has been used.

Write a method to investigate how temperature affects the rate of respiration in yeast.

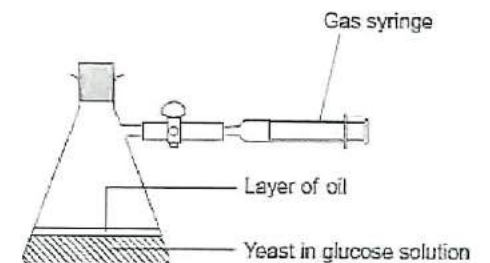
Equipment:

- Gas syringe
- Stop clock
- Water baths
- Yeast
- Glucose solution
- Conical flask
- Balance
- Measuring cylinder

1. Set up the equipment as shown in the diagram.
2. Add 50 mL yeast solution and 10 mL glucose solution to the conical flask.
3. Place into a water bath at  $5^\circ\text{C}$
4. Record the volume of  $\text{CO}_2$  after 10 minutes
5. Repeat steps 2-4 using different temperature water baths.

How could you improve the reliability of your investigation?

Repeat and calculate the mean.

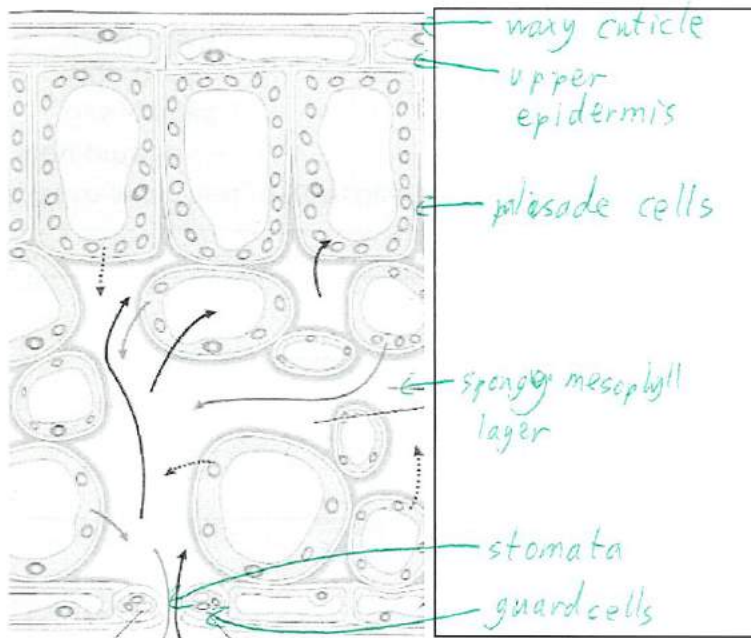


# Photosynthesis

Write the word equation for photosynthesis

carbon dioxide + water  $\xrightarrow{\text{light}}$  glucose + oxygen

Label the diagram of the leaf using the labels in the next question.



Describe the function of each part of the leaf:

Spongy mesophyll: Allows gases to diffuse within the leaf

Waxy cuticle: Prevents water loss

Palisade cells: contains chloroplasts for photosynthesis

Guard cells: Fill with water to open/close the stomata

Stomata: Allows gases to enter/leave the leaf

Upper/lower epidermis: protects the leaf

Explain how the large surface area of leaves makes them well adapted to photosynthesising.

Absorbs more light

Explain why thin leaves allow more efficient photosynthesis.

less light absorbed by other parts of the leaf

In which organelle does photosynthesis take place?

chloroplasts

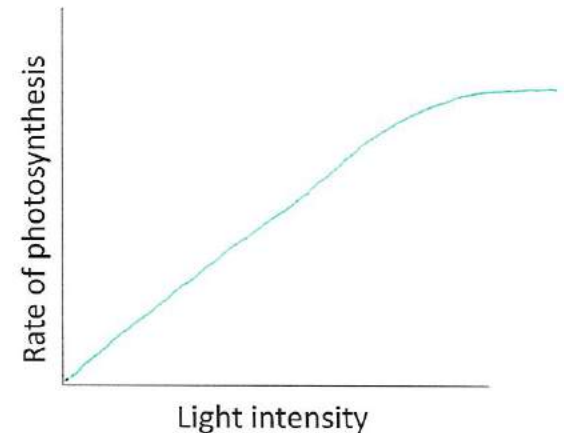
At what time of the day are stomata most likely to be open/closed? Why?

Open during daylight - allows gas exchange for photosynthesis

Which 3 factors are most likely to limit the rate of photosynthesis?

- Temperature
- concentration of carbon dioxide
- Light intensity

Sketch a graph to show the relationship between distance (from light source) and rate of photosynthesis



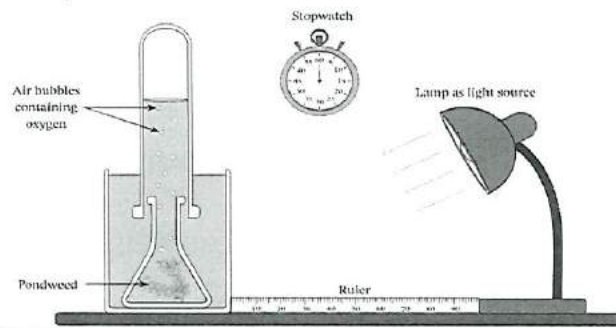
What is the name of the green pigment which absorbs light?

Chlorophyll



Write a method to investigate how the rate of photosynthesis is affected by light intensity.

1. Set up the equipment as shown in the diagram.
2. Add a 10 cm piece of pondweed to the flask.
3. Count the number of bubbles produced in 1 minute when the lamp is at 10 cm from the beaker.
4. Repeat at different distances.



What is the role of the xylem in plants?

Transporting water

What is the role of the phloem in plants?

Transporting sugars (sucrose)

What must be kept the same during the investigation?

- Length of pondweed
- Type of pondweed
- Temperature

How could the investigation be made more reliable?

Repeat and calculate the mean.

What is a better method of measuring the amount of oxygen produced?

Use a gas syringe

Why is photosynthesis important for life on Earth?

1. Creates biomass (food) for animals
2. Release oxygen - required for respiration
3. Absorbs carbon dioxide - reduces the greenhouse effect

Write a method to describe how a leaf can be tested for starch.

1. Boil the leaf in water
2. Boil the leaf in ethanol to remove chlorophyll
3. Rinse and add a few drops of iodine solution
4. If starch is present iodine solution goes from orange/brown to blue/black.

This method is repeated using a leaf which has been wrapped in tin foil for 72 hours. What would you expect to see?

Iodine solution stays orange/brown  
↳ No photosynthesis has taken place

What are two mineral ions required by plants?

1. Nitrates

Used for... Growth

2. Magnesium

Used for... production of chlorophyll

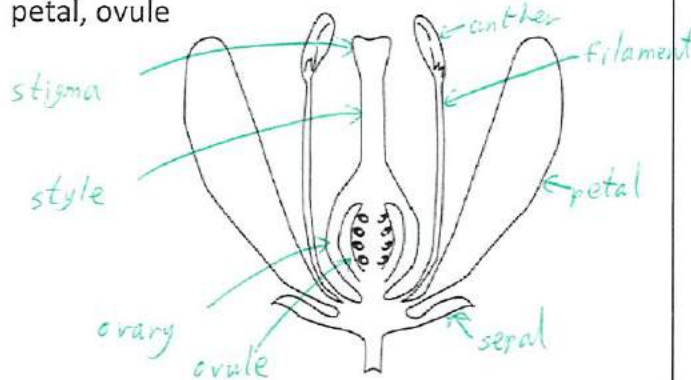
## Reproduction in plants

Put these stages for reproduction in plants in order:

- 2 Fertilisation
- 4 Germination
- 5 Growth
- 1 Pollination
- 3 Dispersal

Label each part of the flower using the following words:

Sepal, anther, stigma, style, ovary, filament, petal, ovule



Which two parts make up the male part of the flower? Filament and anther

Which four parts make up the female part of the flower? stigma, style, ovary,

ovule

What is the difference between pollination and fertilisation?

Pollination: The transfer of pollen from the anther of one plant to the stigma of another plant

Fertilisation: The fusion of the nuclei from the male and female gametes

Suggest two methods of pollination:

1. Insect/animal pollination
2. Wind pollination

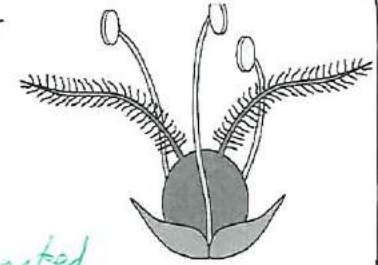
Suggest two ways in which flowers pollinated by bees have adapted.

1. Brightly coloured petals
2. Strong smells

Why do wind pollinated flowers not grow in forests?

Pollen gets trapped by trees

Explain whether this flower is likely to be insect or wind pollinated.



wind pollinated

- no petals to attract insects
- no exposed anther / stigma

What is the name of the male gamete in plants? pollen

Where is this produced? anther

What is the name of the female gamete in plants? egg (ovum)

Where are these produced? ovary

What must happen after pollination for fertilisation to occur?

A pollen tube grows down the style to transport the pollen to the egg.



Why is seed dispersal important?

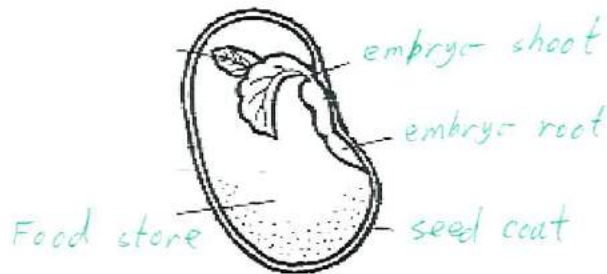
Avoids competition for  
resources

Suggest three methods of seed dispersal.

1. Animals eat + egest seeds
2. Wind (parachutes)
3. Water (low density seeds)

Label each part of the germinating seed using the following labels:

Seed coat, embryo root, embryo shoot, food store



Which three things are required by germinating seeds?

1. water
2. oxygen
3. warmth

Seeds are stored inside fruit. Explain why they need a hard coat, and how this helps with seed dispersal.

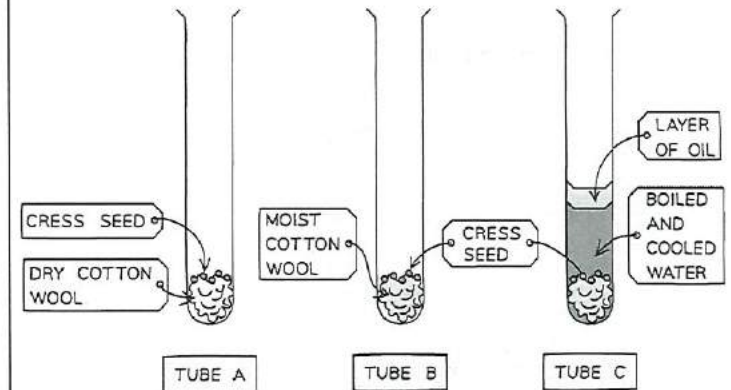
- Fruit is eaten by animals
- seeds are protected from being digested by the hard coat.
- Animals walk around and egest the seeds.

Why do germinating seeds require a food store?

Used for energy for growth until  
the plant can photosynthesise

What happens after the food store has been used up?

plant uses photosynthesis to  
make glucose



Explain which of these seeds you would expect to germinate and which you would not expect to germinate.

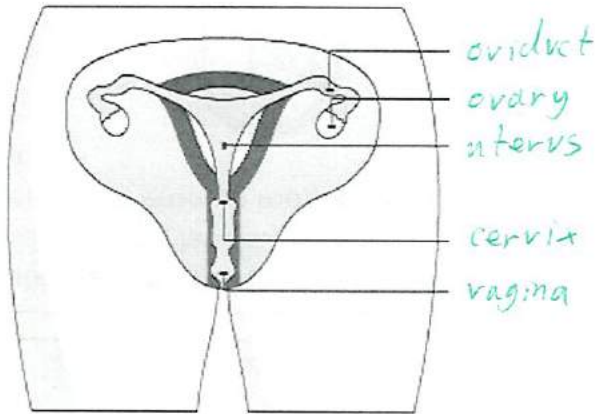
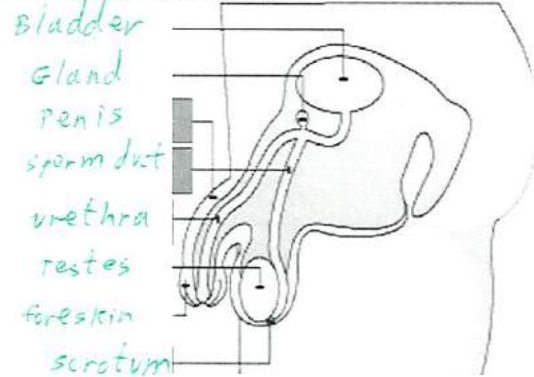
Tube A - X (no water)

Tube B - ✓ (water, oxygen + warmth)

Tube C - X (no oxygen)

## Reproduction in animals

Add labels to the diagrams below



What is the definition for the term 'gamete'?

A sex cell

What is the male gamete in mammals?

Sperm

What is the female gamete in mammals?

Egg

What is the definition for the term 'fertilisation'?

The fusing of the nuclei from the male / female gametes

What is the definition for the term 'zygote'?

A fertilised egg cell

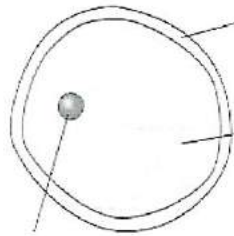
Which is bigger, a sperm cell or an egg cell?

Egg cells

What is special about the nucleus in gametes?

contains half the number of chromosomes (23)

Write down three adaptations of sperm cells and egg cells.



1. Store of nutrients to begin growth

2. Nucleus with 23 chromosomes

3. Wall hardens to prevent multiple sperm entering

1. Flagellum for movement



2. Streamlined shape for efficient movement

3. Lots of mitochondria for energy

Put the stages of the menstrual cycle in order. Complete the final stage yourself.

1 The lining of the uterus breaks down

4 The egg travels down the oviduct towards the uterus

3 On day 14, the egg is released

2 An egg starts to develop and mature inside one of the ovaries and the lining of the uterus starts to build up

If the egg is fertilised...  
the zygote implants on

5 the lining of the uterus and a fetus develops

If the egg is not fertilised...  
the egg passed through the uterus and out through the vagina

5



Approximately how long is the gestation period in humans? 40 weeks

Animal	Gestation period (days)
Dog	61
Hamster	20
Elephant	645
Cow	286
Lion	108

What can you infer from this data about the gestation period of different mammals?

Larger mass = longer gestation period.

Which substances are transported from the mother to the fetus?

1. Oxygen
2. Nutrients
3. Water

Which substance is transported from the fetus to the mother?

Carbon dioxide

By what process does the transfer of substances between the mother and fetus take place?

Diffusion

Suggest 2 chemicals which may be harmful to the development of the fetus.

1. Nicotine

2. Alcohol

Describe how one of these substances may reach the fetus. Use the diagram on the right to help you.

1. Mother inhales cigarette smoke

2. Nicotine diffuses into bloodstream

and is transported to placenta

3. Diffuses through placenta into umbilical cord.

Which of these changes happens during puberty in boys? Which happens in girls?

Put a 'B' for boys and 'G' for girls.

Ovaries start to develop and release eggs G

Voice deepens B

Hips widen G

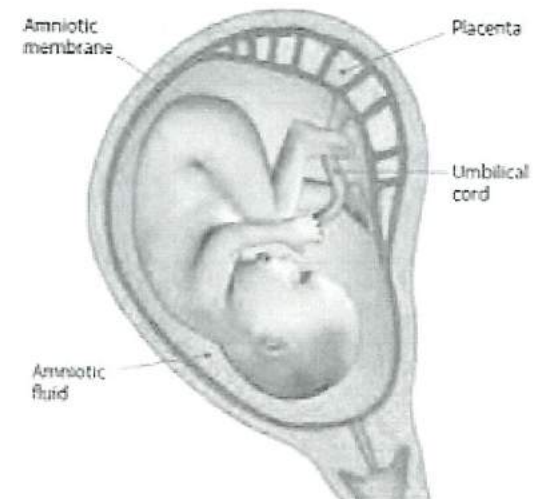
Breasts develop G

Shoulders broaden B

Hair starts to grow on body B+G

Testes start to produce sperm B

Sudden increase in height B+G



## Diet and nutrition

State the function of each nutrient (or food group) in the body:

Carbohydrates - Provides energy

Proteins - Growth + repair

Fats (lipids) - Insulation  
- Energy  
- protects vital organs

Fibre - prevents constipation

Water - regulates body temperature

Vitamin C (a vitamin)  
↳ Growth + repair  
↳ strengthens immune system

Calcium (a mineral)  
↳ strong teeth/bones

What are the two main types of carbohydrate?

1. simple sugars (e.g. glucose)
2. starch

### Starter:

Carrot and coriander soup with buttered bread

### Main:

Sausage and mashed potato with peas

### Dessert:

Lemon meringue pie with ice-cream

In the menu above, which foods are a good source of:

Carbohydrate - bread, potato, pastry

Protein - sausage

Fat (lipids) - butter, sausage, ice-cream

Fibre - carrot, peas

Water - soup

Vitamin C - lemon

Calcium - ice-cream

Why would a pregnant woman need to eat lots of protein?

Used for growth of new cells

↳ Allows fetus to develop

Why would a marathon runner eat pasta before a race and jelly-babies during the race?

Pasta - slow release energy  
(starch)

Jelly-babies - fast release energy  
(glucose)

Which disease is caused by a lack of vitamin C?

Scurvy

Which disease is caused by a lack of calcium?

Rickets

Describe the food test for starch:

Test: Iodine solution

Result: orange/brown → blue/black

Describe the food test for glucose:

Test: Benedict's solution heated

Result: Blue → green/yellow/orange/red.



Write a method to determine which food stores the most energy.

Equipment:

- Various foods
- Tongs
- Bunsen burner
- Thermometer
- Test tube
- Measuring cylinder

1. Add 20mL water to a test tube and record the temperature
2. Burn the food and use to heat the water
3. Record the temperature change of the water.
4. Repeat using the same mass of other foods.

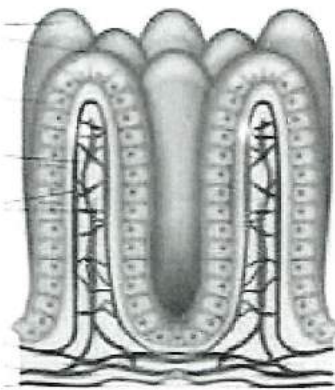
What is the name of the enzyme found in the mouth which breaks down starch?

Amylase

Match each organ with its function:

- |                 |   |
|-----------------|---|
| Mouth           | Stores feces before it is egested   |
| Small intestine | Contains acid which kills bacteria and helps to break down food.<br>Made of muscle to mechanically break down food. |
| Stomach         | Removes excess water from food  |
| Esophagus       | Transports food from the mouth to the stomach   |
| Rectum          | Nutrients pass through the villi into the bloodstream, by diffusion.  |
| Large intestine | Egests food   |
| Anus            | Contains teeth which mechanically break down food.<br>Contains enzymes which chemically break down food.            |

The wall of the small intestine is lined with 'finger-like' projections called villi. What are three adaptations of the villi which allow nutrients to diffuse quickly into the bloodstream?



1. Large surface area - faster diffusion
2. Good blood supply - maintaining the concentration gradient
3. Walls one cell thick - reduces diffusion distance

## Health and the skeleton

What are the three roles of the skeleton?

- Support
- Movement
- Protection

Which words are used to describe...

- Two muscles working in opposing pairs?

Antagonistic

- The shortening of muscle fibres?

Contract

- The lengthening of muscle fibres?

Relax

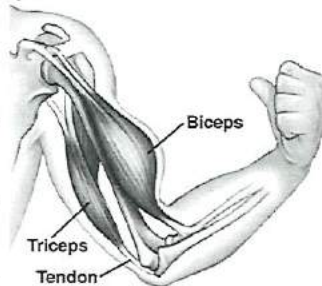
Explain, using the diagram, how we bend and straighten our arm.

Bending - bicep

contracts and

triceps relaxes

straightening - opposite



What are the four types of pathogen (disease causing organisms)?

- Virus
- Bacteria
- Fungus
- Protist

Give two examples of diseases caused by viruses:

- HIV
- Flu

Give two examples of diseases caused by bacteria:

- Tuberculosis
- Cholera

Why can antibiotics not be used to treat the flu?

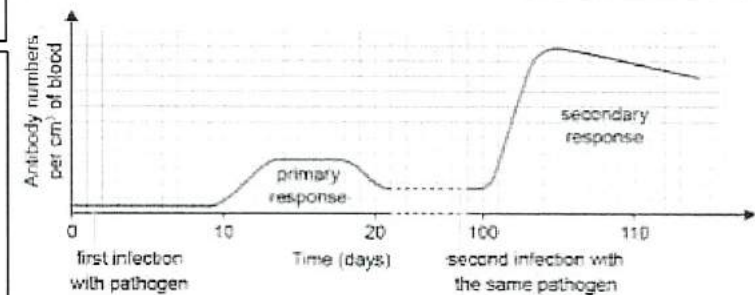
Antibiotics can only be used to  
fight bacteria.

What is the function of white blood cells?

Fight pathogens

Use the graph at the bottom to explain why we cannot catch the same disease twice.

- After being infected, white blood cells are produced
- Once the pathogen has been destroyed, some of the white blood cells remain in the bloodstream.
- If the same pathogen enters the body, it can be easily destroyed





What are three diseases which can be caused by smoking?

- Lung cancer
- Heart disease
- Lung disease

Which organs are most affected by drinking alcohol?

- Brain
- Liver

Which diseases can be caused by a lack of exercise and eating too much fat/sugar?

- Heart disease
- Diabetes

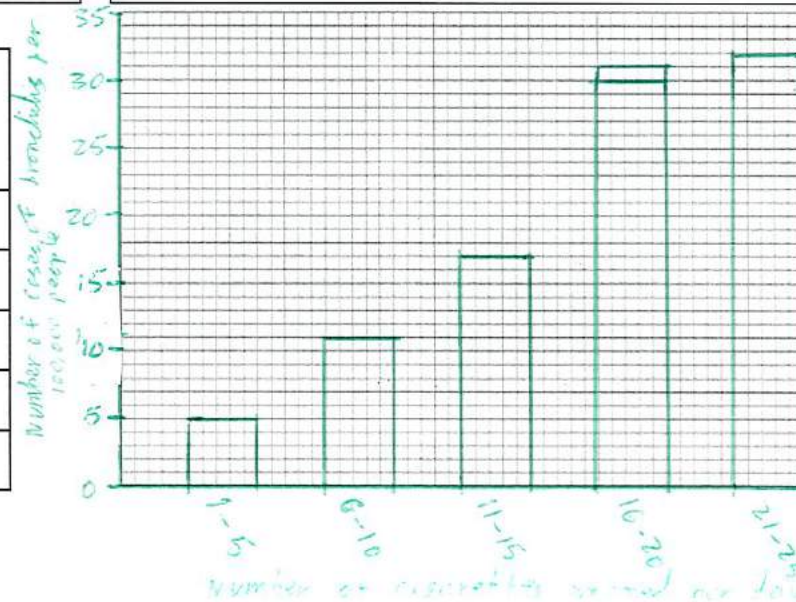
MRSA is a disease which is caused by a bacterium. It spreads quickly in hospitals when people are close to each other and when they touch infected surfaces.

Month	Number of MRSA cases reported
November 2015	65
December 2015	68
January 2016	73
February 2016	56
March 2016	48
April 2016	35
Total	345

Calculate the total number of cases during this time period.

Plot a **bar** graph of the data on the left.

Number of cigarettes smoked per day	Number of bronchitis cases per 100,000 people
1-5	5
6-10	11
11-15	17
16-20	31
21-25	32



Describe the patterns shown in the data from November 2015 to April 2016.

- Number of cases increase until January, and then decrease until April.

Suggest an explanation for the pattern shown in the data.

More people in hospitals during winter, so can be spread more easily

What could be done to limit the spread of MRSA?

- Hand-washing
- social-distancing
- covering mouth/nose

## Relationships in an ecosystem

Suggest 3 resources that plants need to survive;

- Light
- water
- nutrients

What is the definition for a...

Habitat

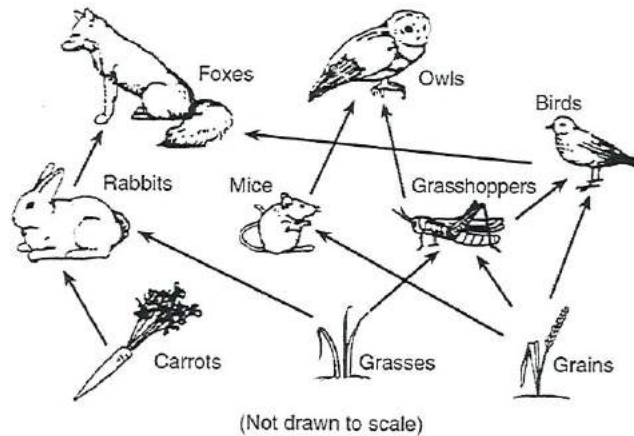
The place where an organism lives

Species

Two organisms which can reproduce to produce fertile offspring

Draw a food chain which includes:  
A hawk, a mouse, a snake, grains

Grains → mouse → snake → hawk.



What is the impact on the food web of a disease killing all of the birds?

- Number of grains increases
- population of foxes decreases

Where does all of the energy in a food chain ultimately come from?

The sun

Which of the organisms in the food web is a producer?

Carrots, grasses, grains

Which of the organisms in the food web is a predator?

birds, owls, foxes

Suggest 3 factors which may affect the population of tuna in the sea:

- Population of predators
- Population of prey
- Amount of pollution

In a food chain, not all of the energy is transferred from organism to organism. What are some of the sources of energy loss?

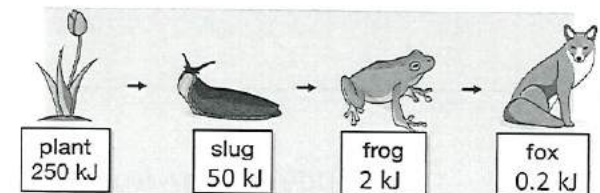
- Energy lost through movement
- Not all biomass is consumed (bones etc.)
- Heat losses (respiration)
- 

Calculate the percentage energy transfer at each stage in the food chain.

Plant → slug:  $\frac{50}{250} \times 100 = 20\%$

Slug → frog:  $\frac{2}{50} \times 100 = 4\%$

Frog → fox:  $\frac{0.2}{2} \times 100 = 10\%$





How might the introduction of wolves (carnivores) to an ecosystem also affect the population of some plant species?

- Wolves eat herbivores.
- Population of herbivores decreases
- Less competition of plants
- Population of plants increases

Maria collected the following data by randomly placing a 1 m<sup>2</sup> quadrat in a 50 m x 60 m field. Calculate an estimate for the total number of flowers in the field.

Trial number	Number of flowers
1	10
2	4
3	11
4	7
5	6
6	9

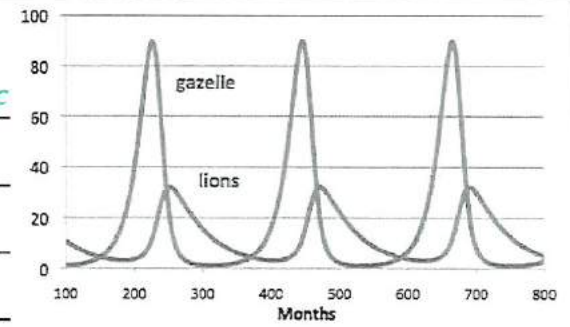
$$\frac{10+4+11+7+6+9}{6} = \frac{67}{6} = 7.8\bar{3}$$

$$50 \times 60 = 3000$$

$$3000 \times 7.8\bar{3} = 23500$$

Explain the shape of the graph on the right.

As number of prey increase, less competition of lions, so population of lions increases.  
Larger population of lions causes population of gazelle to fall.



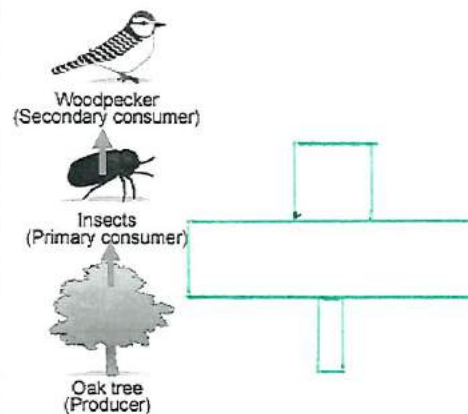
What is conservation?

Actions taken to protect endangered species

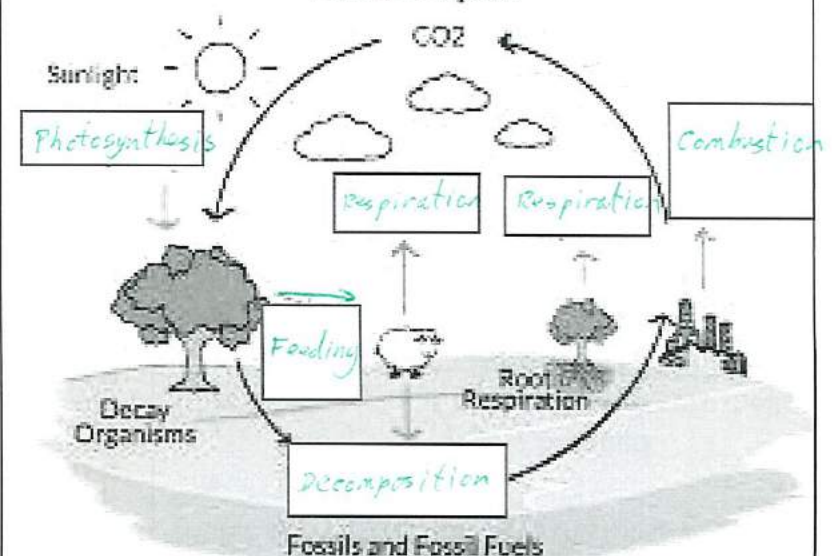
Suggest 2 conservation activities that humans could do to increase biodiversity

- Introducing laws banning hunting and habitat destruction
- Captive-breeding programmes

Draw a pyramid of numbers for this food chain:



Add the process taking place in each box.  
**Carbon Cycle**



## Variation, classification and inheritance

What are the five kingdoms?

- Animal
- Plant
- Fungi
- Protist
- Bacteria

What is a vertebrate?

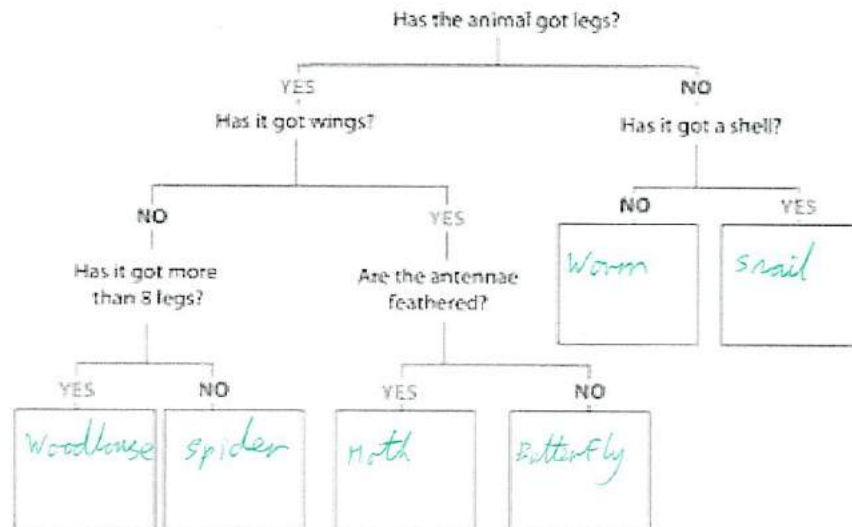
Animal with a backbone

What is an invertebrate?

Animal without a backbone

WILF: Use a key to identify an animal or plant

Use the simple key on the right to sort out the organisms.



Add a tick to the appropriate boxes:

	Animal cells	Plant cells	Fungus cells
Multicellular	✓	✓	some
Nucleus	✓	✓	✓
Chloroplasts	x	✓	x
Cell wall	x	✓	✓
Cell membrane	✓	✓	✓
Cytoplasm	✓	✓	✓
Vacuole	x	✓	✓
Mitochondria	✓	✓	✓

Match the description with the Class of animal

- |            |   |
|------------|---|
| Mammals    | <ul style="list-style-type: none"> <li>• Cold blooded</li> <li>• Lay eggs with soft shells</li> <li>• Have scales and dry skin</li> </ul> |
| Reptiles   | <ul style="list-style-type: none"> <li>• Cold blooded</li> <li>• Lays eggs in water</li> <li>• Has scales and wet skin</li> </ul>         |
| Amphibians | <ul style="list-style-type: none"> <li>• Three main body parts</li> <li>• 6 legs</li> <li>• Arthropods</li> </ul>                         |
| Birds      | <ul style="list-style-type: none"> <li>• Warm blooded</li> <li>• Gives birth to live young</li> <li>• Feeds its young milk</li> </ul>     |
| Fish       | <ul style="list-style-type: none"> <li>• Two main body parts</li> <li>• 8 legs</li> <li>• Arthropods</li> </ul>                           |
| Insects    | <ul style="list-style-type: none"> <li>• Cold blooded</li> <li>• Lays eggs in water</li> <li>• Doesn't have scales</li> </ul>             |
| Spiders    | <ul style="list-style-type: none"> <li>• Warm blooded</li> <li>• Lays eggs with hard shells</li> <li>• Has feathers</li> </ul>            |





What is meant by the term 'variation'?

Differences between organisms

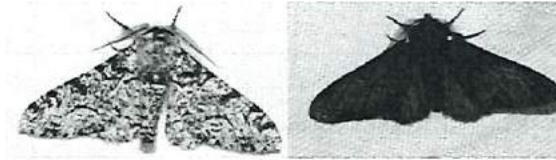
Several different types of variation are listed below. Sort them into the correct columns in the table.

- Number of scars
- Height
- Eye colour
- Blood type
- Natural hair colour
- Whether you can roll your tongue
- Weight
- Hair length

Continuous	Discontinuous
Height	Number of scars
Weight	Eye colour
Hair length	Blood type
	Natural hair colour
	Tongue rollability

Genetic	Environmental	Both
Eye colour	Number of scars	Height
Blood type	Hair length	Weight
Natural hair colour		
Tongue rollability		

During the industrial revolution, it was observed that the proportion of peppered moths which were black increased. Explain why this happened (hint: soot turns building black).



1. Some moths are black, some are not
2. Black moths are better able to camouflage against black buildings
3. More black moths survive and reproduce
4. Offspring are also black.

In what habitat do polar bears live?

Cold, snowy, icy

How have polar bears adapted to their habitat?

- Thick fur - insulation
- White fur - camouflage for hunting
- Large paws - prevents sinking into snow
- Large claws - gripping ice and hunting.

In what habitat do cacti live?

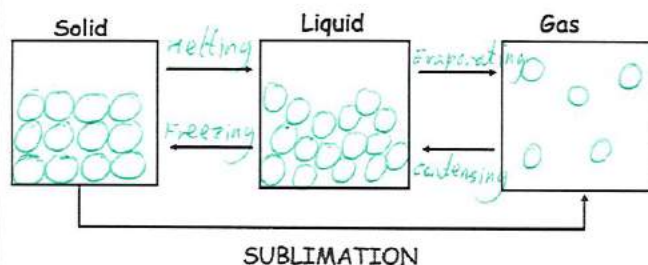
Desert

How have cacti adapted to their habitat?

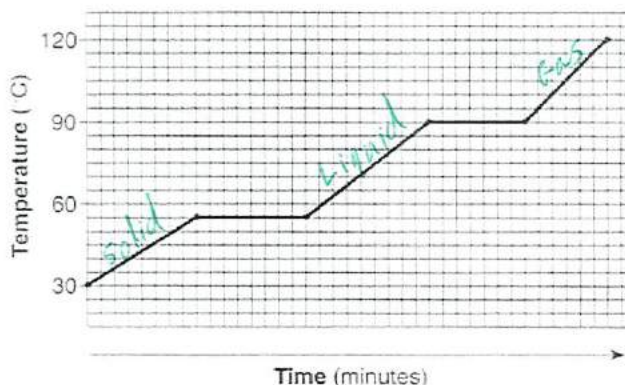
- Long roots - collect water from a larger area
- Waxy skin - prevents water loss
- Spikes - protection from predators
- No leaves - reduces water loss

## Particulate nature of matter

Draw particles diagrams for each state of matter and add the names of the changes of state.



On the graph, label where the substance is a solid, a liquid and a gas.



What is the melting point? 55°C

What is the boiling point? 90°C

What is happening during a change of state?

Intermolecular forces get weaker.

	Solid	Liquid	Gas
Arrangement	- Regular - Touching	- Random - Touching	- Random - Far apart
Movement	vibrate about a fixed point	move around each other	move quickly and freely
Intermolecular forces	strong	weak	negligible (almost zero)

Explain why liquids and gases can flow, but solids cannot.

In liquids and gases the particles can move around each other due to weaker intermolecular forces.

Explain why gases can be compressed, but solids and liquids cannot.

There is space between the particles in a gas, so they can move closer together.

Substance	Melting point /°C	Boiling point /°C	State at 25°C	State at -50°C
Water	0	100	Liquid	solid
Iron	1538	2862	solid	solid
Mercury	-39	357	Liquid	solid
Oxygen	-218	-183	Gas	Gas
Bromine	-7	59	Liquid	solid
Iodine	114	184	solid	solid

Explain why ice floats in water.

It has a lower density than water because the particles are further apart in ice than liquid water.

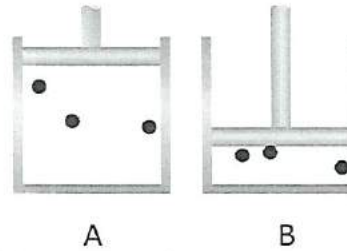


Explain how a thermometer works.

When warmed, the red liquid expands. This causes it to move up the tube.

Which of these gases is under higher pressure?

B



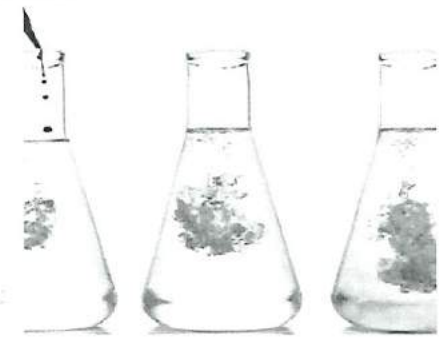
Explain what would happen to the gas pressure if the gas was heated up.

Pressure would increase

- More frequent collisions

- Higher energy collisions

When food colouring is added to water, it spreads out.



What is this called? Diffusion

What is the definition for this process?

The movement of particles from an area of higher concentration to an area of lower concentration.

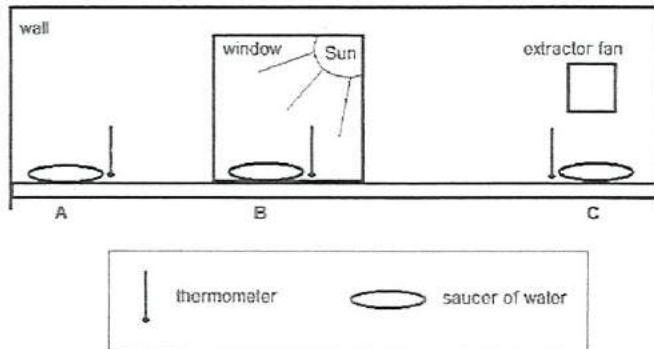
Explain what causes this process to take place.

Water molecules move around and collide with the food colouring particles causing them to spread out.

Would this happen faster or slower if the particles in the food colouring had a larger mass?

Slower

Some students are investigating how temperature and air flow affect the rate of evaporation. They set up their equipment as in the diagram.



What is the purpose of saucer A?

It is a control (allows comparison)

What would be the best way to measure the quantity of water which has evaporated?

Measure the change in mass

Why did they use a saucer of water instead of a beaker?

Larger surface area, so faster evaporation

What are some control variables?

- volume of water
- Time allowed
- surface area of container

## Atoms, element and compounds

What is the definition for:

Atom

The smallest particle of a chemical element which can exist

Element

Atoms of the same type

Compound

Atoms of different types chemically bonded together

Molecule

Two or more atoms chemically bonded together

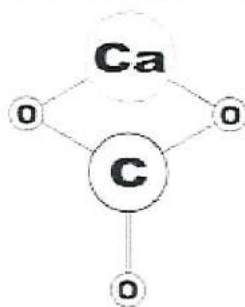
Mixture

Particles of different types not chemically joined together

Add each of these substances to both tables below:  $O_2$ ,  $H_2O$ ,  $Co$ ,  $CH_4$ ,  $Ar$ ,  $Br_2$ ,  $CO_2$ ,  $Ne$ ,  $CO$

Element	Compound
$O_2$	$H_2O$
$Co$	$CH_4$
$Ar$	$CO_2$
$Br_2$	$CO$
$Ne$	

Atom	Molecule
$Ar$	$O_2$ $CO$
$Co$	$Br_2$
$Ne$	$H_2O$
	$CH_4$
	$CO_2$



Write the formula for this compound.

$CaCO_3$

How many atoms are in this compound?

5

What is the name of this compound?

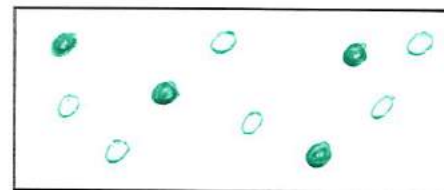
Calcium carbonate

Name the compound:

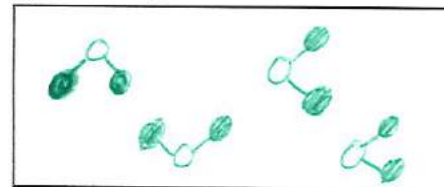
1.  $CuSO_4$  – Copper sulfate
2.  $FeO$  – Iron oxide
3.  $HCl$  – Hydrogen chloride
4.  $CO_2$  – Carbon dioxide
5.  $NaOH$  – Sodium hydroxide
6.  $Al(NO_3)_3$  – Aluminium nitrate

Draw:

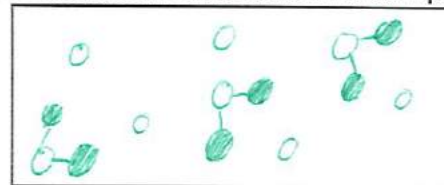
A mixture of elements



A pure compound



A mixture of elements and compounds





Complete the table with some of the physical properties of each substance.

Iron	Sulfur	Graphite
Good conductor of heat	Poor conductor of heat	Good conductor of electricity
Good conductor of electricity	Poor conductor of electricity	Brittle
Malleable	Brittle	
Lustrous	Dull	
Magnetic		

What is the definition for a physical change?

A change where no new substances are made

What is the definition for a chemical change?

A change where new substances are made.

What are some signs that a chemical reaction is taking place?

- Temperature change
- Colour change
- Light given off
- Gas given off

Put a tick in the correct box for each example

Description of change	Physical	Chemical
Cooking an egg		✓
Dissolving sugar in water	✓	
Melting wax	✓	
Respiration		✓
Lighting a match		✓
A towel drying	✓	
Separating inks using chromatography	✓	

Which three factors affect the rate at which a substance will dissolve?

- stirring
- temperature
- surface area of solute

In the graph below, what mass of sugar will dissolve in water at 64°C?

305 g

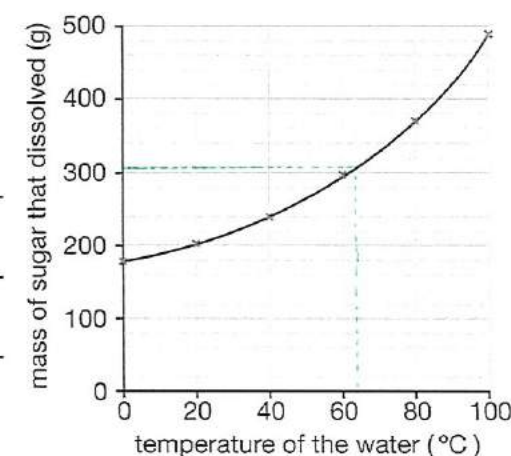
Use the graph to answer these questions:

1. Describe the results in the graph

As the temperature increases, the mass of sugar dissolved increases at an increasing rate

2. Explain the results in the graph.

Higher temperature means that water particles are further apart. Therefore, there are more gaps for sugar to fill.



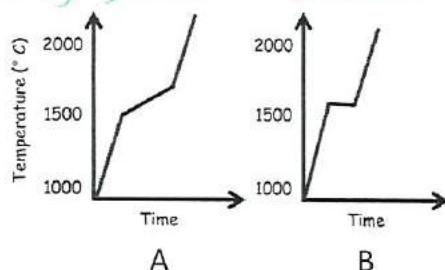
## Pure and impure substances

What is the definition for a pure substance?

Only one type of particle

What is the definition for a mixture?

Different types of particle not chemically joined together



Which of these graphs shows a mixture melting? A

Explain your answer.

Melts across a range of temperatures.

Which of these would melt across a range of temperatures? iron, bronze, tin, steel

Bronze + steel (mixtures)

Write 'pure' or 'mixture' in the second column.

Distilled water	<u>Pure</u>
Coke	<u>mixture</u>
Table salt	<u>Pure</u>
Fruit salad	<u>Mixture</u>
Sea water	<u>Mixture</u>
Coffee	<u>Mixture</u>
Diamond	<u>Pure</u>

5 grams of salt is added to 20 g of water. What mass of salt water is formed?

25 g

100 g of ice is heated until it melts and finally boils. What mass of steam is formed?

100 g

Which concept do both of these examples demonstrate?

Conservation of mass

What happens to the volume of most substances when they are heated?

Increases

Which substance does the opposite when it is melted? water (ice)

Which of these substances is soluble in water?

Substance	Soluble in water?
Sand	<u>X</u>
Sugar	<u>✓</u>
Instant coffee	<u>✓</u>
Flour	<u>X</u>
Tea leaves	<u>X</u>
Table salt	<u>✓</u>

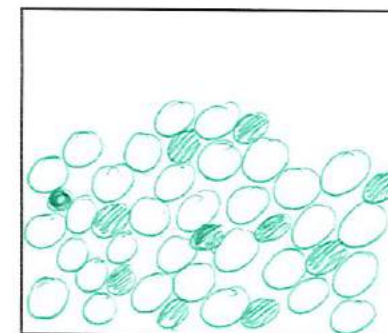
What is the name used for the substance which dissolves?

solute

What is the name used for the substance into which the substance dissolves?

solvent

Draw a diagram of a solution of salt and water. Use different coloured circles to represent the particles.





Which method of separation would you use to separate...

Mixture	Method of separation
The iron from a mixture of sand and iron	Use a magnet
The water in an ink solution	Distillation
The different coloured food dyes in skittles	Chromatography
The flour in a mixture of flour and water	Filtration
The water in a mixture of salt and water	Distillation
The sugar in a mixture of sugar and water	Evaporation
The raisins in a mixture of raisins and flour	Sieving

What is the name of this method of separation?

Distillation

Give an example of a mixture which could be separated using this method.

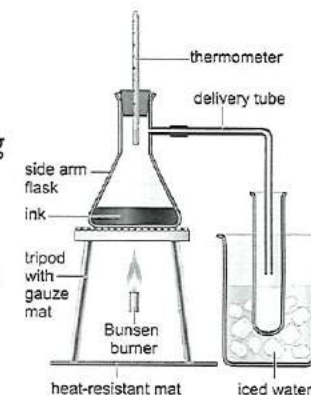
Ethanol and water (although not using a Bunsen burner!)

Which two processes take place during this method of separation?

Evaporation followed by Condensation

How could this experimental setup be improved? Explain your answer.

Use a Liebig condenser for cooling. There is a constant flow of cold water - there is no ice which needs replacing



What is the name of this method of separation?

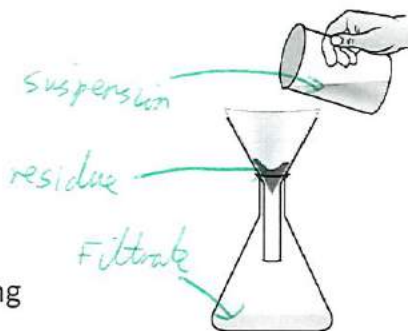
Filtration

Label the diagram using the words:

Filtrate, residue, suspension

Give an example of a mixture which could be separated using this method.

sand and water



Explain how this method of separation works.

The larger, solid particles get trapped whilst the small liquid particles pass through the holes in the filter paper

Explain why the gas exchange tube must be removed from the test tube **before** you stop heating.

To avoid suckback. The hot gas in the conical flask will cool and contract. This reduces the pressure and causes cold liquid to be pulled up the delivery tube leading to the flask shattering

What is the name of this method of separation?

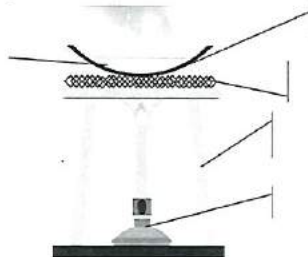
Evaporation

Give an example of a mixture which could be separated using this method.

Salt from seawater

Give two reasons that you should not continue heating salt solution until it is dry.

- The salt can spit
- High heat can cause some salts to thermally decompose



What is the name of this method of separation?

Chromatography

Give an example of a mixture which could be separated Using this method.

coloured dyes in pen ink

How many coloured dyes does ink 'X' contain?

4

Use an arrow to point to the most soluble dye.

How do you know that this is the most soluble?

It travelled furthest up the paper

Explain why the line is drawn in pencil.

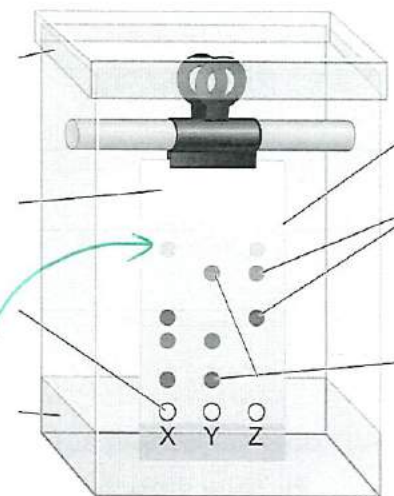
Graphite is insoluble in water so won't move up the paper

Explain why the dyes move up the paper?

The dyes dissolve in the water and get carried up the paper.

Water is usually used as the solvent. Suggest two alternative solvents which could be used:

Ethanol or Propanone



Air is a mixture of gases. Complete the table:

Gas	Abundance in air /%
<u>Nitrogen</u>	78
Oxygen	<u>21</u>
Argon	<u>~1%</u>
Other trace gases	0.04

Suggest how the gases in air could be separated:

Cool the air down until each gas condenses



Write a method (including a diagram for each stage), describing how to separate a mixture of:

Salt, sand, iron powder, high density wooden chips and low density wooden chips

1. Use a magnet to separate the iron powder from the other substances

2. Add water so that the low density wooden chips float

3. Sieve the remaining mixture to remove the high density wooden chips

4. Stir the mixture to dissolve the salt and Filter the mixture to remove the sand.

5. Evaporate the water to leave the salt

## Chemical reactions

What is the definition for a chemical change?

A change involving the creation of a new substance

What is the definition for a physical change?

A change not involving the creation of a new substance

Complete the table below:

Description of change	Physical	Chemical
Ice melting	✓	
Super-glue drying		✓
Separating sand and water by filtration	✓	
Burning fuel in a car		✓
Fruit ripening		✓
Photosynthesis		✓
Tearing a piece of paper in half	✓	

Magnesium metal is heated in a crucible. A white powder is formed.

Write a word equation for this reaction.

Magnesium + oxygen → magnesium oxide

What is the name for this type of reaction?

oxidation

The mass of the crucible is measured before and after the reaction. What will have happened to the mass?

Increased

Explain your answer.

You have added oxygen to the magnesium, so the mass must go up.

Complete these word equations:

Copper + oxygen → copper oxide

Tin + oxygen → tin oxide

Lithium + oxygen → lithium oxide

Nitrogen + oxygen → nitrogen oxide

Oxygen is an example of a non-metal. Other non-metals can also react with metals.

Complete these word equations:

Iron + chlorine → Iron chloride

Gallium + sulfur → gallium sulfide

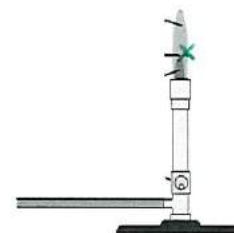
Lead + bromine → lead bromide

Titanium + nitrogen → titanium nitride

What is the name for this piece of scientific equipment?

Bunsen burner

Mark, with an 'x', the hottest part of the flame.



How would you change this from a roaring blue flame to a safety flame?

Close the air hole

Why is a safety flame used when not heating?

- It is easier to see
- It is cooler



Complete the general equation:

Hydrocarbon + oxygen  $\rightarrow$  carbon dioxide + water

What is the name for this type of reaction?

combustion (complete)

Complete these word equations:

Methane + oxygen  $\rightarrow$  carbon dioxide + water

Petrol + oxygen  $\rightarrow$  carbon dioxide + water

Propane + oxygen  $\rightarrow$  carbon dioxide + water

If there is insufficient oxygen, different products are formed.

Complete the general equation for incomplete combustion:

Hydrocarbon + oxygen  $\rightarrow$  carbon monoxide + soot + water

Two of these products can be harmful. Explain why.

Product: carbon monoxide

Harmful because... binds to red blood cells

preventing oxygen from being carried around the body

Product: soot

Harmful because... can irritate the trachea

leading to asthma attacks

What is the chemical test for water?

Test: Cobalt chloride paper

Positive result: blue  $\rightarrow$  pink

Or

Test: Anhydrous copper sulfate

Positive result: white  $\rightarrow$  blue

What is the chemical test for oxygen?

Test: Insert a glowing splint

Positive result: The splint will relight

What is the chemical test for carbon dioxide?

Test: Bubble through lime water

Positive result: colourless  $\rightarrow$  cloudy white

What is the chemical test for hydrogen?

Test: Insert a lit splint

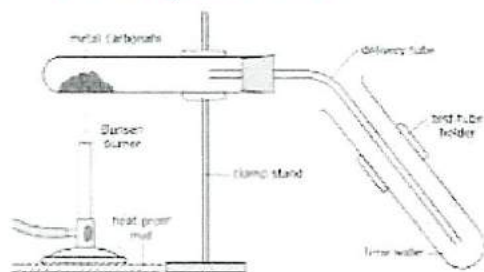
Positive result: Squeaky pop

Complete the general equation:

Metal carbonate  $\rightarrow$  metal oxide + carbon dioxide oxygen

What is the name for this type of reaction?

Thermal decomposition



Complete these word equations:

Copper carbonate  $\rightarrow$  copper oxide + carbon dioxide

Calcium carbonate  $\rightarrow$  calcium oxide + carbon dioxide

Lithium carbonate  $\rightarrow$  lithium oxide + carbon dioxide

What colour is copper carbonate? Green

What colour is the solid product in the first equation? Black

Why must the gas exchange tube be removed from the liquid before the heating is stopped?

To avoid suckback

What will happen to the mass of the solid in the test tube whilst it is being heated?

It will decrease (gas given off)

When potassium permanganate is heated, which gas is given off?

Write a word equation for the rusting of iron:

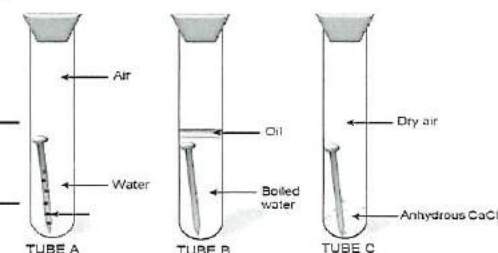
Iron + oxygen + water  $\rightarrow$  hydrated iron oxide

Explain what you would expect to happen to each of the iron nails in the experiment.

Tube A: Rusts (oxygen and water are present)

Tube B: Wont rust (no oxygen)

Tube C: Wont rust (no water)



Adding zinc to iron can prevent rusting. What is this method of protection called? Galvanising

Explain why this prevents rusting.

Zinc is more reactive than iron, so reacts instead.

Painting iron can also prevent rusting. Explain how this works.

Creates a barrier between the iron and oxygen/water

Explain which method is better. Galvanising. Paint can get scratched easily.



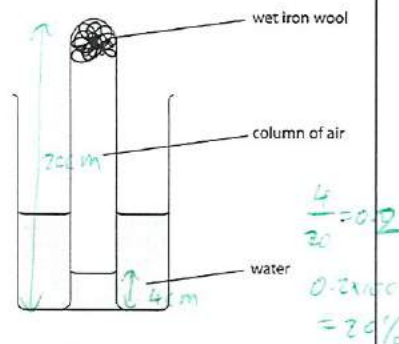
Explain how this equipment can be used to determine the percentage of oxygen in air. Include any measurements you would take.

1. set up the equipment as shown, without any water in the test tube

2. Leave for a few days

3. Measure the height of the water in the test tube.

4. Calculate a percentage of the distance moved



Use the results in the table to write a reactivity series for these four metals:

Most reactive: Calcium  
Magnesium  
Zinc

Least reactive: Copper

Write a word equation for one of the reactions which did take place.

calcium + copper sulfate → calcium sulfate + copper

What will you see when copper sulfate solution reacts with iron metal?

- The solution will change from blue → green
- The solid would change from silver → orange/brown

This type of reaction is often used to extract metals from their ores. Which non-metal is most frequently used to do this?

carbon

Copper oxide + carbon → copper + carbon dioxide

Which substance has been oxidised? carbon

Which substance has been reduced? copper oxide

Why can aluminium not be extracted from its ore using this method?

aluminium is more reactive than carbon

Why does gold not need to be extracted from an ore using this method?

gold is so unreactive, it is found as the pure metal.

The reactions below were carried out in a spotting tile.

	Copper sulfate	Magnesium sulfate	Zinc sulfate	Calcium sulfate
Copper	×	×	×	×
Magnesium	✓	×	✓	×
Zinc	✓	×	×	×
Calcium	✓	✓	✓	×

What is the name for this type of reaction?

Displacement

Complete the general equation:

(reactive) metal + water  $\rightarrow$  metal hydroxide + hydrogen

Complete the word equations:

Lithium + water  $\rightarrow$  Lithium hydroxide + hydrogen

Sodium + water  $\rightarrow$  sodium hydroxide + hydrogen

Potassium + water  $\rightarrow$  potassium hydroxide + hydrogen

Describe what will be seen during the reaction of potassium with water.

Bubbles and the potassium burns with a lilac flame

Reactions with acids produce salts. You need to know about three acids:

Hydrochloric acid - formula: HCl - salt formed: metal chloride

Sulfuric acid - formula: H<sub>2</sub>SO<sub>4</sub> - salt formed: metal sulfate

Nitric acid - formula: HNO<sub>3</sub> - salt formed: metal nitrate

Complete the general equation:

metal + acid  $\rightarrow$  salt + hydrogen

Complete the word equations:

Copper + sulfuric acid  $\rightarrow$  copper sulfate + hydrogen

Iron + nitric acid  $\rightarrow$  Iron nitrate + hydrogen

Magnesium + hydrochloric acid  $\rightarrow$  magnesium chloride + hydrogen

Complete the general equation:

acid + base  $\rightarrow$  salt + water

What is the name for this type of reaction?

neutralisation

All of the reactions below are the reaction between an acid and a base.

Complete the general equations:

Acid + metal oxide  $\rightarrow$  salt + water

Acid + metal hydroxide  $\rightarrow$  salt + water

Acid + metal carbonate  $\rightarrow$  salt + water + carbon dioxide

Complete the word equations:

Hydrochloric acid + copper oxide  $\rightarrow$  copper chloride + water

Nitric acid + magnesium hydroxide  $\rightarrow$  magnesium nitrate + water

Sulfuric acid + tin carbonate  $\rightarrow$  tin sulfate + water + carbon dioxide

Iron carbonate + nitric acid  $\rightarrow$  iron nitrate + water + carbon dioxide

Lithium hydroxide + sulfuric acid  $\rightarrow$  lithium sulfate + water

Calcium oxide + hydrochloric acid  $\rightarrow$  calcium chloride + water

If equal amounts of acid and base are reacted together, what will the pH of the solution be?

7



This reaction often comes up in Common Entrance exams.

Complete the word equation:

Copper oxide + sulfuric acid  $\rightarrow$  copper sulfate + water

Copper oxide is an example of a base.

Copper oxide is insoluble.

Copper sulfate is soluble.

Excess (too much) copper oxide is added to the sulfuric acid. Explain why.

Ensure that all of the acid has reacted

Which three substances are in the beaker now?

- copper sulfate
- water
- copper oxide

How can the excess copper oxide be removed?

Filtration

How can the dissolved copper sulfate be separated from the water?

Evaporation

What colour will the copper sulfate crystals be?

Blue

Air pollution

State three things which humans do which causes carbon dioxide to be given out to the atmosphere.

- Driving petrol/diesel cars
- Burning coal/oil/gas
- 

It is important to have some carbon dioxide in the atmosphere, but too much carbon dioxide causes global warming.

What negative effects does this have on the planet?

- Melting polar ice caps (habitat loss)
- More extreme weather
- Rising sea levels

Explain why burning fossil fuels causes acid rain.

- coal contains sulfur impurities. sulfur + oxygen  $\Rightarrow$  sulfur dioxide  
- sulfur dioxide dissolves in clouds to make sulfuric acid

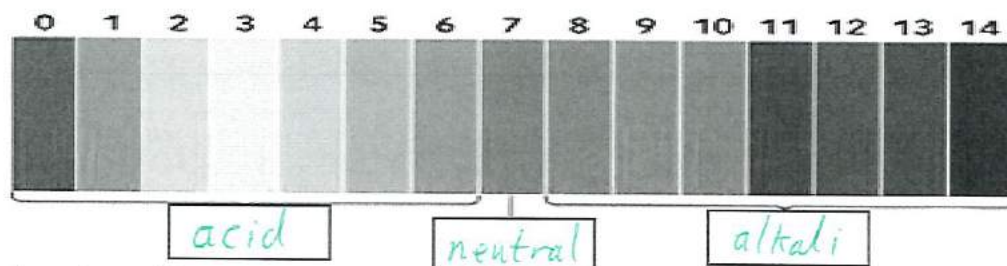
What negative effects does acid rain have?

- Kills fish/other aquatic life
- Damage/corrodes buildings and statues

When metal oxides dissolve in water, they produce alkaline solutions.

When non-metal oxides dissolve in water, they produce acidic solutions.

Fill in the boxes



Complete the table:

Substance	Approximate pH	Colour when Universal Indicator is added
Pure water	7	green
Bicarbonate of soda	10	blue
Hydrochloric acid	1	red
Orange juice	5	yellow
Drain cleaner	13	purple

Which piece of equipment can be used to determine the pH more accurately?

pH probe

Give one other reason that this piece of equipment is better than Universal Indicator.

- can be re-used  
- doesn't contaminate the sample

What is a disadvantage of this piece of equipment?

must be calibrated before use

Red litmus paper turns red in acids and blue in alkalis.

Blue litmus paper turns red in acids and blue in alkalis.

Write a method describing how to make and test an indicator using red cabbage.

1. Cut the red cabbage up into small pieces

2. Boil in water

3. Filter and collect the liquid

4. To test, add a small amount of the indicator to a known acid/alkali.

What is a disadvantage of using red cabbage as an indicator?

- Only indicates if acid/alkali. Doesn't give a pH.



## Energy resources

What is the definition for a non-renewable energy resource?

One which cannot be replaced within a human lifetime

Give four examples of non-renewable energy resources.

- Coal
- Oil
- Gas
- Nuclear

Describe how fossil fuels are formed.

Dead plants/animals exposed to high heat/pressure over millions of years.

How is electricity generated from fossil fuels?

Burned to heat water. steam is used to turn turbines

What is the definition for a renewable energy resources?

one which can be replaced within a human lifetime

Write the name of the energy resources next to its definition.

solar Energy generated from the light of the sun

Biomass Energy generated from burning wood or other recently living things

wind Energy generated from the wind

Hydroelectric Energy generated using water flowing downhill

Geothermal Energy generated using hot rocks to heat up water

Tidal Energy generated using the tides to turn turbines

wave Energy generated using waves

What is the ultimate source of almost all energy on Earth?

The sun

What is an advantage of using solar power instead of burning coal to generate electricity?

Doesn't release greenhouse gases

What is a disadvantage of using solar power instead of burning coal to generate electricity?

Can only be used when it is sunny

Describe the energy transfers in hydroelectric power.

Gravitational  $\rightarrow$  kinetic (water)  $\rightarrow$  kinetic (turbines)  $\rightarrow$  electrical

Why are biofuels described as 'carbon-neutral'?

They give out the same mass of carbon dioxide as they took in through photosynthesis whilst growing

## Energy stores and transfers

What is the unit for energy?

Joules

What is the law of conservation of energy?

Energy cannot be created or destroyed, it can only be transferred.

Complete the tables:

Energy store	Examples
<u>Chemical</u>	Food, batteries, matches
Thermal	<u>A fire</u>
Kinetic	<u>A person running</u>
Elastic (strain)	<u>A stretched spring</u>
<u>Gravitational</u>	Climbing a ladder
<u>Magnetic</u>	Magnets attracting/repelling
<u>Nuclear</u>	The sun

Energy pathway	Example
<u>Radiation</u>	Light, sound,
<u>Electrically</u>	Electric current
<u>mechanically</u>	A force moving through a distance
<u>by heating</u>	Due to a temperature difference
<u>chemically</u>	Due to a chemical reaction

What is the energy transfer in each of these examples?

A torch turning on: (radiation)  
(by light)

Useful energy transfer: chemical → thermal

Wasted energy transfer: (by heating)  
chemical → thermal

Explain why an LED torch is more efficient than a standard torch.

less energy is transferred to the thermal store

An apple falling from a tree and then hitting the ground:

(mechanically) (by heating)  
Gravitational → kinetic → Thermal

A Bunsen burner being lit:

(chemically)  
chemical → Thermal

Bungee jumping:

(mechanically) (mechanically)  
Gravitational → kinetic → elastic

Some energy is always dissipated during an energy transfer (it is never 100% efficient). Explain what this means and where the energy goes.

Some energy is given out to the surroundings as heat.



## Forces and motion

What is the equation which links speed, distance and time?

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

If a car travels 2000 m in 100 s, calculate the speed.

$$s = \frac{2000 \text{ m}}{100 \text{ s}} = 20 \text{ m/s}$$

If an athlete runs at a speed of 5 m/s. How far will she run in one minute?

$$s = \frac{d}{t} \quad d = s \times t$$

$$5 \text{ m/s} \times 60 \text{ s} = 300 \text{ m}$$

A train travels at a average speed of 30 m/s. How long will it take to travel 5 km?

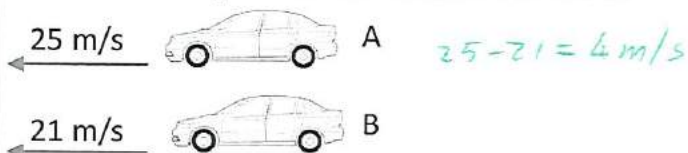
$$s = \frac{d}{t} \quad t = \frac{d}{s} \quad \frac{5000 \text{ m}}{30 \text{ m/s}} = 167 \text{ s}$$

$$= 2 \text{ mins } 47 \text{ s}$$

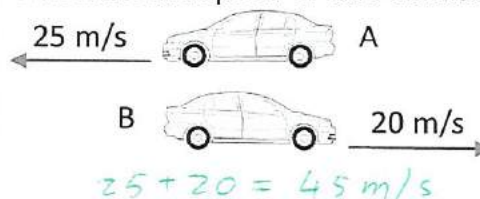
Write a method for determining the speed of a car travelling along the road? Include the equipment that you would use.

1. Measure the distance between two lamp posts using a trundle wheel.
2. Measure the time for a car to travel between the lamp posts using a stopwatch.
3. Use  $\text{speed} = \frac{\text{distance}}{\text{time}}$  to calculate the speed.

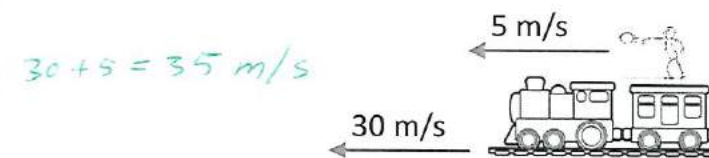
Two cars are travelling in the same direction. Calculate the speed of car A relative to car B.



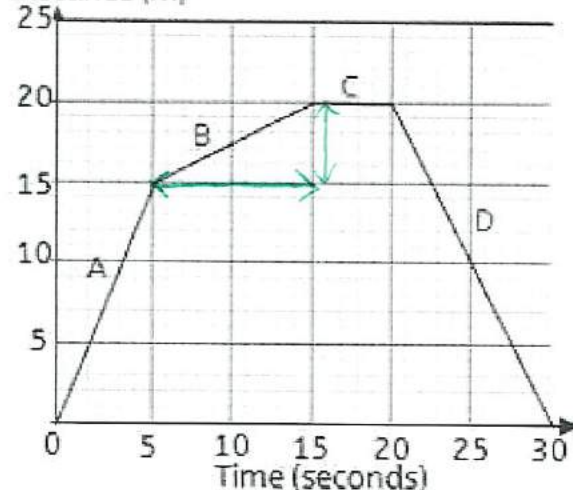
Two cars are travelling in opposite directions. Calculate the speed of car A relative to car B.



A boy stands on the roof of a moving train and throws a ball. Calculate the speed of the ball relative to the ground.



Distance (m)



At which point in the graph is the object travelling the fastest? A

Calculate the object's speed during section 'B' of the graph.  $s = \frac{d}{t} = \frac{5 \text{ m}}{10 \text{ s}} = 0.5 \text{ m/s}$

Describe the motion of the object throughout its journey.

A: Constant speed, Fast, Forward. B: Constant speed, slow, Forward.

C: stationary D: constant speed, Fast, backwards

Calculate the average speed of the object during the first 20 seconds of its journey.

$$s = \frac{d}{t} = \frac{20 \text{ m}}{20 \text{ s}} = 1 \text{ m/s}$$

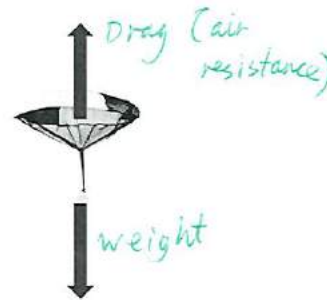
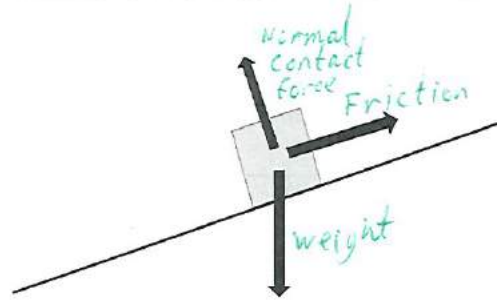
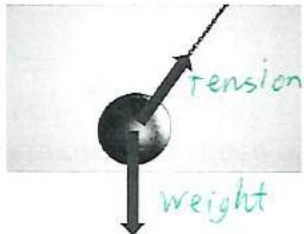
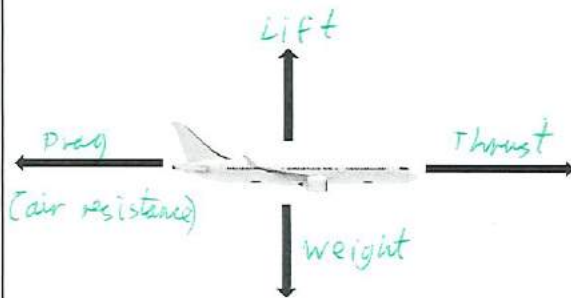
What is the unit for force?

Newton

Which piece of equipment is used to measure the size of a force?

Newton meter (Force meter)

Label the forces in each diagram:



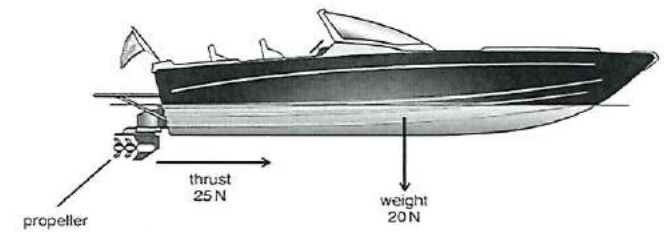
If no resultant force acts upon an object...

It will continue at a constant speed in the same direction

Complete the sentence:

A resultant force acting upon an object causes a change in the:

- speed
- Or
- direction



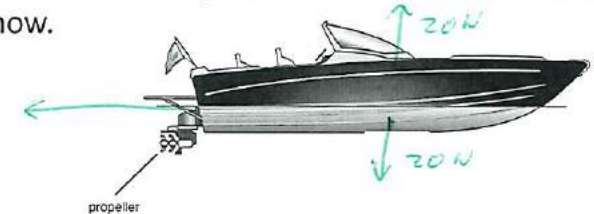
If the boat is moving at a constant speed, what must be the size of the drag force?

25 N

If the boat is floating, what must be the size of buoyancy?

20 N

The engine is turned off whilst the boat is still moving forward. Draw a new diagram to show the forces acting on the boat now.



Explain what will happen to the motion of the boat.

The boat will slow down and then stop

How can friction be reduced?

- Make the objects smoother
- Reduce the speed.

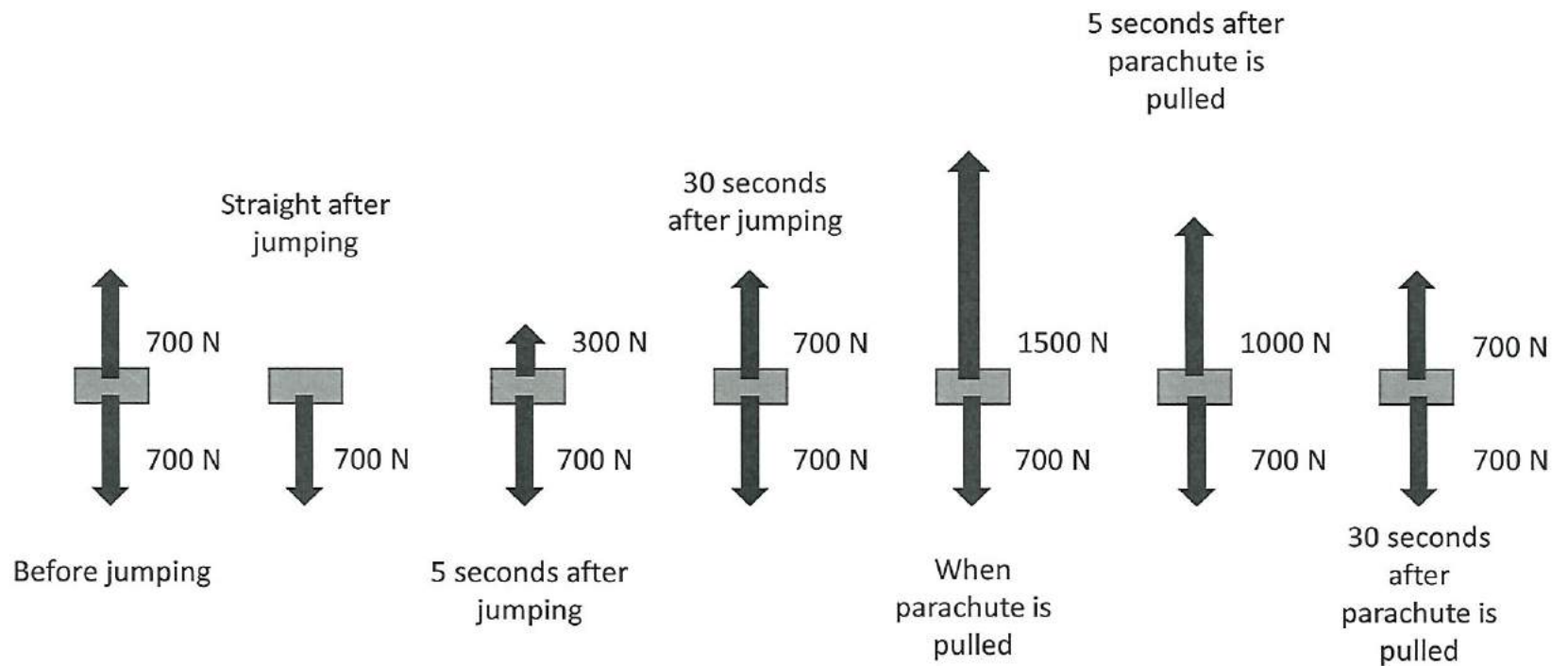


How can air/water resistance be decreased?

- streamlined same
- reduce the speed
- smoother surfaces

As speed increases, what happens to the size of the drag force?

Increases



The diagrams above show the forces acting on a skydiver at different points in their jump.

For each diagram, explain the forces, and describe what will happen to the motion of the skydiver.

Before jumping: In the aeroplane normal contact force = weight

Straight after jumping: Normal contact force removed (no floor), no drag force because stationary

5 seconds after jumping: speed increases therefore drag force increases

30 seconds after jumping: reaches terminal velocity (drag and weight are balanced)

When parachute is pulled: speed decreases because drag force larger than weight

5 seconds after parachute is pulled: speed has decreased, so has drag force

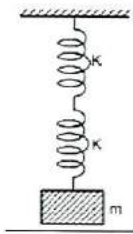
30 seconds after parachute is pulled: new, lower, terminal velocity reached because forces are balanced.

Hooke's law describes how the extension of a spring changes when a force is applied.

For a single spring, if the force doubles, the extension will double.

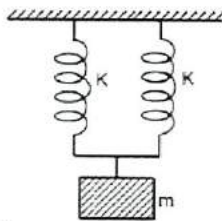
What is the name for this arrangement of springs?

series



What is the name for this arrangement of springs?

parallel



Complete the results table using your knowledge of springs:

Force (N)	Extension (cm)		
	Single spring	2 springs in series	2 springs in parallel
0	0	0	0
1	5	10	2.5
2	10	20	5
3	15	30	7.5
4	20	40	10
5	25	50	12.5
6	30	60	15
7	37		
8	49		

Describe the results in the graph.

As the force increases, the extension increases at a constant rate.

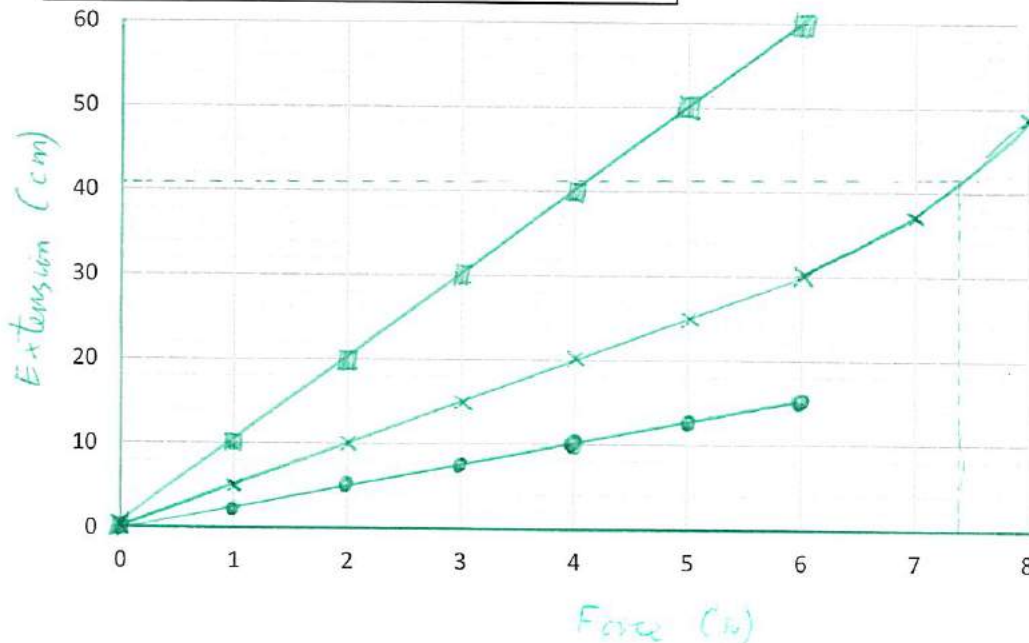
The springs in series extended more than the single spring.

The springs in parallel extended less than the single spring.

Use the graph to estimate the extension of the single spring when the force is 7.4 N.

Show your working on the graph.

41 cm



- Using the data in the table, add axis labels to the graph.
- Plot all 3 sets of data on the same graph (include a key)

x = single spring  
 ■ = springs in series  
 ● = springs in parallel

Why does the data not obey Hooke's law when the force is too large?

The spring has passed its elastic limit and no longer returns to its original shape



## Forces and rotation

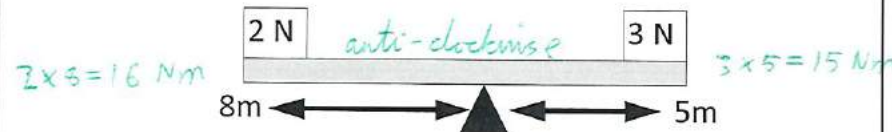
What is the equation which links turning moment, force and distance from pivot?

*moment = force  $\times$  distance from pivot*

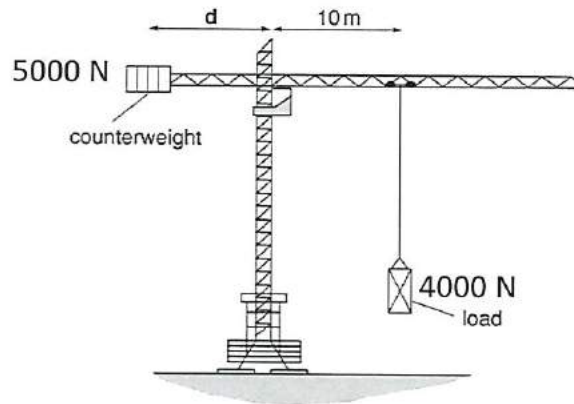
If a see-saw is balanced, what do you know about the clockwise and anticlockwise moments?

*They are equal*

Calculate the clockwise and anticlockwise moment in each example. Which direction will each see-saw tip?



Assuming the crane is balanced, calculate the distance of the counterweight from the pivot.



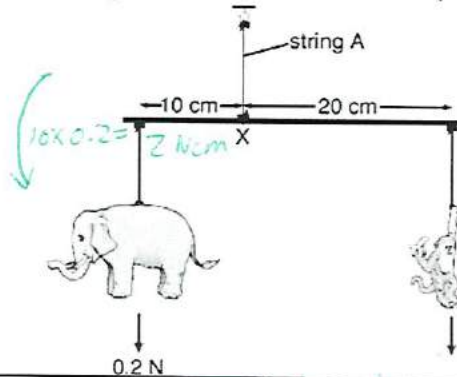
*4000 N  $\times$  10 m = 40000 Nm*

*balanced so anticlockwise moment also = 40000 Nm*

*m = f  $\times$  d*

*d = \frac{m}{f} = \frac{40000 \text{ Nm}}{5000 \text{ N}} = 8 \text{ m}*

Assuming the mobile is balanced, calculate the weight of the monkey.



*10  $\times$  0.2 = 2 Nm*

*balanced*

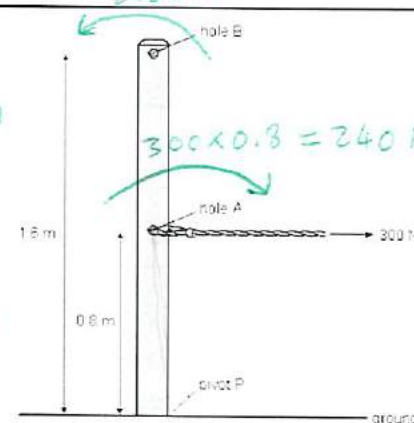
*2 Nm*

*m = f  $\times$  d*

*f = \frac{m}{d} = \frac{2}{20} = 0.1 \text{ N}*

*240 Nm*

*balanced*



With what force would someone need to pull on hole B for the piece of wood to be balanced?

*m = f  $\times$  d*

*f = \frac{m}{d} = \frac{240}{1.6} = 150 \text{ N}*

## Forces and pressure

What is the equation which links pressure, force and area?

$$\text{Pressure} = \frac{\text{Force}}{\text{area}}$$

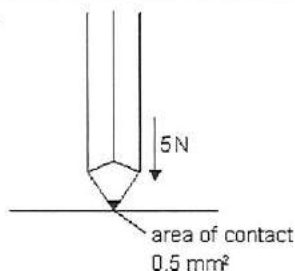
What are the units for force? Newton

What are the units for area? m<sup>2</sup> (or cm<sup>2</sup>)

What are the units for pressure? N/m<sup>2</sup>

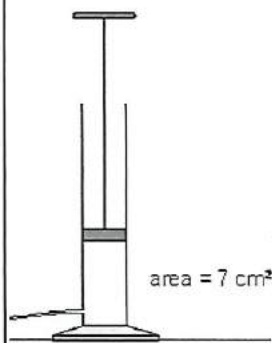
Calculate the pressure of the pencil on the table.

$$P = \frac{F}{A} = \frac{5 \text{ N}}{0.5 \text{ mm}^2} = 10 \text{ N/mm}^2$$



An arrow hits a target with a force of 200 N. The pressure of the arrow on the target is 125 N/mm<sup>2</sup>. Calculate the area of the arrow-head.

$$P = \frac{F}{A} \quad A = \frac{F}{P} = \frac{200 \text{ N}}{125 \text{ N/mm}^2} = 1.6 \text{ mm}^2$$



The pressure on the handle of the pump is 25 N/cm<sup>2</sup>. Calculate the force being applied.

$$P = \frac{F}{A} \quad F = P \times A = 25 \text{ N/cm}^2 \times 7 \text{ cm}^2 = 175 \text{ N}$$

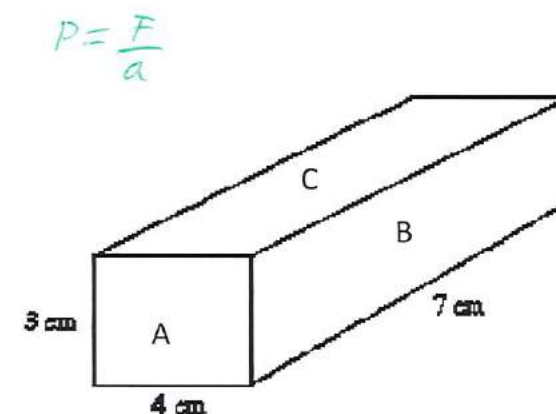
Explain why wearing a snowshoe prevents someone from sinking into the snow.

Larger surface area means  
lower pressure (force is more spread out)



Calculate the pressure of each side if it were touching the floor. The weight of the block is 120 N.

$$\begin{aligned} \text{A: } \frac{120 \text{ N}}{3 \times 4} &= \frac{120 \text{ N}}{12 \text{ cm}^2} = 10 \text{ N/cm}^2 \\ \text{B: } \frac{120 \text{ N}}{3 \times 7} &= \frac{120 \text{ N}}{21 \text{ cm}^2} = 5.7 \text{ N/cm}^2 \\ \text{C: } \frac{120 \text{ N}}{7 \times 4} &= \frac{120 \text{ N}}{28 \text{ cm}^2} = 4.3 \text{ N/cm}^2 \end{aligned}$$



$$P = \frac{F}{A}$$

Give an example of an object which is designed to exert a high pressure.

A needle

Give an example of an object which is designed to exert a low pressure.

Large wheels on a tractor

Explain why standing on a single nail is painful, whilst standing on many nails is not painful.



single nail = small area and so high pressure  
many nails = larger area and so lower pressure



## Density

What is the equation which links density, volume and mass?

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

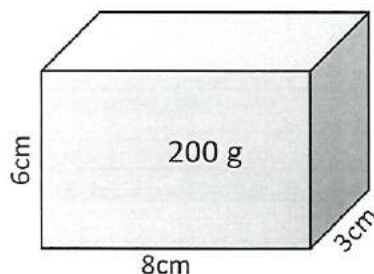
What are the units for mass? kg (or g)

What are the units for volume? cm<sup>3</sup> (or m<sup>3</sup>)

What are the units for density? kg/cm<sup>3</sup>

Calculate the density of the block.

$$d = \frac{m}{V} = \frac{200\text{ g}}{6 \times 8 \times 3} = \frac{200\text{ g}}{144\text{ cm}^3} = 1.4\text{ g/cm}^3$$



A block of wood has a mass of 5 kg and a density of 1.6 g/cm<sup>3</sup>. Calculate the volume. (Hint: check the units)

$$d = \frac{m}{V} \quad V = \frac{m}{d} = \frac{5000\text{ g}}{1.6\text{ g/cm}^3} = 3125\text{ cm}^3$$

A beaker of an unknown liquid has a density of 0.8 g/cm<sup>3</sup> and a volume of 100 cm<sup>3</sup>. What is the mass?

$$d = \frac{m}{V} \quad m = d \times V = 0.8\text{ g/cm}^3 \times 100\text{ cm}^3 = 80\text{ g}$$

Complete the table to show whether the substance will float or sink in water.

Object	Density (g/cm <sup>3</sup> )	Floats in water?
Water	1	
Iron bar	7.9	X
Balloon filled with air	0.001	✓
Cork	0.24	✓
Cooking oil	0.91	✓
Concrete	2.4	X

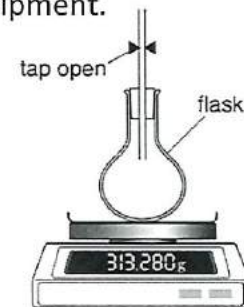
Describe a method for measuring the density of an irregularly shaped rock. Include the equipment that you will use.

1. Measure the mass of the rock using a balance.
2. Fill a displacement can with water and wait for it to stop dripping.
3. Add the rock and collect the water in a measuring cylinder.
4. Calculate the density using  $d = \frac{m}{V}$

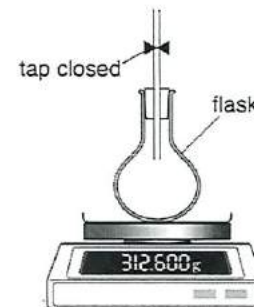
Explain why ice floats in water.

The particles in ice are further apart than in water. Therefore ice has a lower density than water.

The density of air can be measured using this equipment.



before air removed



after air removed

What is the mass of air in the flask?

$$313.280 - 312.600 = 0.68\text{ g}$$

How could you find the volume of air inside the flask?

Fill with water and then pour into a measuring cylinder

# Sound

How are sounds generated?

Vibrating objects

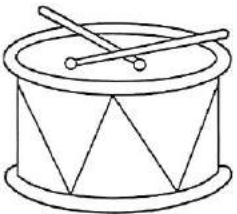
What is causing the sound in each case below?



Wings vibrating



Vocal cords  
vibrating



Drum skin  
vibrating



Violin, Viola, Cello, Double Bass  
THE STRING FAMILY



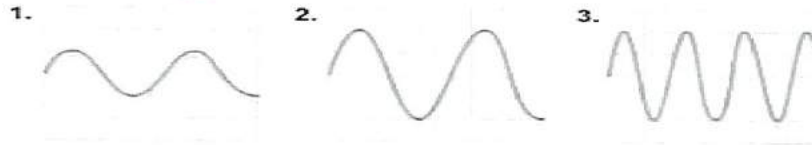
strings  
vibrating

How does a sound wave change when the volume is increased?

Amplitude increases

How does a sound wave change when the pitch is increased?

Frequency increases



Describe sounds 1, 2 and 3. Use key terms: high/low pitch, loud/quiet.

1 - low pitch, quiet

2 - low pitch, loud

3 - high pitch, loud

What is the effect of changing the following on a guitar?

- Shortening the string - higher pitch
- Having a thicker string - lower pitch
- Tightening the string - higher pitch

Describe how the sound made by a mobile phone ringing is heard.

Mobile phone speaker vibrates. Vibration transferred to air particles  
which vibrate and transfer sound to ear. Ear drum vibrates.

What is the definition for the term 'frequency'?

Number of vibrations per  
second

What are the units for frequency?

Hertz (Hz)

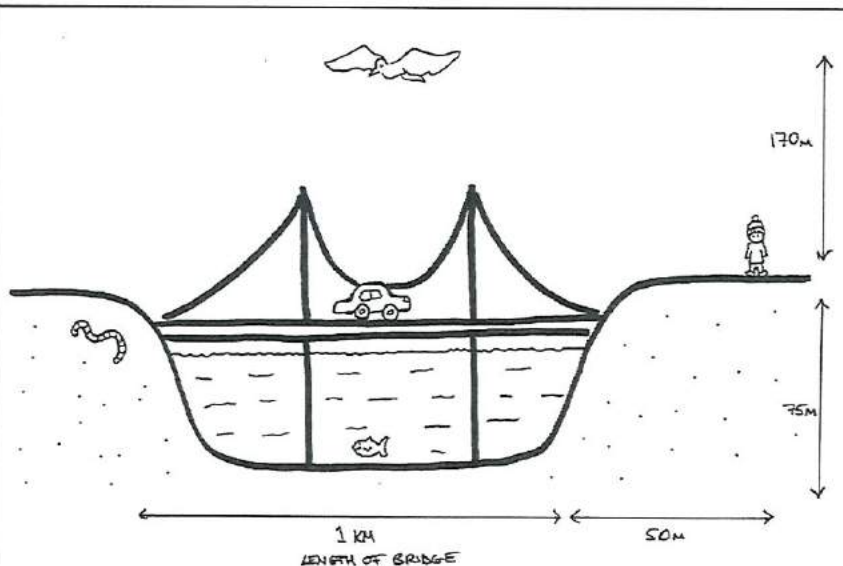
What is the approximate range of frequencies which can be heard by humans?

20 Hz to 20000 Hz

What causes an echo?

Sound waves reflecting  
off an object back  
towards the source. Therefore,  
it is heard twice





The car beeps its horn.

Explain why this sound would be detected by the worm first.

Sound travels fastest through solids

Sounds travels at around 330 m/s in air. Calculate the time that it would take for the sound to reach the bird.

$$s = \frac{d}{t} \quad t = \frac{d}{s} = \frac{170\text{m}}{330\text{m/s}} = 0.51\text{s}$$

Explain why sound cannot travel through a vacuum.

There are no particles to vibrate

Write a method, describing how the speed of sound in air could be measured. Include any equipment that you will need.

1. Stand at the other end of a field to a friend and measure the distance between you using a trundle wheel.
2. One person claps their hands.
3. The other starts the stop watch when he sees the hands touch and stop the stop watch when he hears the sound.
4. Use  $\text{speed} = \frac{\text{distance}}{\text{time}}$  to calculate speed.

Explain why lightening is seen before thunder is heard.

Light travels much faster than sound

Why is it a problem to hear very loud sounds?

Can damage your hearing

Echolocation can be used to work out how far away an object is. A ship sends out a 'ping' and the echo is detected 2 seconds later. If the speed of sound in sea water is 1533 m/s, how far away is the bottom of the sea?

$$s = \frac{d}{t}$$

$$d = s \times t$$

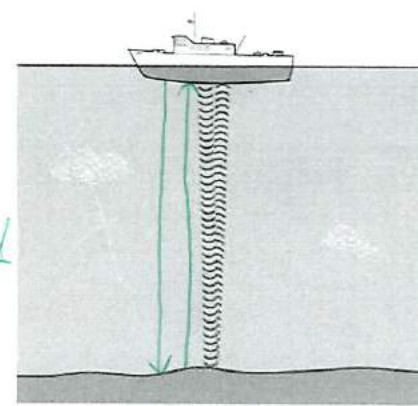
$$= 1533\text{m/s} \times 2\text{s}$$

$$= 3066\text{m}$$

(this is there and back)

$$\text{Just there} = \frac{3066}{2}$$

$$= 1533\text{m}$$



# Light

Give examples of luminous objects:

Natural: The sun

Artificial: A light bulb

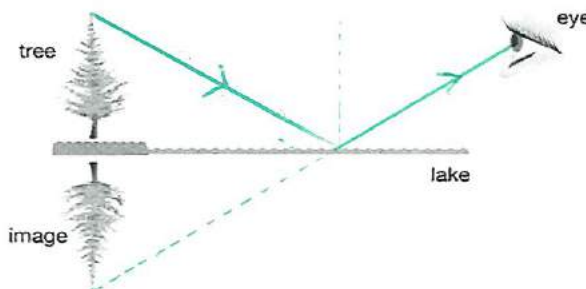
Give examples of non-luminous objects:

- The moon
- A table

Explain how we are able to see non-luminous objects.

Non-luminous objects reflect the  
light from luminous objects into  
our eyes

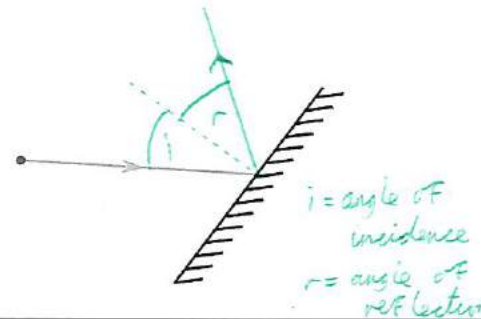
Complete the diagram below to explain why the image of the tree appears beneath the water. You do not need to draw the sun.



What is the law of reflection?

Angle of incidence = angle of reflection

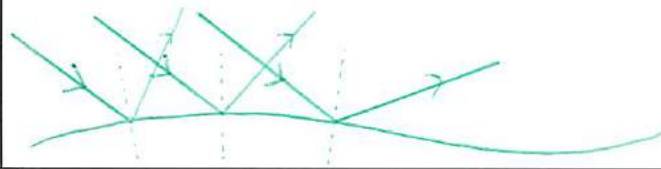
Draw a diagram to show this below. You should label any relevant angles.



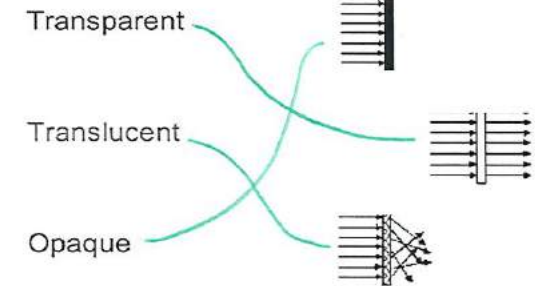
Light rays should always be drawn using a ruler and should include arrows to show the direction. Light travels from the object to the eye.

Explain why the image appears distorted when a stone is thrown into the lake. You may want to include a diagram.

Ripples mean that the light is  
reflected at different angles.



Match the diagram with the key word.



Use these key words to define each type of object: transmit, absorb, reflect, scatter

Transparent: transmits light

Examples: Clear glass

Translucent: transmits and scatters  
light

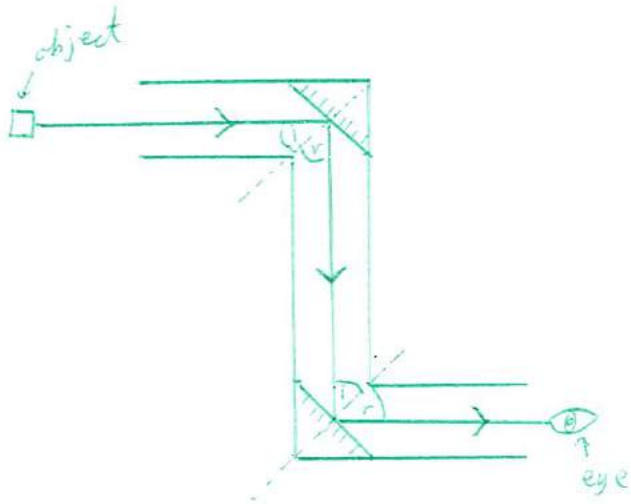
Examples: glass in frosted windows

Opaque: absorbs or reflects  
light

Examples: A wooden door



Draw a diagram of a periscope. You should include an object and an eye.



At what angle should the mirrors be? 45°

Label any relevant angles on your diagram.

Light travels fastest in a vacuum.

When light enters a more dense medium, it slows

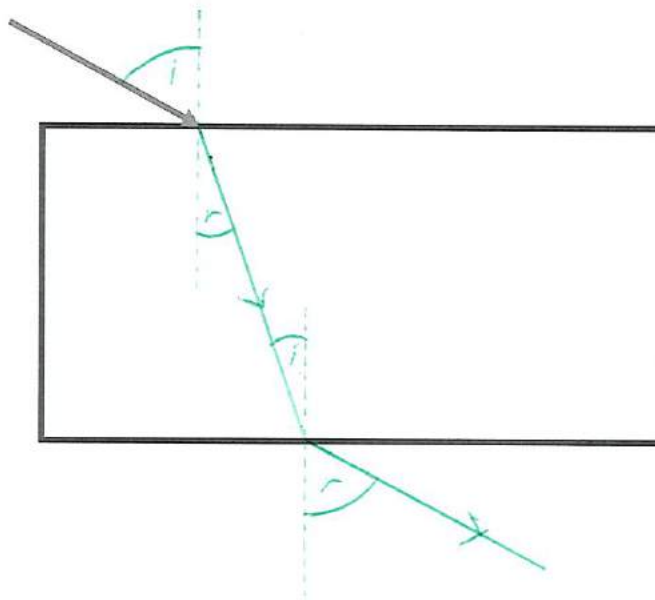
down.

This causes the ray of light to bend towards the

normal.

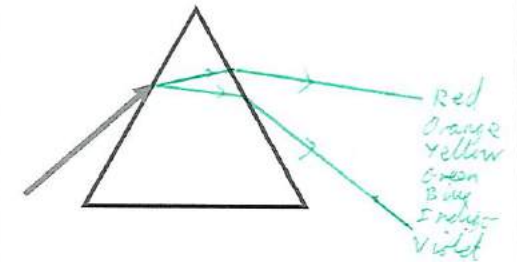
This is called refraction.

Complete the diagram, showing what happens when the light enters and glass block **and** what happens when it leaves the glass block.



Label any relevant angles on your diagram.

Complete the diagram showing what happens to white light when it is shone through a glass prism.



What is this effect called?

Dispersion

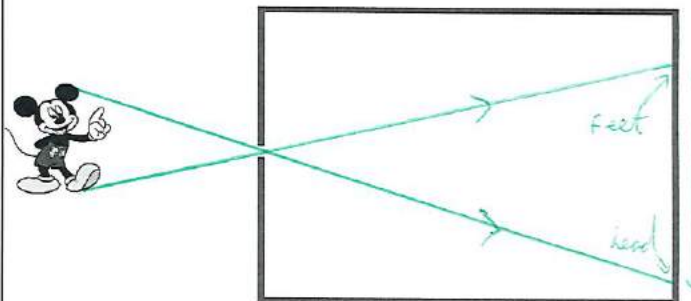
Explain what causes this effect.

Different frequencies

(colours) of light are

refracted by different amounts

Complete the diagram, showing what happens when light enters a pinhole camera.



To which human organ can this be compared?

Eye

What would be the effect on the image of:

Moving the object further away?















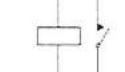
smaller image

Making the pinhole larger?

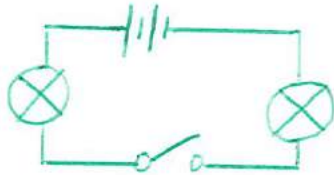
Blurry image

## Electric circuits

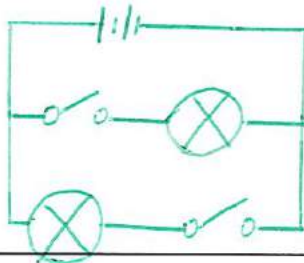
Draw the circuit symbol for each component.

Lamp 	Cell 	Battery 	Fixed resistor 
Diode 	SPST switch 	LDR 	Buzzer 
Ammeter 	Reed switch 	Variable resistor 	Fuse 
Motor 	LED 	Relay switch 	

Draw a series circuit containing 2 cells, 2 lamps and an SPST switch.



Draw a parallel circuit containing 2 cells, 2 lamps and an SPST switch in each branch.



In the two circuits that you have drawn, would you expect the bulbs in the series or parallel circuit to be brighter?

Parallel circuit

What would be the effect of adding an extra cell to the circuit?

No change in brightness

Explain why this would happen.

The current in each branch stays the same.

What would be the effect of adding an extra lamp to the series circuit?

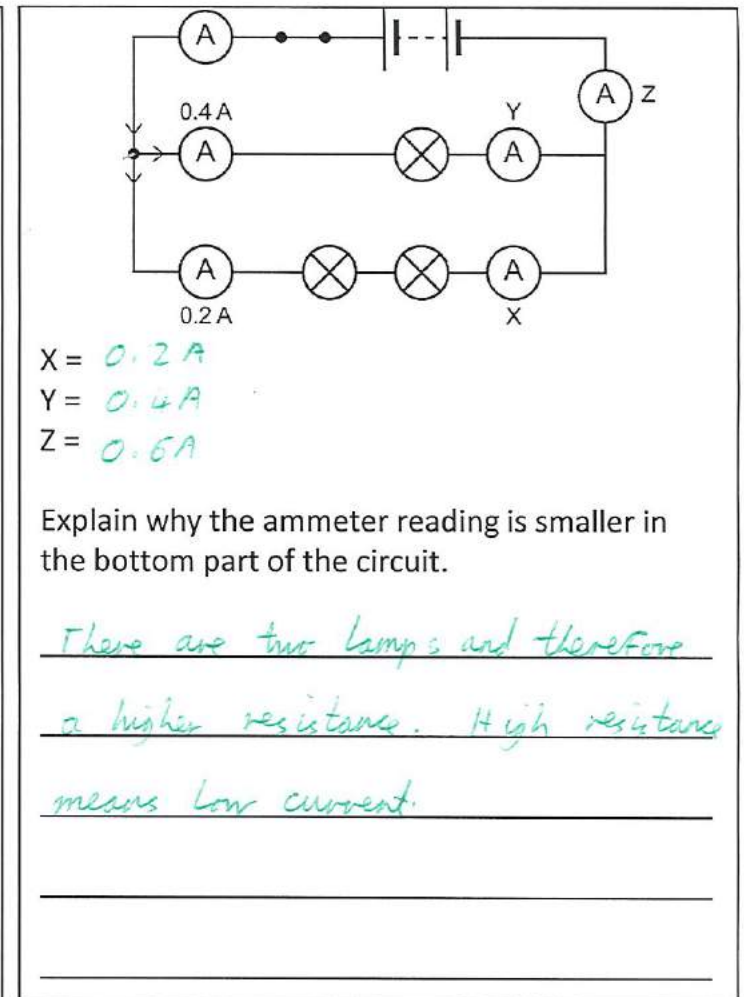
All lamps would get dimmer

Explain why this would happen.

More lamps = higher resistance  
Higher resistance = lower current

What is the purpose of a fuse?

To protect electrical appliances from surges in current.



Explain why the ammeter reading is smaller in the bottom part of the circuit.

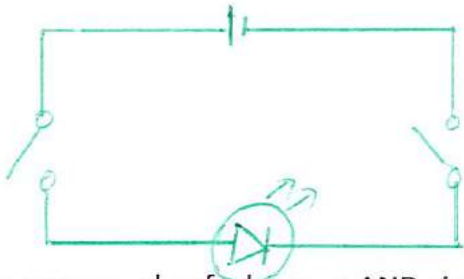
There are two lamps and therefore a higher resistance. High resistance means low current.

How does a fuse work?

If the current is too high, the fuse wire melts. This breaks the circuit.



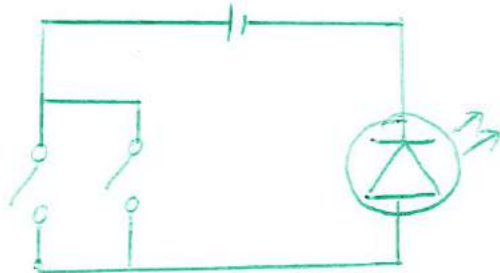
Draw an AND circuit with a cell, an LED and two SPST switches.



Give an example of where an AND circuit would be used.

In a washing machine. Door must be closed and button must be pressed.

Draw an OR circuit with a cell, an LED and two SPST switches.

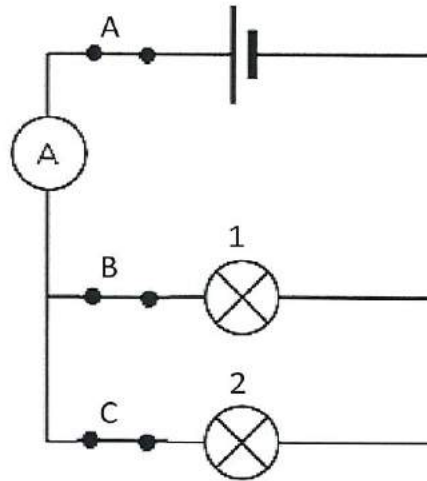


Give an example of where an OR circuit would be used.

Lights inside a car. Either door can be opened and the lights will turn on.

Why will an LED not turn on if it is placed the wrong way around in a circuit?

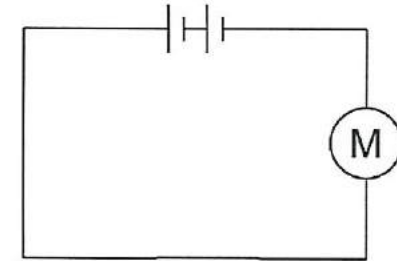
The resistance is very high when placed the wrong way, so current is almost 0.



Complete the Truth table below for this circuit.

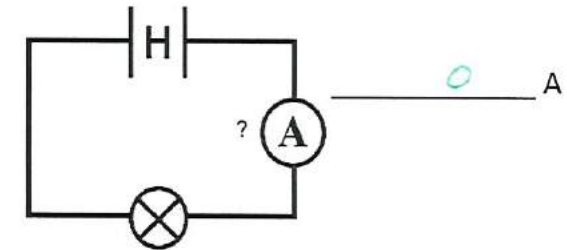
Switch A	Switch B	Switch C	Bulb 1	Bulb 2
Open	Open	Open	off	off
Open	Open	Closed	off	off
Open	Closed	Open	off	off
Open	Closed	Closed	off	off
Closed	Open	Open	off	off
Closed	Open	Closed	off	on
Closed	Closed	Open	on	off
Closed	Closed	Closed	on	on

What is the energy transfer in the circuit below?



chemical → electrical → kinetic

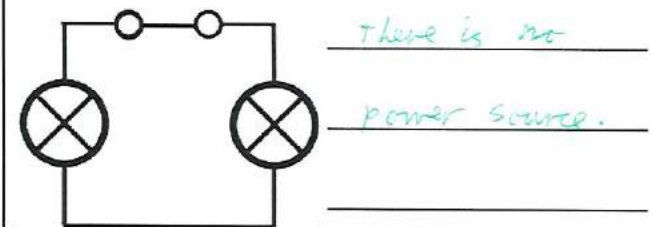
What is the current in the circuit below?



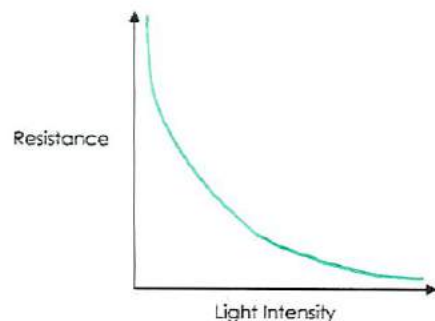
Explain your answer

The two cells are facing each other.

What is the mistake in this circuit?

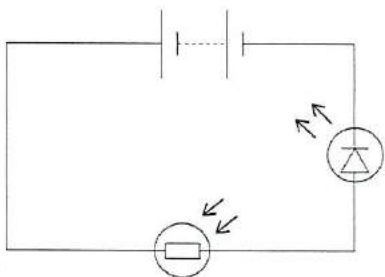


Add a line to the graph below to show the effect of light intensity on the resistance of an LDR.



Describe the relationship between light intensity and resistance in an LDR.

As the light intensity increases, the resistance decreases (at a decreasing rate)



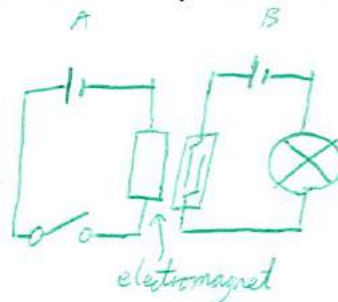
Explain what will happen to the brightness of the LED when the circuit is put into a dark cupboard.

Lower light intensity = higher resistance

higher resistance = lower current

lower current = dimmer LED

Describe how a relay circuit works. A diagram will help.



A relay circuit allows one circuit to control a separate circuit.

When the switch in circuit A is closed, the electromagnet becomes magnetised. This causes the reed switch in circuit B to close, so the lamp will turn on.

Explain how a relay circuit could be used in a burglar alarm.

One circuit placed on the door frame and the other on the door. When the door is opened, the reed switch will open and the alarm be activated.

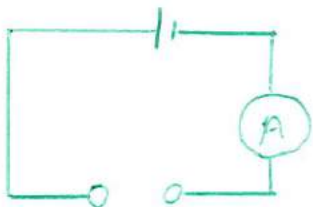
In an investigation using batteries, which component would it be best to use to change the current?

Variable resistor



Describe how a pupil could investigate the effect of the material from which a wire is made on the resistance in a circuit.

You should include a diagram in your answer.



1. Construct the circuit above

2. Add a piece of wire 10cm long between the terminals.

3. Record the current.

4. Repeat with other types of wire

5. The higher the current, the lower the resistance

What is the independent variable?

wire material

What is the dependent variable?

Resistance (or current)

What are some control variables?

- Same length wire
- Same voltage battery
- Same thickness of wire
- Same components in circuit

Draw the results table that you would use to collect your data.

<u>wire material</u>	<u>Current (A)</u>

What sort of graph would you plot to display your data?

Bar because wire material is discontinuous

What happens to components (and wires) when the current is high?

they heat up

Why should the circuit be switched off before the wire is changed?

Avoid electric shocks and/or burns

What could be done to improve the reliability of the results?

Repeat and calculate the mean.

Does it matter where the ammeter is placed in the circuit? Explain your answer.

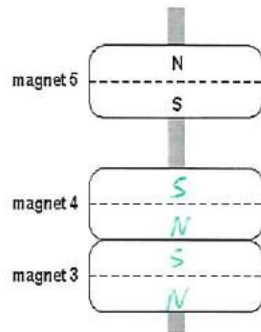
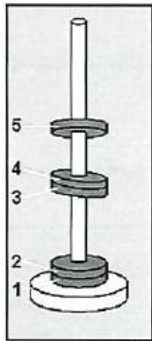
No - current is the same everywhere in a series circuit

## Magnetism and electromagnetism

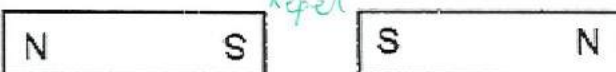
Which 3 elements can be magnetised?

- Iron
- Cobalt
- Nickel

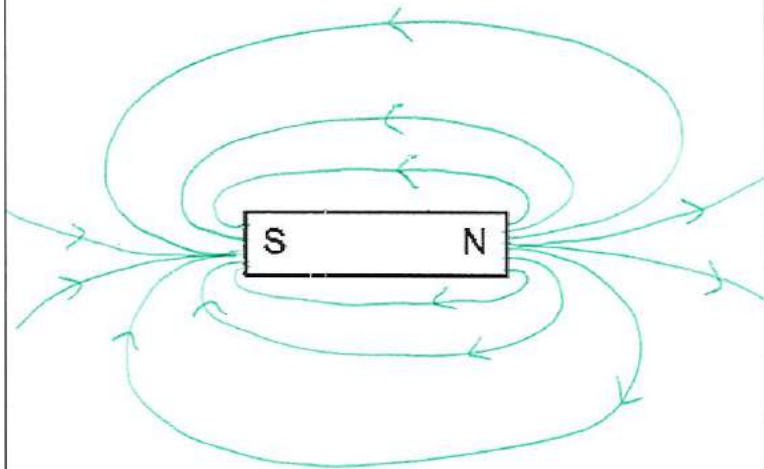
Complete the diagram on the right to show where the north and south poles on magnets 3 and 4 are.



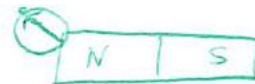
Describe what will happen to the magnets in these situations:



Draw the shape of the magnetic field around this bar magnet. Don't forget the direction!



Write a method describing how the shape of the magnetic field around a bar magnet can be determined. You may include a diagram.



1. Place a plotting compass at one end of the magnet.
2. Put a dot on the paper next to the north arrow.
3. Move the compass to the other side of the dot and repeat until you get back to the magnet.
4. Join the dots.

If you have a known magnet, what is the only true test for another magnet?

Repulsion from another magnet

For a bar magnet, where is the magnetic field strongest?

At the poles

How is this shown with the magnetic field lines?

The field lines are closest together

Why does a compass point north on Earth?

The Earth has a magnetic field



Describe how to make an electromagnet.

1. Wrap a length of <sup>insulated</sup> wire around an iron nail.

2. Connect the wire to a power pack and turn on.

Which three factors will affect the strength of an electromagnet?

- Number of coils
- Current
- Is there an iron core?

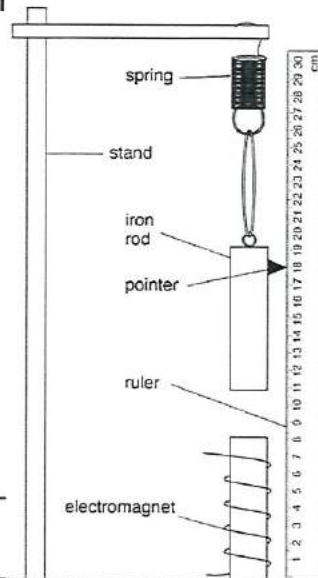
Which component can be used to change the current in a circuit?

Variable resistor

The equipment on the right is set up and the electromagnet is switched on.

What would you expect to happen when the electromagnet is switched on?

Pointer moves down.



Explain what would happen if the rod was made of copper instead?

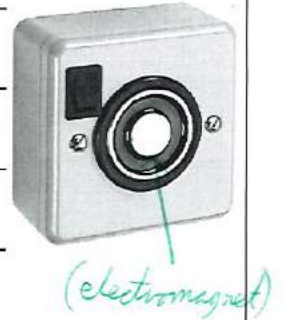
Nothing because copper isn't magnetic.

Would changing the direction of the current affect the investigation? Explain your answer.

Wouldn't make a difference. Iron is always attracted (unless it's a magnet itself).

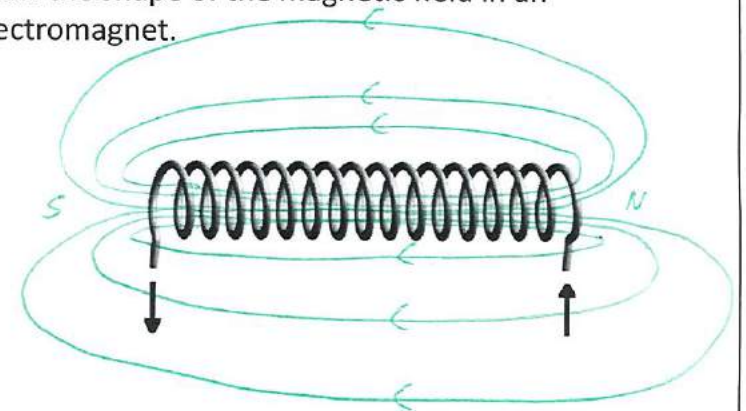
Explain how electromagnetic door holders (such as that shown in the picture) work. You should include an explanation of how the door can be closed automatically.

- An iron plate on the door is attracted to the electromagnet (current is always on).



- When the door needs to be closed, the current is turned off, so the iron plate is no longer attracted.

Draw the shape of the magnetic field in an electromagnet.



## Space

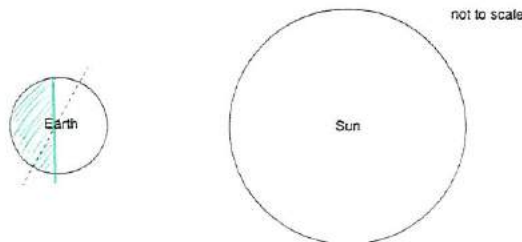
Approximately what shape are the Earth, Sun and Moon?

spheres

Put these in order of size (smallest first).

- |          |              |
|----------|--------------|
| <u>3</u> | Sun          |
| <u>4</u> | Solar system |
| <u>1</u> | Moon         |
| <u>5</u> | Milky Way    |
| <u>2</u> | Jupiter      |
| <u>6</u> | Universe     |

On the diagram, shade where it is night.



Explain what causes day and night.

The Earth rotates on its axis so  
half faces the Sun and half doesn't

Give two examples of non-luminous objects in space.

- Moon
- Planets

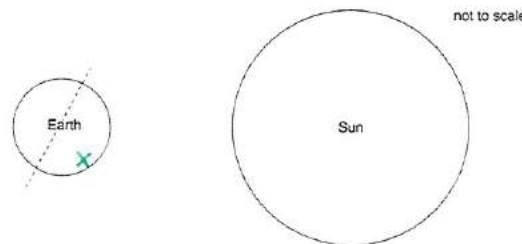
Give an example of a luminous object in space.

The sun (any star)

Explain how we are able to see one of the non-luminous objects on Earth.

Light from the sun is reflected off  
them and down to Earth

What season is it in the UK in the diagram?



Explain your answer.

Summer: UK is in northern hemisphere  
and northern hemisphere is tilted towards  
the sun

Put an 'x' on the Earth to show somewhere on Earth that it is a winter's day.

How long does it take for the Earth to orbit the Sun?

365.25 days

How long does it take for the Moon to orbit the Earth?

27 days (roughly)

How long does it take for the Earth to rotate on its axis?

24 hours

If the Earth's rotation on its axis were to speed up, what would change on Earth?

shorter days/nights

If the Earth were to be more tilted on its axis, what would change on Earth?

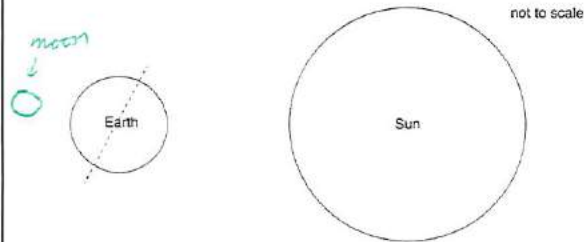
More extreme seasons

If the Earth was further from the Sun, what would change on Earth?

Colder



Draw the position of the Moon when a full moon is seen on Earth.



What is the unit used for measuring distances in space?

Light years

What is the definition for this unit?

The distance travelled by light in 1 year.

What is a galaxy?

A collection of millions of stars

What is the equation which links weight, gravitational field strength and mass?

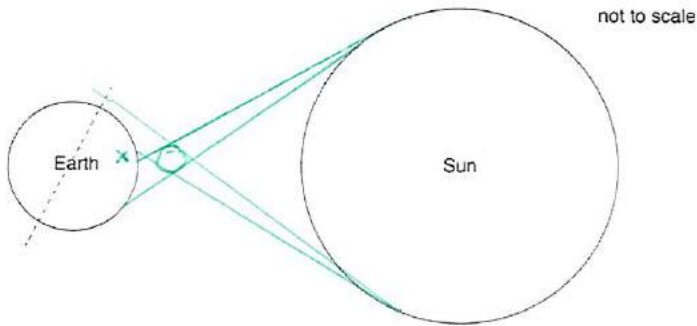
weight = mass  $\times$  gravitational field strength

What are the units for mass? kg

What are the units for weight? N

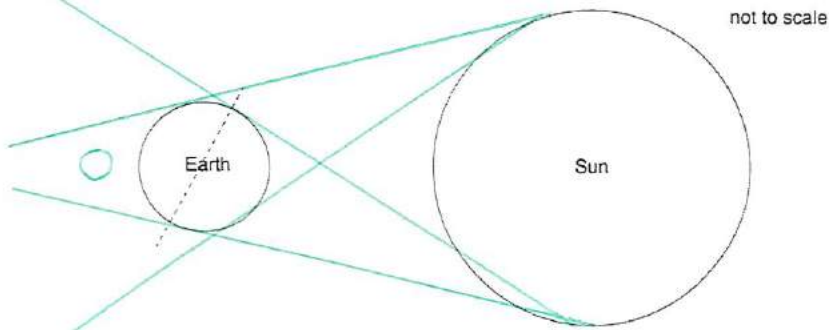
What are the units for gravitational field strength? N/kg

Draw the position of the Moon during a solar eclipse.



Add rays of light to show this eclipse and mark, with an 'x', where a total solar eclipse would be seen on Earth.

Draw the position of the Moon during a total lunar eclipse. Add rays of light to show this eclipse.



Explain why Jupiter's gravitational field strength is much larger than Earth's.

Jupiter has a larger mass than Earth

Jupiter is further from the Sun than the Earth. Would you expect a year on Jupiter to be longer or shorter than a year on Earth?

Longer because...

Jupiter has further to travel to orbit the Sun

The gravitational field strength on Earth is approximately 10 N/kg.

A piece of wood has a mass of 4 kg. Calculate its weight on Earth.

$$w = m \times g$$

$$= 4 \times 10$$

$$= 40 \text{ N}$$

The same piece of wood weighs 4.8 N on the Moon. What is the gravitational field strength on the Moon?

$$w = m \times g$$

$$g = \frac{w}{m} = \frac{4.8}{4}$$

$$= 1.2 \text{ N/kg}$$

On Venus, a hamster weighs 0.176 N. The gravitational field strength on Jupiter is 8.8 N/kg. What is the mass of the hamster in grams?

$$w = m \times g$$

$$m = \frac{w}{g} = \frac{0.176}{8.8}$$

$$= 0.02 \text{ kg}$$

$$= 20 \text{ g}$$

