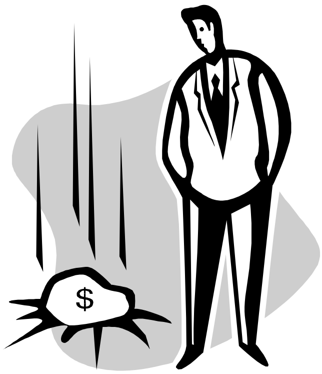
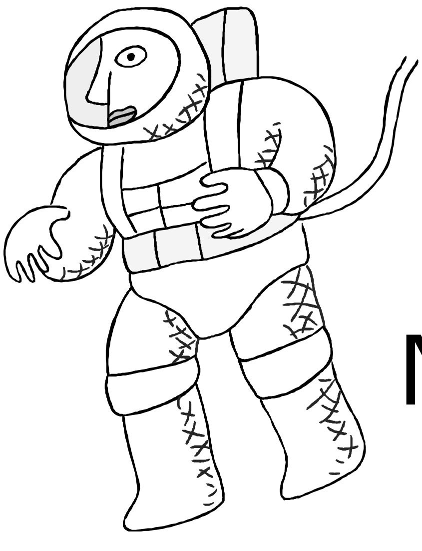
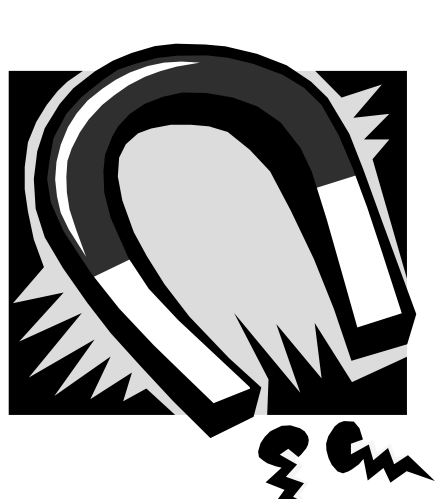
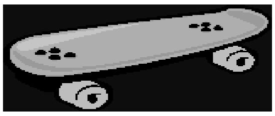


Forces



Name:___________



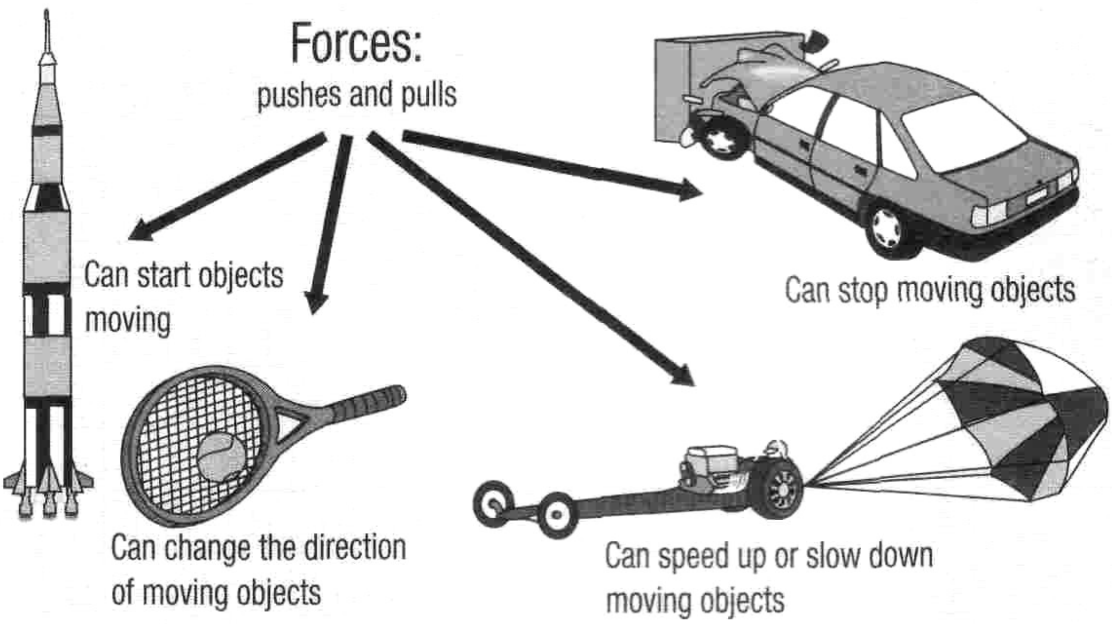


A skate board is given a push

What makes the skate board start going?	What makes the skate board Keep going?	What makes the skate board stop?	Are all moving objects being pushed

Concept:

A Force can be defined as a push or a pull



Whenever you push, pull, twist or turn something you are exerting a force. A force can start a stationary object moving, :or cause a moving object to come to rest or change its direction or speed. Forces can also change the shape of objects. Throwing a ball, riding a bike, walking, dressing and chewing all involve pushes, pulls, twists or turns.
There are many types of forces but they can be divided into two groups, **contact** forces and **non-contact** (or field) forces. Contact forces are exerted when objects actually touch one another. Examples of contact forces include:

- Tension (the force in a rope during a tug of war)
- Upthrust or buoyancy (the force that pushes back on gravity when an object floats)
- Friction (the force between the road and the tyres of a car).

Non-contact forces can have an effect without objects touching. They can act from a distance. Examples of non-contact forces include:

- Gravity (a pulling force between all matter)
- Magnetic force (a force which can pull or push magnetic materials)
- Electrostatic force (a force which can pull or push charged materials).

Experiment: Measuring forces

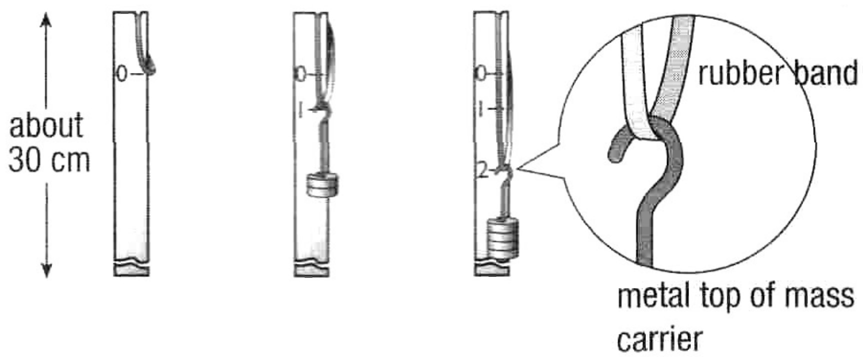
Aim: To make and use a force meter using a rubber band and masses.

Materials:

- A thin strip of timber or a ruler
- a mass carrier
- masses

Method:

1. Take a 30 cm piece of thin timber *and calibrate* it as shown in figure below.



2. Make a small groove on top of the timber. Attach the rubber band to the groove and hang 100 g mass to the rubber band.
3. Note how far the rubber band stretches when 100 g is attached—that amount of stretch shows the force (1 N) needed to pull an object weighing 100 g. Remember 100 g = 1 N. Complete the scale up to 5 N.
4. Use the force meter to measure the size of the following forces:
   - force needed to pull the door open
   - force needed to drag a chair across the floor
   - force needed to open a drawer in the laboratory
   - force needed to move your pencil case
   - force needed to pull up your sock.

Results:

Objects measured	Force required (N)
Open the door to the room	
Drag a chair across the floor	
Open a drawer in the laboratory	
Move your pencil case	

Discussion:

1. Which of the actions needed:
    a. More force?

____

____

    b. Less force?

____

____

2. Did you experience any problems during your experiment?

____

____

3. If so, explain how you would improve the construction of the force meter.

____

____

Conclusion: *(Summarise how you constructed and used the force meter)*

____

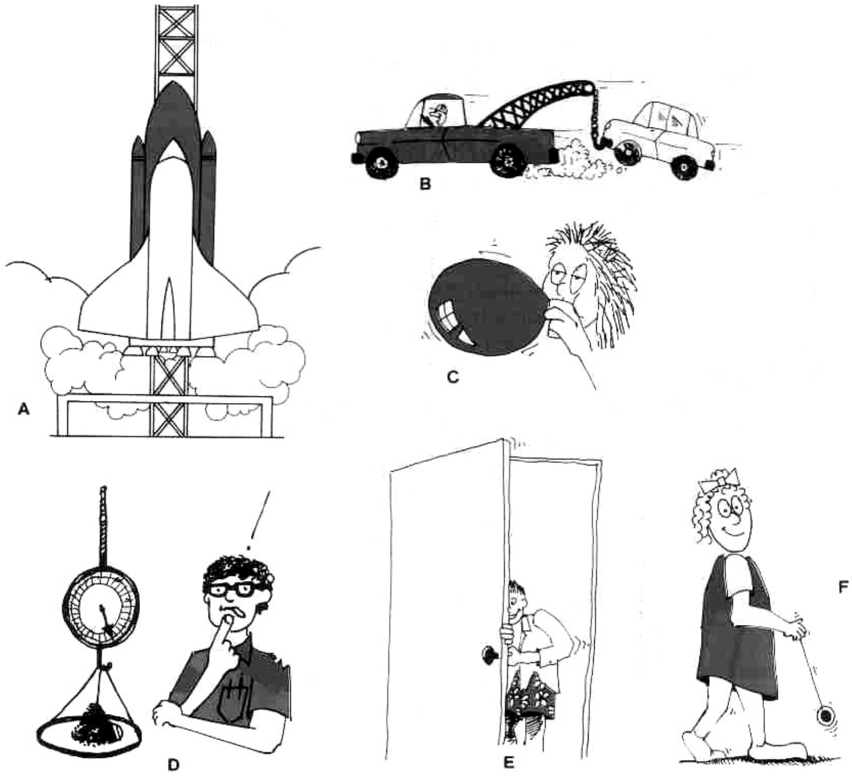
____

____

____

Question

1. Look at the diagrams below. Which show a push, and which show a pull?



Picture	Push/Pull
A	
B	
C	
D	
E	
F	

2.

Rank these forces in order, from biggest to smallest: 1 to 5	
Truck hitting a pole	
Rocket being launched	
Typing a letter on a computer keyboard	
Kicking a *soccer* ball	
Pushing *a car along* the street	

3. State which of the following actions involve push force, pull force *or no force.*

Actions	Push, pull or no force
Opening a window	
Turning a screw a with a screw driver	
Smelling food cooking	
Moulding clay in an art lesson	
Hitting the enter key on a computer keyboard	
Standing on a diving board	
Watching a candle burn	
Throwing a ball	
Turning a page in a book	

4. Complete the sentences below. Choose from these words:

DIRECTION
PULL
MOVE
PUSH

(a) A force is a__________ or a _________________

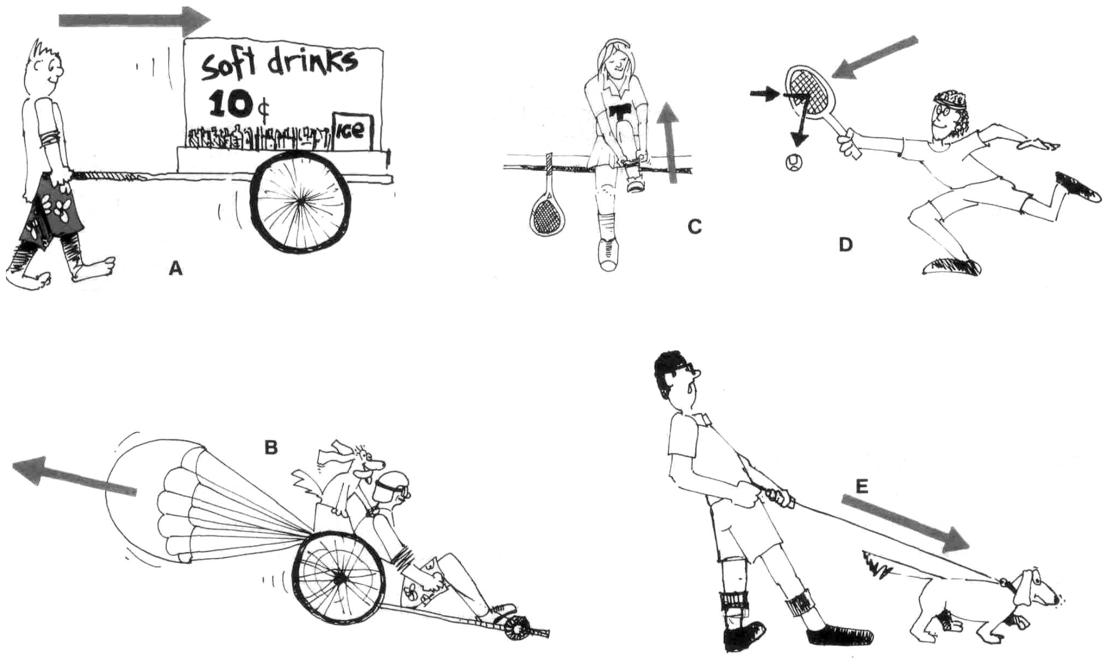
(b) When you close a door, you ___________________

(c) When you lift something, you ___________________

(d) Force can make things ______________________

(e) A force can also make moving things change _________________________

5. The figure to below shows some forces in action. The forces are shown with arrows. For each picture:
   (a) Name the object that the force acts on; eg. in A, the force acts on the cart.



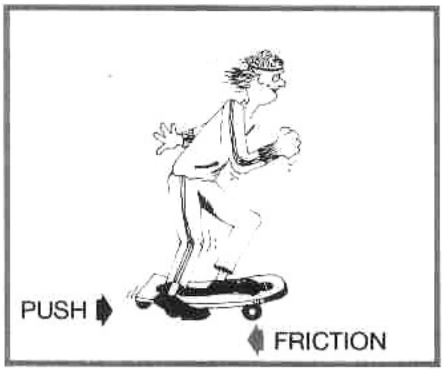
(b) Choose from the list below to say what the force is doing.

What the force is doing	Object (A,B,C,D,E)
starting an object moving	
stopping an object that is moving	
changing the direction of movement	
balancing another force, and preventing movement	
stretching an object	

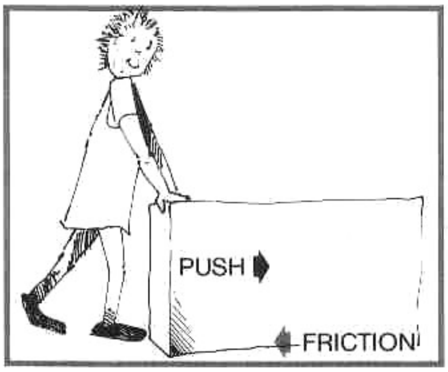
Contact Forces

Concept:

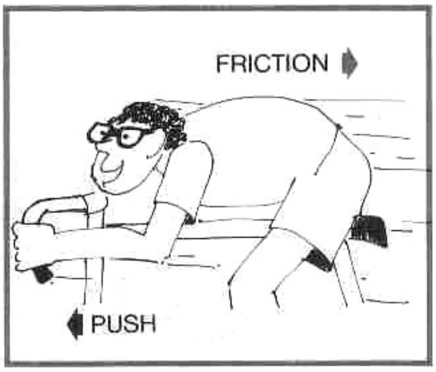
Friction is a force that slows down or prevents movement.



Rolling friction.



Sliding friction.



Fluid friction.

Friction is the force applied to the surface of an object when it moves against the surface of another object. Both surfaces do not have to be moving. Friction acts where the surfaces touch. Friction can slow down an object or stop it from moving. Friction limits how fast you can go. Rough surfaces produce more friction than smooth ones. To slow down quickly on roller blades you need to use a stopper so that there is more friction. If there was no friction, you would not even be able to start moving forward. However, if there was too much friction, it would take too much effort to keep moving.

Experiment: Measuring Friction

Aim: To measure the force of friction on different surfaces.

Materials:

- block of wood with hook attached
- your force meter

Method:

1. Use your force meter to push a block of wood across your desktop. As long as you push steadily, the reading on the force meter will be equal to the force of friction on the moving block. Record your reading in the results table.
2. Repeat your measurement two more times on the desktop and calculate the average force of friction. Record all data in the table.
3. Repeat this procedure on several other surfaces. Surfaces that you might test are: vinyl floor, carpet, doormat, concrete and bitumen.

Results:

Friction on different surfaces				
Surface	**Force of friction (Newton)**			
	Trial			
	1	**2**	**3**	**Average**

Summarise your results in a bar graph

Discussion:

1. List the surfaces in order, from greatest friction force to least

____

____

2. What feature of a surface seems to determine the amount of friction?

____

____

3. Why was it a good idea to repeat each measurement three times?

____

____

4. Design and carry out an experiment to find out the effect of mass on the size of the friction force. Record your results in a table and display them on a line graph.

____

____

5. Do heavier objects experience more friction?

____

____

Conclusion: *(Relate the aim ane the concept of friction)*

____

____

____

____

Question

1. What sort of friction (sliding, rolling or fluid) occurs in the following situations?

    (a) A man pushes a cupboard across the floor.____________________

    (b) A bowling ball moves down a bowling alley._____________________

    (c) The Space Shuttle re-enters the Earth's atmosphere.___________________

    (d) Kurt rides his skateboard.________________________

    (e) A surfer waxes her board, then goes surfing. ________________________

2. In rainy weather the radio sometimes announces that there is a wet weather alert. Why do motorists have to be careful when the roads are wet?

____

____

3. Why do cars that travel in snow have to carry chains that fit around the tyres?

____

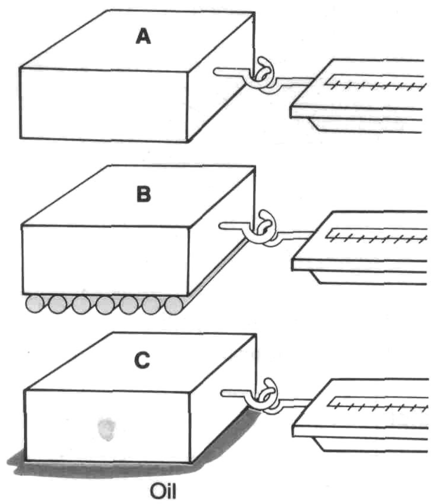
____

4. Why don't bicycle hand brakes work as well when it rains?

____

____

5. Look at the diagrams below. Complete the sentences by circling the correct word.



(a) Diagram A shows (sliding/rolling) friction.

(b) The friction in B is (more/less) than in A.

(c) Rolling friction is (greater/less) than sliding friction.

(d) When an object slides, there is (more/less) resistance to movement than when it rolls.

(e) With lubrication (Diagram C) you need (more/less) force to move an object.

(f) Lubrication (increases/decreases) friction.

6. Copy and complete the paragraph below, choosing from these words to fill the gaps.

CARPET FORCE ROUGH MORE GLASS RUBS SMOOTH LESS

Things move more easily along a ________________ surface than a ________________ surface. This is because of friction. It happens when one surface _______________ on another. Rough surfaces like ________________ make _____________friction than smooth surfaces like____________________

Buoyancy

Archimedes' Principle after the person who first stated it.

Concept:

The upward force is called the buoyant force or up-thrust because it acts upwards against the weight of the object.

Experiment: Feeling the force of water

AIM: To feel the force that water exerts on objects.

MATERIALS:

- balloon
- basin or bucket big enough to contain
- the inflated balloon

METHOD

1. Blow up the balloon and tie off the neck.
2. Half-fill the basin with water. Place the balloon on the surface of the water so it floats.
3. Try to push the balloon into the water so that it is completely submerged.

DISCUSSION

1. How much of the balloon was above the surface of the water when it was floating?

____

____

2. What was resisting you when you tried to push the balloon completely under the water?

____

____

3. What happened to the level of the water in the bucket as you pushed the balloon further down?

____

____

Why do you feel almost 'weightless' when swimming in water? What we feel as an up wards 'push' is called **buoyancy.** This buoyancy is greater in water than in air because water is denser than air. Saltwater has a higher density than fresh water so the buoyancy effect is greater and you float better, or feel more buoyant, in salt water. Aquatic animals can easily swim around in water but some are crushed by their own weight on land. For example, jellyfish float in seawater but are flattened when stranded on the beach.

Surface tension is what keeps a water strider from sinking and drowning. The small weight of the water strider is well spread out over the surface and is not large enough to push the water particles apart.

Concept:

Surface Tension is the pulling of particles in a liquid together

Experiment: Holding It All Together

Materials: Coin
Eyedropper
Beaker
Dishwashing detergent•

Method:

1. Estimate how many drops of water you could get onto a 5-cent coin without water spilling over the edge. With great care and from a very small height, test your prediction with an eyedropper.
2. Repeat your test using water from a small beaker with a few drops of dishwashing detergent added to it.

Results:

Prediction =

	Trail 1	**Trail 3**	**Trail 3**	**Average**
Number of drops with water				
Number of drops with Dishwashing detergent				

DISCUSSION

1. What difference does the detergent make to your result?

____

____

2. Were you surprised by your results?

____

____

3. What seems to keep the water on the coin?

____

____

Non-Contact Forces

Concept:

Like poles repel
Unlike poles attract

Experiment: Magnetic forces

Aim:

1. To test which materials *are* magnetic and non-magnetic?
2. To test forces between two bar magnets.

Materials: Copper, paper, lead, rubber, wood, steel, magnesium, aluminium, plastic, zinc, paperclip, iron nail, 2 bar magnets, string, retort stand and a clamp.

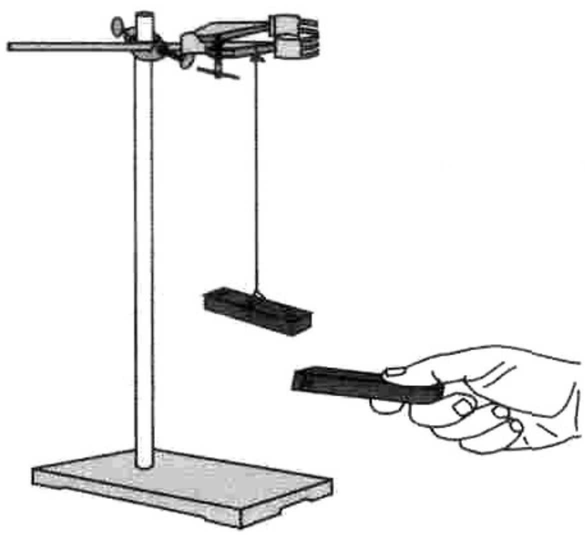
Method:

Part 1—Magnetic or non-magnetic?

1. Place the materials given to you on a small tray. Take a bar magnet and test each material to see if it is attracted by both ends and the middle of the magnet.
2. Record your results in table 1.

Part 2—Testing forces between magnets

1. Use a string to suspend a bar magnet from the retort stand. Take the north pole of the free magnet near the north pole of the suspended magnet and see what happens.
2. Repeat this procedure with the south poles.
3. Repeat this procedure with two unlike poles.
4. Record your results in table 2.



Results:

Table 1—Magnetic and non-magnetic (pl*ace* a tick in the relevant column)

Material	Attracted	Not attracted
Copper		
Magnesium		
Paper		
Zinc		
Lead		
Aluminium		
Rubber		
Plastic		
Wood		
Paper clip		
Steel		
Iron nail		

Table 2—Forces between magnets

Poles *tested*	*Attracted or repelled*
N-S	
S-N	
N-N	
S-S	

Discussion:

1. Which *materials were* magnetic?

____

____

2. Which materials were non-magnetic?

____

____

3. Which part *of the magnet* was strongest in attracting materials?

____

____

Conclusion: (Complete the following statements)

1. ____________________substances are attracted to a magnet and

   __________________substances are not.

2. Like magnetic poles _______________each other and unlike magnetic poles _________________

Magnetic forces affect only those materials that contain *iron, nickel* or *cobalt.* Alloys that contain these metals, e.g. steel, are also affected. Magnets are made of materials that contain one or more of these metals.
You will have found that the ends of a magnet are more magnetic than the middle. These are the **poles** of the magnet. If you suspend a magnet it always points north-south. The end that points north is called the north pole. The other end is called the south pole.
If the north poles of two magnets are placed near each other, they will *repel* each other. Similarly for two south poles. On the other hand, the north pole of one magnet will *attract* the south pole of another magnet.

Concept:

Magnets are made of iron, nickel or cobalt

Magnetic material are attracted to a magnets

Question

1. Complete the sentences below.
   a. A substance which is attracted to a magnet is said to be____________________
   b. A magnet can exert a ____________________________ on a piece of iron without touching it.
   c. Magnets can be made of ____________ or ___________ or_____________
   d. All magnets have two_____________
   e. One end of a magnet is called the _________ ___________. The other end is called the
   f. _________ ___________.
   g. Two south poles or two north poles are called _________ ________.
   h. When two magnets push each other apart we say they ___________
   i. Like poles __________ , and __________ poles repel.

2. Use the words magnetic and non-magnetic to explain why a mixture of steel and brass screws can be separated using a magnet.

____

____

3. Are these statements true or false?

Statement	True/false
Any metal object can be picked up by a magnet.	
A magnet is strongest at its middle.	
A north pole will attract a south pole.	
Like poles attract each other.	
As you move away from a magnet the magnetic force decreases.	

4. A piece of iron is magnetic but it may not be a magnet. What does this mean?

____

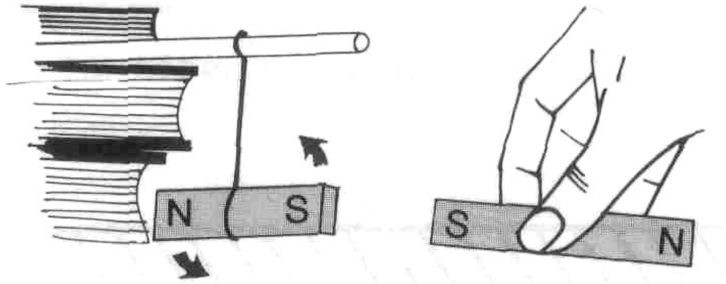
____

5. Complete the table below, by writing 'repel' or 'attract' to say what happens when the poles meet.

	NORTH	SOUTH
NORTH		
SOUTH		

6. Look the figure below and then answer the question by circling the correct answer.

a. The hand in the figure is holding the south pole close to the (north/south) pole of the hanging magnet.



b. The poles that are close together are (like/unlike). The poles will (attract/repel).

Experiment: Making An Electromagnet

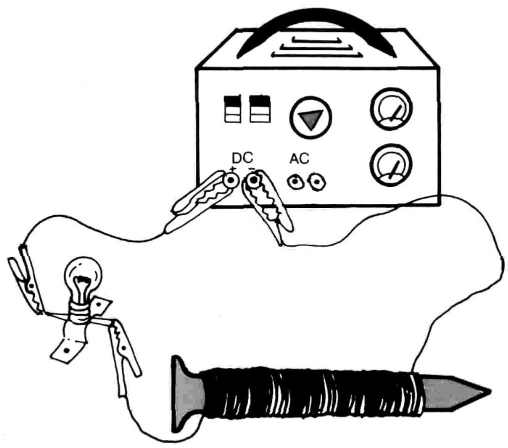
Aim: To make an electromagnet, and investigate how it can be made stronger.

Materials

a. a small compass
b. a large nail (about 8 cm long)
c. 2 thin, insulated wires with fitted alligator clips(one wire about 1 m long, and the other about30 cm)
d. a 6 V torch bulb and holder
e. a power supply
f. a box of paperclips

Method

1. Wrap about 20 turns of wire around the large nail.
2. Use the wires to connect the nail to a power supply, through a 6 V bulb, as shown in the figure below. (The bulb stops the fuse in the power supply from 'blowing.)
3. Set the power supply to 2 *volts DC.* Turn it on.



- Has the nail been magnetised? That is, will it pick up tacks? How many?

____

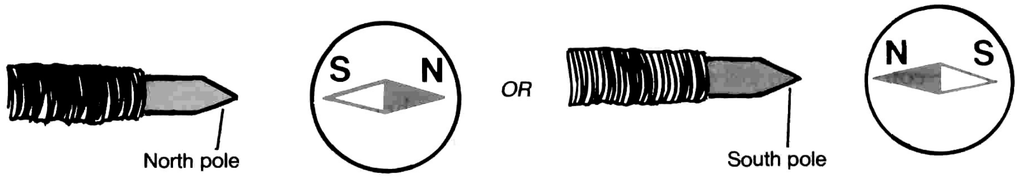
____

- What happens when you turn off the power supply?

____

____

4. Turn the magnet on again, and bring a small compass near the sharp end of the nail. Use the figure below to decide whether the sharp end of the electromagnet is a north pole or a south pole.



5. Test the other end of the electromagnet.
6. Reverse the connections to the power supply.
7. Test the information in the results tables.

Result:

Number of turns	Number of paper clips
10	
20	
30	
40	
50	
60	
Voltage	**Number of paper clips**
A (2 V)	
B (4 V)	
C (6 V)	
D (8 V)	
E (10 V)	
F (12 V)	

Questions and conclusions

1. Why is an electromagnet called a 'temporary magnet'?

___

___

2. How can the poles of the electromagnet be reversed?

___

___

3. List two ways of increasing the strength of an electromagnet.

___

___

Question

1. The data table below shows the results of some experiments. The twelve electromagnets are all different, but their cores are the same size. You can tell how strong each electromagnet is by the number of paperclips it lifts. When the electricity is switched off, the paperclips drop from the iron-cored electromagnets, but not from the steel-cored ones.

Electromagnet	Core Material	Number of turns in	Voltage (volts)	Number of paper clips

		coil		**lifted**
1	**iron**	**10**	**2**	**2**
2	**iron**	**20**	**1**	**3**
3	**iron**	**20**	**2**	**4**
4	**iron**	**20**	**3**	**10**
5	**iron**	**20**	**4**	**17**
6	**iron**	**20**	**5**	**22**
7	**iron**	**20**	**6**	**26**
8	**iron**	**20**	**7**	**28**
9	**iron**	**20**	**8**	**28**
10	**iron**	**30**	**2**	**6**
11	**steel**	**20**	**3**	**7**
12	**steel**	**30**	**2**	**5**

a. How can you tell how strong each electromagnet is?

____

____

b. Write down *three* things that could affect the strength of an electromagnet.

____

____

c. Which electromagnets would allow you to find out how the strength depends on the voltage?

____

____

d. Draw and complete the graph on the left for iron-cored electromagnets with *20 turns* in the coil. Is it true that *the higher the voltage, the stronger the electromagnet?*

____

____

e. If you wanted to find out how the number of turns affects the strength, which three magnets would you compare? Why did you choose them? How *does* the number of turns affect the strength?

____

____

f. Iron is a better core material than steel. Give one reason why.

____

____

Concept:

- **Unlike charges attract**

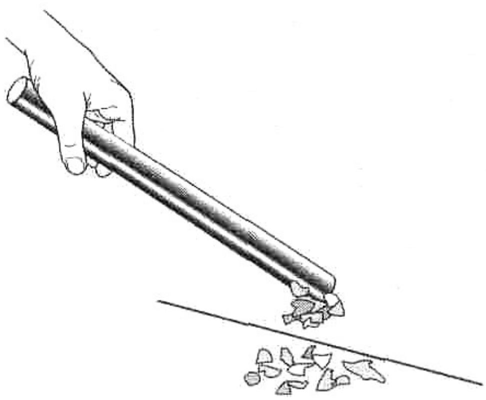
- **Like charges repel**

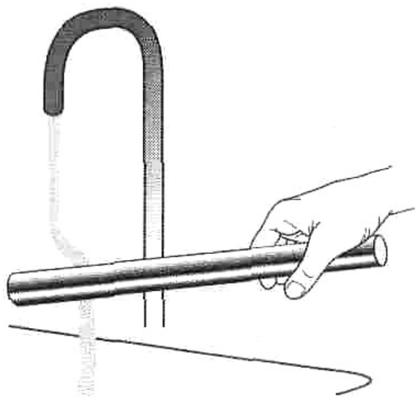
- **Charged object attracts an uncharged object**

Experiment: Investigating electrostatic charges
Aim: To produce static electricity.
Materials: A balloon, a Perspex rod, pieces of wool *and* silk, small pieces of paper *and* running tap water.
Method:

Caution: *do not put the charged rod near anyone's face or eyes.*

1Blow into the balloon *and* tie off the end when it is inflated with air. Rub the balloon with a piece of wool *and* release it *near a wall. Observe what* happens.
1Rub the balloon *over a friend's hair and observe what happens.*
2Take the charged balloon near small pieces of paper and observe what happens
4Take the *charged* balloon near running tap water *and observe what happens.*
5Repeat the above steps with a perspex *rod rubbed* with wool.





Results: *Record* your results in the table—put a tick if it is attracted.

Objects tested	Charged balloon	Charged perspex rod
Wall		
Paper		
Hair		
Water		

Discussion:

1. Which objects did a charged *balloon attract?*

____

____

2. Why did the *balloon* stick to the wall?

____

____

3. What *happened when* a charged perspex rod was taken *near paper, hair and water?*

____

____

Conclusion: How did you create static electricity in this experiment?

____

____

____

____

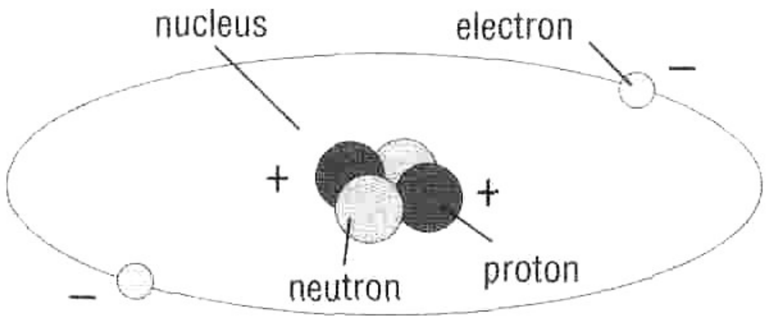
Static electricity is produced by friction when materials are rubbed together. The study of static electricity is called **electrostatics.**

Types of charges

All matter is made up of small particles called **atoms.** Atoms are made of smaller particles called electrons, neutrons and protons. **Protons** and **neutrons** are found in the **nucleus** (centre) of the atom. **Electrons** are smaller in size and move around the nucleus at high speed.

•Electrons have negative charge.
•Protons have positive charge.
•Neutrons have no charge.

Neutral atoms have equal numbers of electrons and protons. Rubbing can tear electrons from certain atoms and they become **positively charged.** Other atoms gain electrons and become **negatively charged.**



Complete the following:

Atoms are made of particles called _______________, neutrons and _______________ , Protons and _____________ are found in the _____________ of the atom. ________________ are _________________ in size and move around the ________________ at high speed.

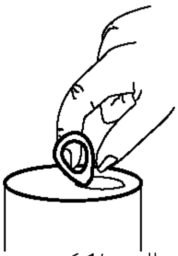
Electrons have _____________ charge, protons have _______________ charge and neutrons have ____________ charge. A charged object has an _____________ force ____________ around it and other objects will be attracted or _______________.

Electrical Electrons No Field Negative Protons Neutrons Nucleus Smaller Nucleus Positive repelled Electrons

Question

1. Look at the pictures below. For each picture, complete the two sentences to describe the forces that are occurring. The words in the box below will help you complete the first sentence for each picture.

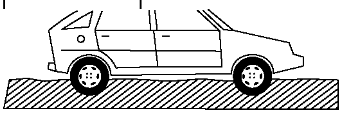
friction gravity buoyant force (upthrust) mechanical



The type of force is ______________________ .

It is acting between the ______________________

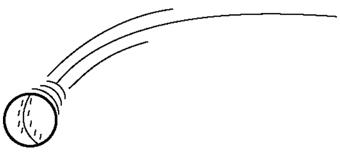
and the ______________________ .



The type of force is ______________________ .

It is acting between the ______________________

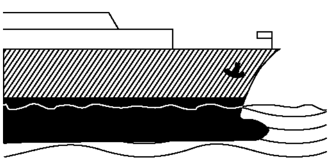
and the ______________________ .



The type of force is ______________________ .

It is acting between the ______________________

and the ______________________ .



The type of force is ______________________ .

It is acting between the ______________________

and the ______________________ .

2. Draw arrows to show the direction of the forces acting in each of the pictures above. Label each arrow with the name of the force.

3. Choose words from the box to complete the sentences.

energy build up pull magnet start energy stopped attract repel

Force is the general name for a push, a ______________________ or a twist.

Forces can ______________________ , stop or change the direction of an object.

Forces give ______________________ to objects.

Motion cannot be started, altered or ______________________ except by a force.

Electricity is ______________________ that results from the movement of electrons.

When electrons gather together in one place a ______________________ of static electricity occurs.

A ______________________ is an object that is able to attract magnetic material.

Like poles ______________________ and opposite poles ______________________ .

4. Choose a word from the box to complete the sentences below. You may use a word more than once.

poles north magnetic metals repel lines magnetism

Magnets point to the ______________________ pole if you hang them from a string.

Heating a magnet destroys its ______________________.

Planes and large ships use ______________________ compasses for navigation.

A magnetometer is a sensitive magnet that finds ______________________ underground.

______________________ resonance imaging (MRI) is used to find out what is wrong with sick people.

Like poles ______________________ and unlike (different) poles attract.

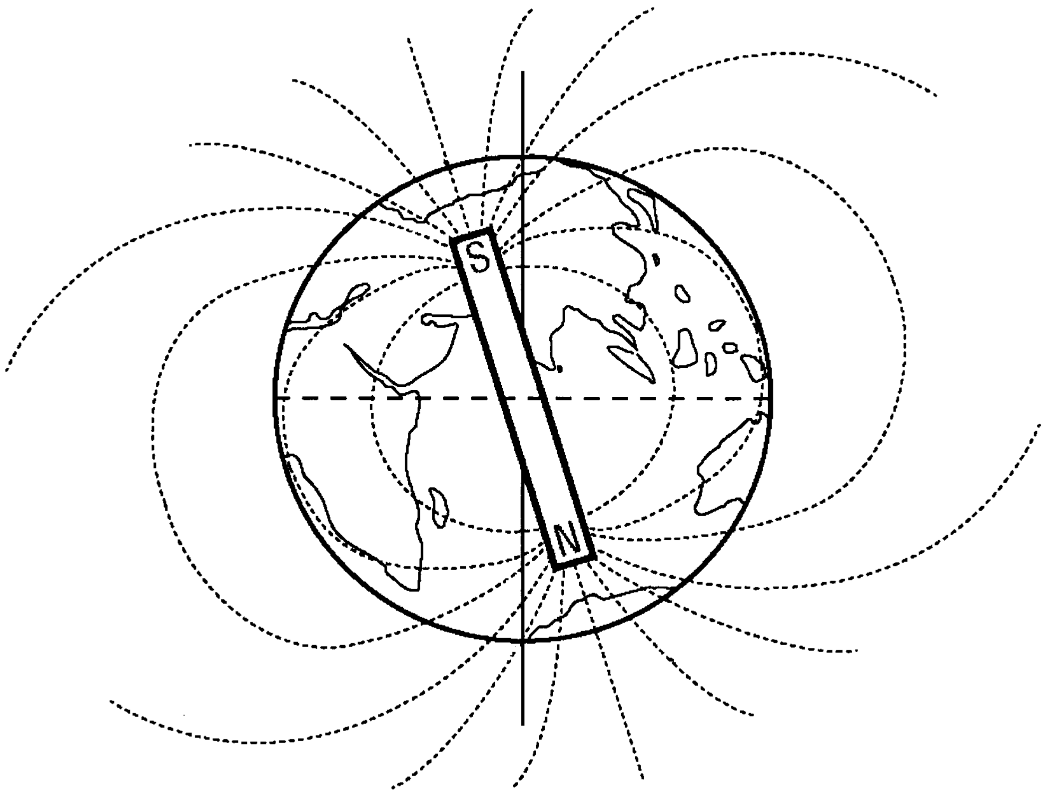
The magnetic north pole of the Earth attracts the ______________________ pole of a compass.

The magnetic field of a magnet is strongest near the ______________________ of a magnet.

Magnetic field ______________________ can be used to represent a magnetic field.

2 Add the following labels in the correct places on the diagram below.

geographic north pole geographic south pole magnetic north pole magnetic south pole north-seeking pole of magnet south-seeking pole of magnet



3Cross out the wrong word in each sentence.

a. North and south poles attract/repel.

b. Two south poles attract/repel.

c. Two north poles attract/repel.

4You are given three similar painted metal rods, one made of copper, one of soft iron and one a permanent magnet. Describe how you could distinguish between the three rods without using any other equipment. (Note: copper cannot be magnetised.)

Concept:

The gravitational attraction between two objects depends on their masses. The bigger the mass, the stronger the gravitational Force.

Everything made of matter is affected by the pull of **gravity.** All matter on or near the Earth is attracted to the Earth. In fact, all bits of matter attract each other. Sir Isaac Newton discovered this in the seventeenth century.

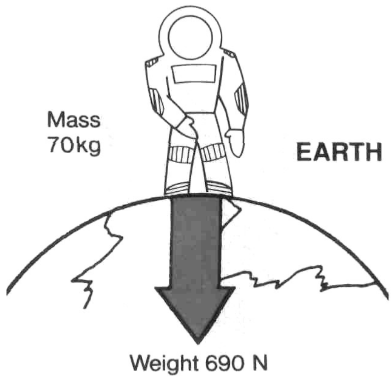
Gravitational forces exist between objects even when they are not touching. For example, there is a gravitational force between the Earth and the moon. This keeps the moon in place. Similarly, a gravitational force keeps satellites in orbit around the Earth. The Earth itself is kept in orbit around the sun by a gravitational force. So are all the other planets.

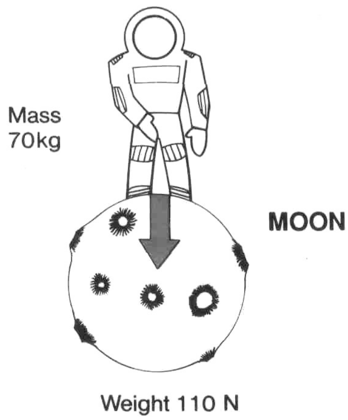
Concept:

Mass and weight are not the same.

Mass is the quantity of matter in an object. It is measured in grams or kilograms. **Weight** is a force — measured with a spring balance. It is the downward force of gravity. Because it is a force, weight is measured in newtons (N).

The scales of weighing machines are usually marked in mass units (kilograms). This is why most people think mass and weight are the same, even though they aren't. When you weigh yourself, you are measuring the pull of gravity on you. And this is a force, not a mass. The moon has less mass than the Earth. So the moon would not attract you as strongly as the Earth does. This is why gravity is less on the moon than it is on Earth. Your mass does not change, but your weight does You can jump higher on the moon, and you don't come down as quickly as you would on Earth.





Question

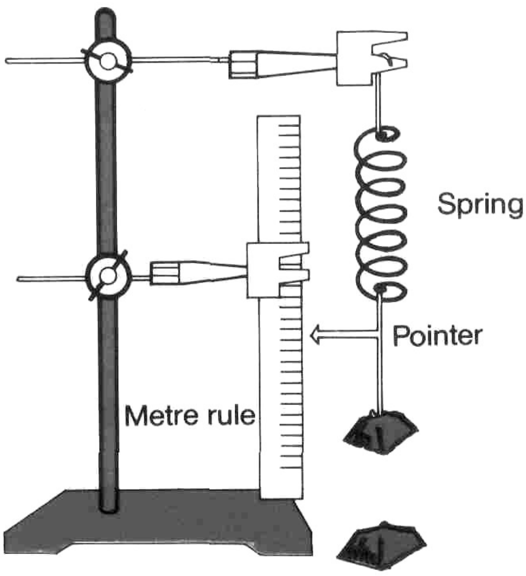
1. Match these weights with the correct object.

1 N	a 5 litre can of petrol
50 N	the Guinness Book of Records
450 N	an apple
10 N	you

2. Are the following statements true or false?

Statement	True/False
Mass and weight are the same.	
Weight depends on gravity.	
Mass depends on gravity.	
Objects are light when gravity is weak	
An astronaut has the same mass on the moon as on Earth.	
An astronaut weighs the same on the moon as on Earth.	
The moon's gravity is stronger than the Earth's gravity.	
Gravity only affects heavy things.	

3. Look at the figure below. Circle the correct word to complete these sentences in your notebook.



a. The force of gravity is a (push/pull).

b. A force pulls the spring (up/down).

c. The heavier the object, the (less/greater) the force.

d. The stronger the force, the (more/less) the spring stretches.

e. A 10 N weight is a (stronger/weaker) force than a 20 N weight.

f. A 20 N force stretches the spring (twice as much/half as much) as a 10 N force.

Find each of the following words.

ATTRACT	PROTON	SOUTH	NEWTON
POSITIVE	ELECTROMAGNET	MAGNET	TENSION
CHARGE	FORCE	WEIGHT	SURFACE
CONTACT	FRICTION	ELECTROSTATIC	BUOYANCY
REPEL	PUSH	NORTH	GRAVITY
MASS	NEGATIVE	ELECTRON	PULL

N	S	U	R	F	A	C	E	N	A	T	T	R	A	C	T	E	N	P	U	L	L	E
T	A	N	H	A	E	L	O	T	I	O	P	C	N	C	G	I	P	T	E	N	G	V
I	E	O	F	R	I	C	T	I	O	N	H	E	N	N	C	B	T	P	O	R	E	H
N	H	N	O	R	T	H	E	T	L	A	W	L	N	N	E	E	O	M	C	V	L	R
C	N	M	G	N	T	G	I	B	R	T	U	E	N	E	T	S	Y	R	P	R	E	A
I	N	N	A	A	C	M	O	G	O	L	A	P	T	C	I	E	Y	A	U	O	C	T
N	N	H	O	G	M	C	E	N	U	C	I	E	O	T	S	H	L	O	S	C	T	M
I	O	T	Y	H	N	O	T	O	I	V	A	R	I	S	S	N	A	T	H	C	R	A
L	R	S	C	H	O	E	R	T	T	T	A	V	S	O	U	T	H	Y	A	C	O	T
R	T	L	N	E	T	A	T	T	R	C	E	E	O	C	E	G	T	T	A	A	S	T
C	C	N	A	F	O	R	C	E	C	P	E	N	A	O	I	I	N	P	E	A	T	G
P	E	P	Y	C	R	M	T	A	I	E	P	N	F	E	V	O	T	H	E	F	A	E
E	L	O	O	E	P	S	H	T	T	V	L	T	W	A	C	N	T	E	A	N	T	L
E	E	H	U	T	E	N	S	I	O	N	G	E	R	E	G	C	T	V	S	L	I	I
A	E	I	B	N	E	G	A	T	I	V	E	G	R	T	M	A	S	S	R	O	C	T
I	O	C	R	C	R	C	I	T	R	P	E	N	C	H	L	L	T	G	A	S	T	T