Your High School

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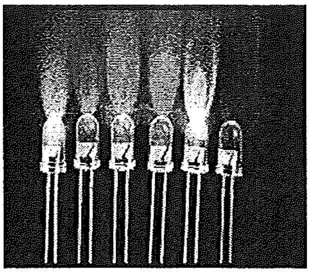
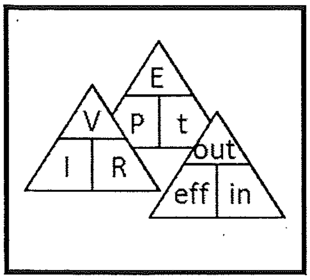
School

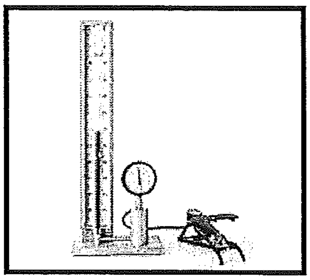
Crest

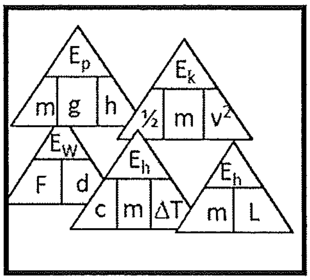
North Lanarkshire Council

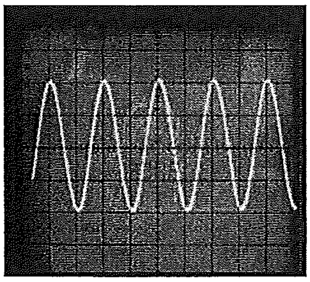
N4 N5 Physics

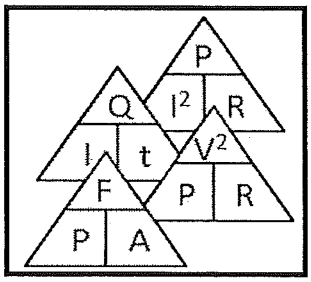


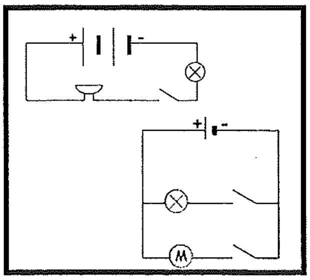










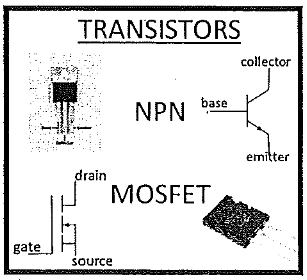


$R_{series} = R_1 + R_2 + R_3 \ldots$

$1 / R_{parallel} = 1/ R_1 + 1/ R_2 + 1/ R_3 \ldots$

%efficiency = (output / input) x 100

$P_1V_1 / T_1 = P_2V_2 / T_2$



Electricity & Energy

Summary Notes

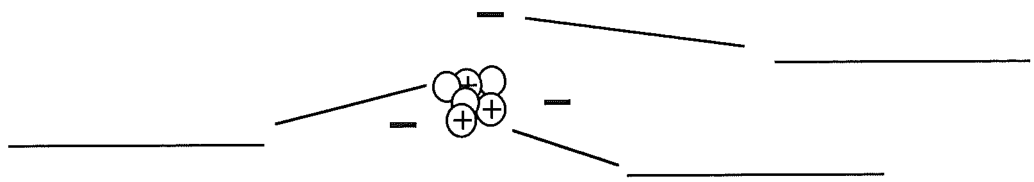
NQ 5	Unit 3	Electricity and Energy	Summary Notes

A. Electric Circuits

1. Electric Charge

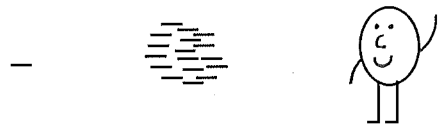
All matter is made from tiny particles called __________. An atom has a tiny central core called the ______________. The nucleus is made from protons which have a __________________ charge and neutrons which have _____ charge. Around the nucleus is a 'cloud' of _______________ which have a ________________ charge.

The atom



If an atom loses electrons the atom becomes ___________________ charged.
If an atom gains electrons the atom becomes ____________________ charged.

Each electron carries a tiny charge.
The symbol for charge is ______.
The unit for charge is
______________ or ______.
An electron's charge is so small it is difficult to measure. So we bundle billions of electrons together into 1 coulomb of charge.

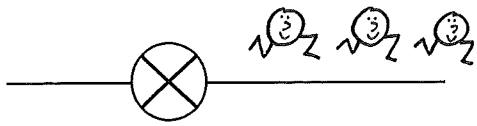


1 electron | 1 coulomb of charge | cartoon Coulomb

2. Electric Current.

Current is the number of coulombs of charge which pass a point each ______________. The symbol for current is _____.
The unit of current is ________________ or ______.

In this diagram 3C of charge pass through the bulb in 1s.
So the current is _________.

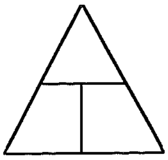


1 second

3. Current, Charge and time

Charge = current x time

$Q = It$



quantity	unit
Charge	
Current	
Time	

Example 1. The current in a wire is 2.5A. How much charge will pass through the wire in 30s?

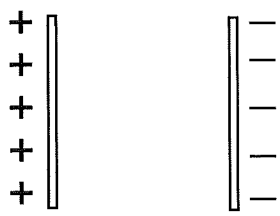
4. Electric Fields

Just like there is a gravitational force field around mass there is an electrical force ____________ around __________________ particles. The direction of an electric field is the direction a _______________ particle would travel if placed in the field.

Draw the field lines in these diagrams.

point +ve charge

point -ve charge



parallel plates

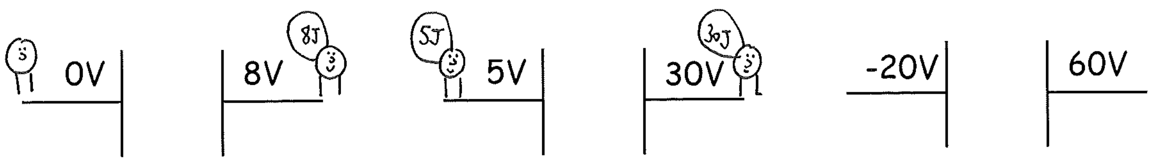
two charges placed close to each other

5. Potential and Potential difference.

The amount of electrical energy a coulomb of charge has is defined by its voltage or p____________________. The difference between the potential a coulomb has at one point in a field and another is called the potential __________________ or ____ for short.

Potential and potential difference are measured in _____________ or ____.

The following diagrams show charged parallel plate. The voltage or potential at each plate is shown. For each parallel plate state the potential difference.



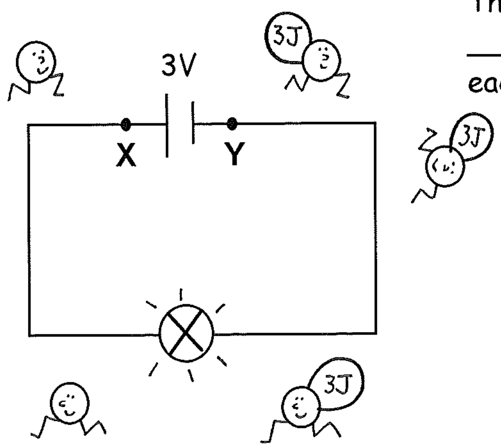
pd = ______ pd = ______ pd = ______

6. Voltage

Because one plate of a battery is always at 0V the pd across the battery is the same as its voltage of the opposite plate.
The voltage of a cell tells you the amount of _____________ the cell gives or transfers to each coulomb of charge. The coulombs carry the energy round the circuit to the component. The voltage across the component is the amount of _____________ each coulomb gives up at the component.
The symbol for voltage is ___. The unit of voltage is _________ or _____

This 3V cell is connected to a bulb

The cell gives ____ of energy to each coulomb

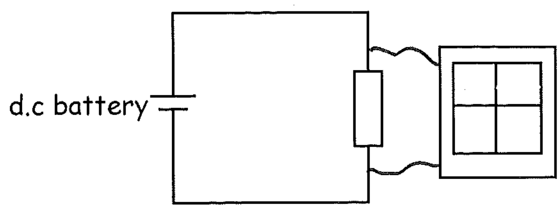


At the component each coulomb gives up _____ of energy.

At point X the coulombs have 0J energy = 0V of potential.
At point Y they have 3J of energy = 3V of potential.
The potential difference (pd) between two points = ____V.

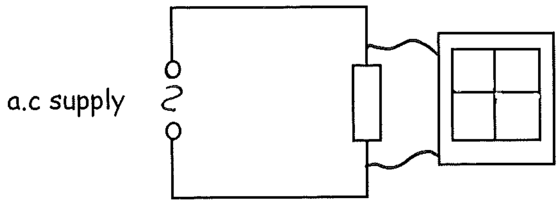
7. Direct current and alternating current

In a circuit with a dc battery the current is a constant size and travels in the __________ direction from the negative side of battery to the________________side.



Sketch what you would see on the oscilloscope trace

In a circuit with an alternating supply the current continually changes size and ___________.
In British homes the current changes direction in kettles and TVs ______ times each second.
Mains frequency = _____Hz



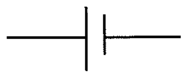
A car battery and a watch battery are ______ supplies

Mains electricity in your house is an ______ supply.

8. Electrical Components

Electrical circuits are made up of electrical components. Here are the circuit symbols for various electrical components.

(a)
____

(b) 
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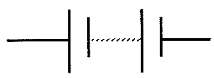
(c) 
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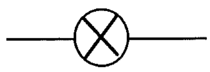
(d) 
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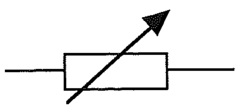
(e) 
____

(f) 
____

(g) 
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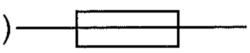
(h) 
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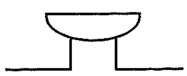
(i) 
____

(j) 
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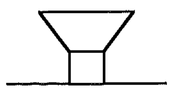
(k) 
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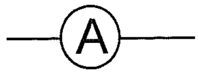
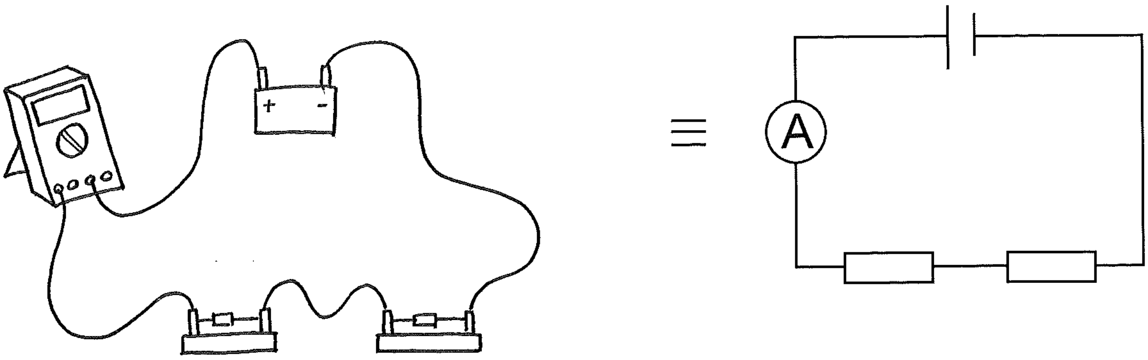
9. Measuring Current.

Current is measured using an ________________.

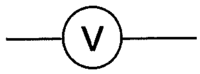


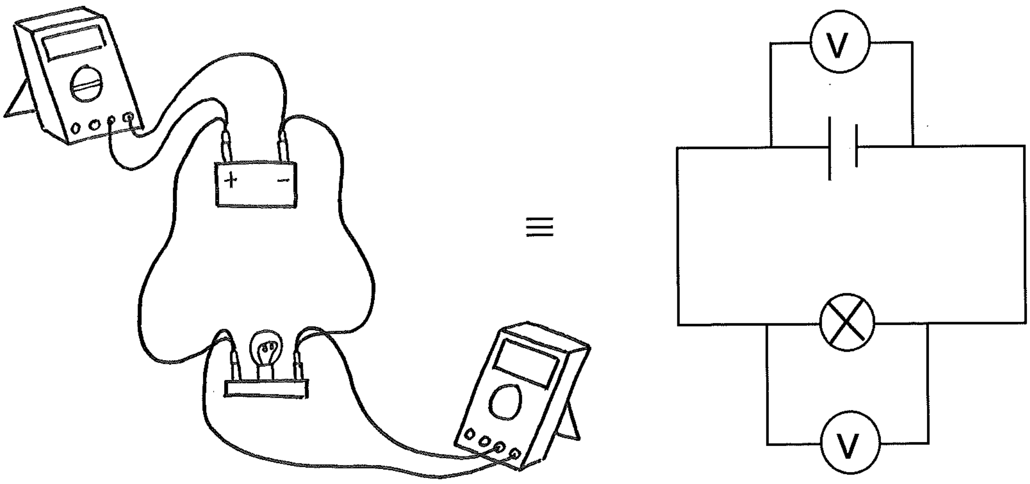
The ammeter measures the number of ______________ passing a point each second. The ammeter is placed in series in the circuit.



10. Measuring Voltage

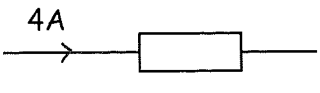
Voltage is measured using a ________________.
A voltmeter is placed across a component.

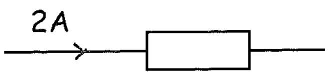




11. Resistance

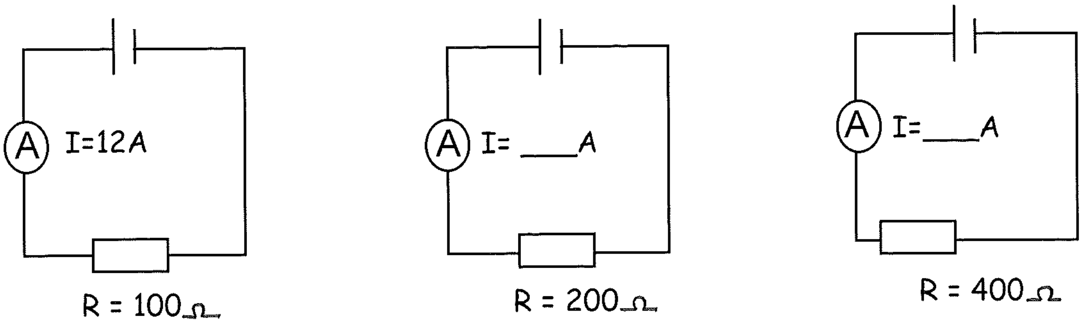
All materials oppose the flow of current. This opposition to the flow of current is called ________________. The symbol for resistance is _____. The unit of resistance is __________ or _____.





This resistor is twice as difficult for the current to flow through so its R = _______

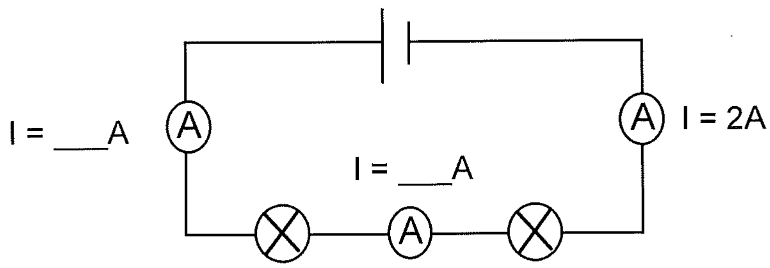
As the resistance of a circuit increases the coulombs find it more difficult to flow, so the current in the circuit _______________.



The higher the temperature of a component the _________________ its resistance so the ______________ the current passing through it.

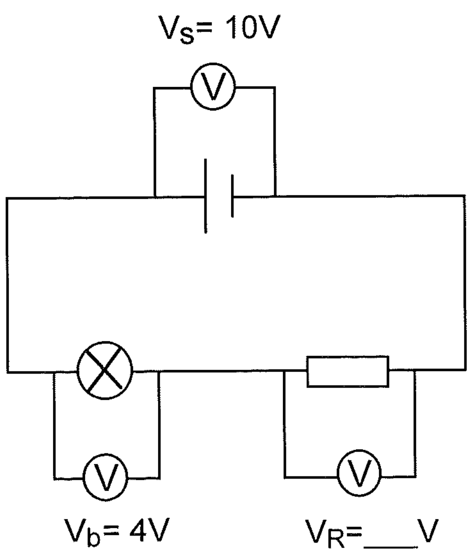
12. Current in a series circuit

In a series circuit there is only _________ path for the current to take. The current at all points in a series circuit is the ____________.



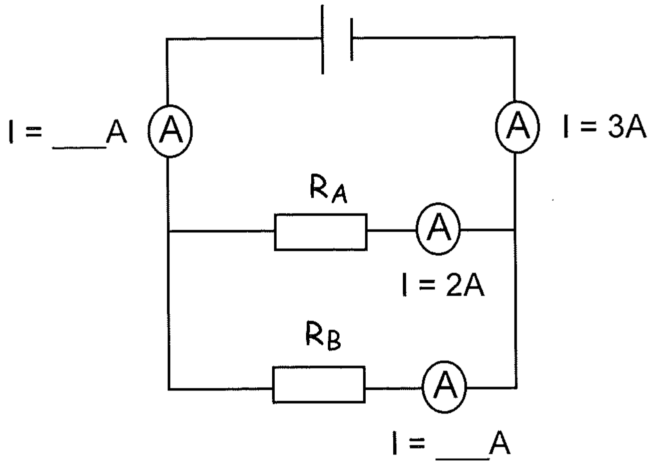
13. Voltage in a series circuit.

The voltage across each component in series adds up to the ______________ voltage.



14. Current in a parallel circuit.

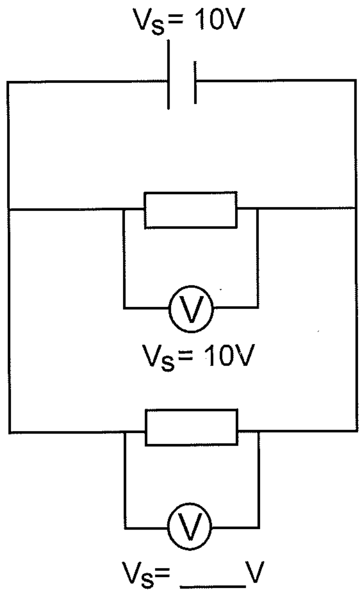
In a parallel circuit there is **more** than ________ path for the current to take. The current in each branch adds up to the total current drawn from the supply



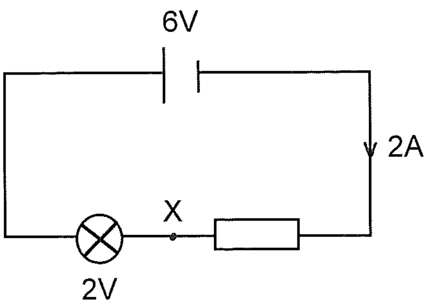
In this circuit resistor A has a smaller value than resistor B because ____________ current flows through the branch it is in.

15. Voltage in a parallel circuit.

The voltage across each branch is the __________ and equal to the supply voltage. It does not matter the size of the resistance of each branch. The coulombs have only one device to pass through before getting back to the battery so they dump all their energy at the device.



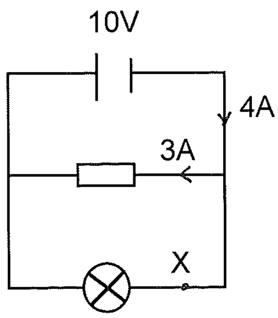
Ex Look at this series circuit



Current at point X = _____A

Voltage across resistor = ______V

Look at this parallel circuit



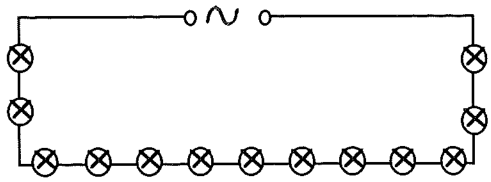
Current at point X = _______A

Voltage across bulb and resistor = _____V

16. Practical applications of series circuits (NQ4)

Wiring circuits in series is simple and therefore cheap.

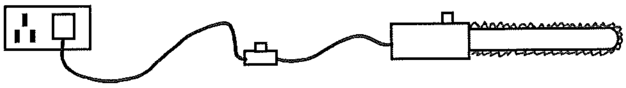
1. Christmas tree lights

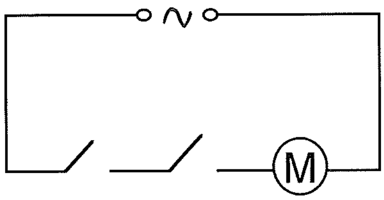


The main problem with wiring anything in series is if one of the components breaks there is gap in the circuit so none of the other components will ___________.

2. Safety switches in devices

Some devices, for example electric saws or lawn mowers have two switches which must be switched on together. This makes it less likely that it would be switched on by a________________.

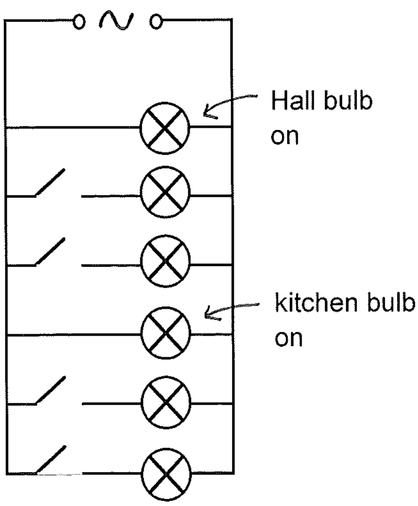




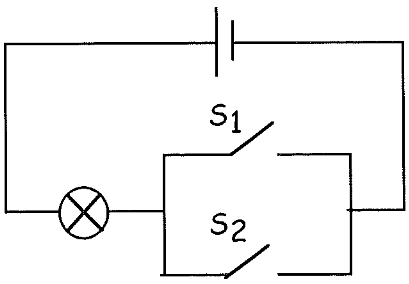
17. Practical applications of parallel circuits

When we wire components in parallel we can switch each branch on and _______ independently. Each branch gets the same ___________________.

We wire the ceiling bulbs and plug points in our homes in __________.



We can wire switches in parallel so we can choose how we switch devices on and off.

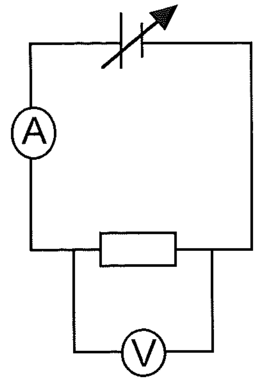


The bulb will light if switch 1 ___ 2 is closed

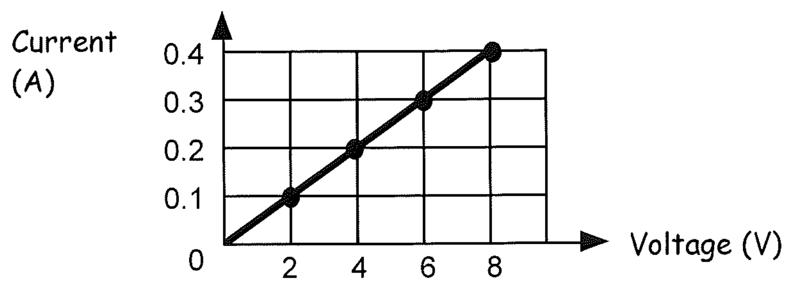
18. Ohm's Law

Ohm's law describes the relationship between the current through a component and the ________________ across the component.

By using a variable voltage supply we increase the voltage across the resistor. We use the ammeter to measure the ______________ through the resistor and a ___________________ to measure the voltage across the resistor



A graph of current vs voltage looks like this.



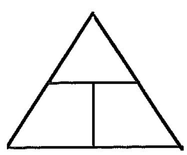
A graph showing a straight line passing through the origin means that current is ________________ proportional to the voltage.
ie if you double the voltage you double the __________________.
If you divide a voltage by its corresponding current we get a constant value.

$\frac{2}{0.1} =$ ______ $\quad \frac{4}{0.2} =$ ______ $\quad \frac{6}{0.3} =$ ______

$$\frac{\text{Voltage}}{\text{Current}} =$$ a constant value which we call the component's ____________

$$\frac{V}{I} = R$$

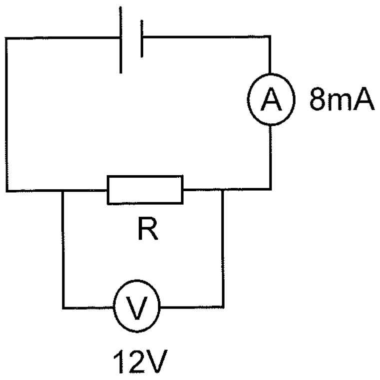
or $V = IR$



quantity	unit
Voltage	
Current	
Resistance	

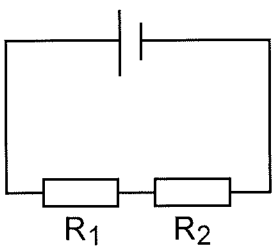
NB Not all components obey Ohm's law and if the temperature of a resistor increases its resistance actually __________________.

Example The voltage across this resistor and current through it are shown. Calculate the resistance of the resistor.

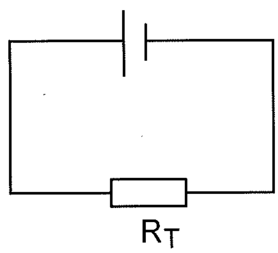


19. Resistors in a series circuit.

In a series circuit the total resistance, R_T, is the sum of the individual resistors

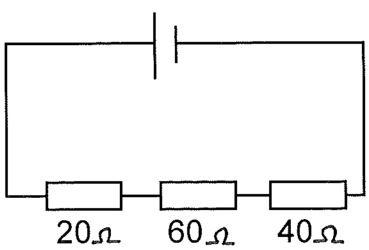


$R_T = R_1 +$ ____ $\equiv$

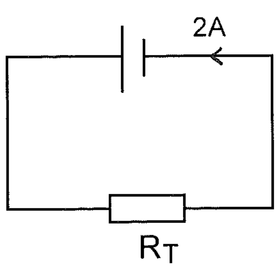


Because R_T is the equivalent resistance then the current in each circuit is the ________________.

Ex Here is a series circuit containing 3 resistors.



$\equiv$

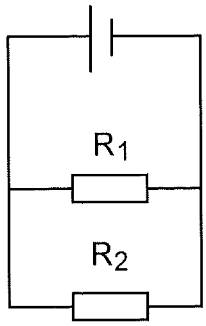


(a) What is the total resistance of this circuit R_T?

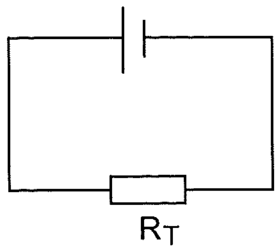
(b) If the current in the 2nd circuit is 2A. What is the current in the first circuit?

20. Resistors in a parallel circuit

The total resistance of a parallel circuit is found using the formula

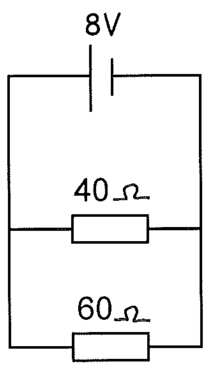


$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \equiv$$



Note that the total resistance is always ______________ than the resistance of any of the individual branches.

Example A parallel circuit is set up a shown.

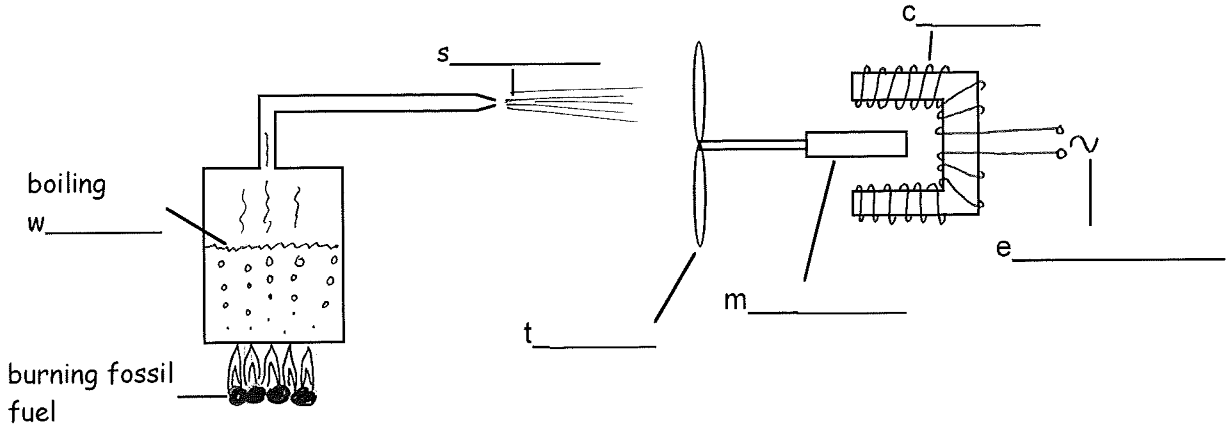


Calculate.
(a) the total resistance of the circuit.
(b) the total current drawn from the battery.

21. Electricity Generation. (NQ4)

In most power stations some sort of movement is turned into e____________ energy. Coal, oil and gas are sometimes called f________ fuels because they are the fossilised remains of dead plants and sea creatures.
In coal, oil and gas power stations the fuel is b____________. This releases h__________ energy which is used to create jets of fast moving steam.
This steam is used to spin a t______________. Attached to this turbine is a m_____________ which spins inside a coil of w____________.
Electricity is produced in the coil. The turbine, magnet and coil is sometimes called the g_________________________.

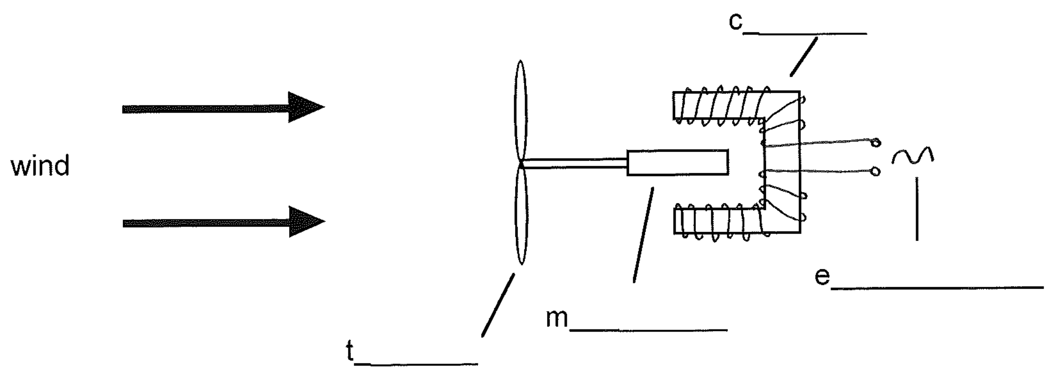
Fossil fuel fired power station



In wind, wave, hydro electric and tidal powers stations it is the movement in nature we use to spin the turbines.

Wind turbine

In a wind turbine it is the wind and not steam which turns the turbine blades.



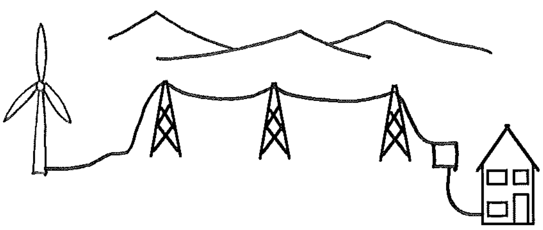
Renewable energy sources will never _______ out. (Examples-wind, wave, solar)
Non renewable energy sources will one day r______ out. (Examples - coal,oil, gas)

Each method has advantages and disadvantages.

Method of Generation	Advantages	Disadvantages
Coal, Oil and Gas	Very r____________	Non r______________. Produce g______________ gases.
Wind	Re______________ source. Does not produce g______________ gases	Not very r______________. Some think they spoil the c__________________
Wave	Re______________ source. Does not produce g______________ gases	Not very r____________. Expensive to get electricity to the main__________.
Solar	Re______________ source. Does not produce g______________ gases	Not very r____________.
Hydroelectric	Re______________ source. Does not produce g______________ gases	Can damage w___________ when valleys are flooded. Requires high m___________.
Biomass	Re____________ source.	Can use land which could be used to produce f_________.
tidal	Re______________ source. Does not produce g______________ gases	Can kill sea l_______. Salt water causes ____________.
Nuclear	Very r___________ Does not produce g______________ gases	Produces dangerous radioactive w___________. Non r_____________ source

22. Distribution. (NQ4)

Electricity has to be carried many km from the power station to your home. This can be very expensive. The cheapest way is to use overhead c___________. These can be an eyesore especially if they pass through beautiful countryside. Burying the cables hides them but is very e_______________.



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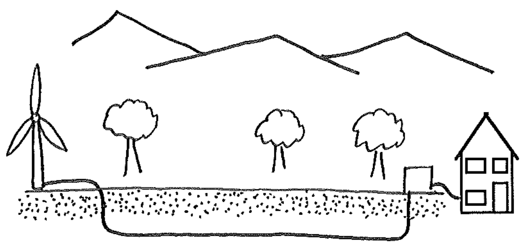


ch___________ ex___________

B. Energy and Power

23. Energy

When electricity flows through a component some electrical energy is changed or transferred into another form of ______________.

A bulb changes electrical energy into ______________ energy
An electric heater changes electrical energy into __________________ energy.
A loudspeaker changes electrical energy into __________________ energy.

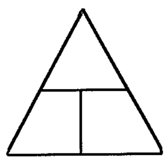
The symbol for energy is _____ and the units are _____________ or _____.

24. Power

The power of an electrical component tells us how much electrical ______________ it transfers or changes into another form each ____________.
The symbol for power is ____ and the unit is __________ or _____.
A 12W bulb changes 12J of electrical energy into ___J of ___________ and __________ energy each second.

$$\text{Power} = \frac{\text{Energy}}{\text{time}}$$

$$P = \frac{E}{t}$$



quantity	unit
Power	
Energy	
Time	

Example   A kettle is rated at 2000W. How much electrical energy does it convert or transfer in 3mins.

25. Power Consumption of Various Devices (NQ 4)

Device	Typical Power Rating (Watts)
Kettle	2000
Electric Fire	2000
Energy saving bulb	20
Hair dryer	1500
Drill.	500
TV	300
radio	10

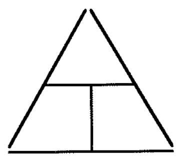
We can see that the devices with the highest power usage are ones which change electrical energy to ____________ energy.

As E = Pxt we can reduce energy usage by using lower power devices or using them for less __________. In our homes if we use loft ______________ or fit double ____________ we can reduce heat loss so we do not need to have the electric fires or central heating on constantly.

26. Linking power to current and voltage.

Power = Current x Voltage

$P = IV$



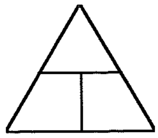
quantity	unit
Power	
Voltage	
Current	

Example A hair dryer has a power rating of 1.2kW. If it is plugged into the mains the voltage is 230V. Calculate the current flowing through the hair dryer

27. Two more useful power equations

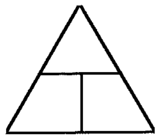
By combing the equations P = IV and V = ________ we can create two more useful equations.

$P = I^2R$



quantity	unit
Power	
Current	
Resistance	

$P = \frac{V^2}{R}$



quantity	unit
Power	
Voltage	
Resistance	

Many devices use energy very quickly so they have very high power ratings. If the power rating is in kW - remember to change k to x 10^3.

Example An electric drill with a resistance of 24 Ω is plugged into the mains. (V = 230V) What is the power of the drill?

Example A heater has a power rating of 4.8kW. If the resistance of the heater is 11 Ω calculate the current flowing through the heater.

28. **Energy Transformations**

Energy is a master of disguise. It can take many forms. Here are some forms of energy:

Light energy	Comes from the sun or electric bulbs or candles etc.
Heat energy	Comes from the sun. burning fuel. All object give off some.
Sound energy	Created when particles vibrate against one another.
Chemical energy	Energy stored in fuel like c________, p__________ and human fuel - f_______________.
Electrical energy	Energy that flows through electrical __________________.
Kinetic energy	Energy found in objects which are ___________________.
Gravitational potential energy	Energy gained by objects which have risen in h_________
Mechanical potential energy	Energy stored in wound up c_________________ or stretched elastic b______________ or s______________ .
Nuclear energy	Energy found in the nucleus of _________________.

One of the most important laws in physics is the 1st law of thermodynamics:

Energy cannot be made or _____________________ but it can be __________________________from one form to another.

When energy is transferred from one system to another _______________ has been done.

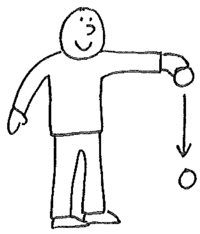
Revision : Here are two formula that let you calculate an amount of energy:

Kinetic energy $E_k =$

Gravitational potential energy $E_p =$

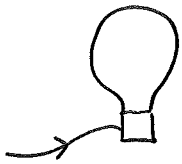
State the main energy transfers in these examples. Ignore energy losses in these examples

A. Ball being dropped



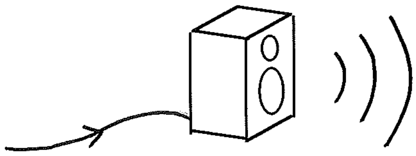
G ______________ → ______________ energy

B Light Bulb



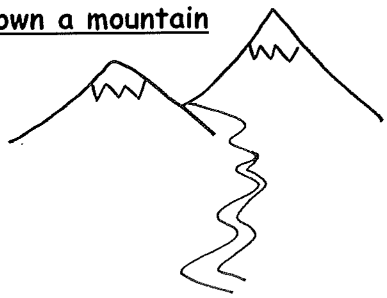
______________ → ______________

C Loudspeaker



______________ → ______________

D Water running down a mountain

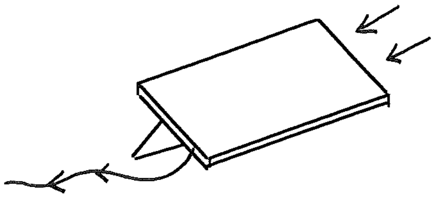


______________ → ______________

E Burning a lump of Coal

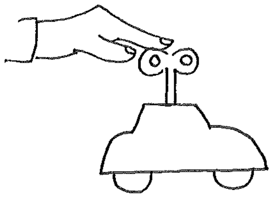
______________ → ______________ + ______________

F **Solar Cells**



L ________________ → ________________

G. **A wind up toy**



________________ → ________________ → ________________

In the moving fingers of person turning key. | stored in coil | when car is let go

Revision

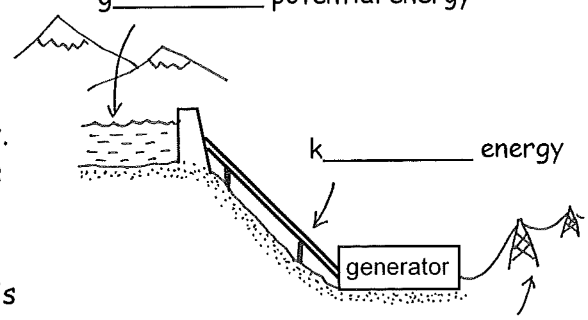
When we heat an object we can calculate the amount of heat energy we are transferring to to the object using

$$E_h = mc\Delta T$$

m = mass
c = specific heat capacity
ΔT= change in temperature

Hydroelectric Power Stations

In a hydroelectric power station the water high up in the reservoir in the mountains has gravitational ________________ energy. When it falls down through the pipes it gains ____________energy. The generator at the bottom of the hill turns this kinetic energy into ________________ energy. The water is collected in a reservoir at the bottom of the hill.



At night the generator is put in r___________ and uses cheap electricity to pump the water back up to the top reservoir in preparation for the demand the next day.

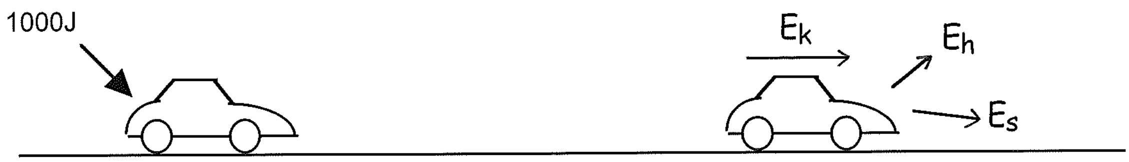
29. Useful and Waste Energy.

When energy is transferred, not all the starting energy is transferred to the form you want. Some of the energy is transferred to waste forms of energy.

For example you put 1000J of chemical energy into your car in the form of petrol. It would be great if your car could change all this 1000J of chemical energy into 1000J of kinetic energy. (No lost energy)
During the journey you may only transfer 400J of this 1000J into kinetic energy, which is the useful output energy you want. A force called ________________ will transfer the other 600J of chemical energy into heat and sound.

We call these, waste forms of energy. The output energy is made up from useful forms and waste forms.

Input energy **Output energy**



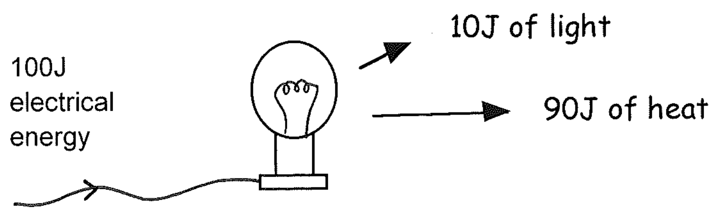
Useful energy Wasted energy

1000J Chemical → 400J of ______________energy + 500J of heat

_____J of sound

A filament bulb is very wasteful.

Input energy **Output energy**



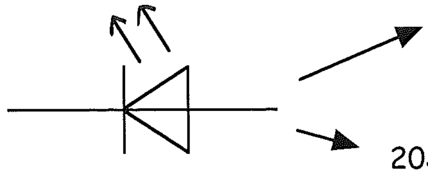
Useful energy Wasted energy

100J Electrical → 10J of __________________ + _____J of heat

An LED bulb is much less wasteful.

Input energy | **Output energy**

100J of electrical energy



80J of light

20J of heat

Useful energy | Wasted energy

100J Electrical → 80J of ________________ + 20J of heat

In many energy transfers the force of friction is responsible for transferring a lot of the useful input energy into ____________________ energy.

Example A 0.2kg ball, starting at rest, rolls down the following slope. At the bottom of the slope the speed of the ball is $3ms^{-1}$.

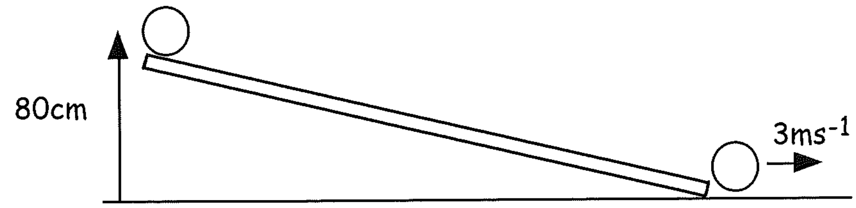
(a) Calculate the gravitational potential energy it loses as it rolls down the slope. (ie how much grav pot energy does it have at top?)

(b) Calculate the kinetic energy at the bottom of the slope.

(c) How much energy has been wasted as it rolls down the slope?

(d) Which force has been acting to transfer this energy?

(e) If the length of the slope is 2m calculate the size of the frictional force acting on the ball.



Example A 200W heater is switched on for 30mins and supplies heat energy to a beaker containing 4kg of water. The water's temperature rises from 20°C to 35°C. (c_{water} = 4180Jkg^{-1}°C^{-1})

(a) How much electrical energy was used by the heater?
(b) How much heat energy is absorbed by the water?
(c) How much energy has been wasted?

30. Efficiency (NQ4)

The efficiency of a system tells you the percentage of the input energy that is turned into useful energy.

A bulb uses 20J of electrical energy. It produces 10J of light energy and 10J of heat energy. So half the input energy is converted to a useful form so the bulb is _____% efficient.

$$\%\ \text{efficiency} = \frac{\text{useful output energy}}{\text{input energy}} \times 100$$

or

$$\%\ \text{efficiency} = \frac{\text{useful output power}}{\text{input power}} \times 100$$

Example A kettle uses 8000J of electrical energy. The water only absorbs 3000J of heat energy

(a) Calculate the efficiency of the kettle.

(b) What happened to the other 5000J of heat energy?

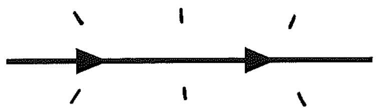
31. Magnets and Electromagnets (NQ4)

A magnet exerts a magnetic force on materials made of iron. Draw the magnetic field lines round this bar magnet.

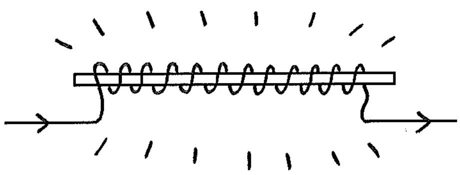
One end of the magnetic is called the South pole the other side is called the N_______________ pole. Like poles r_______________ each other. Unlike poles a_________________ each other.

attract / repel   attract / repel   attract / repel

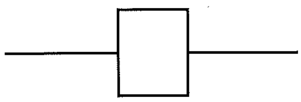
When electricity flows through a wire a weak m_______________ field is created round the wire.



However if we coil the wire round an iron core the strength of the magnetic field _____________________. This coil is called an _____________________.

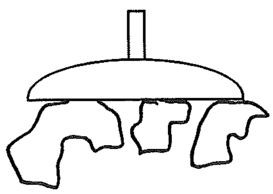


Circuit symbol for an electromagnet

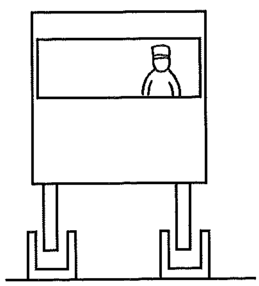


As the current or number of turns increases the strength of the field _____________

32. Uses of Magnetic Fields. (NQ4)

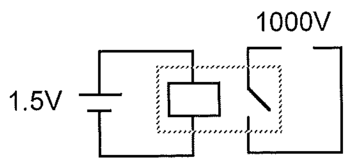


Scrapyard electromagnet used to lift scrap i__________



magnets

Maglev trains "float" on a magnetic field. This reduces the force of f_______________.



relay

A relay is an electromagnet placed beside an iron switch. A relay switch allows high voltage circuits to be switched _____ safely.

C. Electronic Systems

33. Electronic systems

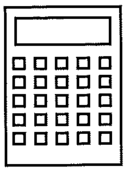
All complicated electronic devices can be reduced down to an input device, a process device and an output device.

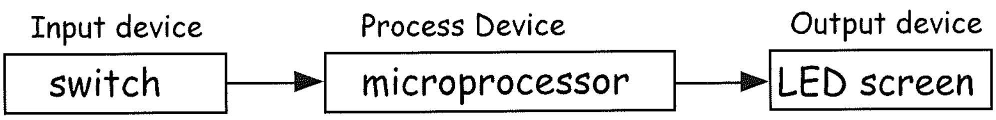
The **input device** starts the system. It usually picks up some external signal and converts it into an ______________________ signal.

The **process device** changes the electrical signal coming from the input device in some way. For example an amplifier makes a signal ____________.

The **output device** changes the altered electrical signal from the process device into a useful signal.

Example A calculator





34. Input devices.

Device	Circuit symbol	Energy transfer or function
Microphone		______________ to electrical energy
Thermocouple		______________ to electrical energy
Photovoltaic cell		______________ to electrical energy
Thermistor		A resistor whose resistance ______________ as the temperature rises.
LDR (light dependent resistor)		A resistor whose resistance ______________ as the light level rises.
Capacitor		Stores electrical ____________ and can be used to produce a time ____________.

35. Output devices

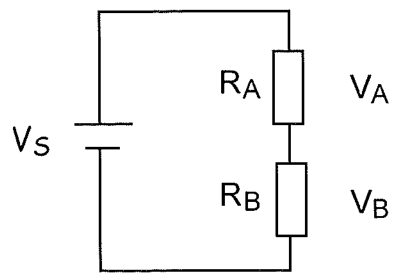
Device	Circuit symbol	Energy transfer or function
Bulb		E_____________ to ___________
LED		E_____________ to ___________
Motor		E_____________ to ___________
Loudspeaker		E_____________ to ___________
Diode		Allows current to flow only in ______ direction.
Relay		An electromagnet and switch which allow dangerous high voltage circuits to be switched on s_______________.

36. Voltage Divider

A voltage divider is a voltage supply in series with two or more ____________________. The voltage divider takes a large supply voltage and divides into s______________ voltages.

In this circuit a 12V supply is to be divided across two resistors. If the resistors have the same value then the voltage across each resistor = ____V.

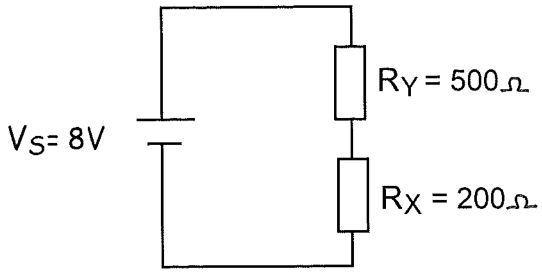
If the resistors are different values we can use the voltage divider formula.



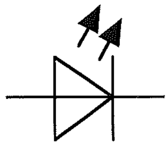
$$V_A = \frac{R_A}{R_A + R_B} \times V_s$$

If you know the voltage across resistor A then the voltage across resistor B, V_B, is found as follows $V_B = V_S$ - ____.

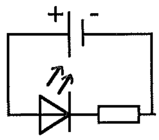
Example Calculate the voltage across resistors X and Y in this circuit.



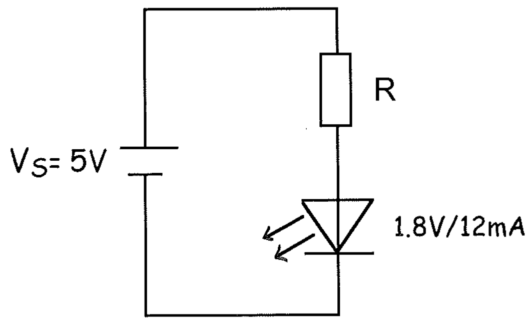
37. LED (Light Emitting Diode)



An LED will only work when the triangle side is connected to the ____________________ side of your battery.
An LED is a sensitive device so a____________________ is placed in series with it to limit the current and prevent it being damaged.



Example. A 1.8V/12mA LED is to be placed in a circuit with a 5V supply. Calculate the size of resistor required for the LED to work at its given rating.



38. Transistors

A transistor is an electronic s________________. It is designed to come on when a certain ____________________ is applied across it.

We will look at two types of transistors.

This is an npn ____________________

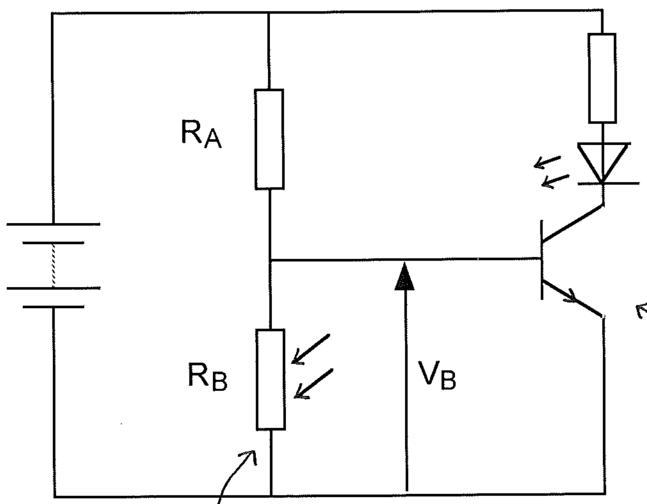
This is a MOSFET (metal oxide semiconductor ______________ effect transistor)

39. Control circuits.

We use transistors in control circuits. A control circuit is just an electronic circuit. It looks complicated but it is quite easy to understand.

This is the bit that gets switched on. It's the output d_______________

Supply V__________



The transistor is the process d_____________. It switches on when V_B rises above ______V

The LDR is the input d___________

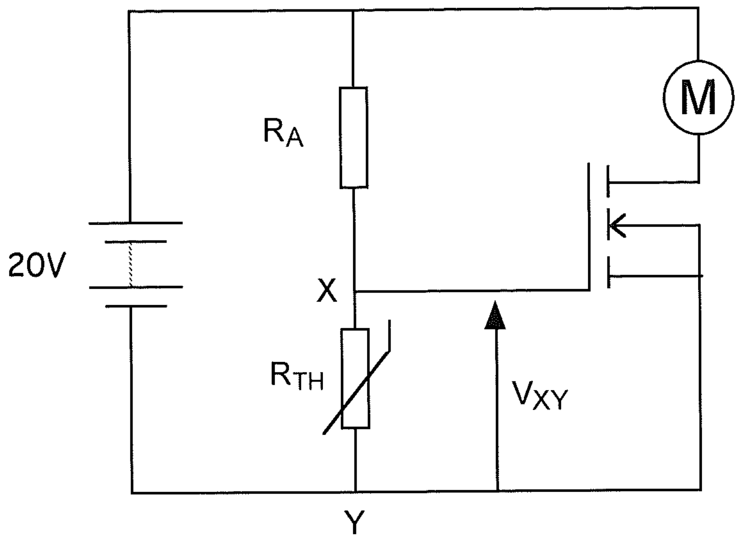
The resistors A an B act as a voltage divider dividing up the ___________ voltage. Because the resistor B is an LDR then its resistance can change as the _____________level changes. Therefore the output voltage V_B could change.

When the voltage V_B across the bottom resistor gets above _______V the ___________________ switches on.

When the transistor is on it now lets current flow up through the ______________ and it lights up.

Example Explain how the following circuit can switch on the motor of a central heating system when the temperature falls below a certain level.

The mosfet switches on when V_{XY} is equal to or greater than 2V.



As the temperature decreases the resistance of the thermistor _______________. Therefore the voltage V_{XY} _________________.

When V_{XY} reaches _______ the transistor switches ______ and current flows through the ________ and it starts spinning.

If you want the motor to come on when the temperature increases then swap round R_A and ___________.

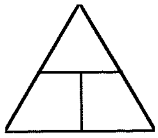
D. Gas Laws and Kinetic Theory

40. Pressure.

The pressure acting on a surface is defined as the __________________ acting on ______ of surface area.

$$\text{Pressure} = \frac{\text{force exerted}}{\text{surface area}}$$

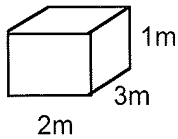
$$P = \frac{F}{A}$$



quantity	unit
Pressure	
Force	
Area	

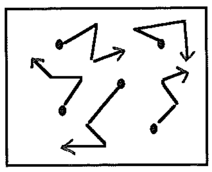
Example The following box of mass 20kg sits on the floor.

(a) What is the force the box exerts on the floor?
(Hint - what is its weight?)
(b) What is area over which the force acts?
(c) Calculate the pressure the box exerts on the floor?



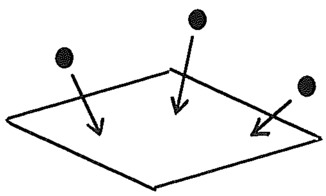
41. Describing a Gas.

A gas is made from particles which are far apart. The particles are in continuous random motion in all directions.



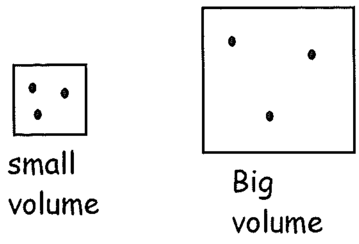
Pressure of a gas. (Pascals Pa)

When these randomly moving particles hit a surface they exert a __________.
So gas pressure is the total force the particles exert over an area of ______.



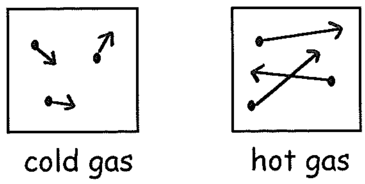
Volume of a Gas (m^3 or cm^3)

The volume of a gas is the s___________ taken up by the gas. The volume of a gas can be taken as the volume of the container it is in.



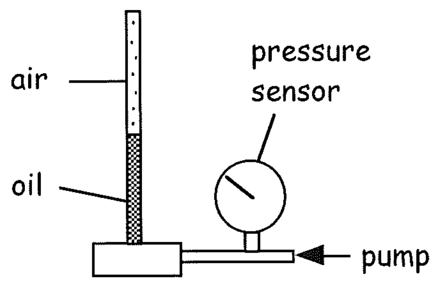
Temperature of a gas (^{o}C) or (K)

The temperature of a gas is a measure of how f___________ the particles in the gas are moving.



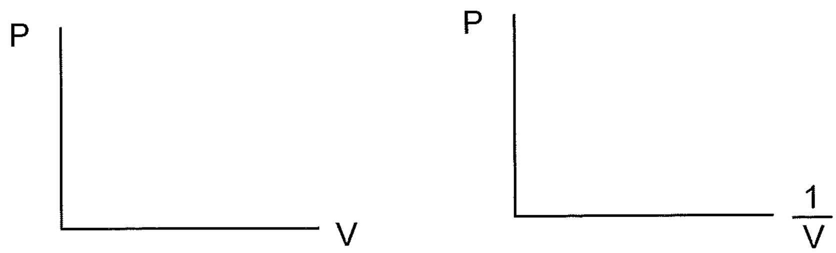
42. Pressure and Volume. (Boyle's Law)

This apparatus is used to find the relationship between the volume of a gas and its pressure.



A pump is used to apply a force to the oil. The oil in turn applies a force to the air and the air squashes or compresses.
The volume of the air and its pressure are noted at intervals

The results allow the following graphs to be produced.



$$P \propto \frac{1}{V}$$

$$P = \frac{k}{V}$$

$$PV = k$$

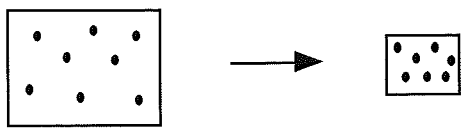
$$P_1V_1 = P_2V_2$$

Boyle's Law

For a fixed ____________ of gas at a constant temperature the pressure is ___________________ proportional to its volume.

Explanation using Kinetic Theory.

As the volume of the container decreases the surface area the particles are hitting also ______________________.

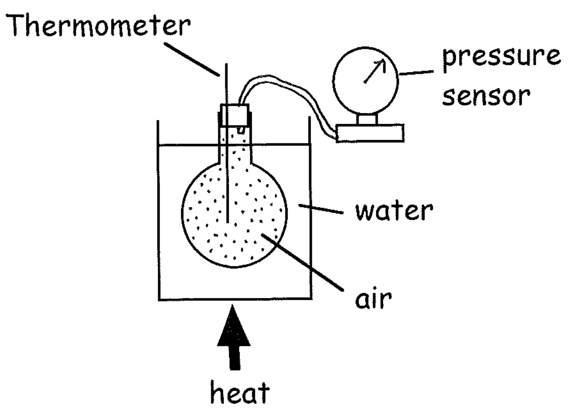


The particles hit the walls more often so the total force exerted ________________. P = F/A so as Force _____________ and area ____________________ the pressure _______________

Example A gas container of volume 5m^2 contains a gas at a pressure 120kPa. What is the new pressure of the gas if the volume of the container is decreased to 2m^2 ?

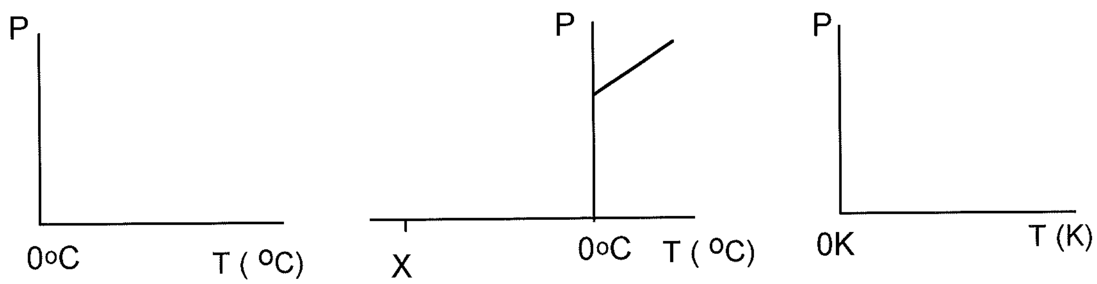
43. Pressure and Temperature (Pressure Law)

This apparatus is used to find the relationship between the temperature of a gas and its pressure.



The water is heated. The heat is transferred evenly to the ________ in the flask. As the air is heated the temperature and pressure of the gas are noted.

The results allow the following graphs to be produced.



The value X is ________ °C. This temperature is called absolute zero , It is the temperature at which the pressure of a gas is _______. This means that the particles have lost all their ________________ energy and therefore have stopped ______________. You cannot cool a substance below ________°C

Lord Kelvin then created a new temperature scale based upon zero being -273°C. He called this temperature 0Kelvin or 0K.

Converting °C to K	add 273	ie	30°C = 30 +273 = _________K
Converting K to °C	subtract 273	ie	400K = 400 - 273 = ________°C

Lord Kelvin noticed that if you made -273°C zero temperature then the graph of pressure vs temperature (measured in Kelvin) is a _______________ line going through the ______________________. This means that

$$P \propto T \text{ (in Kelvin)}$$

$$P = kT \qquad (k = \text{constant})$$

$$\frac{P}{T} = k$$

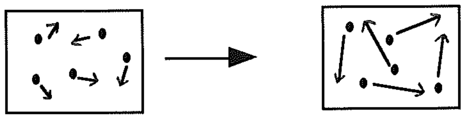
$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

The Pressure Law.

For a fixed mass of gas at a constant volume the pressure is ____________________ proportional to its temperature measured in units called ____________________.

Explanation using Kinetic Theory.

As the temperature of the gas increases the particles gain more ____________________ energy and move about faster.

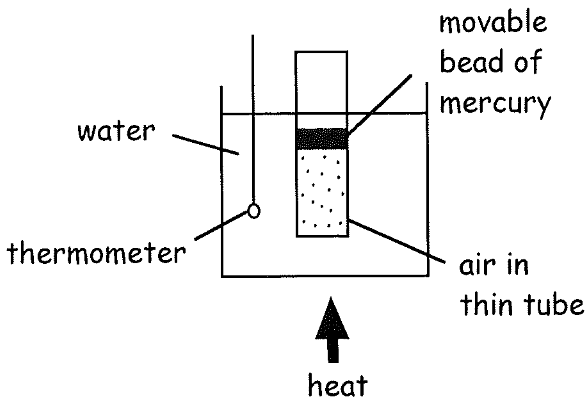


Therefore the particles hit the walls of the container ____________________ and more ____________________. Both factors increase the ____________________ exerted on the walls. As P = F/A, so if Force increases therefore the pressure also ____________________.

Example. The pressure and temperature of a gas in a container is 108kPa and 20°C, The gas is then heated up to a temperature of 200°C. Calculate the new pressure of the gas.

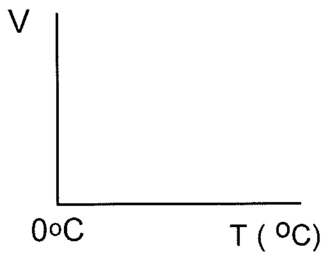
44. Volume and Temperature (Charles' Law)

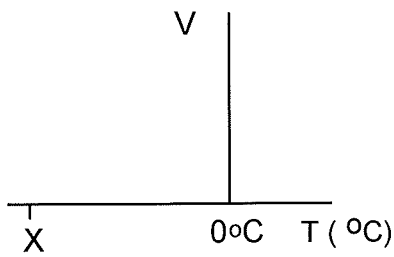
This apparatus is used to find the relationship between the temperature of a gas and its volume.

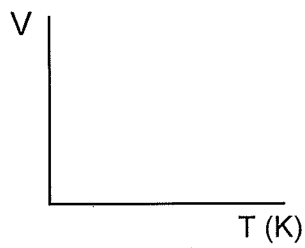


The air is in a thin tube capped with a mercury bead. The water is heated and the heat is transferred evenly to the ________. The bead of mercury is free to move upwards if the force on it increases. As the air is heated its temperature and volume are noted.

The results allow the following graphs to be produced







X = ________ °C

$$V \propto T \quad \text{(KELVIN)}$$

$$V = kT$$

$$\frac{V}{T} = k$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Charles' Law

For a fixed ____________ of gas at a constant ____________________ the volume is ______________________ proportional to its temperature measured in ________________

Explanation using Kinetic Theory.

As the temperature increases the particles gain more ________________ energy and hit the mercury bead harder and more often. This causes the bead to move up and the volume _________________. Now because the volume increases the particles hit the walls _________ often so the pressure reduces back to its original value.

Example The volume of gas in a syringe with a movable piston is $12cm^3$ at a temperature of 25^oC. The gas is heated to a temperature of 75^oC. Calculate its new volume.

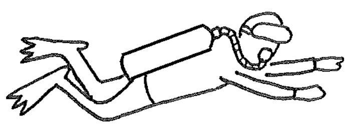
45. Combined Gas equation

In most real life situations all three quantities change at the same time.
We can combine the 3 gas laws to create a General gas law.

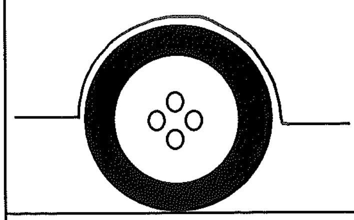
$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Example A gas occupies a volume of 40l at a temperature of 40°C and a pressure of 120kPa. If the temperature rises to 150°C and the pressure rises to 230kPa calculate the new volume of the gas.

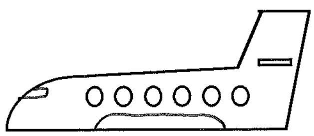
46. Applications of Kinetic Model (NQ4)



Scuba diver's air canister. . Pressure of gas ________________ as it is compressed into a small volume



A car tyres volume ________________ as friction causes the air to heat up.



Aeroplane cabins are kept at atmospheric pressure which is ______________ than the pressure outside