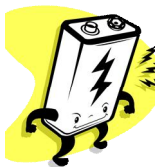
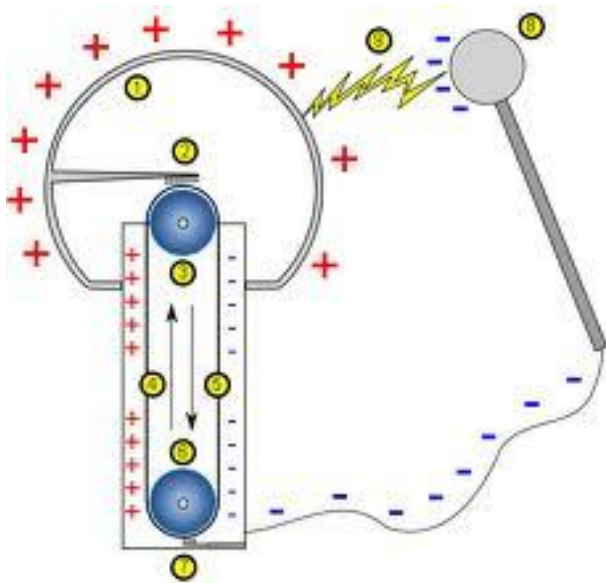


National 4

Electricity and Energy Homework



Homework 1: Energy Changers

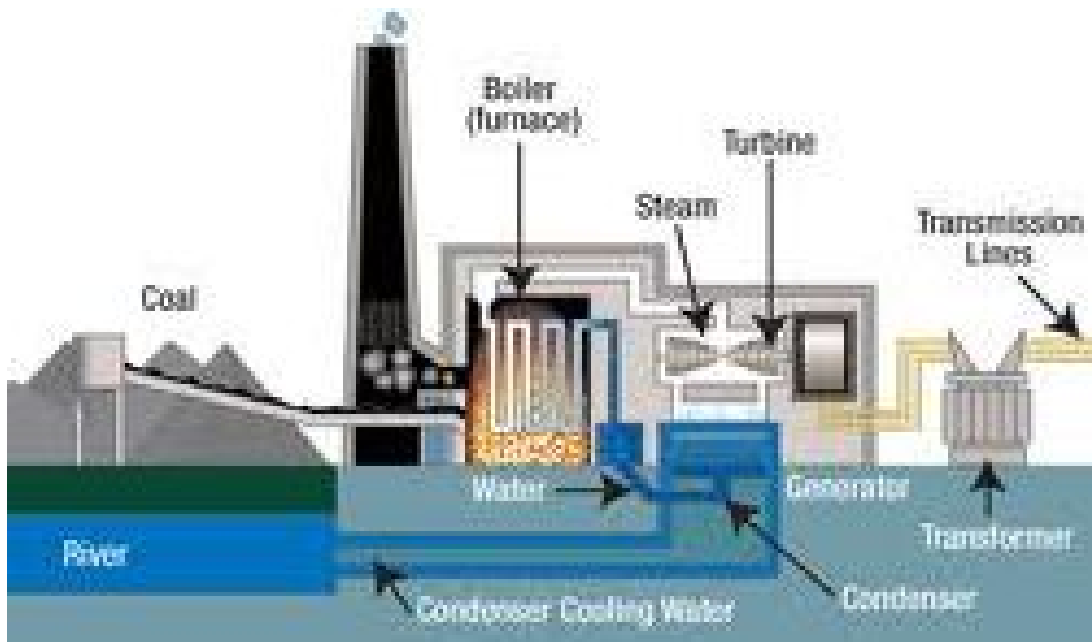
1. List the eight different types of energy.
2. What is meant by the Law of Conservation of Energy?
3. What form of energy do the following have:
 - (a) a spinning wind turbine
 - (b) water stored behind a dam
 - (c) water flowing down a hill
 - (d) water waves
4. List the energy changes in the following examples:



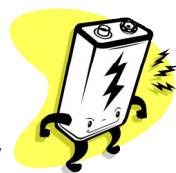
- (a) An electric oven
- (b) A light bulb
- (c) A falling stone
- (d) A loudspeaker in a stereo
- (e) Burning wood



5. Coal is being burned in the thermal power station shown below.



- (a) What energy change occurs in the boiler?
 - (b) What is the energy change in the generator?
6. What is the energy change in a solar cell?



Homework 2 : Energy Generation

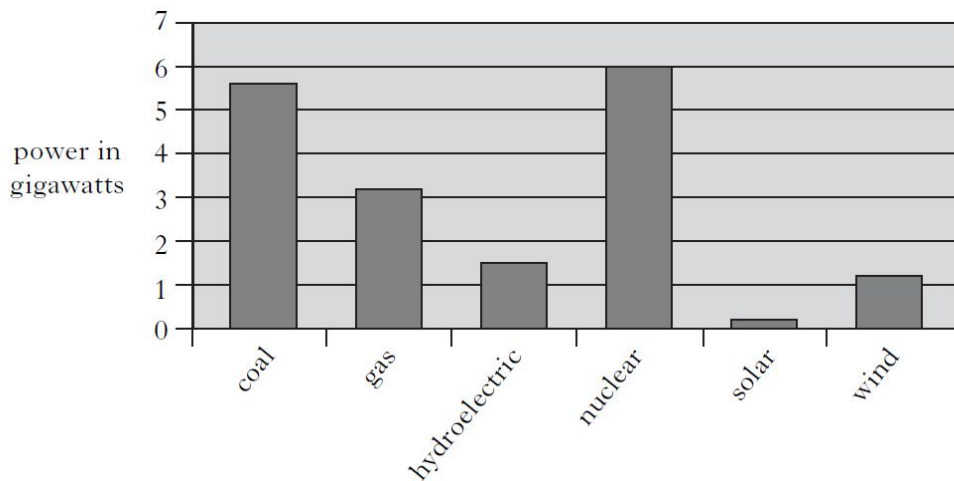
1. Examples of energy sources are:

gas wind oil solar wave hydro coal

These energy sources can be classified as renewable or non-renewable. Complete the table below to show which of these examples are renewable and which are non-renewable.

Renewable	Non-renewable

2. The bar chart shows the main energy sources used in Scotland.



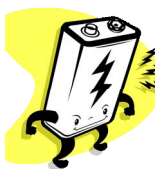
- (a) Which energy source provides the most power in gigawatts?
- (b) How much power does hydroelectricity produce?

3. The stages in a nuclear power station are shown below.



At what stage is the main energy transformation:

- (a) kinetic to electrical;
- (b) nuclear to heat?

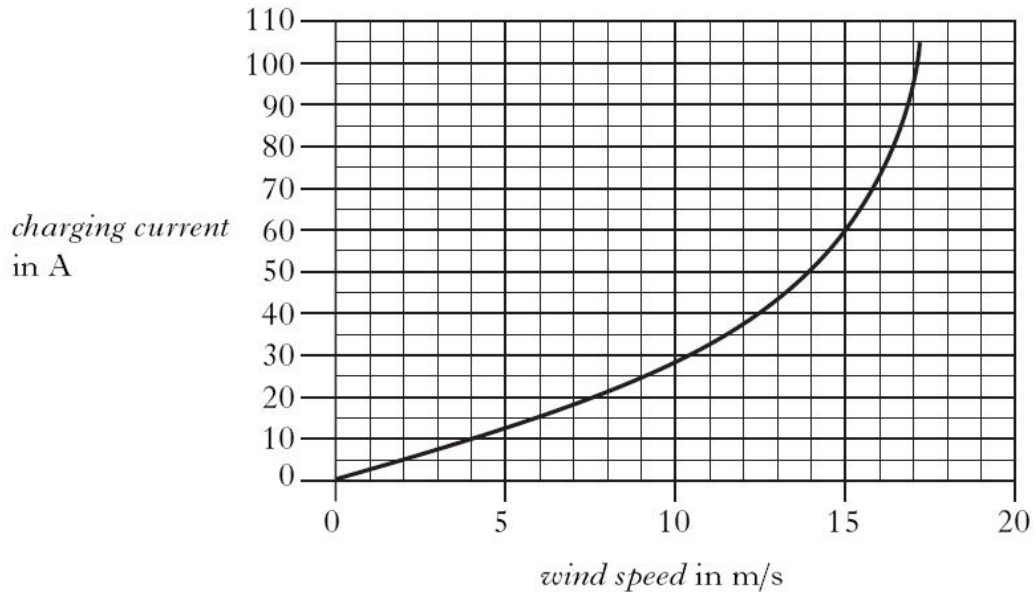


Homework 2 cont.

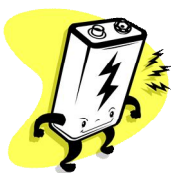
4. A wind generator is used to charge a battery. The charging current depends on the wind speed.



The graph below shows the charging current at different wind speeds.

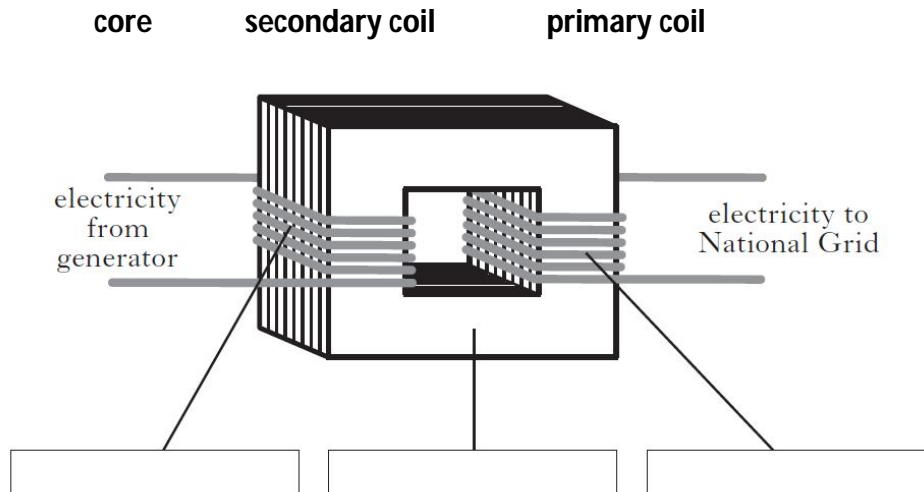


- (a) What happens to the charging current as the wind speed increases?
- (b) What is the charging current at 15 m/s?
- (c) What is the wind speed when the charging current is 20 A?
5. Biomass is a source of renewable energy.
- (a) State **one** other renewable energy source.
- (b) State **one** advantage and **one** disadvantage of this source.

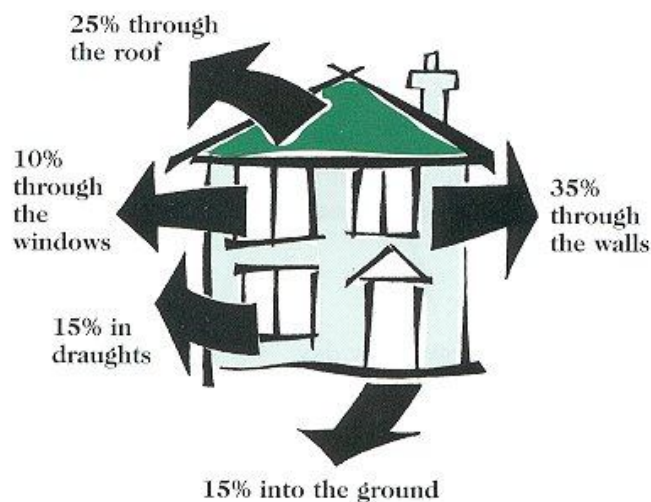


Homework 3 : Energy Efficiency

1. A transformer consists of three parts.
Copy the diagram below and label each of the three parts using the names below:

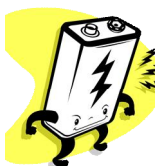


2. Why are transformers used in the transmission of electrical energy?
3. The diagram below shows the areas through which heat is lost from the home.



Give one way heat loss may be reduced from each of the following areas of the house:

- (a) roof
- (b) windows
- (c) walls



Homework 4 : Power & Efficiency

1. A light bulb has a power rating of 100 W. How much electrical energy does the bulb use in 30 s?
2. How much energy can a 20 W motor produce in 2 minutes?
3. What is the power rating of an electrical appliance which uses 48 kJ of energy in 40 s?
4. A firework rocket gains 135 joules of energy in 4 seconds. Calculate the power of the rocket motor.
5. How long would it take for a 2 kW iron to use 100 kJ of electrical energy?
6. How long does it take to completely discharge a battery which stores 100 000 kJ and is used to power a 5 kW heater?
7. A power station produces 1 800 000 kW of heat, which gives 450 000 kW of electrical power. Calculate its efficiency.
8. What is the efficiency of a machine which has a power input of 1 kW and a power output of 750 W?
9. Students are investigating the efficiency of an electric kettle.



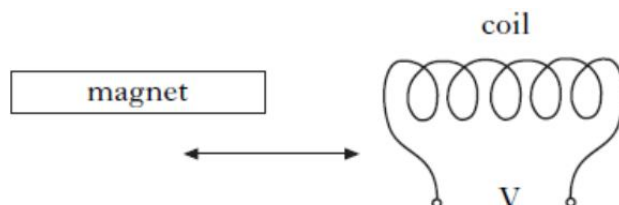
They find that every second a kettle uses 2200 J of electrical energy, of which 1870 J is converted to heat energy. Calculate the efficiency of the kettle.

10. A turbine converts 75 000 J of heat energy into 15 000 J of kinetic energy. What is the efficiency of the turbine?



Homework 5 : Electromagnetism

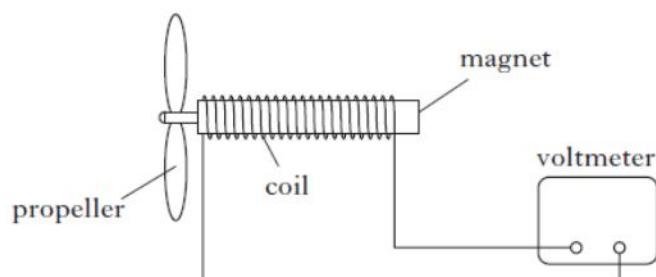
1. When a magnet is pushed into or pulled out of a coil of wire, a voltage is induced across the ends of the coil.



Which of the following produces the greatest induced voltage?

	<i>Strength of magnet</i>	<i>Speed of magnet</i>	<i>Number of turns in a coil</i>
A	weak	slow	20
B	weak	fast	40
C	strong	slow	20
D	strong	fast	20
E	strong	fast	40

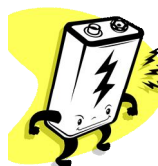
2. A wind speed meter is designed as shown.



Air blows across the propeller causing the magnet to rotate. A voltage is induced across the coil. Which of the following changes will produce an increase in the induced voltage?

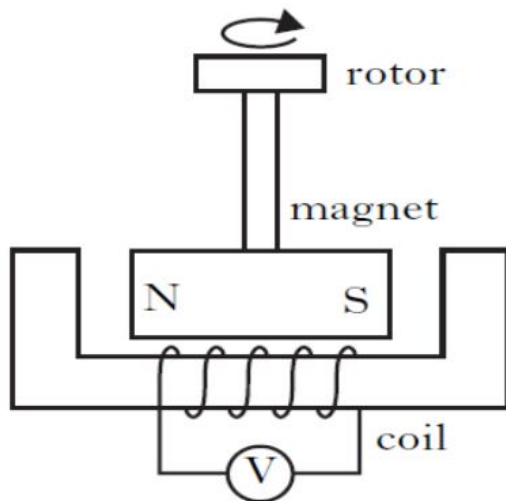
- I Replacing the magnet with one of greater field strength.
- II Spinning the propeller faster.
- III Reducing the number of turns on the coil.

- A. I only
- B. I and II only
- C. I and III only
- D. II and III only
- E. I, II and III



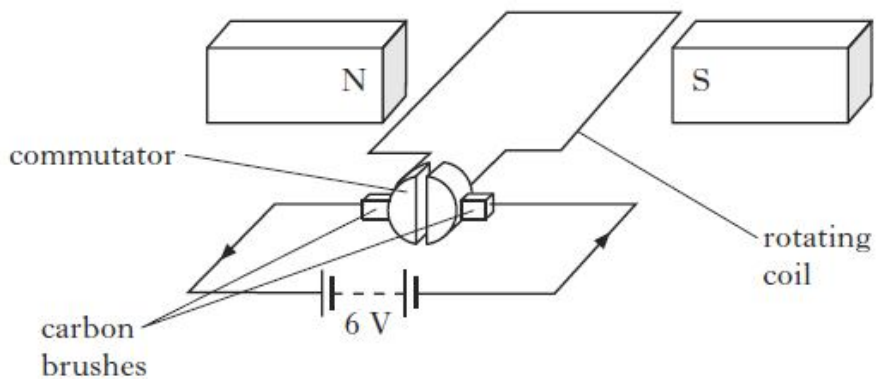
Homework 5 cont.

3. The diagram shows a model bicycle dynamo.

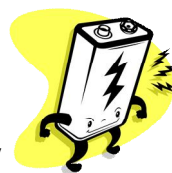


When the rotor is turned the magnet rotates, inducing a voltage in the coil.
Describe three changes which would bring about an increase in the induced voltage.

4. A simple electric motor is shown below.



- (i) What is the purpose of the brushes in a simple electric motor?
- (ii) State **two** ways in which the direction of rotation of the motor could be reversed.



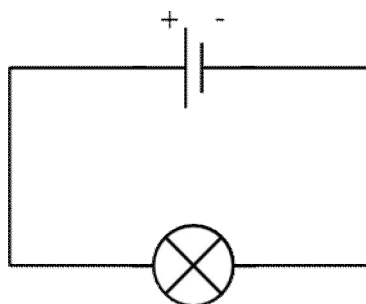
Homework 6 : Circuits

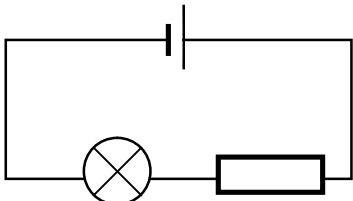
1. What are the two types of electrical charge?
2. What happens to a negatively charged particle when it is brought close to
 - (a) another negatively charged particle?
 - (b) a positively charged particle?
3. Copy and complete the following sentences using these words

Amperes, electrons, current

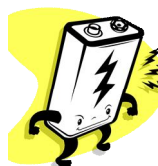
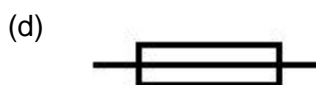
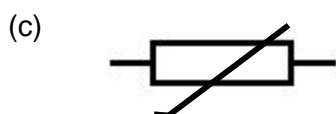
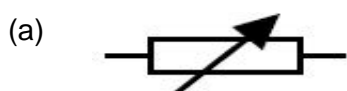
A conductor is a material in which _____ are free to move. The movement of electrons around an electrical circuit is called a _____. Current is measured in _____.

4. In the simple circuit, opposite
 - (a) What is the purpose of the cell?
 - (b) What is the energy change in the bulb?
 - (c) What would happen to the bulb if the circuit was broken?
Explain your answer.



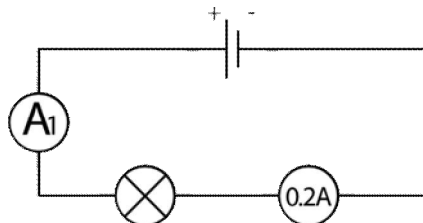
5.  Redraw the circuit diagram, opposite, to show how to measure :
 - (a) the voltage across the bulb
 - (b) the current through the resistor.

6. Identify the following circuit symbols:



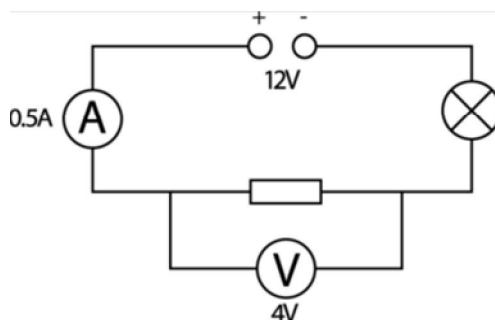
Homework 7 : Circuit Rules

1. In the following circuit, what is the reading on ammeter A1?

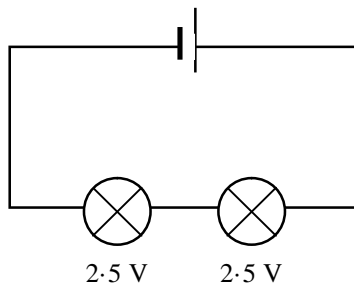


2. In the circuit opposite the ammeter reading is 0.5A and the voltmeter reading is 4V.

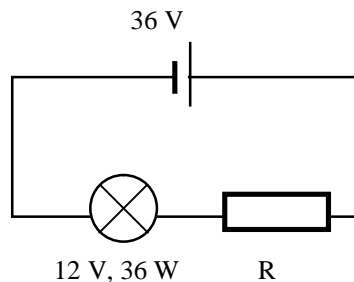
- (a) State whether this is a series or parallel circuit.
 (b) (i) What is the current through the lamp?
 (ii) What is the potential difference across the lamp?



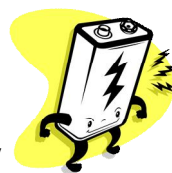
3. Two identical 2.5 V bulbs are connected to a supply as shown below. What is the voltage of the supply?



4. A simple circuit with a bulb and resistor in series is shown below.

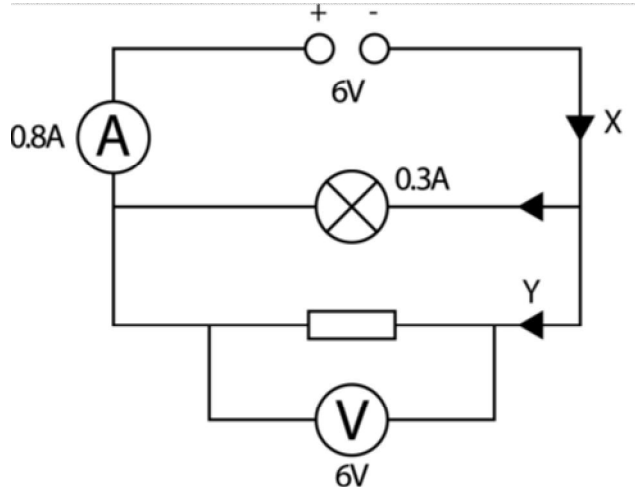


- (a) If the bulb is operating at its correct voltage and power rating, what is the voltage across the resistor R?
 (b) The current in the bulb is 3 A. What current flows through the resistor?



Homework 7 cont.

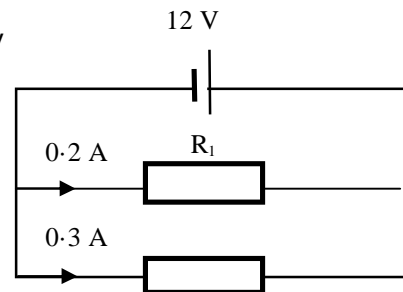
5. In the circuit below the ammeter reads 0.8A, the current through the lamp is 0.3 A and the voltmeter reads 6V.



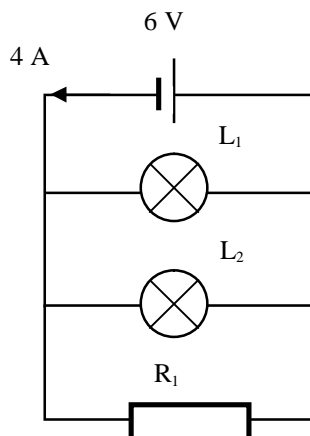
- (a) Is this a series or parallel circuit?
 (b) (i) What are the current values at X and Y?
 (ii) What is the potential difference across the lamp?

6. Two resistors are connected in parallel to a 12 V battery as shown opposite.

- (a) What is the voltage across R_1 ?
 (b) What is the voltage across R_2 ?
 (c) What size of current is drawn from the battery?

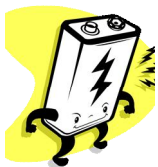


- 7.



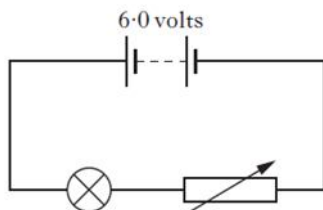
Two identical bulbs and a resistor are connected in parallel to a 6 V supply.

- (a) What is the voltage across L_2 ?
 (b) A current of 1.8 A flows through each of the bulbs. What is the current flowing through the resistor?



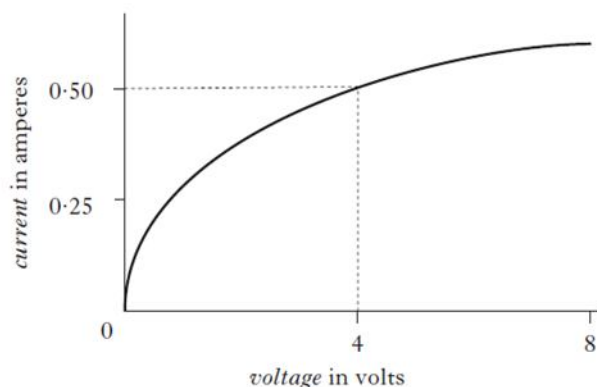
Homework 8 : Resistance

1. A student is investigating the operation of a filament lamp using the following circuit.



When the voltage across the lamp is 2 volts the current through the lamp is 0.2 ampere.

- Calculate the resistance of the lamp.
 - What is the voltage across the variable resistor?
 - The resistance of the variable resistor is increased.
 - What happens to the brightness of the lamp.
 - Explain your answer.
2. The results of an investigation are shown in the graph below.



Calculate the resistance when the voltage is 4 volts.

3. A resistor is labelled: “ $10 \Omega \pm 10\%$, 3 W”.
- This means that the resistance value could actually be between 9Ω and 11Ω .

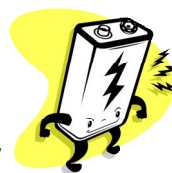


- (a) A student decides to check the value of the resistance.

Draw a circuit diagram, including a 6 V battery, a voltmeter and an ammeter, for a circuit that could be used to determine the resistance.

- (b) Readings from the circuit give the voltage across the resistor as 5.7 V and the current in the resistor as 0.60 A.

Use these values to calculate the resistance.



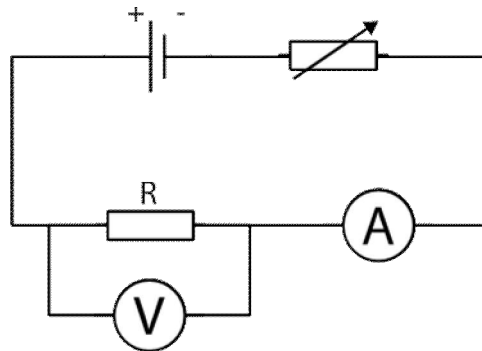
Homework 8 cont.

4. A student sets up an experiment to investigate the current in and the voltage across two different resistors. The results obtained for each resistor are shown in the table below.

<i>Resistor</i>	<i>Current (amperes)</i>	<i>Voltage (volts)</i>
X	0.6	1.5
Y	7.5	1.5

Use the information in the table to calculate the resistance of both resistors, X and Y.

5. This circuit below was connected up to verify ohm's law.

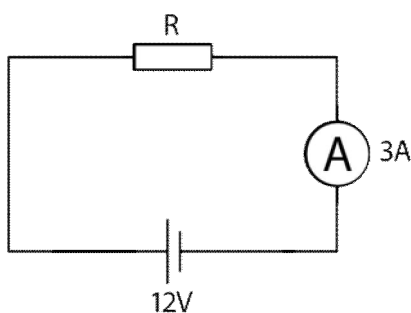


The current through and voltage across R were varied and the results are shown in the table:

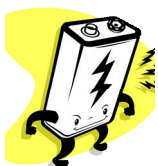
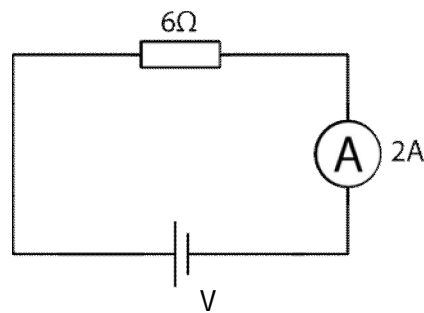
Voltmeter Reading	2V	4V	6V	8V	10V	12V
Ammeter Reading	0.4A	0.78A	1.22A	1.64A	2.02A	2.35A

- (a) Explain how the current and voltage were varied.
 (b) Plot a line graph of voltage against current. (**Use graph paper**)
 (c) From your graph, find the value of resistor R.
6. Calculate the value of the unknown in the following circuits

(a)

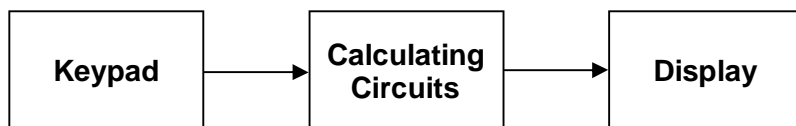


(b)



Homework 9 : Devices

1. The block diagram for a calculator is shown below.



Copy the block diagram and identify the input, process and output subsystems.

2. Draw a block diagram of the following systems, showing the input, process and output subsystems on each diagram.

- (a) A public address system in an airport.
- (b) A radio.

3. What is sensed by each of the following input devices?

- (a) microphone
- (b) thermistor
- (c) light dependent resistor.

4. A number of input devices are shown in the list below:

Microphone, thermocouple, solar cell, thermistor, LDR

From this list, choose an appropriate input device which could form part of a circuit to be used for the following:

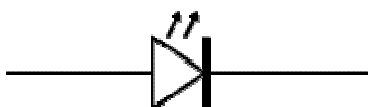
- (a) to charge batteries during the day
- (b) to adjust the brightness of a television to suit the light level in the room
- (c) to measure the temperature of the flame on a Bunsen burner
- (d) to allow sound to be observed on an oscilloscope.

5. State what happens to the resistance of:

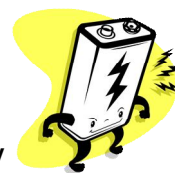
- (a) A thermistor subjected to increasing temperature
- (b) An LDR as the light intensity falling on it increases.

6. Identify the following circuit symbols:

(a)



(b)



Homework 9 cont.

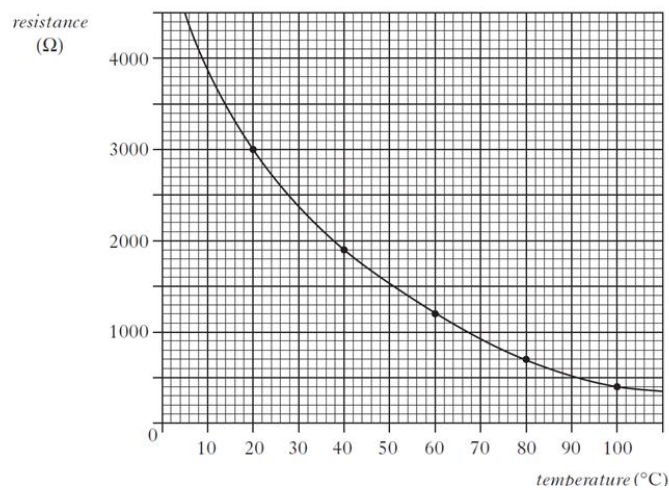
7. Copy and complete the table below:

Device	Symbol	Input or Output	Energy Change
Bulb			
L.E.D			
Microphone			
Loudspeaker			
Thermocouple			
Buzzer			
Solar cell			

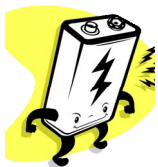
8. For each application listed below identify the most suitable output device.

- (a) A radio.
- (b) A standby indicator on a television.
- (c) A car headlamp.

9. The graph below shows how the resistance of a thermistor changes with temperature.

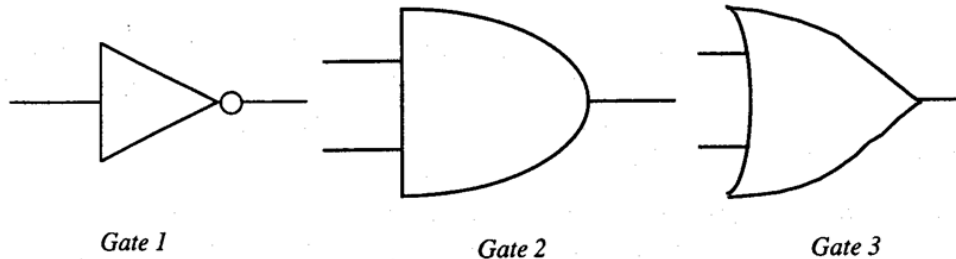


What is the **change** in resistance of the thermistor when its temperature rises from 20°C to 100°C ?



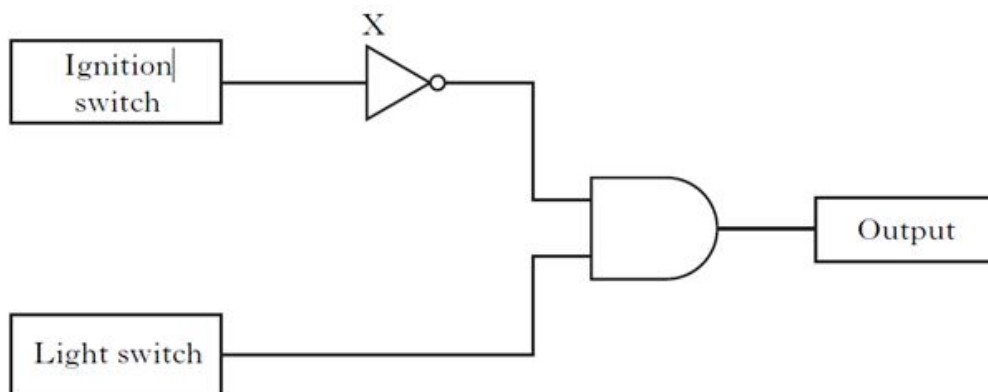
Homework 10 : Logic Gates

1. For each of the logic gates shown below:



- (a) Name the gate
- (b) Draw the truth table
- (c) Describe the operation of the gate in words.

2. In a car, a warning sounds if the lights are left on after the ignition switch is turned off. The system has two inputs, one from the ignition switch and the other from the light switch.



- (a) Name logic gate X.
- (b) Copy and complete the logic table for gate X.

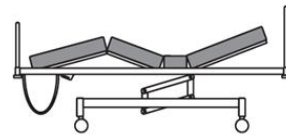
<i>Logic level from ignition switch</i>	<i>Output logic level from the gate</i>
0	
1	

- (c) Explain why the output device is **on** when the ignition switch is **off** but the lights are **on**.

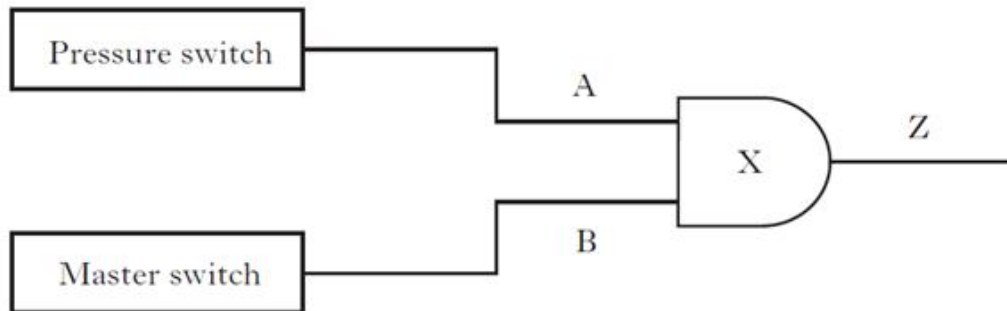


Homework 10 cont.

3. A hospital bed can be raised using an electronic circuit.



A logic diagram for this circuit is shown below.



Pressure switch when closed gives logic 1
Pressure switch when open gives logic 0

Master switch when closed gives logic 1
Master switch when open gives logic 0

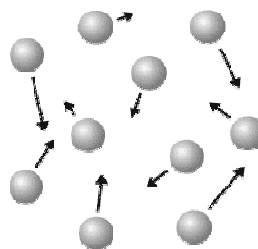
- (a) Name logic gate X.
- (b) Name an output device which could be used to raise the bed.
- (c) Copy and complete the table for component X.

<i>Input A</i>	<i>Input B</i>	<i>Output Z</i>
0	0	
0	1	
1	0	
1	1	

- (d) Explain why the bed cannot be raised when the master switch is off.




Homework 11 : Pressure



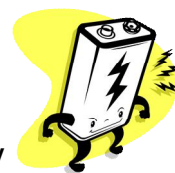
1. Describe the kinetic model for gases.
2. What is the definition of pressure?
3. A box weighs 120 N and has a base area of 2 m^2 . What pressure does it exert on the ground?
4. A bag weighs 30 N and has a base area of 0.5 m^2 . what pressure does it exert on the ground?
5. A suitcase has a weight of 400 N and has dimensions 0.3m by 1.5 m.
 - (a) What is the area of the suitcase?
 - (b) What pressure does it exert on the floor?
6. A girl has a mass of 45 kg. Her foot has dimensions 0.2 m by 0.1 m.
 - (a) What pressure does she exert with her foot on the ground?
 - (b) What pressure would she exert with her two feet on the ground?
7. Why do camels have big feet? (This sounds like a joke but isn't)
8. How do you increase the pressure of gas particles?
9. A youngster who is learning to swim inflates his arm bands before entering the pool.
 - (a) What happens to the pressure of the bands as they are inflated?
 - (b) What happens to the pressure of the bands if they are placed in an ice bath?

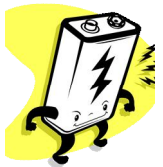


10.  A sealed syringe containing air is placed in a large beaker of boiling water. Why does the plunger move as the air takes up a greater volume within the syringe?

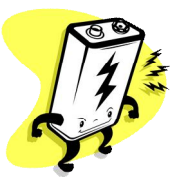


A sealed syringe containing air is placed in a large beaker of boiling water. Why does the plunger move as the air takes up a greater volume within the syringe?





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6. The diagram below shows the eye of someone who has short site. Using a diagram, show how a lens can be used to correct this defect.



