PHYSICAL SCIENCE

Malawi School Certificate Examination

Questions and Model Answers

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FORWORD

This book (questions and model answers) has been compiled to help students understand the nature of questions asked by MANEB and how they should attempt to answer them.

HOW TO USE THIS BOOK

The students should attempt the questions first and then compare their answers with those that are suggested in this book. Calculations and clarifications given for all the solutions which need them respectively. If you meet any problems, consult the author on the number or E-mail address given or come in person to Likuni Boys' Secondary School. Lastly, I wish you all the best in your preparation for the examinations.

Q U E S T I O N S

1998

1.a. **Figure 1** is a graph of boiling points against atomic number of the first 19 elements in the periodic table. Use the graph to answer the questions that follow.

(i) Estimate the boiling point of Na.
(ii) Write down the atomic number of the element with the highest boiling point.
(iii) In which group of the periodic table does element P belong?
(iv) Identify the element which is in the same group as Be.
(v) Which three elements have the lowest boiling points?
(vi) Give a common property of the elements you have identified in 1.a.(v) above
(vii) Ca is an element whose atomic number is 20. Would you expect it to have a higher or lower boiling point than K?
(viii) Study the graph and describe in general terms how the boiling point of elements in a given period changes as the atomic number increases.

b. Below is a list of some elements which may be prepared by electrolysis of suitable molten substances or aqueous solutions.

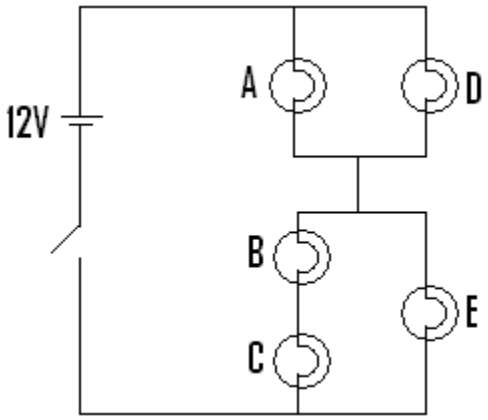
Oxygen	**Zinc**	**Potassium**
Silver	**Copper**	**Chlorine**
Hydrogen	**Bromine**	**Lead**

(i) In the statement above, what is meant by an element?
(ii) Why must substances be in molten state or aqueous solution in order for electrolysis to take place?
(iii) From the above list, pick out **all** elements whose ions would be discharged at the cathode during electrolysis if the elements were in molten state.

(iv) One of the elements in the list can only be made from the electrolysis of a molten substance. Name the element, and explain why an aqueous solution would not be suitable in this case.

(v) From the above list, select one element whose ions would be discharged at the anode and give the equation to represent the discharge reaction of this ion.

2. a. **Figure 2** is a circuit diagram showing the arrangement of five bulbs A to E. The bulbs are identical and each has a resistance of 6 ohms.



(i) Find the total resistance in the circuit. Show your working.

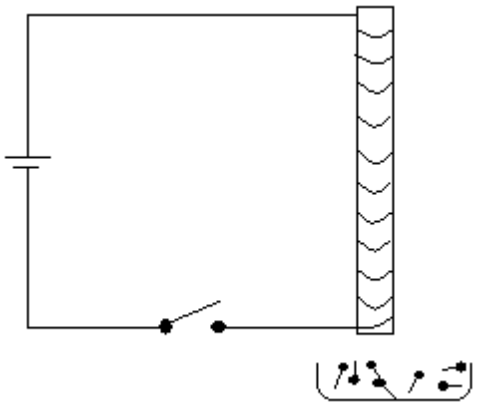
(ii) Calculate the total current drawn from the cell when the switch is closed. Show your working.

(iii) When the switch is closed which bulb or bulbs will be:
1. Brightest
2. Most dim

(iv) Explain how you have arrived at your choices in 2.a. (iii) above.

(v) Draw a circuit diagram to show how these five bulbs could be arranged so that they are equally bright and as bright as possible.

b. **Figure 3** is a diagram of a circuit in which a cell, a switch and a solenoid are connected in series. Iron pins are placed in a container just below the solenoid.



(i) What will you observe when the switch is closed for sometime and later opened?
Switch closed _____
Switch opened_____

(ii) Explain your answer to question 2. b. (i)

(iii) Give an example of an appliance where an electromagnet is used.

(iv) State 2 advantages of using an electromagnet instead of a permanent magnet in the appliance mentioned in 2. b. (iii)

3. a. The equations below represent displacement reactions involving four elements. The elements are represented by

letters A, B, C and D. Study the equations and then answer the questions that follow.

(1) $A_{(S)} + B^{2+}_{(aq)} \rightarrow A^{2+}_{(aq)} + B_{(S)}$

(2) $A_{(S)} + 2C^{+}_{(aq)} \rightarrow A^{2+}_{(aq)} + 2C_{(s)}$

(3) $B_{(s)} + 2C^{+} \rightarrow B^{2+}_{(aq)} + 2C_{(s)}$

(4) $D_{(s)} + B^{2+}_{(aq)} \rightarrow D^{2+}_{(aq)} + B_{(s)}$

(5) $D_{(s)} + A^{2+}_{(aq)} \rightarrow$ no reaction

(i) Are these elements A, B, C and D likely to be all metals, all non-metals, or some of each? State the reason for your answer.

(ii) Write half reactions to represent the changes which occur in the reaction in equation (1)

(iii) Arrange the elements A, B, C and D in order of reactivity starting with the least reactive.

(iv) Write an equation to represent what you would expect to happen when solid C is placed in an aqueous solution of D^{2+}?

(v) Which reaction would you expect to be most vigorous if concentrations and temperature were the same? Give a reason for your choice.

b. The formula of hydrated sodium carbonate is $\mathbf{Na_2CO_3.XH_2O}$ where **X** represents the numbers of molecules of water

of crystallization.To determine the value of X, a sample of hydrated sodium carbonate crystals was heated to a

constant mass. The results obtained were as follows;

Mass of hydrated sodium carbonate before heating =7.15g

Mass of sodium carbonate after heating =2.65g

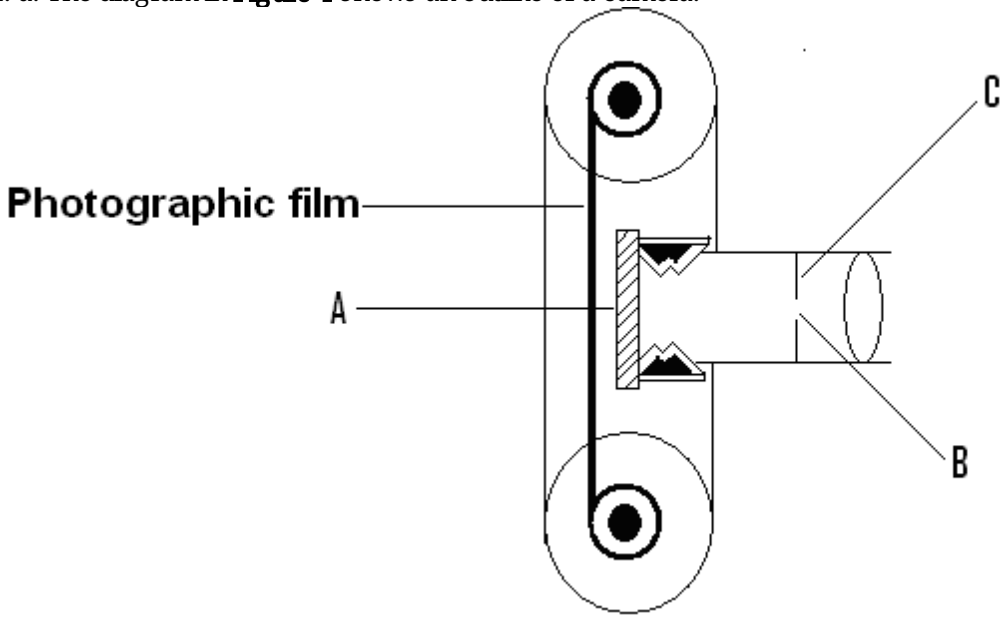
(i) Calculate the decrease in mass.

(ii) How many moles of water were lost in the experiment?

(iii) How many moles of anhydrous sodium carbonate were formed at the end of the experiment?

(iv) Using your answer to (ii) and (iii) work out the value of **X** in the formula $\mathbf{Na_2CO_3.XH_2O}$. (RAMs: H=1, O=16, Na=23, C=12)

4. a. The diagram in **Figure 4** shows an outline of a camera.



(i) Name the parts labelled A, B and C

(ii) What is the function of each of these parts A, B and C

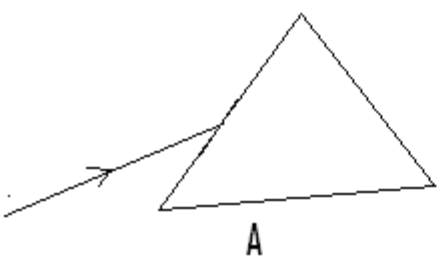
(iii) The camera has a lens of focal length 150mm and produces a sharp image of an object which is 2.0metres away from the lens. Calculate the distance between the lens and the film.

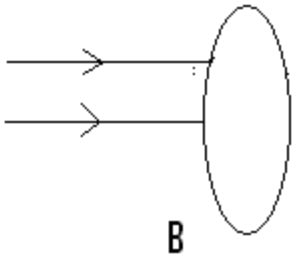
(iv) If the object were moved farther away from the camera so that it is a distant object, by how much

should the lens be moved to get a sharp image on the film?

(v) The camera is said to be similar to the human eye. Explain why this is so.

b. **Figure 5A and B** are diagrams representing a prism and a convex lens respectively. Complete the ray paths shown.





5. When sodium thiosulphate is mixed with dilute hydrochloric acid, sulphur precipitate is produced. To study the speed of this reaction different volumes of sodium thiosulphate and water were added to a constant volume of hydrochloric acid. In each case time taken for the precipitate to appear was noted and the value of 1/time calculated. The table below shows the results of the experiment. Use the table to answer the questions that follow:-

Volume of sodium thiosulphate (cm^3)	Volume of distilled water (cm^3)	Volume of hydrochloric acid (cm^3)	Time for the sulphur precipitate to appear (s)	1/time (s^{-1})
40	0	40	8	0.125
30	10	40	11	0.091
20	20	40	14	0.071
15	25	40	21	0.048
10	30	40	32	0.031

a. Suggest two reasons for adding water to the reacting mixture.

b. Plot a graph of 1/time on the vertical axis and the volume of sodium thiosulphate on the horizontal axis. Scales (1cm=0.01s^{-1} and 1cm = 5cm^3).
Draw the best straight line through the points.

Use the plotted graph to answer questions c, d, and e

c. one of the readings is probably wrong. Put a circle round it on your graph and explain how you know it is wrong.

d. What volume of sodium thiosulphate and water would have to be used for the sulphur precipitate to appear in a time of 20 seconds?

e. State the factor that is being investigated in this experiment and the conclusion that could be drawn from the results shown.

f. The balanced full ionic equation for the reaction between sodium thiosulphate and dilute hydrochloric acid is as follows:-

$$2Na^{+}_{(aq)} + S_2O_3^{2-}{}_{(aq)} + 2H^{+}_{(aq)} + 2Cl^{-}_{(aq)} \rightarrow 2Na^{+} + SO_2 + H_2O + S + 2Cl^{-}$$

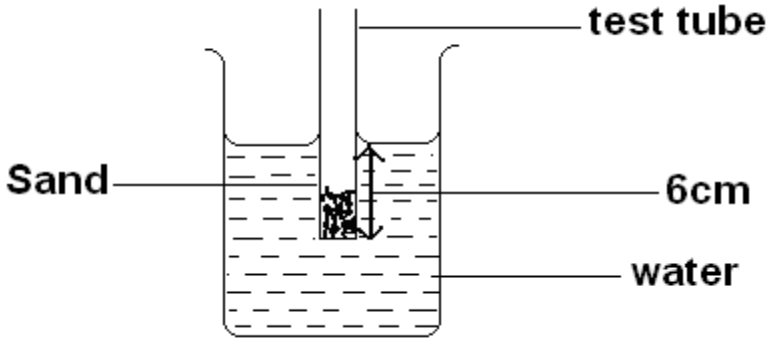
(i) indicate the states of products in the above equation.

(ii) Write a balanced simplified ionic equation for the reaction.

6. a. A flat bottomed test tube of length 12 cm and uniform cross-sectional area of 4 cm^2 has a mass of 8g when empty.

When the test tube is partly filled with sand it floats upright in water with 6 cm of its length submerged as shown in

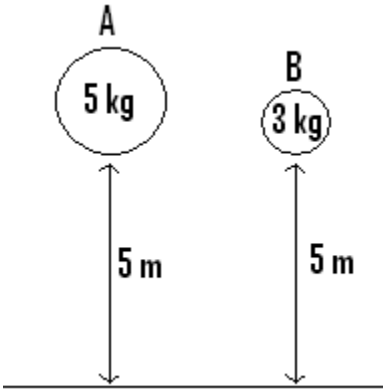
the diagram in **Figure 6**.



(i) Calculate the volume of water displaced.
(ii) What is the mass of water displaced?
(iii) State the rule you used to answer question 6.a.(ii)
(iv) Calculate the length of the test tube that would be below the surface of the liquid if the test tube were transferred and placed in alcohol of density $0.8g/cm^3$.
(v) The densities of glass and sand are greater than the density of water . Why does the test tube partly filled with sand float in water?

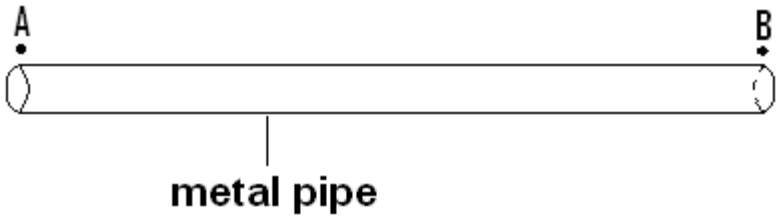
b. Explain what is meant by Free Fall.

c. The diagram in **Figure 7** shows metal spheres A of mass 5kg and B of mass 3kg at rest 5m above the ground



(i) When the spheres are released from rest simultaneously they strike the ground at the same time. Why is this so?
(ii) Describe the motion of sphere B from the time it is released to the time it hits the ground.
(iii) Find the force with which A hits the ground.
(iv) Suppose metal sphere A was released from a height of 3m above the ground, what effect if any would this have on the force with which A hits the ground?

7. Using suitable examples and with help of diagrams in each case , explain the difference between the terms given below:
   a. hydronium and hydroxyl ions;
   b. covalent bonding and ionic bonding
   c. isomerism and conformation
8. The diagram in **figure 8** represents a long open metal pipe of large diameter in an open space. A student at position A bangs the pipe and her colleague at position B listens for the sound to reach her.



a. Explain why the student at B will hear two sounds, one arriving after the other.
b. Suppose the two students wanted to measure the differences between the speeds of the two sounds heard in 8. (a). Describe step by step what they would do, results they would obtain and calculations they would make.

1999

1. a. **Table 1** below shows the boiling points of some chlorides which are represented by letters A, B, C, D, E and F.

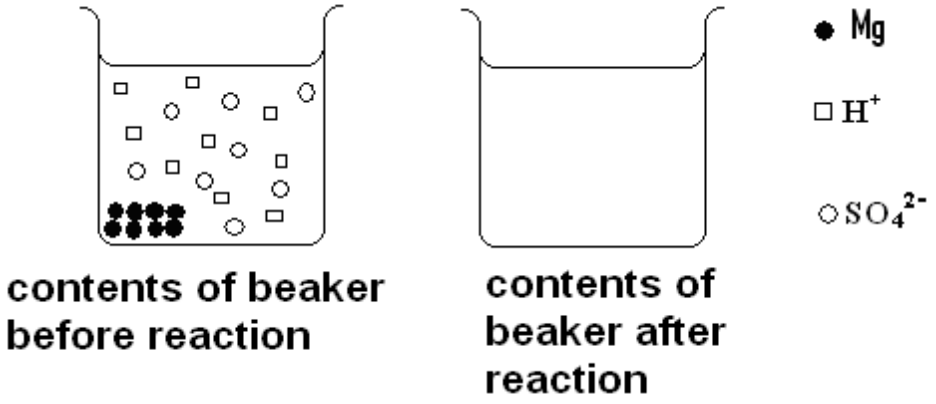
CHLORIDES	BOILING POINT ^{O}C
A	1460
B	1410
C	180
D	1380
E	-85
F	60

(i) Which chloride has the lowest boiling point?
(ii) Hydrogen chloride is a gas at room temperature. Select a letter from the table which could represent hydrogen chloride.
(iii) Divide the chlorides into those which are likely to be ionic and those which are likely to be covalent.
(iv) Explain your reasoning in 1. a. (iii)
(v) Helium does not form a chloride. Why?

b. The equation for the reaction between magnesium metal and sulphuric acid is

$$Mg_{(s)} + H_2SO_{4\,(aq)} \rightarrow MgSO_{4\,(aq)} + H_{2\,(g)}$$

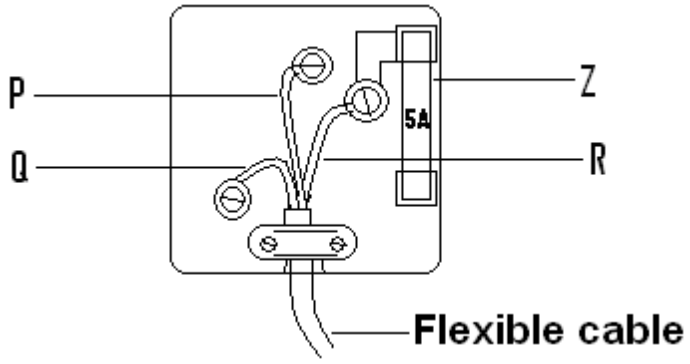
(i) What do the symbols (s) , (aq) and (g) stand for?
(ii) Name the two products of the reaction.
(iii) State the type of reaction that is represented by the equation.
(iv) **Figure 1** represents a mixture of magnesium and sulphuric acid solution before the reaction starts. Use the symbols given to show the contents of the beaker after reaction has gone to completion.



(v) Suppose the beaker and its contents were weighed before and after the reaction, would you expect the mass to increase , decrease or remain the same?

(vi) Explain your answer in 1.b.(v)

2. a. **Figure 2** is a diagram of a wired three pin plug.



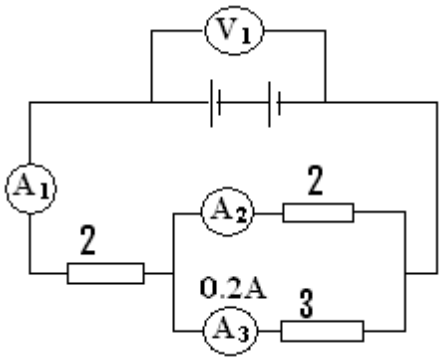
(i) Identify the wires labelled P, Q, and R in the flexible cable.

(ii) What is the colour of Q?

(iii) Name the part labelled Z and explain its importance.

(iv) An electric kettle rated 2.4 KW, 240V is plugged into the 240V mains socket using the plug shown in **figure 2**. Calculate the size of the current it requires, and explain whether or not the kettle will work.

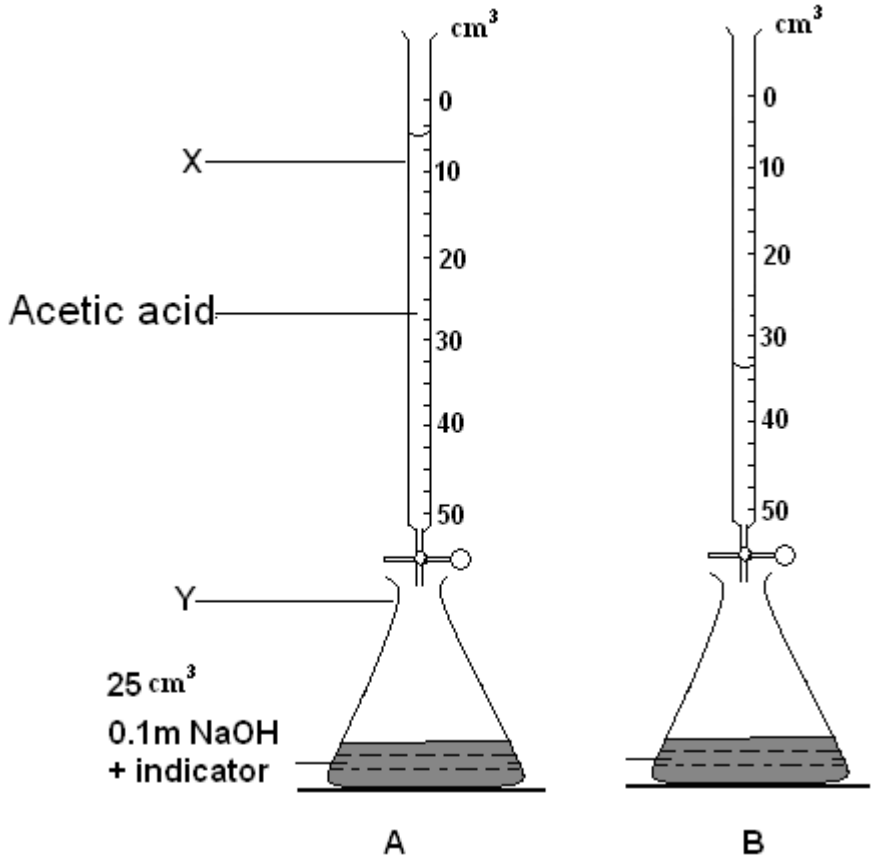
b. **Figure 3** is a circuit diagram showing the arrangement of thre resistors.



Using the values shown in the diagram, calculate the following:

(i) total resistance in the parallel arrangement.
(ii) Voltage across the 3 ohm resistor.
(iii) Current through A_1.
(iv) Reading of the voltmeter V_1.

3. a. The arrangement shown in **figure 4** below was used to carry out a titration of acetic acid against 0.1 M sodium hydroxide solution. Diagram A shows the volume of acetic acid before the reaction and diagram B shows the volume of the acid at the end point.



(i) Give the names of the pieces of apparatus labelled X and Y
(ii) State the name of the indicator and its colour in A

(iii) What is meant by "end point"?
(iv) What volume of acetic acid was added to the 25cm^3 of 0.1M NaOH?
(v) Calculate the concentration in moles per litre of the acetic acid.

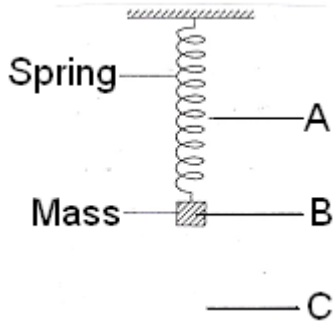
b. Table 2 shows the results obtained by a student who was investigating factors affecting the rate of reaction between
magnesium and hydrochloric acid. Six experiments A,B,C,D,E and F were carried out. In each experiment a
weighed amount of magnesium was added to 25cm^3 of acid and stirred with a thermometer. The initial and final
temperatures of the solutions as well as the time taken for the magnesium to disappear were noted and recorded.

Study the table carefully and answer the questions that follow:

Experiment	Volume of acid (cm^3)	Conc. of HCl (mol/dm^3)	Mass and nature of magnesium	Temperature (^{0}C)		Time (s)
				Initial	Final	
A	25	0.5	0.1g ribbon	24	26	450
B	25	0.6	0.1g powder	24	36	50
C	25	0.6	0.1g ribbon	24	39	250
D	25	1.0	0.1g ribbon	24	36	100
E	25	1.5	0.1g ribbon	24	35	30
F	25	1.0	0.1g ribbon	35	48	75

c. Choose from the table four experiments which could be used to show the effect of concentration on the rate of reaction.
d. Which two experiments could be used to determine the effect of temperature on the rate of reaction?
e. State the third factor which is being investigated and select two experiments which show the effect of this factor on the rate of reaction.
f. Explain the reasoning you used to select the two experiments in 3.b.(iii)

4. a. The diagram in **Figure 5** represents a mass moving up and down on the end of a spring between points A and C



(i) Complete each of the statements using one word selected from the following list (maximum, minimum, zero and same).

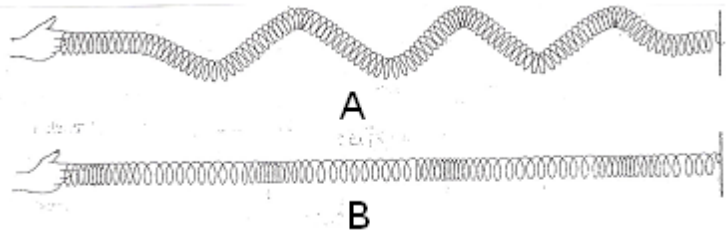
When the mass is at position A
Acceleration of the mass is _____

Weight of the mass is_____
Strain in the string is_____

When the mass is at position B
Speed of the mass is_____
Kinetic energy of the mass is_____

(ii) Measure in cm the amplitude of vibration of the mass.
(iii) Measure the distance in cm which represents one complete oscillation of the mass.
(iv) What effect, if any, would there be on the up and down movement of the mass if the distance A to C were reduced.
(v) As the mass continues to move up and down the distance AC gradually decreases. Explain.

b. **Figure 6** shows diagrams A and B representing two kinds of waves on a slinky spring.



(i) Label the positions of crest and rarefaction in the figure
(ii) State how each kind of wave is produced on the spring
(iii) Explain the difference in which the two kinds of waves are transmitted
(iv) Give the name of each wave
(v) Mark the distance which represents one wave length in A and B

5.a. Given below are general formulae of some homologous series represented by the letters M, N, O and P.

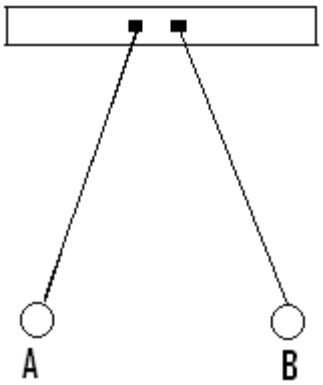
M C_nH_{2n}
N C_nH_{2n+2}
O $C_nH_{2n+1}OH$
P $C_nH_{2n+1}COOH$

(i) Name the homologous series represented by the letters M and P
(ii) Which general formulae represent hydrocarbons?
(iii) Draw the structure of a member with three carbon atoms from series N and one member with one carbon atom from series O
(iv) Name the compounds whose structures you have drawn in 5.a. (iii)
(v) Explain how you would distinguish a sample of a member of series M from a sample of series N

6. a. A car accelerates uniformly for 10 seconds from a velocity of 0km per second to a velocity of 25km per second,
continues at the velocity of 25km per second for a further 40 seconds and then decelerates uniformly for 20 seconds
so that it stops.

(i) Calculate the total time for the journey
(ii) On the graph provided , draw to scale a velocity time graph to represent the motion of the car.
Scale: (1cm = 5km/s and 1cm = 5s)
(iii) From your graph , calculate :
1. Acceleration during the first 10 seconds
2. Deceleration during the last 20 seconds of the journey

b. **Figure 7** is a diagram showing polythene balls A and B suspended on nylon threads. After being charged , the balls
come to rest in the position shown.



(i) What charge was given to A and B?
(ii) Using arrows, show the direction of all the forces acting on ball A in the diagram which has been redrawn below. Label the foores.
(iii) Draw a diagram to represent the electric field between the two balls
(iv) What would be observed if the two balls were momentarily touched? Explain.

7. A teacher performed an experiment to find out the effect of pH on corrosion of iron . The results obtained are shown in **Table 3**. A graph of the results was plotted as shown in Figure 8

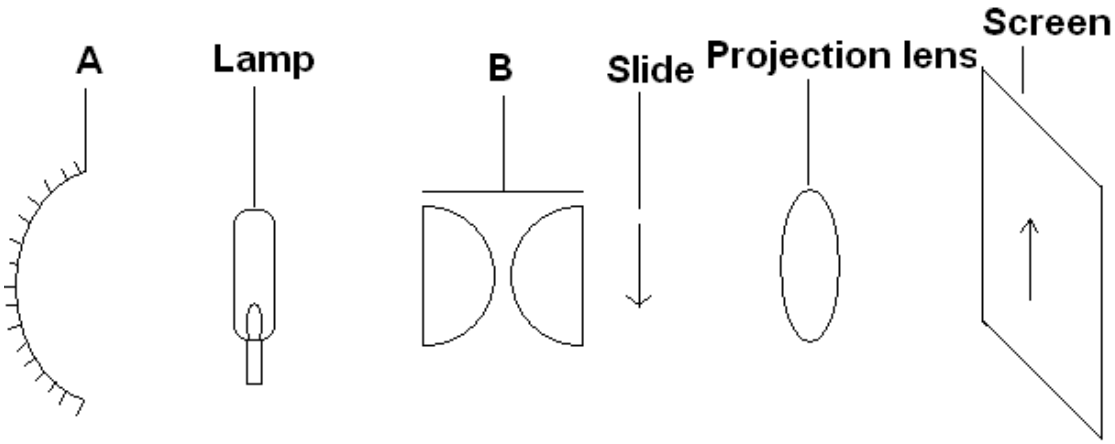
Table 3

pH	1	2	3	4	5	6	7
Percentage corrosion of iron (%)	60	55	50	45	15	10	5

a. (i) How does percentage corrosion vary as pH increases from one to seven?
(ii) What conclusion can be drawn from the results?

b. You are asked to verify the results in Table 3, write a detailed plan of the experiment. In your plan show the materials you would use and the procedure you would follow to do the experiment.

8. **Figure 9** is a diagram of a simple slide projector

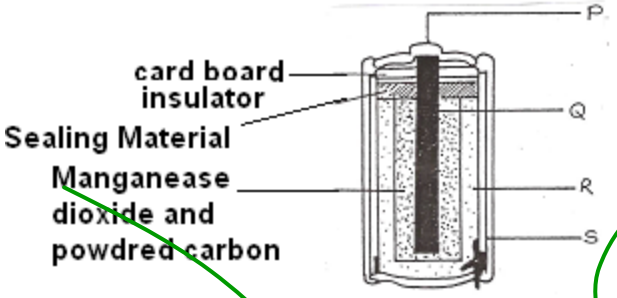


a. Name the parts labelled A and B
b. Explain in detail the function of each of the parts shown in the diagram.
c. If the screen is placed 200cm away from the projection lens, how far away from the projection lens

should the slide be placed to give a focused image whole magnification is 10?

2000

1. **Figure 1** is a diagram of a longitudinal section of a dry cell.



a. Name the parts P, Q, R, S
b. State the function of each of the parts P, Q, R, S.
c. There are different sizes of dry cells which can be bought from most shops but are marked 1.5v.
(i) Why is the voltage of each cell 1.5v regardless of the size of the dry cell.
(ii) Give two advantages of using a large cell.
d Rust is an example of corrosion.
(i) State the conditions that are favorable for rusting.
(ii) One way of preventing rusting is by galvanizing. What is involved in galvanizing process?

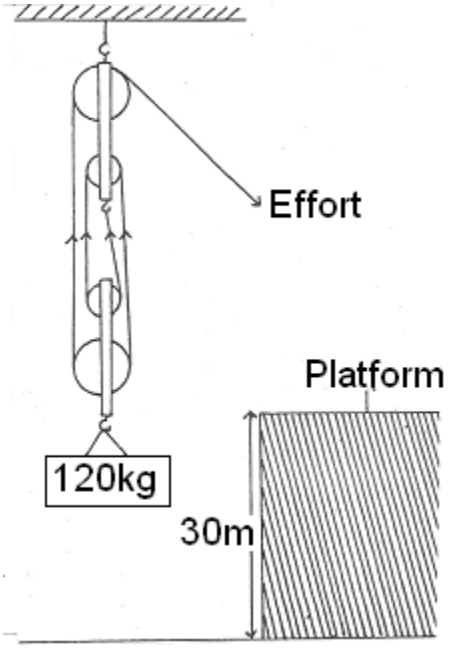
e. In a punctured tin can, iron (Fe) and tin (Sn) react according to the following half equations:

$Fe_{(s)} - 2e^- \rightarrow Fe^{2+}_{(aq)}$

$Sn^{2+}_{(aq)} + 2e^- \rightarrow Sn_{(s)}$

Write a balanced overall equation for the reaction.

2.a. **Figure 2** is a diagram of a pulley system being used to lift a mass of 120kg vertically through a height of 30 m.



(i) Calculate the work done in lifting the mass to a height of 30m.
(ii) How much energy is supplied by the effort in raising the mass through the height of 30m?
(iii) If it takes 0.5 minutes to complete the work using the pulley system, work out the power

of this machine.

(iv) What do you understand by the term 'efficiency'?

(v) Give three reasons why in practice the machine in figure 2 is not 100% efficient.

b. Water waves are transverse.

(i) Define transverse waves.

(ii) Draw a diagram of a transverse wave. In the diagram, indicate amplitude, wavelength, direction of particle vibration and direction of wave motion.

(iii) If a water wave has a speed of 0.1 m/s and a wave length of 0.2 m, calculate its frequency.

2. a. The relationship between organic compounds, compounds that dissolve in water, and hydrocarbons can be represented by a Venn diagram . Using the letter A to represent organic compounds, B to represent compounds that dissolve in water and C to represent hydrocarbons:

(i) draw a venn diagram to show the relationship of the compounds.

(ii) Write the following in the appropriate areas of the venn diagram:- **$CH_3CH_2CO_2H$, ethane and sodium hydroxide.**

b. The relationship between ethanoic acid and potassium hydroxide can be represented by the equation below:

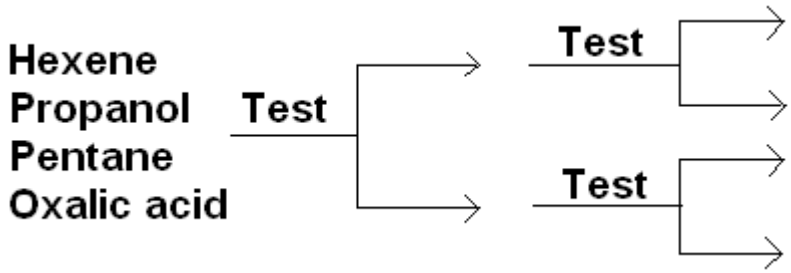
$$CH_3CO_2H_{(aq)} + KOH_{(aq)} \rightarrow H_2O_{(l)} + CH_3CO_2K_{(aq)}$$

(i) Write the full ionic equation for the reaction.

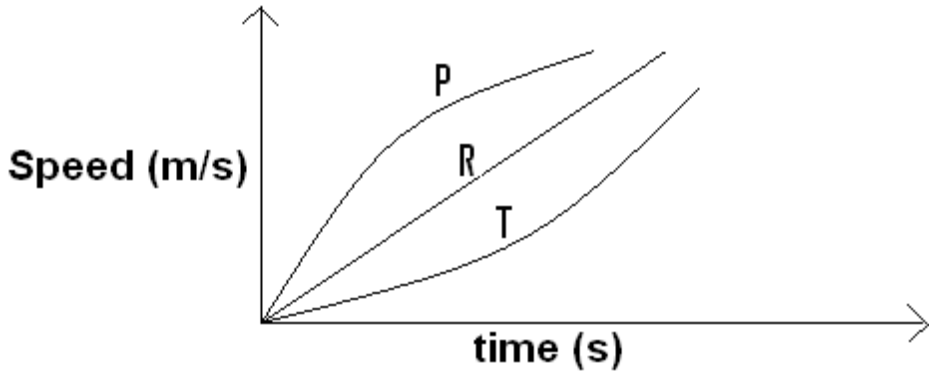
(ii) What are spectator ions?

(iii) Write the spectator ions in the ionic equation in 3b(i).

c. The flow diagram below could help in identifying the four chemical substances given. Complete the diagram by describing the necessary tests you would use as well as results expected in order to identify the four substances.



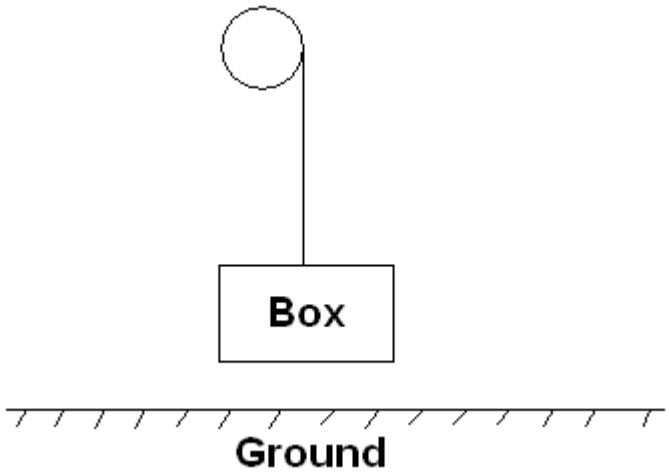
4. a. **Figure 3** is a sketch of three speed-time graph P, R and T on the same axes



What type of acceleration is represented by each of the graphs P, R and T?

b. Presenting numerical data graphically is widely used by scientists. Give 2 reasons why this so.

c. **Figure 4** is a diagram showing a box being raised by a rope from the ground. The box accelerates as it rises.



(i) What are the forces acting on the box as it rises assuming air resistance is negligible?
(ii) Which of the forces is greater?
(iii) How would the forces compare if the box was moving upwards at a constant speed?
(iv) How would the forces compare if the box stopped moving?

d. A car travels from point A due north to point B 40km away in 30 minutes.it then travels 30km due east to point C in another 30 minutes.

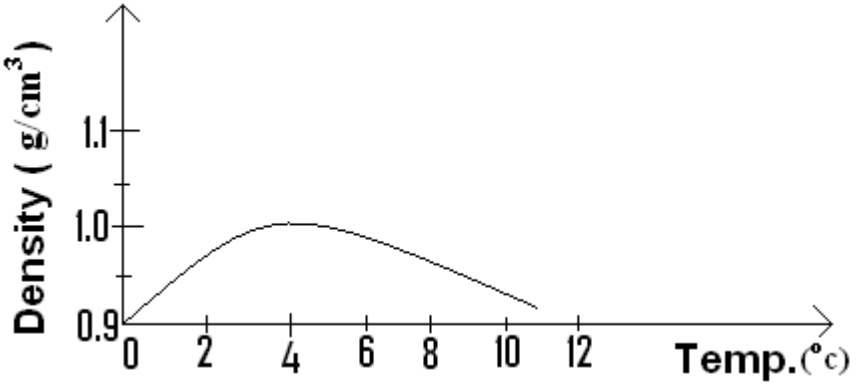
(i) Find the average speed in kilometers per hour for the journey.
(ii) If the car travelled from A to C using the most direct route, what distance would it cover?
(iii) What is the difference between a vector quantity and a scalar quantity?
(iv) Give one example of a vector quantity and one example of a scalar quantity?

5. a. **Figure 5** shows nuclear charges of some atoms D, E, F and G.

(i) Complete the diagrams by drawing the energy levels and indicating the number of electrons in each energy level.
(ii) What are the valencies of E and F?
(iii) What type of bonding takes place when elements E and F combine?

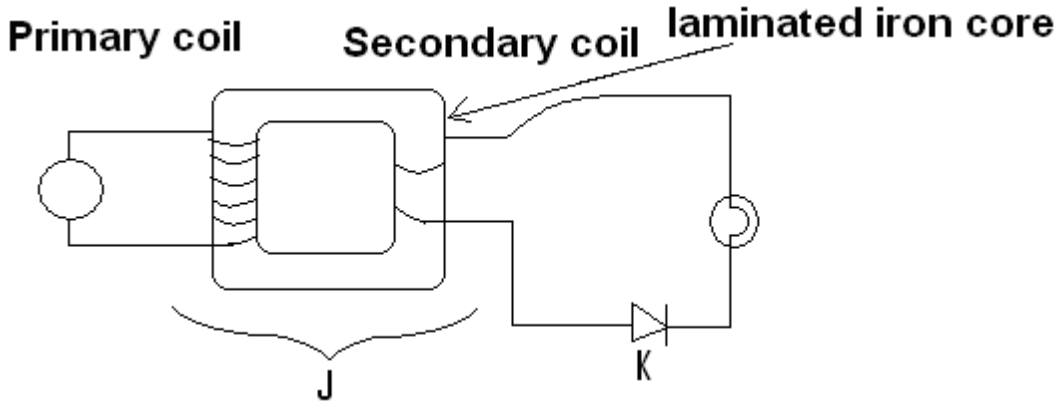
(iv) To which group of the periodic table does element G belong?
(v) From the electron configurations, how can you tell the period to which the elements belong?
(vi) Which of the two elements E and G is more reactive?
(vii) Give a reason for your answer to 5. a (vi).

b. **Figure 6** is a sketch showing changes in the density of water as its temperature rises.



(i) Describe how the density of water changes from 0^0C to 10^0C
(ii) What would be the effect on the density of the water when salt is added to it?
(iii) Explain why in general, the density of an object decreases as the temperature increases?

6. a. Examine **Figure 7** which is part of the electric circuit and answer the questions that follow:



(i) Name the parts labeled J and K.
(ii) How is K being used in the circuit?
(iii) Draw an arrow above K in the circuit to show the direction of flow of the current.
(iv) If the voltage in the secondary coil is 24 V, what is the voltage in the primary coil if the transformer has a turns ratio of 10:1?
(v) Give two advantages of using alternating current in the transmission of power?
(vi) How is current induced in the secondary coil of the transformer?

7. a. What are Van der Waals forces?
b. Explain giving examples, how the strength of van der waals forces depend on the molecular size and the kind of atoms in the molecule.
c. Explain why sodium chloride (NaCl) has a much higher melting point than $C_{70}H_{142}$

8. a. Define electromotive force of a battery
b. Using one cell, two identical bulbs, a voltmeter and a switch, describe an experiment you would carry out to show that the brightness of the bulbs depends on the voltage.

2001

1.a. An element X has atomic number 18.

(i) If the element has 19 neutrons, what is its mass number?

(ii) What could happen if element X were mixed with sodium metal? give a reason for your answer.

b. (i) Draw an electron dot and cross diagram of the compound formed when chlorine ($^{35}_{17}Cl$) reacts with Potassium ($^{39}_{19}K$).

(ii) State three physical properties of the compound formed when chlorine reacts with potassium.

c. Study the chemical equation below and answer the questions that follow:

$2C_2H_6 + \_\_\_\_O_2 \rightarrow \_\_\_\_ CO_2 + 6H_2O$

(i) Balance the equation by filling in the missing coefficients.

(ii) What type of reaction is represented by the equation?

(iii) Name the reactants in the equation.

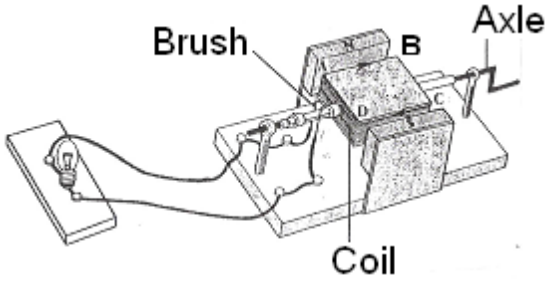
d. Sulphuric acid (H_2SO_4) reacts with sodium hydroxide (NaOH) to form sodium sulphate (Na_2SO_4) and water according to the equation below:

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

(i) How many moles of Sulphuric acid are required to form 4 moles of water?

(ii) How many grams of sodium hydroxide will react completely with 24.5g of sulphuric acid? (RAMs: O=16, S=32, H=1, Na=23).

2.a. **Figure 1** is a diagram of a dynamo being used to light a bulb. When the coil turns in a clockwise direction between the magnets, current flows in the direction ABCD.



(i) Explain how current is produced in the coil.

(ii) State three ways of increasing the current flowing in the circuit.

(iii) Describe the energy changes that take place when the rotating dynamo is connected to the bulb.

(iv) What is the effect on the bulb of reversing the direction of rotation of the coil?

b. Takondwa rubbed a ball point pen in her hair and found that it picked up small pieces of paper.

(i) If the charge on the ball point pen is positive, what is the hair charge on the hair?

(ii) Give a reason for your answer to 2.b. (i)

(iii) Explain what happens for the pieces of paper to be picked up by the pen.

(iv) State three ways in which the papers can be picked up more easily using the same pen.

c. Why is it difficult to charge a piece of metal by rubbing?

3. a. Acetic acid (CH_3COOH) ionizes slightly in water. The ionization is reversible and can be represented by the following equation:

$$CH_3COOH_{(l)} + H_2O_{(l)} \rightarrow CH_3COO^-_{(aq)} + H_3O^+ + Heat$$

(i) What is a reversible reaction?

(ii) Write the conjugate acid-base pairs in the equation.

(iii) In the equation above, the equilibrium lies to the left. What do you understand by this statement?

b. What effect would the following have on the equilibrium position of the reaction represented in 3 (a) above? Give a reason for each.

(i) Decreasing the temperature of the contents of the container.

(ii) Increasing the concentration of CH_3COOH.

c. (i) Define an electrolyte

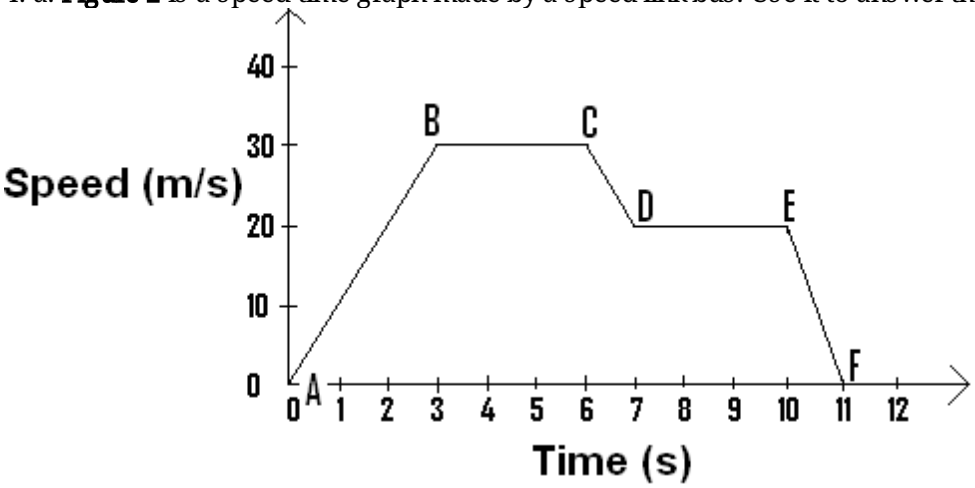
(ii) Explain why concentration of an electrolyte affects its conductivity.

d. A 2kg mass of copper drops in temperature from 15^0C. The heat loss is 4000 J and the specific heat capacity of copper is 400J/kg^{0}C.

(i) What do you understand by the term 'specific heat capacity'?

(ii) Calculate the new temperature of the copper.

4. a. **Figure 2** is a speed-time graph made by a speed link bus. Use it to answer the questions that follow:

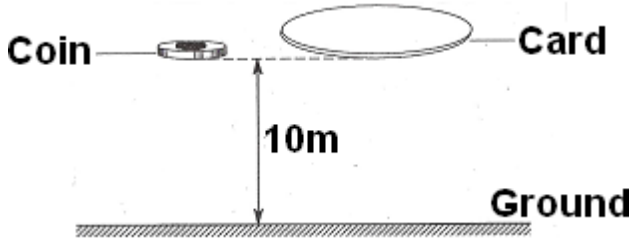


(i) Describe the motion of the bus from A and D.

(ii) Calculate the acceleration of the bus between A and B.

(iii) Calculate the total distance travelled between A and C.

b. A piece of card and a coin of equal mass are released at the same time from a height of 10 m as shown in **Figure 3** below.



(i) Which of the two would reach the ground first? Give a reason for your answer.

(ii) State the three forces which act on each object as it falls.

(iii) Which forces remain constant as the object falls?

c. **Figure 4** below shows two cars of equal masses traveling in opposite direction at the same speed.

(i) What would happen to the velocities of both cars if they collided head on?

(ii) Give a reason for your answer to 4. c. (i)

5. a. Below are results of a set of experiments carried out by a pupil. Study them and answer the questions that follow.

$Cu + MgSO_4 \rightarrow$ No reaction

$Mg + CuSO_4 \rightarrow$ Fast reaction

$Zn + CuSO_4 \rightarrow$ Slow reaction

$Mg + ZnCl_2 \rightarrow$ Moderate reaction

$Zn + MgSO_4 \rightarrow$ No reaction

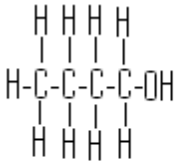
(i) Write a balanced equation for the reaction between magnesium (Mg) and copper sulphate ($CuSO_4$) solution.

(ii) Name the oxidizing agent and the reducing agent in the equation you have written in 5. a. (i).

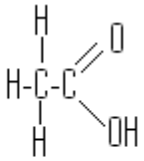
(iii) Arrange the metals in order of reactivity, starting with the most reactive.

(iv) Which combination of metals could give a higher voltage, magnesium/Zinc or magnesium/copper? Give a reason for your answer.

b. Study the structures of compounds A and B below and answer the uestions that follow.



A



B

(i) Name compound A.

(ii) To which family of organic compounds does B belong?

(iii) Write two isomers of compound A.

(iv) Complete the equation for the reaction between compound A and Sodium (Na)

$2CH_3CH_2CH_2CH_2OH + 2Na \rightarrow$ _____+_____

(v) Explain briefly how you would distinguish a sample of A from B.

(vi) Calculate the percentage by mass of oxygen in compound A. (RAMs: C=12, O=16, H=1).

6. a. The following information appears on the rating plate of an electric heater in normal use.

Electrical Supply	220V
Maximum Power	2 200W
WARNING: This appliance must be earthed	

(i) Calculate the current which will flow through the element of the heater.

(ii) Calculate the resistance of the element of the electric heater.

(iii) How much electrical energy, in joules, would this heater use in 5 minutes at maximum power?

(iv) If electrical energy costs k3.00per kwh, what is the cost of using this heater for 8 hours at its maximum power?

(v) Why is it important to earth the appliance?

b. For a convex lens

(i) Define focal length.

(ii) State two ways of determining the focal length.

(iii) What would be the magnification of an object placed at 2F?

(iv) State one difference between real and virtual images.

7. a. What is a standard solution?

b. A laboratory technician has one litre of 2M hydrochloric acid solution. Describe how she could prepare a 250 cm^3 volume of 0.2M hydrochloric acid from the 2M hydrochloric acid solution.

c. The diluted hydrochloric acid solution was used to determine the concentration of sodium hydroxide solution.

Describe how she could have carried out the experiment.

8. a. Given a string, bob, clamp, stop watch and ruler, describe an experiment that you would carry out to find out whether the frequency of vibration of a pendulum depends on the length of the string.

b. Define amplitude.

c. Explain why the amplitude of a vibrating pendulum decreases with increase in time.
d. State two ways in which the amplitude of a pendulum could be increased.

2002

1. a. (i) Draw a labeled diagram of the set up of the apparatus that could be used to separate a mixture of ethanol and water.

(ii) Explain why the distillate is not pure.

b. (i) Define 'molarity'.

(ii) Calculate the morality of a solution prepared by dissolving 5g of sodium chloride (NaCl) in water to make one litre of solution. (RFM of NaCl is 58.5).

(iii) If 10 cm^3 of the solution in 1b (ii) was vaporized, how much NaCl would be left on the evaporating basin?

c. (i) In which of the following substances are atoms covalently bonded?

CH_3OH, $CuCl_2$, SO_2 and BeF_2

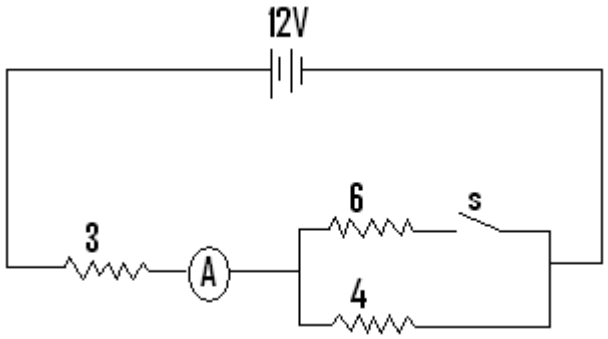
(ii) Draw an electron dot and cross diagram of CH_3OH.

d. (i) Balance the following chemical equation:

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

(ii) What type of reaction is represented by the equation in 1d(i)?

2.a. **Figure 1** is diagram of an electric circuit.



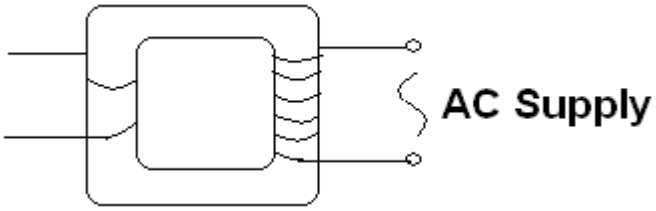
(i) What will be the ammeter reading if the switch, S is in the following conditions?

(1) open

(2) closed

(ii) If switch S is closed and the voltage across the 3Ω resistor is 6.6V, what will be the voltage across the 4Ω resistor?

b. **Figure 2** is a diagram of a transformer connected to an alternating current (AC) power supply.



(i) What type of transformer is shown in the figure?

(ii) If the input voltage is 240V, the number of turns in the secondary coil is 400 and the primary coil is 8000, calculate the output voltage.

(iii) State two advantages of alternating current (AC) over direct current (DC).

c. (i) State Newton's second law of motion.
(ii) A car weighing 500kg moves from rest and reaches a speed of 15 m/s in 5 seconds. Calculate:
(1) acceleration of the car
(2) force exerted by the car's engine

d. (i). Why is force a vector quantity?
(ii) An object is pulled by two forces whose magnitudes are 250 N and 320 N. The angle between the two forces is 60^0. Draw a scale diagram to show the size of the resultant force.

3. a. Define the following:
(i) atomic number
(ii) electron configuration

b. **Figure 3** is a graph of density against atomic number for the first 20 elements of the periodic table.

(i) What is the density of Be?
(ii) How does the graph show that density is a periodic property of elements?
(iii) Which element has the greatest density?
(iv) How many complete periods are represented by the graph?

c. (i) Define 'reduction'
(ii) A pupil carried out a series of experiments to find out positions of metals in a displacement series. The following results were obtained after dipping metals in column X into solutions containing ions in column Z.

X	Z

METAL	IONS	RESULTS
Fe	Pb^{2+}	Lead (Pb) deposited
Pb	Cu^{2+}	Copper (Cu) deposited
Na	Mg^{2+}	Magnesium (Mg) deposited
Mg	Na^{+}	No change

(1) Name the type of reaction that took place during deposition of the metals.
(2) List down the metals in order of decreasing reactivity.

d. **Figure 4** is a diagram of a Daniel cell being used to light a bulb.

(i) State two functions of the porous pot.
(ii) Write down a half equation for the reaction at the zinc electrode.
(iii) Explain why the brightness of the bulb gets weaker after some time.

4. a. (i) State two similarities between a camera and an eye.
(ii) Define the following terms:
1. focal length
2. principal axis

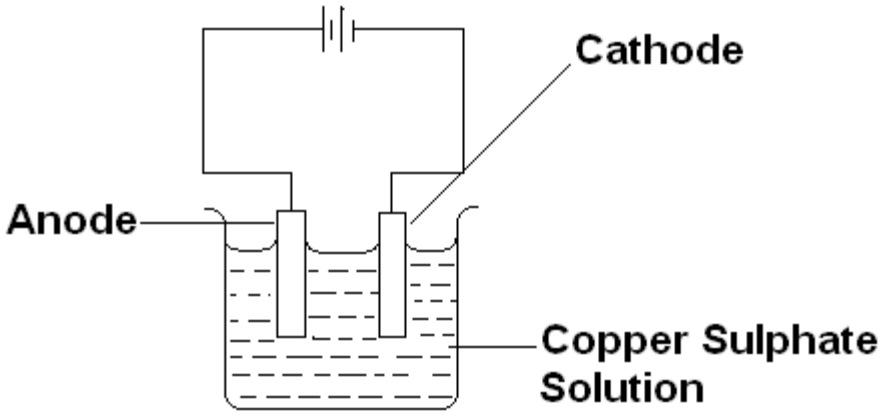
b. An object 2 cm high is placed 4 cm in front of a converging lens of focal length 5cm.
(i) Draw a ray diagram and find the position of the image formed. (Use a scale of 1 cm : 2 cm on the vertical and the horizontal axes).
(ii) Describe the nature of the image formed.
(iii) Calculate the magnification of the image.

c. A person holds a book at arms length when reading in order to see the print clearly.
(i) What eye defect does this person have?
(ii) What type of lenses could be used to correct this defect?

5. a. (i) What is the difference between strong and weak acids?
(ii) Give an example of:
1. strong acid
2. weak acid

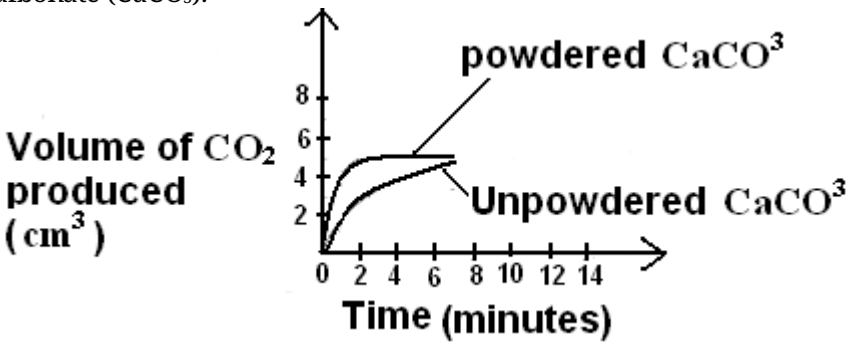
b. (i) State the products formed when acids react with metals.
(ii) Write a chemical equation to represent the reaction between hydrochloric acid (HCl) and zinc metal (Zn)

c. **Figure 5** is a diagram of the apparatus used in the purification of copper metal where one electrode is pure copper and the other impure copper.



(i) Which of the electrodes is impure copper?
(ii) Give a reason for your answer to 5c (i)
(iii) What happens to the electrodes if the experiment is left for a few hours?
(iv) What evidence will be there to show that the purification process was taking place?
(v) Why does the colour of copper sulphate solution remain the same as the purification process takes place?

d. **Figure 6** is a graph of the reaction between dilute hydrochloric acid (HCl) and calcium carbonate ($CaCO_3$).



(i) What factor affecting the rate of reaction was being investigated?
(ii) State any two factors that should be kept constant when investigating the factor you have mentioned in 5d(i).
(iii) Calculate the rate of reaction for powdered $CaCO_3$ in the first minute of the reaction.

6. a. State 'Hook's law'.

b. A spring with its upper end fixed hangs vertically alongside a meter rule. The lower end of the spring gave the following readings when various masses were hung on it.

Mass (g)	0	20	40	60	80	100
Length of spring (cm)	110	121	129	139	151	161
Extension (cm)	0	11		29		51

(i) Complete the table by filling in the extensions for the 40 g and 80 g masses.
(ii) Plot a graph of extension (cm) against force (N)
(iii) From the graph, find the extension when the force is 0.5 N.
(iv) What is the value of the force constant of the spring?

c. (i) The force constants for springs A, B, C and D are 2.5N/cm, 0.5 N/cm, 0.25 N/cm and 5.5N/cm respectively. Arrange them in order of increasing stiffness.

(ii) Which spring in 6c (i) would stretch by 2 cm if a force of 1 N were applied

7. a. A certain hydrocarbon has a carbon to hydrogen ratio of 4:9 and a relative molecular mass of 114. (RAM: C=12, H=1). Work out the molecular formula of the compound.

b. A student was given samples of C_5H_{12}, C_9H_{20}, C_5H_9COOH and CH_3CH_2OH in unlabelled bottles. Using a flow diagram, describe an investigation he would carry out in order to identify the samples.

8. a. (i) Give one example of each of the following:

1. transverse wave
2. longitudinal wave

(ii) A wave travels a distance of 30 cm in 2 seconds and the distance between two successive troughs is 3.0 m.

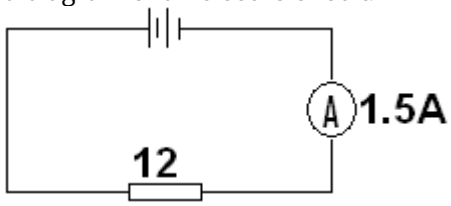
Calculate:

1. Velocity
2. Frequency of the wave

b. A pupil wanted to find out if the mass affects the frequency of vibration of a cantilever. Describe an experiment that the pupil would carry out.

2003

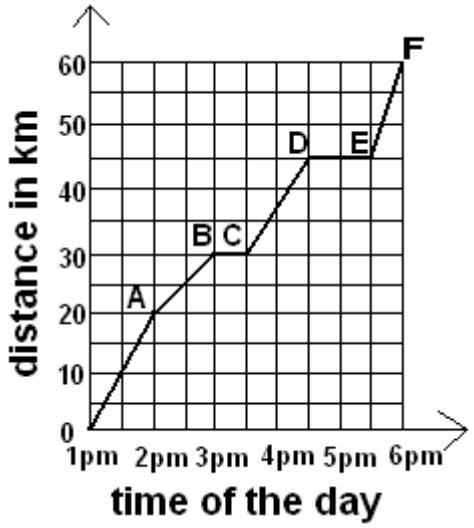
1. a. **Figure 1** is a diagram of an electric circuit.



(i) What kind of energy is produced in the 12Ω resistor as electric current flows through it?

(ii) Calculate the amount of energy produced in the resistor if electric current flows through it for 10 minutes.

b. Figure 2 is a distance-time graph for a cyclist. Use it to answer the questions that follow.



(i) What is total distance traveled by the cyclist?
(ii) How long did it take the cyclist to cover the distance?
(iii) Describe the motion of the cyclist from 2:00pm to 4:30pm.
(iv) Calculate the average speed of the cyclist during the first 2 hours of the journey.
(v) State whether 'distance' is a vector or scalar quantity. Give a reason for your answer.

c. (i) What is the difference between a transverse wave and a longitudinal wave?
(ii) Give any two characteristics of a wave.

2. a. What are isotopes?

b. Chlorine has two isotopes, $^{35}_{17}Cl$ and $^{37}_{17}Cl$

(i) Give the number of neutrons in the nucleus of $^{37}_{17}Cl$.

(ii) Given that the two isotopes are present in ordinary chlorine in the ratio of three atoms of Cl-35 to one atom of Cl-37, calculate the average atomic mass of chlorine.

c. How would the chemical properties of the two isotopes compare?

d. (i) What is 'radioactivity'?

(ii) When the nucleus of radium emits an alpha particle it decays to radon according to the equation:

$$^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$$

1. Besides radon, what other particle is produced when radium decays?
2. How does the mass of the decaying atom compare with the masses of the products?
3. Name the alpha particle in this equation?

e. Explain how gamma rays are emitted.

f. Give one use of gamma rays.

g. Give one way of detecting radioactive particles.

3. a. (i) What is a 'mole'?

(ii) A solution was made by dissolving 8g of sodium hydroxide in $100cm^3$ of water. Calculate the molarity of the solution. (RAM: C=12, O=16, H=1)

b. Copper (Cu) reacts with silver ions (Ag^+) according to the following chemical equation:

$$Cu^0_{(s)} + 2Ag^+_{(aq)} \rightarrow 2Ag^0_{(s)} + Cu^{2+}_{(aq)}$$

(i) What is the meaning of the zero sign (0) in Cu^0 (s)?

(ii) Pick out the oxidizing agent and the reducing agent from the equation.
Oxidizing agent:_____
Reducing agent: _____

(iii) Write the two half equations for the reaction.

c. Table 1 shows the first 20 elements of the periodic table.

(i) Write down the atomic number of Si.

(ii) Work out the electron configuration of K given that its atomic number is 19.

(iii) Draw an electron dot and cross diagram of CO_2

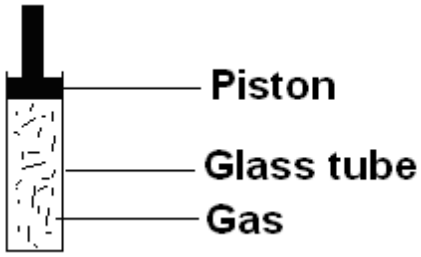
(iv) How can aluminium (Al) attain an inert gas configuration?

(v) Explain why the melting point of group (vii) elements increase with ncreasing atomic number.

4. a. (i) Explain the term 'absolute temperature'.

(ii) Convert 25 degrees Celsius to Kelvin

b. **Figure 3** shows a gas in a glass tube fitted with a piston.



(i) What will happen to the volume and pressure of the gas when the piston is pressed down the glass tube?

Volume _____

Pressure_____

(ii) Explain your answer to 4b(i)

(iii) A container with a cross sectional area of 3 cm^2 is filled with 9cm^3 of water. Calculate the pressure at the bottom of the container. (Density of water is 1g/cm^3).

(iv) Give any two uses of liquid pressure in everyday life.

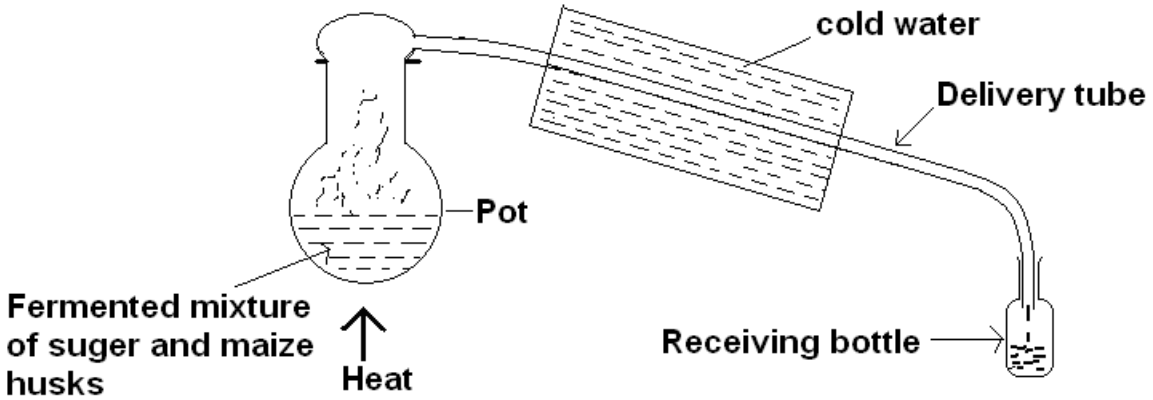
c. In terms of kinetic theory of matter, explain why increase in temperature causes candle wax to melt.

5. a. (i) Name the compound $C_7H_{15}OH$.

(ii) What is the general formula of the compound in 5a(i).

(iii) Draw the structure of the compound $C_7H_{15}OH$.

b. **Figure 4** shows one indigenous way of preparing alcohol



i. Name the process illustrated in Figure 4.

ii. Name the alcohol received in the collecting bottle.

iii. The alcohol collected in figure 4 is produced by fermentation.

1. Define 'fermentation'.
2. Write a word equation for the fermentation of sugar.

c. Ethanoic acid (CH_3COOH) reacts with ethanol (C_2H_5OH) according to the equation:

$$CH_3COOH_{(l)} + C_2H_5OH_{(l)} \xrightarrow[\text{Heat}]{\text{Conc. } H_2SO_{4(aq)}} CH_3COOC_2H_{5(l)} + H_2O_{(l)}$$

(i) What is the name of this reaction.

(ii) Name the two products of this reaction.
(iii) Give one use of $CH_3COOC_2H_2$.

d. Draw and name the isomers of pentane (C_5H_{12})

6. a. Why are metals good conductors of heat?

b. Table 2 shows the atomic numbers, melting points, boiling points and atomic radii of some halogens. Use it to answer the questions that follow.

TABLE 2

Name of element	Atomic number	Melting point (^oC)	Boiling point (^oC)	Atomic radius (nm)
Fluorine	9	-220	-188	0.071
Chlorine	17	-101	-34	0.099
Bromine	35	-7	59	0.114
Iodine	53	114	184	0.133

(i) Which element is a liquid at 25^{o}C?
(ii) Why does iodine have the biggest radius?
(iii) Work out the effective nuclear charge for fluorine.
(iv) Mention any two chemical properties of halogens.

c. (i) Give one natural source of sulphur.
(ii) State any two uses of sulphur in everyday life.

d. (i) What is meant by 'emperical formula of a compound'?
(ii) Work out the empirical formula of a compound that has the following percentage composition by mass of elements:
C=40%, H=6.67%, and O=53.33%. (RAM: C=12, H=1, O=16)

e. State two differences between ionic compounds and covalent compounds.

7. a. Briefly explain how a piece of iron can be magnetized by stroking.

b. (i) Describe how a step up transformer works.
(ii) Explain two ways in which energy losses in a transformer are minimized.

8. a. What is the difference between an exothermic reaction and an endothermic reaction?

b. Given that the reaction between methane (CH_4) and oxygen (O_2) to produce carbon dioxide (CO_2) and water (H_2O) is exothermic and the dissolving of ammonium nitrate (NH_4NO_3) is endothermic, draw energy level diagrams to illustrate the difference mentioned in 8a.

c. Describe how 250 cm^3 of a 1 M copper sulphate solution could be prepared using hydrated copper sulphate crystals ($CuSO_4.5H_2O$). (molar mass of $CuSO_4.5H_2O$ is 250g)

2004

1. a. Table 1 shows particles found in the atoms of four elements.

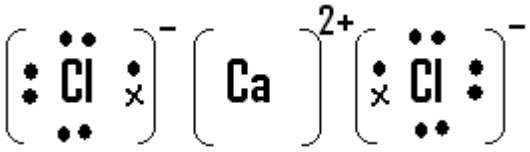
TABLE 1

ELEMENT	PROTONS	NEUTRONS	ELECTRONS	MASS NUMBER
Hydrogen (H)	1			1
Carbon (C)			6	12
Nitrogen (N)				

	7	7		
Sodium (Na)		12	11	

(i) Complete the table by filling in the missing numbers.
(ii) Which element in the table will easily form an ionic compound?
(iii) Give a reason for the answer to 1a (ii).
(iv) Work out the molecular mass of methane (CH_4).
(v) What kind of chemical bonds are involved in methane?
(vi) Explain the answer to 1a (v).

b. The dot and cross diagram of calcium chloride is shown below.



(i) Write the chemical formula of calcium chloride.
(ii) Explain the meaning of the sign **2+** on the Ca atom.

c. Table 2 shows elements represented by letters **Q, R, L, M, X, W, Y** and **Z** in the same period of the periodic table.

TABLE 2

GROUP	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
ELEMENTS	**Q**	**R**	**L**	**M**	**X**	**W**	**Y**	**Z**

(i) Write the formula of a charged atom of R.
(ii) Give the letter of the element in the table which belongs to the halogen family.
(iii) Give the letter of an element in the table that would not react with another element.
(iv) Give a reason for the answer to 1c (iii).

2. a. Table 3 shows results in an experiment to verify gas law.

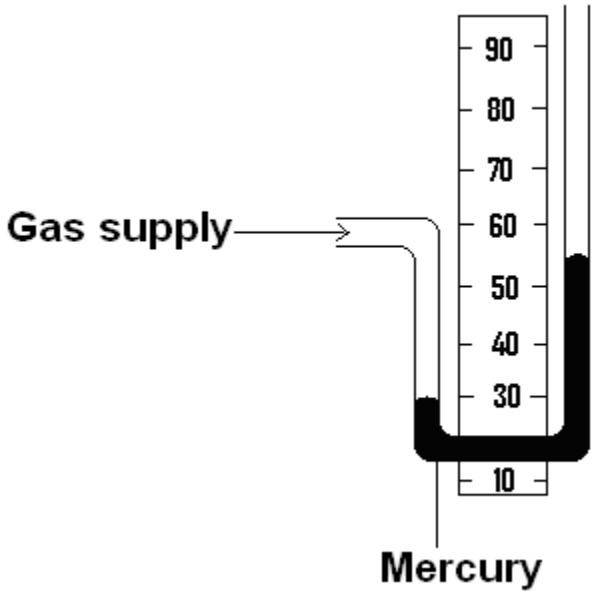
TABLE 3

VOLUME (cm^3)	**10**	**12**	**14**	**16**	**18**
PRESSURE (kpa)	**200**	**169**	**144**	**127**	**114**

(i) Plot a suitable graph to show the relationship between pressure and Volume.
(ii) What relationship is being demonstrated by this graph?
(iii) Which variables would be kept constant in this investigation?

b. (i) A pressure of 50 000 Pa is exerted by a column of water at the base of a container. Calculate the height of the water column. (Density of water= 1000 kg/m^3; g = 10ms^{-2}).
(ii) Explain why the base of a dam is thicker at the bottom than the top.
(iii) Two identical gas jars were filled with liquid mercury (density 13.6 g/cm^3) and the water respectively.
Explain the difference in pressure exerted at the base of the jars by the two substances.

c. **Figure 1** is a diagram of an instrument used to measure gas pressure.

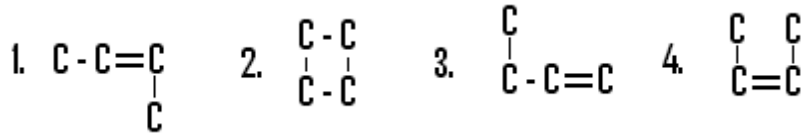


(i) Name the instrument
(ii) Read the pressure difference in mm Hg.
(iii) What is the pressure of the gas supply if the atmospheric pressure is 755mm Hg and the pressure difference is 30 mm Hg?

3. a. State one use of each of the following polymers.
(i) plastic
(ii) carbohydrate

b. State any two ways of disposing of plastics to avoid polluting the environment.

c. The following are structural formulae of four molecules with the molecular C_4H_8.



(i) Name the molecules 1 and 2.
(ii) Which two structures are conformations of each other?

d. Table 4 shows molecular formulae and boiling points of some compounds.

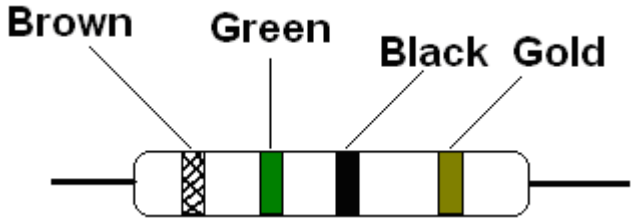
TABLE 4

COMPOUND	MOLECULAR FORMULA	BOILING POINT (^oC)
A	C_2H_4	-104
B	C_2H_5OH	79
C	CH_3COOH	118
D	H_2O	100
E	C_2H_6	-89

(i) Which compounds in the table are hydrocarbons?
(ii) Which compounds in the table are soluble in water?
(iii) Which compounds in the table are gases at room temperature?
(iv) Explain why the boiling point of compound D is higher than the boiling point of compound E.
(v) Describe a test which can be done to distinguish the compounds C and D.

4. a. Explain why a voltmeter is connected in parallel while an ammeter is Connected in series.

b. **Figure 2** is a diagram of a resistor.



What is the resistance of the resistor?

c. (i) Explain the difference between an electric motor and an electric generator.

(ii) State any two factors which affect the amount of voltage produced by a generator.

d. (i) What is a 'semiconductor'?

(ii) Draw a circuit diagram in which a bulb , cell and a diode are connected in series such that the diode is forward biased.

(iii) What is meant by the term 'doping' in relation to a semiconductor?

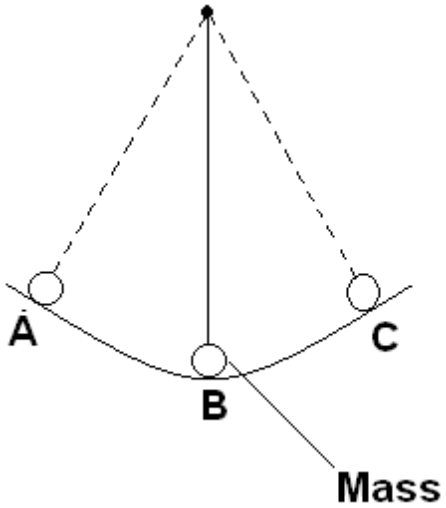
(iv) State two functions of transistors.

e. (i) Are headlamps of a motor car connected in series or in parallel?

(ii) Give a reason for your answer to 4e(i)

5. a. Define the term 'oscillation' in relation to a swinging pendulum.

b. **Figure 3** is a diagram of a simple pendulum. The mass vibrates between points A and C through B.



(i) What happens to the speed of the mass as it moves from positions:

1. A to B?
2. B to C?

(ii) What is the speed of the mass at C?

(iii) What happens to the frequency and amplitude of oscillation of a pendulum as time increases?

(iv) State the energy changes of the mass as it changes from A to C.

(v) What happens to the frequency of vibration of a pendulum when the length of the string is changed?

c. An object 2 cm high is placed 7.5 cm in front of a converging lens of focal length 5 cm.

(i) Calculate the image distance.

(ii) Describe the nature of the image formed.

(iii) Calculate the magnification of the image.

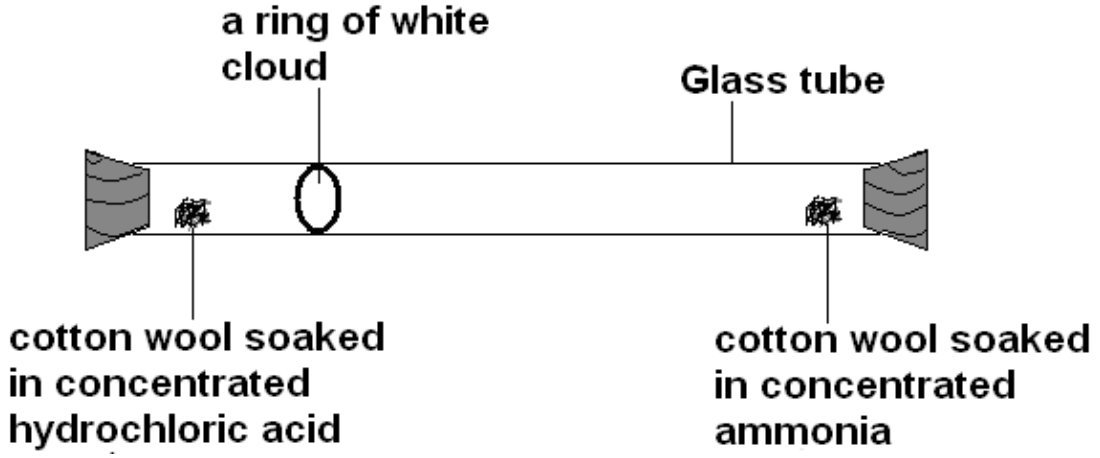
6. a. State any two safety precautions to be taken when handling radioactive substances.
b. (i) Describe the 'alpha particles' and 'beta particles'.
(ii) Explain why gamma radiation is used in sterilization of medical equipment.
c. (i) The Radon-222 (Rn) isotope is formed from the alpha decay of radium-226 (Ra). Write a nuclear equation to show this change. (Atomic number of Ra is 88).
(ii) **Figure 4** is a diagram showing radiation passing through an electric field. Draw and label in the diagram the paths taken by the alpha-particles and the beta particles.

(iii) Explain why the behavior of particles is as shown in 6c(ii)
7. a. Describe how the concentration of 20 cm^3 of sodium chloride can be eternined by evaporation method.
b. Suggest two sources of error in this method.
c. 100cm^3 solution of concentration 20 g/l is diluted by raising the volume to 250cm^3 with distilled water. Work out the concentration of the new solution.
8. a. Describe an experiment that could be done to determine the average speed of an athlete.
b. State two sources of error in 8a.

2005

1. a. (i) Define the term 'diffusion'.
(ii) In which state of matter does diffusion occur more quickly?
(iii) Give a reason for your answer to a(ii)

b. **Figure 1** is a diagram of a sealed glass tube containing two balls of cotton wool, one soaked in concentrated hydrochloric acid solution and the other in concentrated ammonia solution. Gases from the solution diffuse along the tube and a white cloud forms where they meet.

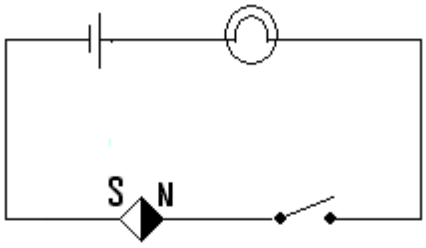


(i) Which of the two gases is lighter?
(ii) Give a reason for your answer to b(i)
(iii) When the experiment is done on a sunny day, it takes a shorter time for the white cloud to form. Give a reason.

c. The volume of air in a container is 6 m^3 and has a pressure of 4 atmospheres (atm) when the temperature is 27°C.

Calculate its pressure when the volume is reduced to 3 m^3 and its temperature raised to 177°C.

d. **Figure 2** is a diagram of a compass needle placed under a connecting wire.



(i) Draw arrows on the diagram to show, when the switch is closed, the rection of movement of :
(1) the compass needle
(2) the current
(ii) What effect would the following changes have on the movement of the compass needle?
(1) reversing the cell
(2) increasing the number of cell

e. Mention two devices which use electromagnets.

2. **Table 1** shows the arrangement of some elements in the periodic table.

TABLE 1

H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca						

a. Draw the atomic structure of Cl.

b. A certain element could be represented as $^{28}_{14}X$;

(i) To which group of the periodic table does X belong? Give a reason.
(ii) Identify element X in the periodic table.

c. (i) Write the chemical formula of the compound formed between **Al** and **O**.
(ii) What type of bond exists between Al and O atoms in the compound formed in c (i) ? Give a reason.

d. Define the term 'allotropes'.
e. State two allotropes of sulphur.
f. Give the halogen used for:
   (i) sterilizing drinking water.
   (ii) Photography

TABLE 2

ELEMENT	ATOMIC NUMBER	MELTING POINTS (^{o}C)	BOILING POINTS (^{o}C)
Chlorine	**17**	**-101**	**-35**
Bromine	**35**	**-7**	**59**
Iodine	**53**	**114**	**184**

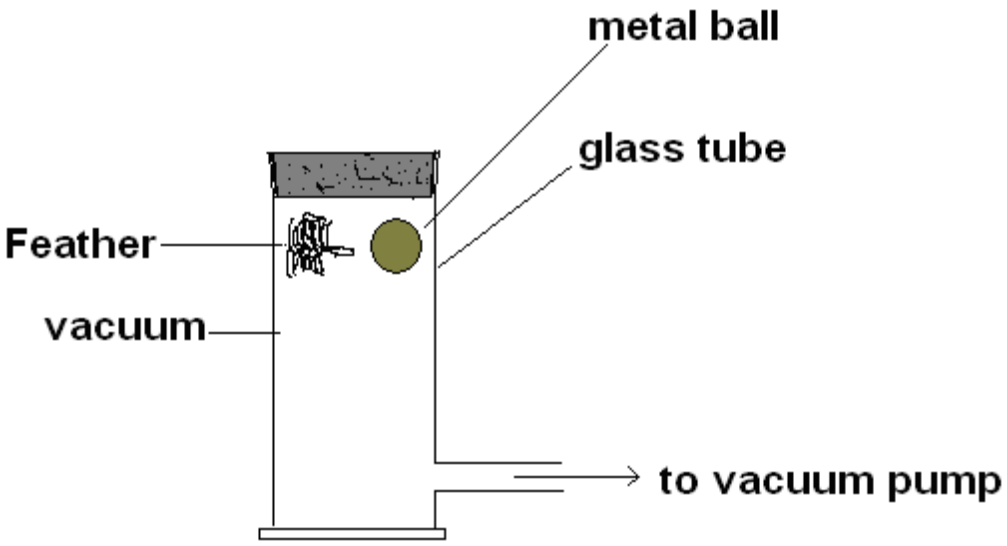
g. (i) Explain the increase of melting and boiling points from chlorine to Iodine
   (ii) What would happen if a solution of iodine is mixed with an aqueous solution of potassium Bromide? Give a reason.

3. a. Define 'acid' according to Bronsted-Lowry theory.

b. In a titration, 20 cm^3 of hydrogen chloride solution reacted completely with 25 cm^3 of 0.2 M sodium hydroxide solution mixed with phenolphthalein solution.
   (i) Explain the function of phenolphthalein in the titration.
   (ii) Which was the standard solution in the titration? Give a reason.
   (iii) Write a balanced equation for the reaction between sodium hydroxide and hydrochloric acid.
   (iv) Calculate the concentration of the acid.

4. a. Forces of 40 N and 50N are acting at right angles. Draw a scale diagram to find the resultant force. (Use a scale of 1 cm to represent 10N).

b. **Figure 3** is a diagram of a set up used up in an experiment that was carried out to investigate how a feather and a metal would fall in a vacuum.



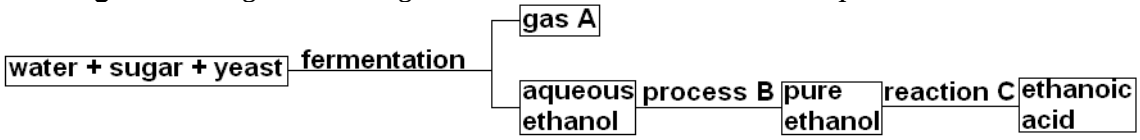
(i) Name the resultant force acting on the ball.
(ii) State the direction of the resultant force in b (i).
(iii) If the feather and the metal ball were allowed to fall at the same time, draw in the diagram to show the positions of both the feather and the metal ball before they reach the bottom of the tube.
(iv) Explain your answer to b(iii) above.

c. (i) The half life of a radioactive substance is 3 hours. What mass of the substance would remain after 12 hours if the initial mass was 20g?
(ii) Why is it important to use radioisotopes with a short half life as tracers in agriculture?
(iii) Explain why fission is a useful process in industry.

d. **Figure 4** is a diagram showing nuclei of two atoms.

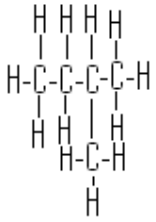
(i) Explain why these atoms react in the same way.
(ii) What are atoms of this type called?
(iii) To which period of the periodic table could each belong?
(iv) Explain the answer to d(iii).

5. a. **Figure 5** is diagram showing how ethanol and ethanoic acid are produced.

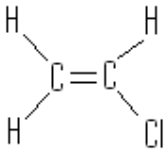


(i) Give the names of
(1) gas A
(2) process B
(3) reaction C
(ii) Name the substance that is used in reaction C.
(iii) What is the function of the substance in a(ii)?

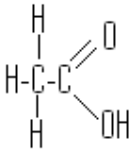
b. The following are structures of some organic compounds.



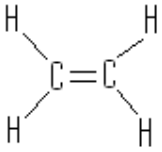
A



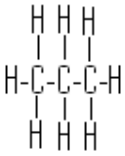
B



C



D

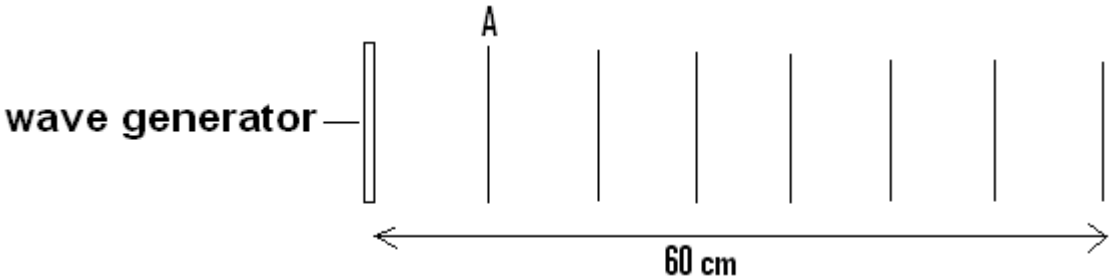


E

(i) Name compound A.
(ii) Which compound is soluble in water? Give a reason.
(iii) Write letters representing any **three** compounds that would not react with potassium, a group 1 metal element.
(iv) Which one of the compounds, A and E would have a lower boiling point? Give a reason.
(v) Compound B is a monomer. Write an equation to show its polymerization.
(vi) Give the name of the kind of polymerization in b(v)
(vii) Give one use of the substance formed in the polymerization of compound B.
(viii) What is the state of D at room temperature?
(ix) Describe a test that could be done to distinguish the compounds D and E.
(x) Write the other isomers of substance A.

c. Give two advantages of thermoplastics.

6. **Figure 6** is a diagram showing crests of straight ripples on water surface produced in a ripple tank by a wave generator.



a. What kind of waves are represented by the crests?
b. What is the wavelength of the ripples if there are 5 complete waves in a distance of 60 cm?
c. What is the frequency of the ripples if four crests pass through point A in one second?
d. Calculate the speed of the waves.
e. What would happen to the wavelength if the waves moved from deep water to shallow water?
f. Explain answer to (e).
g. Describe 'constructive interference' in water waves.
h. What is the difference between 'longitudinal' and 'transverse' waves?
i. What type of waves are radio waves?

7. a. Draw a labelled diagram of the apparatus that would be used to electroplate an iron nail with copper using copper chloride as an electrolyte.

b. Explain what happens during the process of electroplating of the Nail in (a). Support the explanation with relevant chemical equations.

8. a. 6 KW of power is fed to a transmission cable of resistance 3 ohm. Calculate the power wasted in the cable if power is transmitted at 300V.
b. Describe an experiment that could be done to find out if electrical resistance of a wire varies directly proportional to its length.

2006

1. a. Given below are the general formulae of some homologous series represented by letters **P, Q, R** and **S**.

P : C_nH_{2n}
Q : C_nH_{2n+2}
R : $C_nH_{2n+1}OH$
S : $C_nH_{2n+1}COOH$

(i) Name the homologous series represented by letters Q and S.
(ii) Which general formulae represent hydrocarbons?
(iii) Draw the structure of a compound with three carbon atoms in homologous series P.
(iv) Name the compound drawn in 1. a. (iii).
(v) Explain how a compound of homologous series Q could be distinguished from a compound of homologous series R.

b. (i) Write down all structural isomers of pentane.
(ii) Name the isomers in 1.b.(i).

c. Ethene (C_2H_4) reacts with bromine (Br_2) in an addition reaction.
(i) Draw the structure of the product formed .
(ii) Name the product formed in 1.c.(i).
(iii) Why are addition reactions important in industries? Give two reasons.

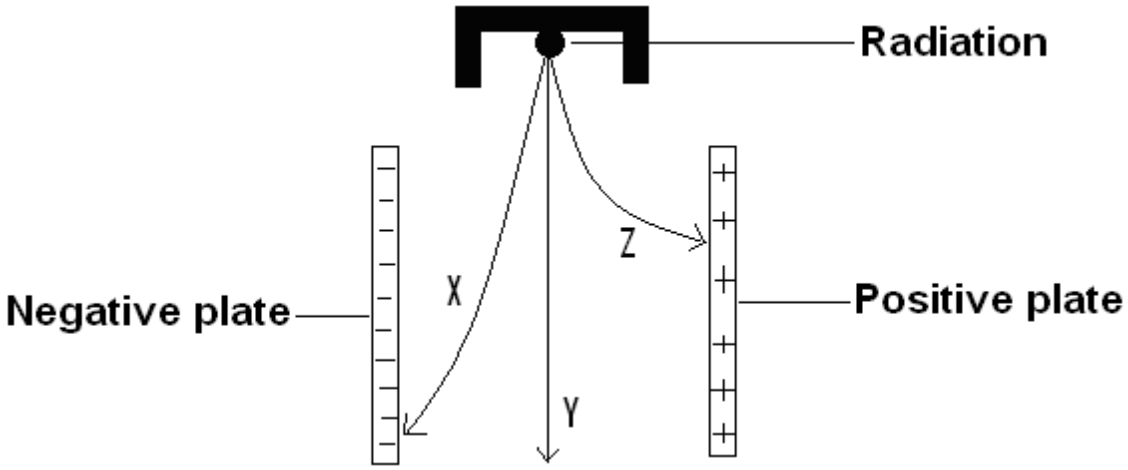
2. a. Halogens such as bromine (Br_2), chlorine (Cl_2), and iodine (I_2) can be prepared by reacting an alkali metal salt with concentrated sulphuric acid in the presence of a catalyst. Name any salt from which each of the following can be prepared.
(i) Br_2
(ii) Cl_2
(iii) I_2
b. State any two properties of halogens.
c. Draw an electron shell diagram for a fluorine atom ($^{19}_{9}F$).
d. Arrange the elements $^{127}_{53}I$, $^{35.5}_{17}Cl$, $^{80}_{35}Br$ in order of increasing reactivity.
e. Explain the difference in reactivity of the elements in 2.d.
f. State any chemical property of sulphur.
g. Explain, with the aid of diagrams, why rhombic sulphur is more stable than monoclinic sulphur.

3. a. Define 'nuclear fission'.
b. Name two particles found in the nucleus of an atom.
c. Two radioactive samples showed the following characteristics.

SAMPLE	EFFECT ON GOLG LEAF ELECTROSCOPE	EFFECT OF CARD BOARD ON SAMPLE
A	No effect	Sample passes through
B	Discharged	Sample blocked

(i) Identify particles emitted by samples A and B.
(ii) Why does the particle emitted by sample B get blocked by the card board?

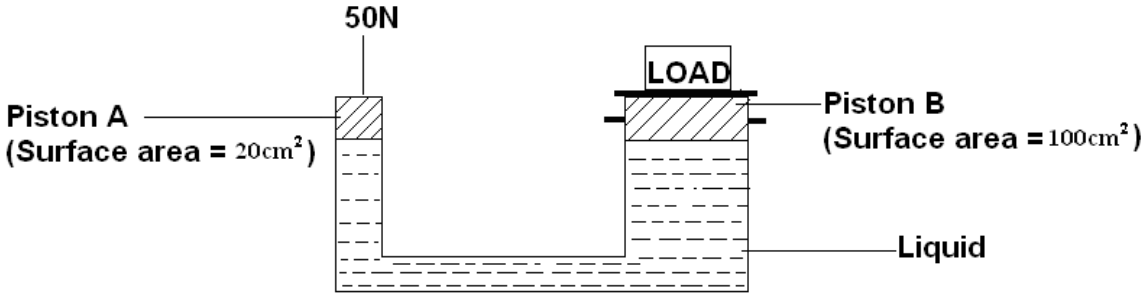
d. **Figure 1** is a diagram showing radiation passing through an electric field.



(i) Name the particles taking paths X, Y and Z.
(ii) Explain why particle Z will deflect towards the positive plate

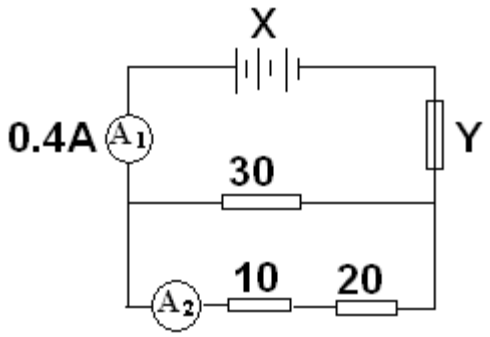
e. At atmospheric pressure a mercury barometer reads 0.76 m. If one atmosphere equals to 101 000 Pa, calculate the
density of mercury.

f. **Figure 2** is a diagram showing a hydraulic system being used to raise a load. A force of 50N is applied on piston A.



i. Calculate the pressure piston A exerts on the liquid.
ii. How much pressure does the liquid exert on piston B?

4. a. **Figure 3** is a circuit diagram.



(i) Name the components labelled X and Y.
(ii) Calculate the total resistance in the circuit.
(iii) Calculate the current in the 30Ω resistor.
(iv) Work out the voltage across the 10Ω resistor.

b. (i) Define 'kilowatt-hour'.
(ii) The power rating of a television is 150 W. How much power in kilowatt – hours will it use if it is on for 10 hours?
(iii) If the cost of power is k5.00 per kilowatt-hour, what will be the cost of running the television in 4.d.(ii) for 10 hours per day for 2 days?

5. a. (i) Name the ion responsible for the acidic properties of a substance.
(ii) Why is carbonic acid a weak acid while hydrochloric acid a strong acid?

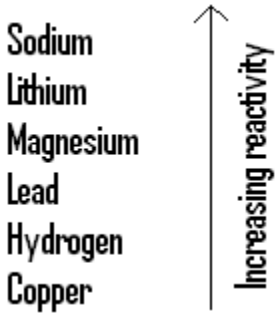
b. Calculate the volume of 0.1 M sodium hydroxide that is needed to neutralize 20 cm^3 of 0.1 M hydrochloric acid.

c. (i) What does the symbol $\rightleftharpoons$ mean in a chemical equation?
(ii) Complete the following chemical equations:

1. $HSO_4^-{}_{(aq)} + \_\_\_\_\_ \rightleftharpoons H_3O^+{}_{(aq)} + \_\_\_\_\_{}_{(aq)}$

2. $H_3PO_{4(aq)} + NH_{3(l)} \rightleftharpoons \_\_\_\_\_ + H_2PO_4^-{}_{(aq)}$

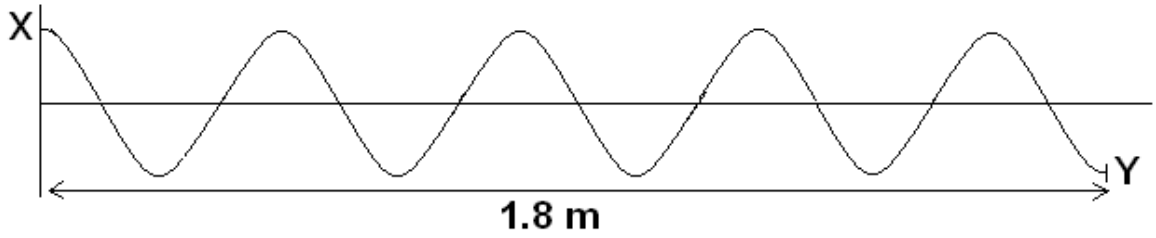
d. The following is part of an activity series.



(i) State whether copper (Cu) will react with a solution of Magnesium sulphate ($MgSO_4$).
(ii) Explain the answer to 5.d.(i)
(iii) Which element is the most electropositive in the activity series?
(iv) Give a reason for the answer to 5.d.(iii)

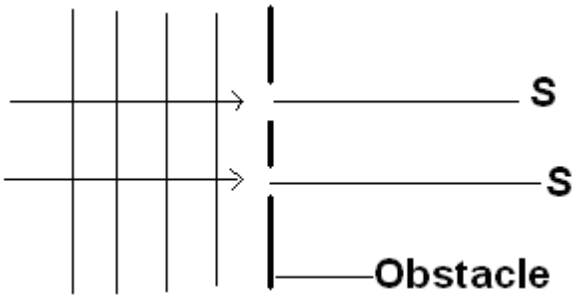
e. (i) Write half equations for the reaction between silver nitrate ($AgNO_3$) and Sodium (Na).
(ii) Name the reducing and oxidizing agents in 5. e. (i)

6. a. Define 'acceleration'.
b. The speed of a runner dropped from 80 m/s to 60 m/s in 4 seconds.
(i) Calculate the average deceleration of the runner.
(ii) If the runner maintained the deceleration in 6.b.(i), after how long did the speed reach zero?
c. **Figure 4** is a diagram showing waves on a rope xy



(i) Calculate the wavelength.
(ii) If the rope, xy is swung up and down 20 times in 2 seconds, calculate the average speed of the wave.

d. **Figure 5** is a diagram showing water waves approaching two slits S_1 and S_2 in an obstacle.



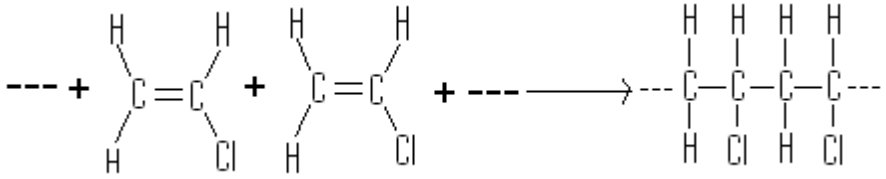
(i) Complete the diagram to show waves emerging on the other side of the obstacle.
(ii) State two properties of waves that are demonstrated in the completed diagram.
(iii) What would happen to the waves emerging on the other side of the obstacle if the width of S_1 and S_2 were increased?

7. a. Describe how the thickness of a sheet of plastic could be controlled using radiation during manufacture.
b. Explain, with the help of diagrams, the difference between constructive interference and destructive interference.

8. a. A metal ball is released on the surface of rublicating oil in a tall glass tube. Explain the change in velocity of the ball as it falls through the oil to the bottom of the tube.
b. Derive a formula to that the pressure of a liquid depends on its density and depth.

2007

1. a. Polymerization of ethene can be represented by the following equation:



(i) Name the polymerization represented by the equation.
(ii) Describe how the polymer is formed from ethene molecules.
(iii) Give two examples of artificial polymers.

b. The following are formulae of some organic compounds:

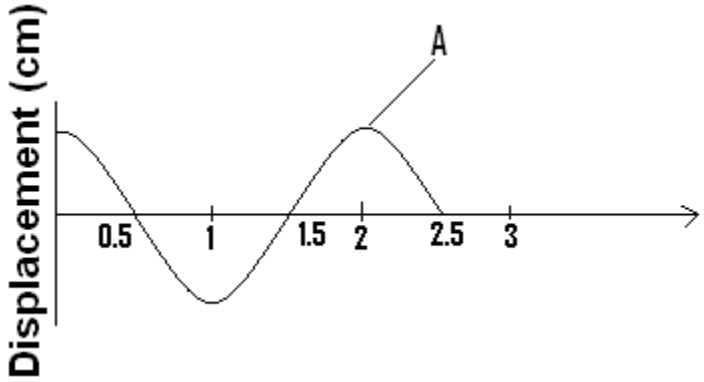
A. $CH_3CH_2CH_2CH_2OH$
B. $CH_3CH_2CH_3$
C. $CH_3CH_2CH_2COOH$
D. $CH_3CH_2CH=CH_2$
E. $CH_3CH_2CH_2CH_3$

(i) Identify one compound which is an alkanol.
(ii) Which compounds belong to the same homologous series?
(iii) Explain why a solution of compound C conducts electricity.
(iv) Draw a full structure of compound D.
(v) Name compound **D.**

c. (i) Name three differences between thermosetting and thermoplastic polymers.
(ii) State two ways of disposing off plastic waste to avoid pollution.
(iii) Give three advantages of plastic materials over metallic materials.

2. a. Give two factors that affect the frequency of a vibration spring.

b. **Figure 1** is a diagram of a wave.



(i) Name the part labelled A.
(ii) Calculate the frequency of the wave.
(iii) Calculate the velocity of the wave if its wavelength is 50 m.

c . (i) State any three similarities between a camera and a human eye.
(ii) What is the function of an aperture in a camera?

d. An object is placed 15 cm away from a convex lens of focal length 10 cm.

(i) Using the lens formula, calculate the image distance.
(ii) Calcualte the magnification of the image.
(iii) What is the nature of the image produced?

3. a. Ammonia is an example of a strong base.

(iv) What is a 'strong base'?
(v) Write a chemical equation to show the ionization of ammonia in water.
(vi) Identify one conjugate acid-base pair from the equation in 3.a.(ii)

b. (i) Draw an energy level diagram for the following chemical reaction:

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$.. $\Delta H = -57$ Kj/mol

(ii) Is the reaction in 3.b.(i) endothermic or exothermic?
(iii) Give a reason for your answer to 3.b.(ii).
(iv) What is the meaning of (aq) and (l) in the equation?

c. A 300mg tablet of a drug was completely dissolved in 10 ml of water. The molecular formula of the drug is

$C_9H_8O_4$.

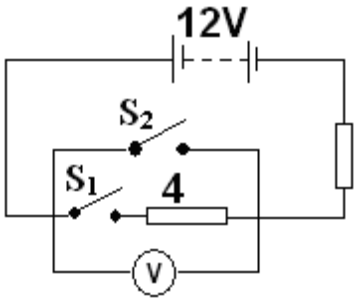
(i) Calculate the number of moles in the tablet. (RAM: C=12,H=1, O=16)
(ii) Calculate the concentration of the solution in moles per litre.

4. a. A current of 2A flows through an electric heater connected to a voltage supply of 240V. Calculate the

i. resistance of the element
ii. power dissipated by the heater.
iii. Cost of running the heater for 3 hours if the cost of electrical energy is k5 per kwh.

b. (i) Give one advantage of alternating current over direct current.
(ii) State any two causes of energy loss in a transformer.
(iii) How can each cause of energy loss mentioned in 4.b.(ii) be reduced?

c. **Figure 2** is a diagram of an electric circuit.



(i) If S_1 is closed and S_2 is open, calculate the reading of the ammeter and voltmeter.
(ii) What will be the effect on the voltmeter if both switches are closed?
(iii) Give a reason for the answer to 4.c.(ii).

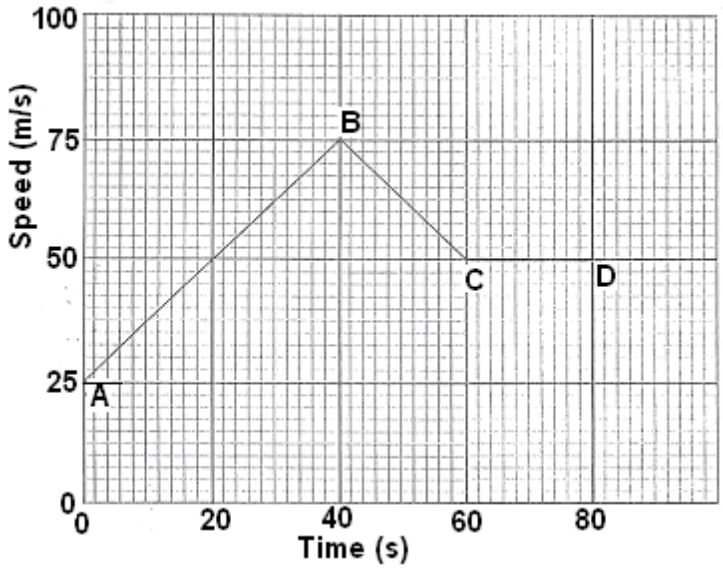
4. a. **Table 1** shows atomic numbers and electron configurations of some elements.

TABLE 1

Element	Atomic number	Electron configuration
A	18	2,8,8
B	10	2,8
C	20	2,8,8,2
D	12	2,8,2
E	2	2
F	9	2,7

(i) Identify an element that comes first in period 2.
(ii) Which two elements can form positive ions?
(iii) Give a reason for the answer to 5.a.(ii).
(iv) Give any three properties of element A.

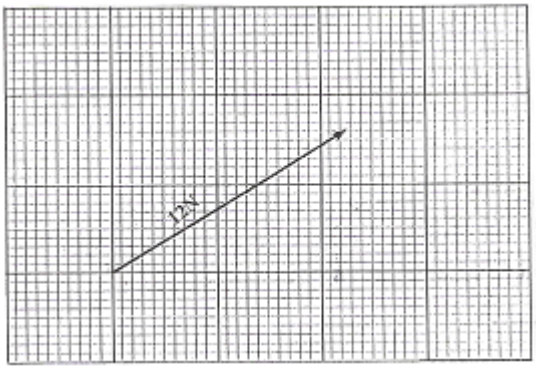
b. **Figure 3** shows a speed-time graph of a car in motion.



(i) Describe the motion of the car from point A to D.

(ii) Calculate the distance covered when the car moves from point A to B.

c. **Figure 4** shows a resultant of two forces.

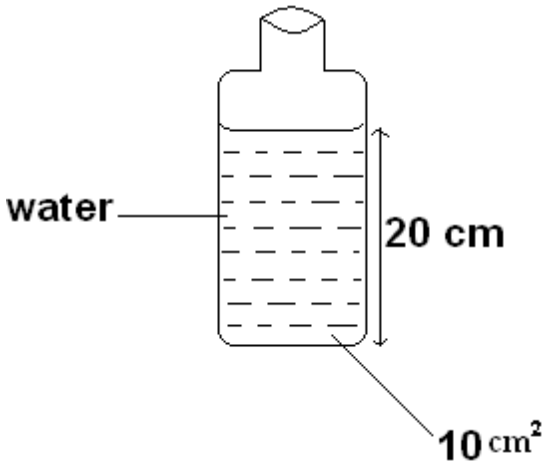


(i) Complete the diagram to show the vertical and horizontal components.

(ii) Calculate the magnitude of the horizontal component.

6. a. Give any two properties of liquid pressure.

b. **Figure 5** is a diagram of a bottle containing water.



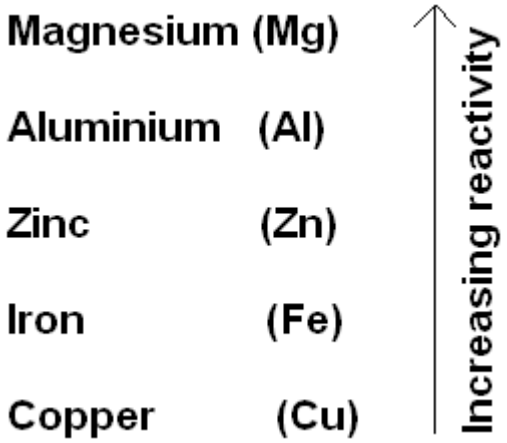
Calculate the pressure of water at the bottom of the bottle. (Density of Water = 1 g/cm^3)

c. Mention any two devices which make use of liquid pressure.

d. (i) Define the term 'absolute temperature'.

(ii) Convert 546 K to degrees Celsius.

e. The following is part of a reactivity series.



(i) Which two elements will displace Zinc from its oxide?

(ii) Give a reason for your answer to 6.e.(i).

f. The following are half equations for the reaction between magnesium and silver nitrate ($AgNO_3$):

$$2Ag^{+}_{(aq)} + 2e^{-} \rightarrow 2Ag^{o}_{(s)}$$

$$Mg^{o}_{(s)} \rightarrow Mg^{2+}_{(aq)} + 2e^{-}$$

(i) Write a full chemical equation for the reaction.

(ii) Name the reducing and oxidizing agents in 6.f.(i)

7. a. Draw full structures of ethanol (C_2H_5OH) and (H_2O).

b. Explain the difference in boiling points between ethanol and water.

c. With the help of a labelled diagram, describe an experiment that can be done to separate a mixture of water and ethanol.

8. Describe the following radioactive processes: alpha decay, beta decay and gamma emission. In the description

Include atomic numbers, penetrating power, ionizing ability and behaviour in magnetic and electric fields.

2008

1.a. Element X has a mass of 39 amu and atomic number 19

(i) How many protons are in the atom?
(ii) What would happen if element X was mixed with water?
(iii) Give a reason for the answer to 1.a. (ii).

b. Magnesium and chlorine can be represented as $^{24}_{12}Mg$ and $^{35..5}_{17}Cl$ respectively
(i) What are the valencies of magnesium and chlorine?
Magnesium_____
Chlorine _____
(ii) What is the molecular formula of the compound as a result of magnesium reacting with chlorine?

c. (i) Draw an electronic dot and cross diagram of carbon dioxide (CO_2) given that carbon is in group 4 and oxygen
in group 6 of the periodic table
(ii) What type of bonding exists in carbon dioxide?
(iii) Give a reason for the answer to 1.c. (ii).

d. Table 1 show the melting points of metals A, B, C and D.

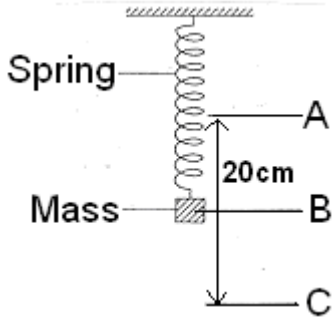
Metal	Melting point (°C)
A	240
B	3370
C	1539
D	120

(i) Which metal would be the most suitable for making a filament of a bulb?
(ii) Give a reason for the answer to 1.d.(i).

e. (i) Sulphuric acid (H_2SO_4) can be used as a dehydrating agent. Name the products in the dehydration of sucrose
($C_{12}H_{22}O_{11}$).
(ii) Give any four uses of Sulphuric acid.

2. a (i). Define focal length of a convex lens.
(ii) State any two ways of determining focal length of a convex lens.
(iii) An object 10 cm is placed 25 cm from the centre of a convex lens of focal length 10 cm. Draw a ray diagram to
show the position of the image formed. (scale: 1 cm to represent 5 cm).

b. **figure 1** is a diagram showing a mass hanging on a spring. If the mass is pulled to point A and released, it vibrates
between point A and C through the rest position, B.



(i) Calculate the initial amplitude of the vibration .
(ii) At which point does the vibrating mass have the highest kinetic energy?
(iii) Describe how potential energy and kinetic energy change as the mass is vibrating from A to C.
(iv) Give two reasons why a mass would eventually stop vibrating.

3. a. Define nuclear fussion
b. The equation below shows the fussion of a heavy hydrogen.
$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}He + {}^{1}_{0}n$
(i) Name the products.
(ii) Identify the type of radioactive decay.

c. Uranium $^{238}_{92}U$, decays in a series as follows:

Stage 1: $^{238}_{92}U \rightarrow {}^{234}_{90}Th$

State 2 : $^{234}_{90}Th \rightarrow {}^{234}_{91}Pa$

(i) Which particles are emitted at each stage?

State 1: _____

Stage 2:_____

(ii) Apart from the particles mentioned in 3.c. (i), what else is emitted at each stage?

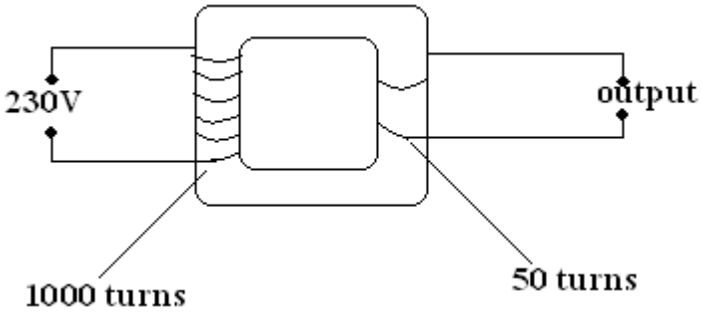
d. State any three safety precautions that must be followed when handling radioactive substances.

e. When a source of radiation is placed in front of a Geiger-Muller counter, the initial count rate is 128. After 16 minutes, the count rate is 8. Calculate the half life of the source .

f. 60 cm^3 of a solution whose concentration is 15g/cm^3 was diluted with distilled water by raising its volume to 80 cm^3. Calculate the concentration of the new solution.

g. Calculate the empirical formula of an organic compound containing 48.0g of carbon, 12.0g of hydrogen and 32.0g of oxygen. (RAM of C = 12, H = 1 and O = 16).

4. a. **Figure 2** is a diagram of a transformer.



(i) Name the type of the transformer shown in the diagram.

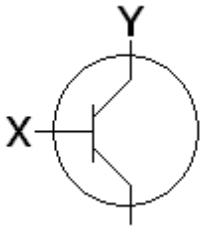
(ii) Give a reason for the answer to 4.a (i).

(iii) Calculate the output voltage of the transformer.

b. (i) What are semiconductors?

(ii) Explain how raising the temperature of semiconductors affects their electrical conductivity.

c. **Figure 3** is a diagram of a transistor.



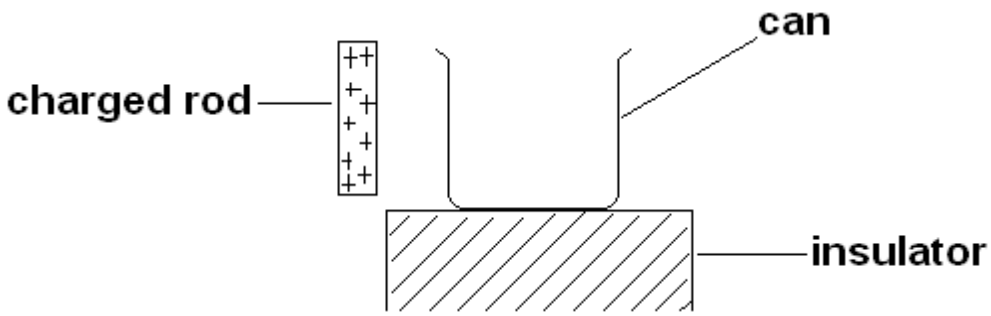
(i) Name the parts marked X and Y

(ii) Give any two uses of transistors.

d. (i) Why are diodes sometimes referred to as rectifiers?

(ii) Draw a circuit diagram consisting of a cell, a bulb and a diode such that the diode is forward biased.

e. **Figure 4** is a diagram showing a charged rod brought close to a metal can standing on an insulator.

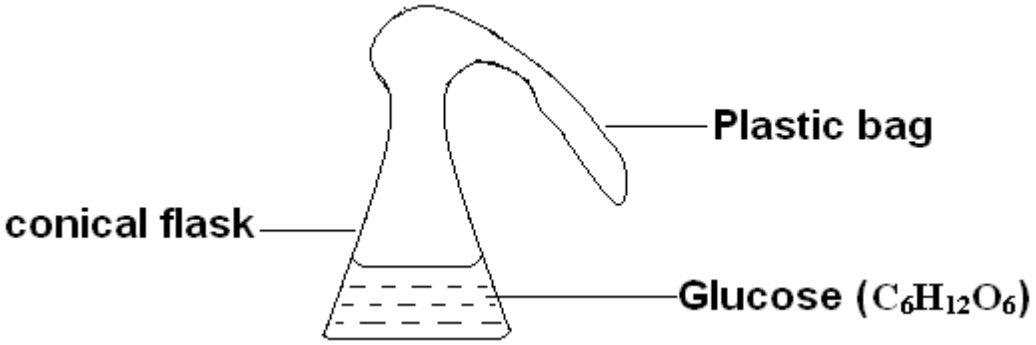


(i) Complete the diagram by indicating the induced charges on the can.
(ii) Why was the can placed on an insulator?

5.a. Define isomers.

b. (i) Draw structural formulas for the 2 isomers of butane (C_4H_{10})
(ii) Name the isomers drawn in 5 b (i).

c. **Figure 5** is a diagram of an experimental set up



(i) Name the process that would occur in the flask.
(ii) Write down a balanced equation of the process named in 5.c.(i).

d. State any two disadvantages of synthetic polymers

e. **Table 2** shows boiling points and solubility of some alkanols in water.

TABLE 2

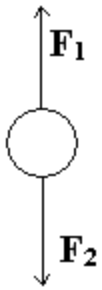
Name	Boiling point (^{0}C)	Solubility
Methanol	65	Most soluble
Ethanol	78	Soluble
Propanol	97	Partially soluble
Butanol	117	Insoluble

(i) Explain why the boiling points of alkanols increase from methanol to butanol.
(ii) Explain why ethanol is more soluble in water than propanol.

f. (i) Complete the following equation to show the reaction between methane and chlorine.
$CH_4 + Cl_2 \rightarrow$ _____ + _____
(ii) Name this type of reaction.
(iii) Give any one use of alkanes.

6. a. State any two factors that affect the terminal velocity of a free falling object in air.

b. **Figure 6** is a diagram showing an object falling at terminal velocity. F_1 and F_2 are forces acting on the object.



(i) Name the forces F_1 and F_2.
(ii) What would be the relationship between the magnitude of F_1 and F_2 at terminal velocity?

c. State newton's second law of motion.

d. An object of mass 200 kg accelerates uniformly from rest to a velocity of 20 m/s in 4 seconds. Calculate:

(i) acceleration of the object
(ii) force required to produce the acceleration in 6. d. (i).

7. a. Describe an experiment that can be done to distinguish octane from octesne.
b. What is the difference between oxidation and reduction in terms of electron transfer?
c. Explain how each of the following prevents rusting of iron.
(i) painting
(ii) galvanizing

8. a. Explain why candle wax melts when it is heated.
b. With the aid of a well labelled diagram, describe how a manometer works to measure gas pressure.

2009

1. a. Define "electron configuration".
b. **Figure 1** is a graph of atomic radius across the periods against atomic number for some elements in the periodic table.

(i) To which group of the periodic table does elements O belong?

(ii) Give a reason for the answer to 1.b.(i).
(iii) Why is there a sudden increase in atomic radius from F to Na?
(iv) In terms of atomic radius, explain the difference in reactivity between F and Cl.
(v) Give two differences between the type of bonding in lithium metal (Li) and chlorine gas (Cl_2).

c. (i) Mention any two uses of sulphur.
(ii) Give any two physical properties of sulphur.

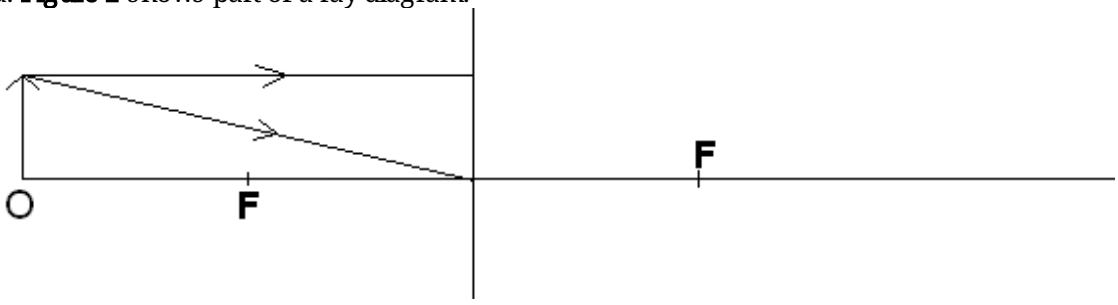
d. Table 1 shows the number of valence electrons and valencies of some elements.

Table 1

Element	Number of valence electrons	Valency
Li	1	1
Be	2	2
N	5	3
O	6	2

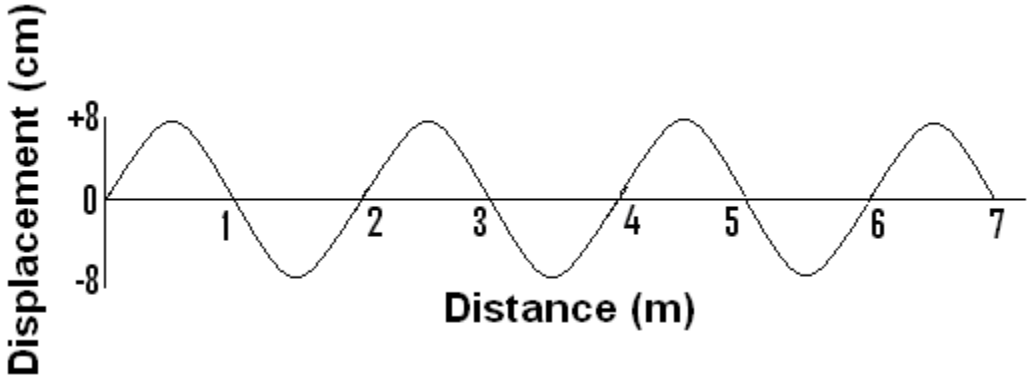
(i) How can element N attain a stable configuration?
(ii) Give a reason for the answer to 1.d.(i).
(iii) What is the formula of a compound that is formed between Li and O?
(iv) Give the charge on a Be ion.

2. a. **Figure 2** shows part of a ray diagram.



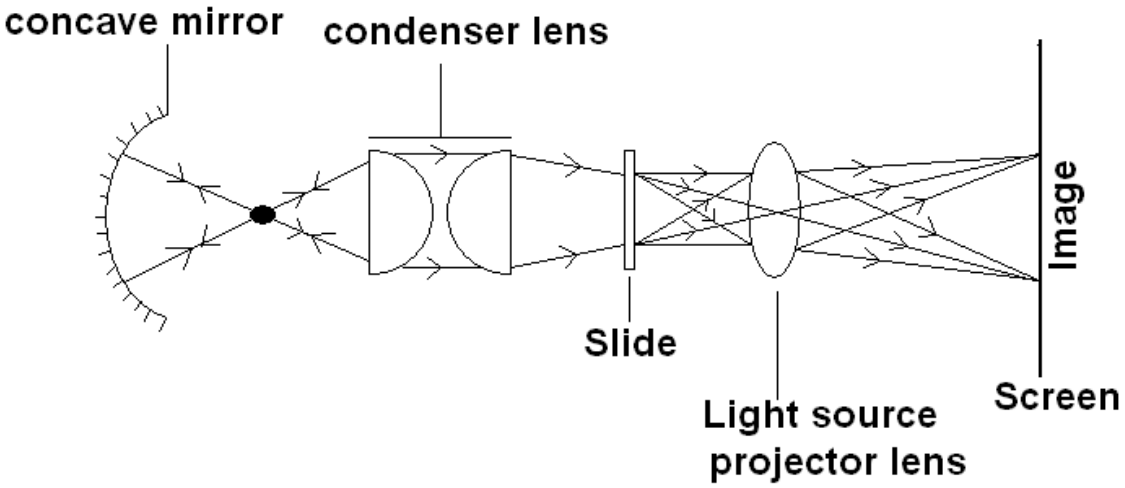
(i) Complete the ray diagram to show the position of the image.
(ii) Calculate the magnification of the image.

b. **Figure 3** is a diagram of a wave with a frequency of 2 Hz.



(i) Name the type of wave shown in Figure 3.
(ii) Give any two properties of the wave.
(iii) What is the wavelength of the wave?
(iv) Calculate the speed of the wave.

c. **Figure 4** is a diagram of a slide projector.



(i) state the function of each of the following:
- Concave mirror
- Condenser lens

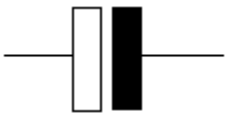
(ii) Describe the nature of the image formed on the screen.

3. a. Define "radioactivity".
b. Name three types of radiation.
c. Mention any two instruments that are used to detect radiation.
d. (i) How do chemical properties of the isotopes of uranium, $^{238}_{92}U$ and $^{234}_{92}U$ compare?
(ii) Give a reason for the answer to 3.d.(i).

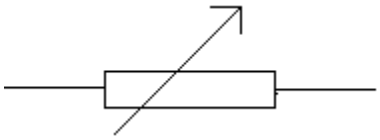
e. Mention any one natural source of radiation

f. A radioactive source has a half-life of 30 minutes. Calculate the fraction left after 2hours.

4. a. What do the following electrical symbols stand for?
(i)



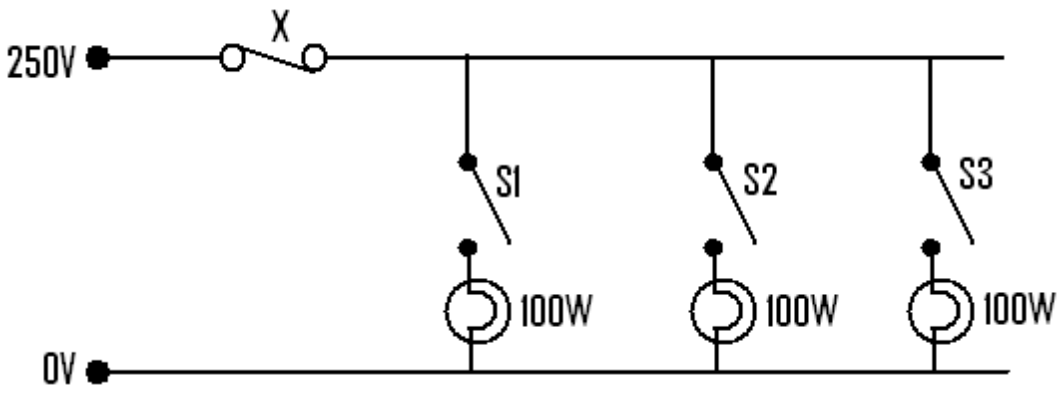
(ii)



b. In a circuit, a 60Ω resistor and a 3 Ωresistor are connected in parallel and an 8Ω resistor is connected in series with them.

(i) Draw a circuit diagram using the given information.
(ii) Calculate the total resistance in the circuit.

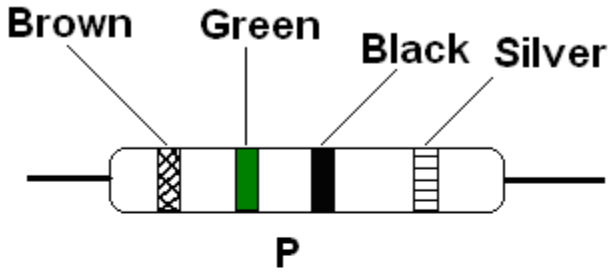
c. **Figure 5** is a diagram of an electric circuit for a house.



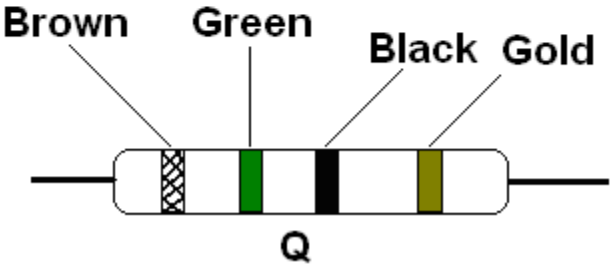
(i) What type of circuit is shown in the diagram?
(ii) Give two reasons why this type of circuit is preferred for wiring houses.
(iii) Explain the importance of including the device labeled X in the circuit in Figure 5.
(iv) Give any one appliance where device X is used.

d. **Figure 6** is a diagram showing colour codes and resistors marked P and Q.

Colour code	
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5



Tolerance:
Gold = 5 %
Silver = 10 %



(i) What is the resistance of resistor P?
(ii) What is the advantage of using resistor P in the circuit than resistor Q?

5. a. State any three uses of ethanoic acid.

b. Why is ethanoic acid regarded as a weak electrolyte?
c. Write down the ionization equation of ethanoic acid (CH_3COOH) in water (H_2O).
d. Why does sodium metal react with ethanol in the same way as it does with water?
e. Silver ions ($Ag^+_{(aq)}$) react with iron (Fe) according to the following equation:

$$2Ag^+_{(aq)} + Fe^o_{(s)} \rightarrow Fe^{2+}_{(aq)}\ 2Ag^o_{(s)}$$

(i) What is the meaning of (2+) on $Fe^{2+}_{(aq)}$?
(ii) What is the oxidation number of silver before reaction?
(iii) Which substance has been reduced?
(iv) Give a reason for your answer in 5.e.(iii).

f. (i) Write down the general formula for carboxylic acids.
(ii) What is the formula and name of the smallest carboxylic acid?
(iii) How would the boiling point of butane compare with that of a carboxylic acid of similar size?
(iv) Explain your answer to 5. f. (iii).

g. State any three ways of managing plasic wastes.

6. a. Define "resultant vector".
b. Why is "speed" a scalar quantity while "velocity" a vector quantity?
c. Two forces of magnitude 240N and 420N are being used to pull a boat at an angle of 60^0 to each other. Find the resultant force by using a scale diagram. (Use a scale of 1cm to represent 100N)
d. (i) Define "gas presure".
(ii) Give any three uses os gas pressure.
(iii) Why does gas pressure in a closed container increase when the temperature of the gas is increased?
e. Table 2 shows results of an experiment that was done to demonstarate a gas law.

TABLE 2

Pressure (Pa)	0.9	1.1	1.3	1.5
	0	50	100	150

(i) Plot a graph of pressure against temperature.
(ii) Use the graph to find pressure of the gas when temperature was 120^0C.

7. a. Explain any three characteristics of thermoplastics.
b. Explain any two advantages of recycling organic compounds.
c. Explain why thermosetting plastics can be heated and moulded only once.

8. a. What is an "electrolyte"?

b. With the aid of a well labeled diagram, describe an experiment that can be carried out to compare the electrical conductivity of potassium nitrate solution and potassium chloride solution.

S O L U T I O N S

1998

1. a. (i) 900^0C

(ii) 6 (the element is C)

(iii) - group 5 (Its atomic number is 15 and its electron configuration is: 2,8,5. the last number represent the group)

(iv) Mg (it is second from bottom and third from above and Be is also second from bottom and third from above)

(v) He, Ne and Ar

(vi) they have lowest intermolecular forces

(vii) Ca is expected to have a higher boiling point than K.(boiling points are increasing along the period)

(viii) - along the first period, the boiling points decreases.

- along the second and third periods, the boiling points increase up to group 4 elements and from group 4 to group 5 elements, they decrease tremendously. From group 5 to group 8, the boiling points are

low and
relatively the same.

b. (i) molecule consisting of the same kind of atoms.

(ii) electrolysis uses ions for conduction, and ions can only be free to move in molten or in aqueous form.

(iii) zinc, potassium, silver, copper, hydrogen and lead (their ions will be positive, hence they will be attracted to
the negative cathode).

(iv) - potassium
- because when an aqueous solution is used, hydrogen is produced at the cathode in preference to reactive
metals, in this case potassium.

(v) 1. oxygen
$\{2O^{2-}_{(aq)} \rightarrow O_2(g) + 4e^-\}$

2. bromine
$\{Br^-(aq) \rightarrow Br_2(g) + 2e^-\}$

3. chlorine
$\{2Cl^-_{(aq} \rightarrow Cl_2 + 2e^-\}$

2. a. (i) 7Ω

Calculation

For A and D: $1/R = 1/6 + 1/6 = (1+1)/6 = 2/6 = 1/3$ hence $R = 3\Omega$

For B and C: $R = 6 + 6 = 12\Omega$

For B, C and E: $1/R = 1/12 + 1/6 = (1+2)/12 = 3/12 = 1/4$ hence $R = 4\ \Omega$

$R_T = 3\Omega + 4\ \Omega = 7\Omega$

(ii) 1.7A

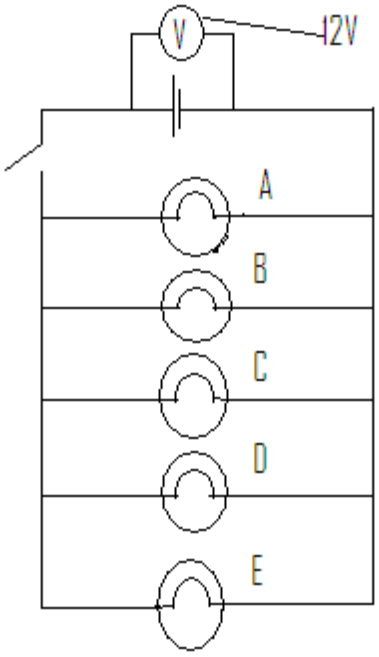
Calculation

$I_T = V_T/R_T = 12V / 7\Omega = 1.7A$

(iii) brightest : E
Most dim : B and C

(iv) the highest current passes through E (1.13A) and the lowest current passes through B (0.57A)

(v)



b.(i) **switch closed:** iron pins will be attracted to the solenoid
switch open : iron pins will fall back into the container

(ii) When the switch is closed, current will flow in the circuit and the bar will be Magnetized and the pins will be attracted to the magnet. When the switch is open, the current will stop flowing and the bar in the solenoid will be demagnetized making the iron pins fall back.

(iii) electric bell, relay, speaker, etc

(iv) **For electric bell:**
Magnetizes and demagnetizes an electromagnet which helps in the ringing of the bell. On the Contrary, there is no magnetization and demagnetization when a permanent magnet is used. / The strength of an electromagnet can be changed according to the preference of the user while the strength of a permanent magnet can not be changed.

For relay:
Magnetization helps in switching on the circuit and demagnetization helps in permanent magnet is used since there is no magnetization and demagnetization.

3. a. (i) - all metals
- they all need to lose two electrons for them to react, so they are group two metals.

(ii) $A^{2+}_{(aq)} \rightarrow A_{(s)} + 2e^-$
$B^{2+}_{(aq)} + 2e^- \rightarrow B_{(s)}$

(iii) C, B, D and A

(iv) $C_{(s)} + D^{2+}_{(aq)} \rightarrow$ no reaction (D is more reactive as such can not be displaced by a less reactive C)

(v) 2
- this is because the reaction involves the most reactive and the least reactive.

b. (i) 4.5g
Calculation
(7.15g – 2.65g = 4.5g)

(ii) n = 0.25mol

Calculation

$^{m}H2O = 4.5g$, $^{M}H_2O = 18g\ mol^{-1}$, $^{n}H2O = m / M = 4.5g/18g\ mol^{-1} = 0.25mol$

(iii) n = 0.025mol

Calculation

$^{m}Na_2CO_3 = 2.65g$, $^{M}Na_2CO_3 = 106g mol^{-1}$, $^{n}Na_2CO_3 = m/M = 2.65g/106g\ mol^{-1} = 0.025mol$

(iv) X = 10

Calculation

$^{n}Na_2CO_3 : {}^{n}H2O = 0.025mol : 0.25mol = 1: 10$. According to the equation $^{n}Na_2CO_3 = 1$, $^{n}H2O = X$, hence X = 10)

4. a. (i) A : film
B : aperture
C : diaphragm

(ii) A: acts as a screen where the image is formed
B: allows light from the object to enter the camera.
C: controls the amount of light entering the camera by making the aperture smaller or larger.

(iii) 162mm

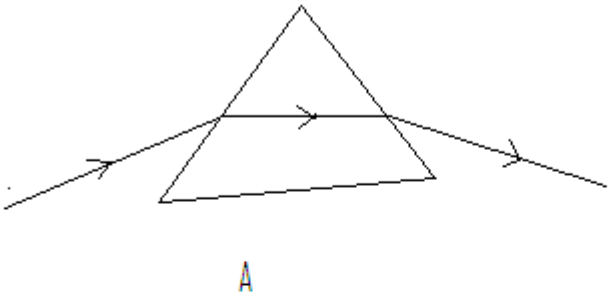
Calculation

$1/f = 1/u + 1/v$, this implies $1/v = 1/f - 1/u$, $v = fu / u-f = (0.15m \times 2m) / (2m - 0.15m) = 0.3m^2 / 1.85m$, $= 0.162m$ or 162mm)

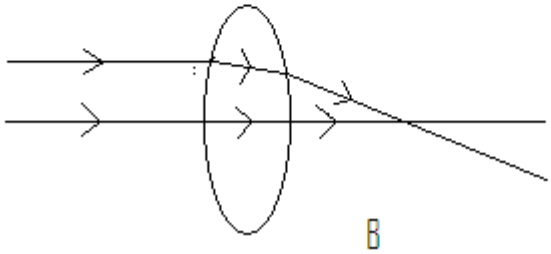
(iv) Lens must be moved a distance of 12 mm (162 – 150 mm) towards the film to get a sharp image. This is because the sharp image for a distant object is formed at the focal point

(v) - Both have light sensitive parts
- Both use converging lenses
- Both have black inside surfaces
- In both light is controlled

b.



A

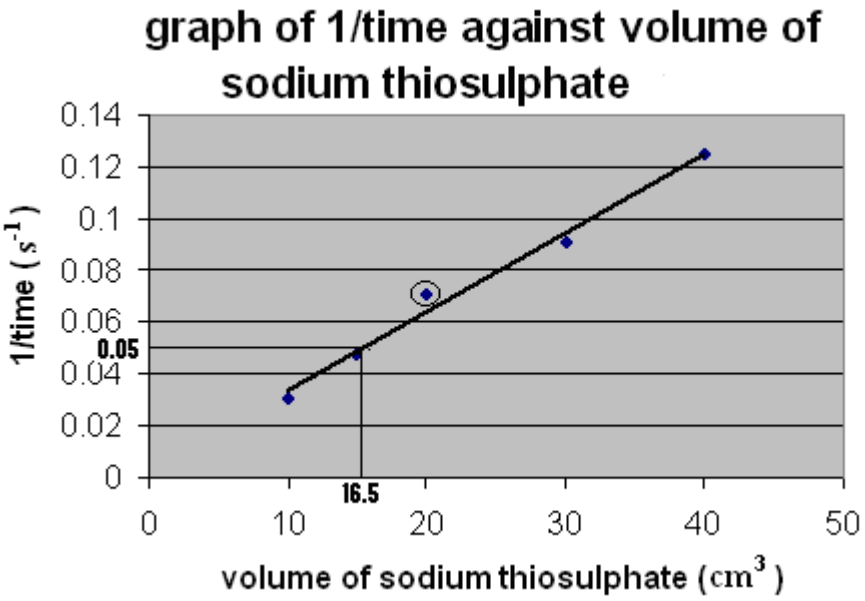


B

5. a 1. to vary the concentrations of sodium thiosulphate

2. to maintain the volume of sodium thiosulphate at 40 cm^3 to react with the same volume, 40 cm^3, of hydrochloric acid.

b.



c. it has deviated more from the line of best fit / normal

d. 16.5 cm^3 of sodium thiosulphate and 23.5 cm^3 of water. (16.5 cm^3 for $Na_2S_2O_3$ from the graph. Subtract from

40cm^3, volume for every mixture of $Na_2S_2O_3$ and H_2O, the volume of water, 23.5 cm^3 is found)

e. - the effect of concentration on reactivity
- the conclusion is that the higher the concentration, the faster the reaction.

f. i. $2Na^+_{(aq)} + S_2O_3^{2-}(aq) + 2H^+_{(aq)} + 2Cl^-_{(aq)} \rightarrow 2Na^+_{(aq)} + SO_{2(g)} + H_2O_{(l)} + S_{(s)} + 2Cl^-_{(aq)}$

ii. $S_2O_3^{2-}(aq) + 2H^+_{(aq)} \rightarrow SO_{2(g)} + H_2O_{(l)} + S_{(s)}$

6. a. (i) water displaced = 24cm^3. (volume of tube = area x height = 4cm^2 x 12cm = 48cm^3. half of the tube has volume of 24 cm^3 . therefore the volume of water displaced is equivalent to the volume occupied by the tube which is 24cm^3)

(ii) 24g

(iii) one to one ratio of mass (g) and volume of water (cm^3) (water has a density of 1g/cm^3)

(iv) 7.5 cm

(v) the average density of the test tube and its contents (sand and air) is less than the density of water.

b. Free fall is the motion of a body falling with the acceleration due to gravity (10m/s^2), in which air resistance is negligible.

c. (i) because they move with the same acceleration (acceleration due to gravity)

(ii) just after release, it accelerates and then decelerates before moving with constant speed. It hits the ground with that constant speed (constant velocity)

(iii) 50N

Calculation

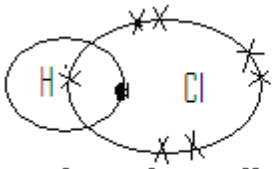
F = ma = 5kg x 10m/s^2 = 50kgm/s^2 =50N

(iv) there would be no effect. (force will depend on mass and acceleration not distance)

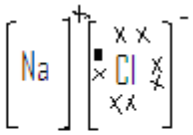
7. a. hydronium ion (H_3O^+) is an ion formed when a water molecule combines with a hydrogen ion i.e. $H_2O + H^+ \rightarrow H_3O^+$, while a hydroxyl ion (OH^-) is an ion formed when a water molecule loses a hydrogen ion i.e. $H_2O - H^+ \rightarrow OH^-$.

b. covalent bonding occurs when elements share electrons while ionic bonding occurs when elements ionize and then combine electrostatically.

e.g



covalent bonding

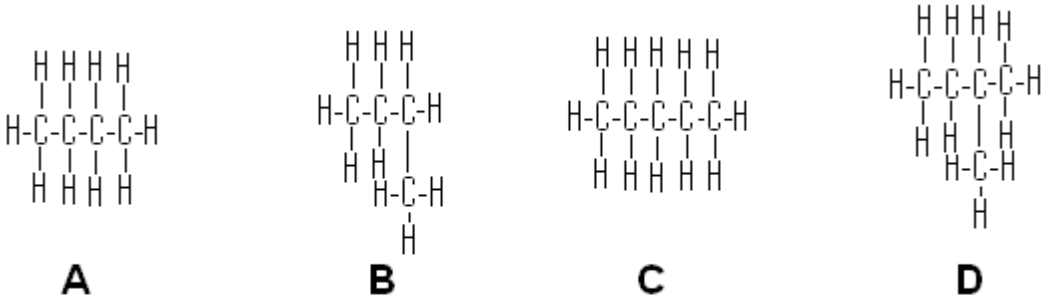


ionic bonding

c. Isomering is the existence of compounds having different structures but the same molecular formula, while

conformations are arrangements of molecules in space that result from rotations of atoms about single bonds.

e.g.



A B C D

A and B are conformations, C and D are isomers

8. a. He will hear 2 sounds because there are two media transmitting the sound i.e air and Metal, one transmitting the sound faster than the other.

b. **Title :** Investigating the differences between the speeds of two sounds traveling through different media (metal and air)

Materials : meter rule, stop watch and metal pipe

Procedure: a. first, measure the length of the pipe using the ruler provided

b. let student at A bang the pipe and start the stop watch at once.

c. stop the stop watch when the first sound is heard and record the time taken for the sound to travel.

d. repeat steps (b) and (c), and this time, the time should be noted for the second sound.

TABLE OF RESULTS

Time taken for the first sound	
Time taken for the second sound	

e. calculate the speed of the first sound using the formula: speed = length of pipe (m)/ time taken (s)

f. calculate the speed of the second sound using the same formula used in (e).

The sound passing through the metal has high speed hence it is the first sound that is heard. The second sound is the one which passes through air since speed of sound is higher in metals than in air

1999

1. a. (i) E

(ii) E

(iii) Ionic : A, B and D

Covalent : C, E and F

(iv)Ionic substances have high boiling points and covalent substances have low melting points.

(v)Because it is unreactive / inert

b. (i) (s) : solid

(aq) : aqueous

(g) : gas

(ii) magnesium sulphate and hydrogen gas

(iii) displacement reaction / corrosion

(iv) $MgSO_{4(aq)}$

(v) It would decrease

(vi) Hydrogen gas (one of the products), which has mass, will escape from the beaker

2. a. (i) P: Earth wire

Q: Neutral wire

R: Live wire

(ii) blue or black

(iii) Fuse. It is there to avoid high current from flowing into the appliance hence protecting it from damage.

(iv) 10 A

Calculation

P = 2.4KW = 2400W, V = 240V, P = VI, this implies that I = P/V = 2400W/ 240V =10A). the kettle will

not work because it needs 10A but the fuse will allow only 5A of the current to pass through it.

b. (i) 1.2 Ω

Calculation

1/R = 1/2 + 1/3, 1/R = (3+2) /6 = 5/6, R = 6/5 = 1.2Ω)

(ii) 0.6 V

Calculation

$V_{(3\Omega)} = IR = 0.2A \times 3\Omega = 0.6V$

(iii) 0.5 A

Calculation

$V_{(2\Omega par)} = 0.6V$ because V in parallel is equal, $I_{(2\Omega par)} = V/R = 0.6V/2\Omega = 0.3A.$, current throug the parallel arrangement $= I_{(2\Omega par)} + I_{(3\Omega)} = 0.3A + 0.2A = 0.5A$

(iv) 1.6 V

Calculation

$V_{(2R, Ser)} = IR = 0.5A \times 2\Omega = 1.0V$. this implies that $V_T = 1.0V + 0.6V = 1.6V$

3. a. (i) X: Burette.

Y: Conical flask

(ii) Phenolphthalein indicator, it is pink

(iii) it is the point at which enough acid solution is added to the alkali solution to cause neutralization

(iv) $30cm^3$

Calculation

$35cm^3 - 5cm^3 = 30cm^3$

(v) 0.083 moles/*l*

Calculation

$C_1V_1/n_1 = C_2V_2/n_2$, $C_1 = n_1C_2V_2/n_2V_2$, where $C_1 = ?$, $V_1 = 30CM^3 = 0.03l$, $n_1 = 1$, $C_2 = 0.1M$, $V_2 = 25CM^3 = 0.025l$, $n_2 = 1$. n_1 & n_2 are from the equation $\mathbf{1}CH_3COOH + \mathbf{1}NaOH \rightarrow CH_3COONa + H_2O$. Therefore, $C_1 = (1 \times 0.1M \times 0.025l) / (1 \times 0.03l) = 0.083M$ or $0.083mol/l$)

b. (i) A, C, D and E.

(ii) D and F

(iii) Nature of magnesium, B and C

(iv) Because all other variables are constant apart from the one under investigation (nature of magnesium i.e one is powder and the other one is ribbon).

4. a. (i) **When the mass is at position A**

- acceleration of the mass is zero
- weight of the mass is the same
- strain in the string is minimum

When the mass is at position B

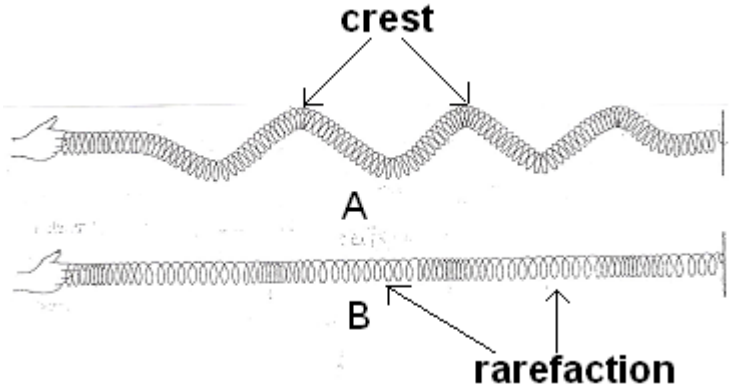
- speed of the mass is maximum

- kinetic energy of the mass is maximum

(iv) amplitude is 2.2cm (measure using a ruler from A-B or B-C)

(v) complete cycle is 8.8 cm (a complete cycle is 4 times the amplitude)

b. (i) **crest and rarefaction**



(ii) A is produced by moving the spring up and down, and B is produced by moving the spring forward and backward

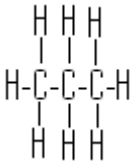
(iii) longitudinal waves (represented by B) always need a medium through which they can travel, but transverse waves (represented by A) can also travel through vacuum.

(iv) A: Transverse waves
B: Longitudinal waves

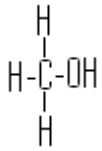
5. a. (i) M: Alkenes
P : Carboxylic acids

(ii) M and N

(iii) 1.member with three carbon atoms from series **N**



2. member with one carbon atom from series **O**



(iv) 1. Propane
2. Methanol

(v) I would add a few drops of bromine solution to 5 cm^3 of a member of series M and a member of series N in test tubes labelled 1 and 2 respectively, and shake the test tubes. Solution in test tube 1 will be colourless and solution in test tube 2 will remain brown (the colour of bromine)

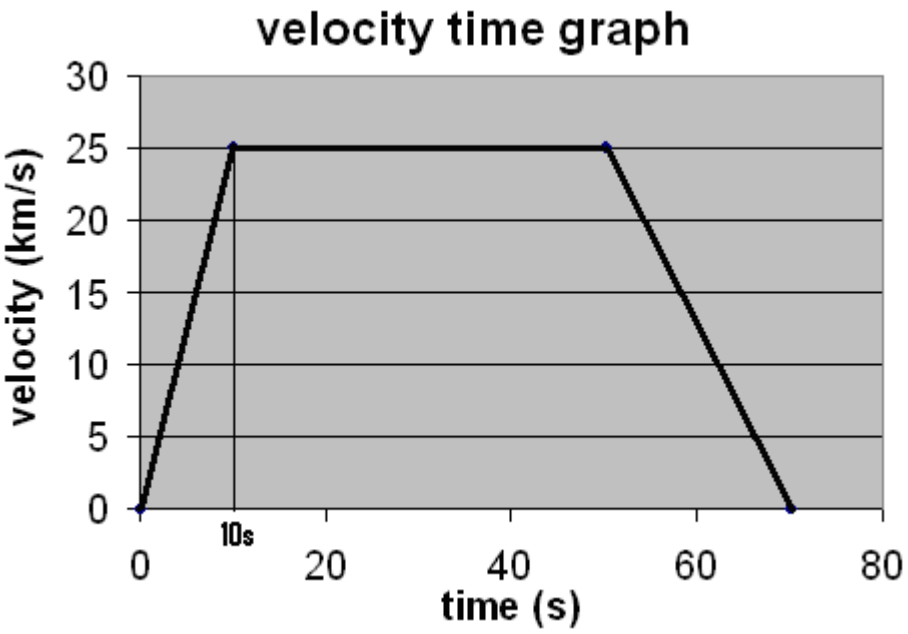
6. a. (i) 70 s

Calculation

uniform acceleration =10s, uniform speed of 25km/s =40s, uniform deceleration =20s and total time taken

= 10s + 40s + 20s = 70s

(ii) **velocity time graph representing the motion of the car**



(iii) - acceleration during the first 10s : 2500 m/s^2

Calculation

a = (V-U)/t = (25km/s – 0km/s) /10s = 25km/s / 10s = 2.5km/s =2500m/s

- deceleration during the last 20 seconds of the journey : 1250 m/s^2

Calculation

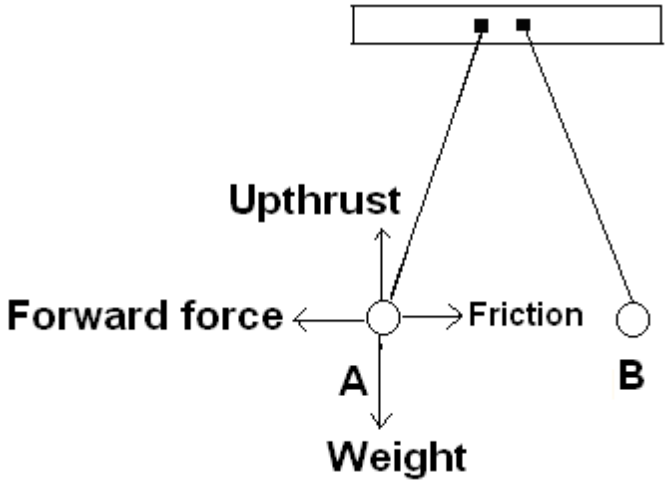
a = (V-U)/t = (0km/s – 25km/s) /20s =-25km/s /20s = - 1.25km/s^2 = - 1250m/s^2

this implies that deceleration is 1250m/s^2)

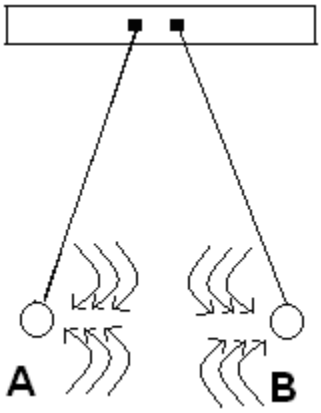
b. (i) A : a negative charge

B : a negative charge

(ii)



(iii)



(iv) they will no longer repel since they will lose their negative charge.

7. a. (i) percentage corrosion of iron decreases as pH increases from 1 to 7
(ii) acidity has a direct effect on corrosion (acidity is directly proportion to percentage corrosion)

b. **Investigation :** Verifying the inverse relationship of P^H and percentage corrosion of iron
Materials : test tubes (7), $HCl_{(aq)}$ of pHs ranging from 1 to 7, iron nails (7).
Procedure : a. label the test tubes 1 to 7
b. put the $HCl_{(aq)}$ of different pHs in respective test tubes.
c. put the iron nails in all the test tubes
d. leave the test tubes at a safe place for a week.
e. observe the degree of corrosion of the iron nails in each test tube
Conclusion : The degree of corrosion in each test tube will determine the relationship between pH and percentage corrosion from the results. Expectedly, the degree of corrosion increases with decrease in pH

8. a. A : concave mirror
B : condenser lenses

b. - the concave mirror reflects the light forward and focuses it onto the condenser lens
- the lamp (very powerful) is used to illuminate the film
- the condenser lens is used to converge and direct light rays onto the slide (film)
- the slide/film is the object to be projected on the screen
- the projection lens is used to project the light lens from the object (film) onto the screen.
- the screen is where the image is formed

c. 20 cm.

Calculation

V =200cm, M = 10, U =? But M = V/U = 10. this implies u = v/10 = 200cm /10 = 20cm)

2000

1. a. P: brass cap
Q: carbon rod
R: ammonium chloride jelly
S: zinc casing

b. P: positive terminal and connects the carbon as an anode of the cell to the outside circuit
Q: acts as an anode of the dry cell
R: work as an electrolyte
S: work as a cathode

c. (i) appliances need battery of voltage which is divisible by 1.5V
(ii) 1. it lasts long (it has large voltage ampire rating)
2.it is easy to handle

d. (i) 1.oxygen
2. water
3. iron

(ii) Zinc metal corrodes releasing electrons. The electrons are captured by Fe^{2+}, which becomes $Fe_{(s)}$. in this case,
there are no Fe^{2+} ions to react with water and oxygen to form rust

e. $Fe_{(s)} + Sn^{2+}_{(aq)} \rightarrow Fe^{2+}_{(aq)} + Sn_{(s)}$

2. a. (i) 9000 J

Calculation

Mechanical Advantage = 4 (number of lopes pulling the mass). Hence the effort,
E = 1200N / 4 = 300N. Work done, W = E X d = 300N X 30m = 9000J

(ii) 9000 J (work done is the energy suppled)

(iii) 300 W

Calculation

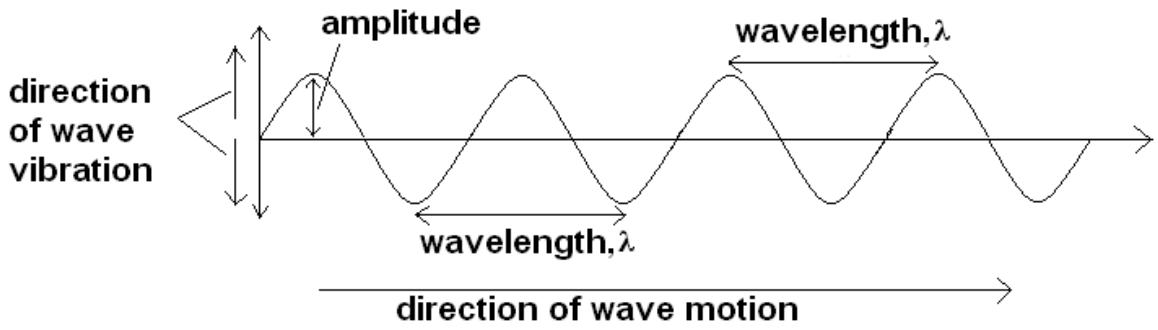
W = 9000J , t= 0.5 min = 30s; P = W/ t =9000J / 30s =300W

(iv). Efficiency is the ratio of an output to an input (how well a machine works)

(v) - Some energy is wasted to overcome friction.
- some energy is also lost in moving the rope
- some is lost in lifting the 2 bottom reams.

b. (i) It is a wave in which the disturbance causing the wave move perpendicular to the direction of the wave.

(ii) **Transverse Wave**

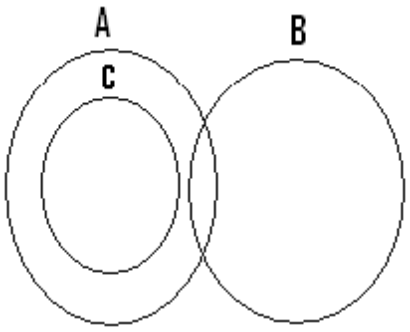


(ii) 0.5 Hertz

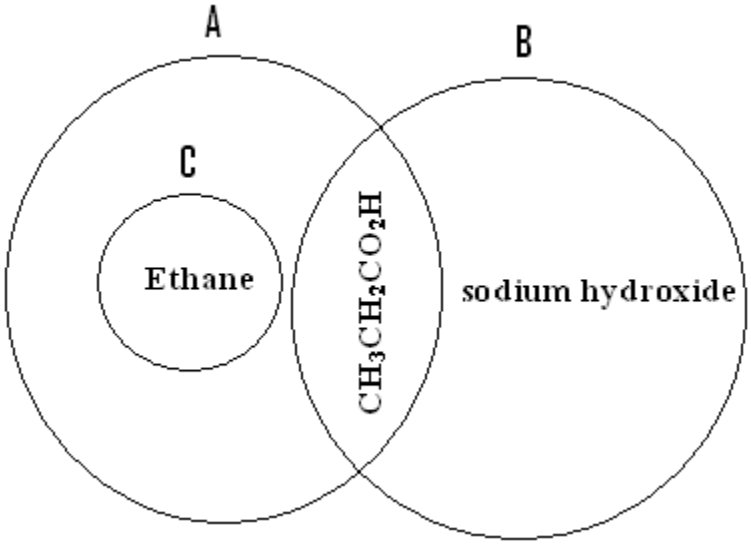
Calculation

V=0.1m/s , λ= 0.2m, but V= f λ therefore f= V/ λ =0.1 m/s /0.2m = 0.5 Hertz

3. a. (i).



(ii)



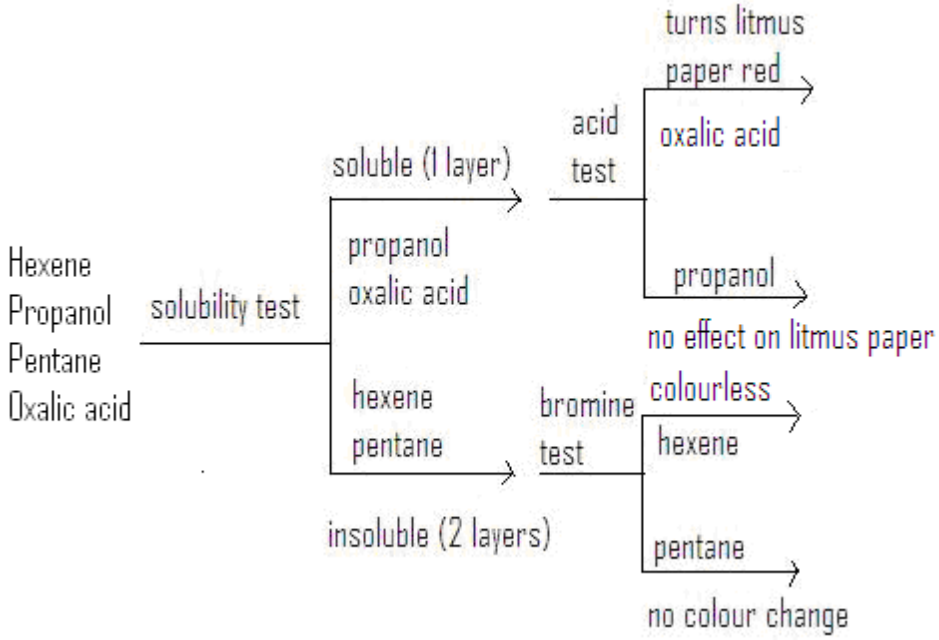
b. (i) $CH_3CO_2^-(aq) + H^+(aq) + K^+(aq) + OH^-(aq) \rightarrow H_2O + CH_3CO_2^-(aq) + K^+(aq)$

(ii) Spectator ions are ions which do not take part in the reaction (they appear on both sides of the equation in the

same form or state)

(iii) $CH_3CO_2^-$ and K^+

c.



4. a. P: decreasing acceleration

R: constant acceleration

T: Increasing acceleration

b.(i) graphs give a lot of information at a glance

(ii) graphs ease interpretation of numerical data

c. (i) upthrust and weight

(ii) upthrust

(iii) upthrust would be equal to weight

(iv) upthrust would be equal to weight

d. (i) 70km/hr

Calculation

average speed =total distance covered / total time taken = (40km + 30km) /(30min+ 30min) = 70km / 1hr = 70km/hr

(ii) 50km

Calculation

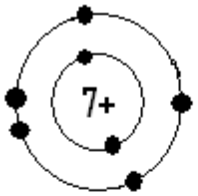
$AC^2 = AB^2 + BC^2 = 40^2 + 30^2 = 1600 + 900 = 2500$, $AC = \sqrt{2500} = 50km$

(iii) A vector quantity has direction while a scalar quantity has no direction.

(iv) **Vector quantity**: acceleration, force, velocity, displacement.

Scalar quantity: speed, distance, density, volume, temperature.

5. a (i)



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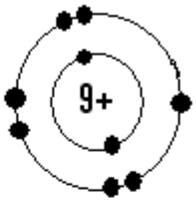

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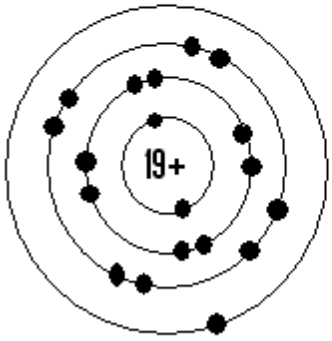
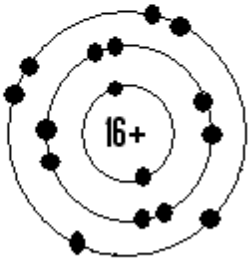


F



G

(ii) E: 1
F: 1

(iii) ionic bonding (E is non metal and F is a metal)

(iv) group 6 since it has 6 outer most electrons

(v) by counting the number of figures e.g for Na (2, 8, 1), there are three figures which are 2, 8 and 1. hence it belongs to period three

(vi) E

(vii) because E requires only one electron to full-fill its outer most shell (to be stable) while G requires two electrons to do the same or to become stable. The outermost shell of E is closer to the nucleus than in G hence more attraction in E than in G.

b. (i) The density of water is increasing from $0^{o}C$ to $4^{o}C$ and then from $4^{o}C$ to $10^{o}C$ the density of water is decreasing (note that water experiences the highest density at $4^{o}C$)

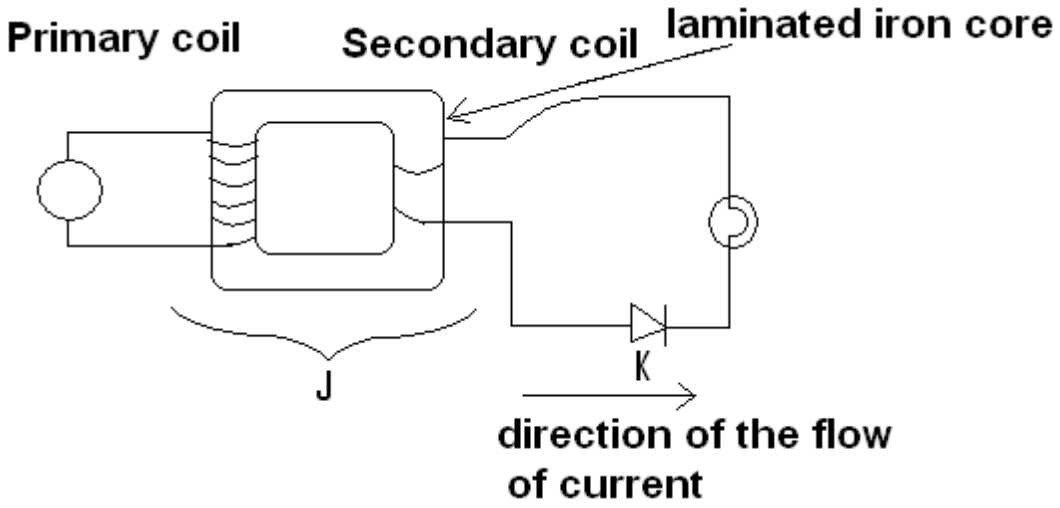
(ii) when salt is added to water, its density would increase.

(iii) as temperature increases, volume also increases. If volume increases and mass remains the same, the density will increase.

6.a (i) J is a transformer
K is a diode

(ii) K is being used as a rectifier (changing AC to DC)

(iii) **Transformer**



(iii) 240V

Calculation

Vs = 24V, N_P/N_S = 10/1, but $N_P/N_S = V_P/V_S$, therefore, V_P/V_S =10/1 which implies that V_P =10V_S = 10 X 24V =240V

(v) - it is easily stepped up or down

- line loses are easy to minimize for AC than DC for a given wattage delivery and wire diameter.

(vi). Magnetic field lines spread from the primary coil towards and cut the secondary coil. The field lines cut the secondary coil and the current is induced in it. Since alternating current is used in the primary, the field lines move forward and backward , so when moving backward, they also cut the secondary coil hence inducing a backward current. So backward and forward current (AC) is induced in the secondary coil.

7. a. they are forces which act in-between molecules (intermolecular forces, IMF)

b. as a molecule increases in size, charges also accumulate hence there will be more attraction between molecules.

For example, there will be strong Van der waals forces in iodine (bigger) than in chloride (smaller). The kind of atoms in a molecule, will also determine the number of charges in the whole molecule. For example, there will be more charges in bromine than in oxygen. The amount of charges will determine how much van der waals forces will be in between molecules. Hence there will be strong van der waals forces in bromine than in oxygen, and this is why bromine is a liquid and oxygen is a gas at room temperature.

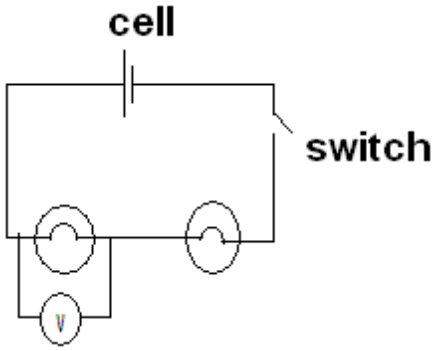
c. ions in NaCl are held together by strong electrostatic forces while in $C_{70}H_{142}$, atoms are held together by weak intermolecular forces

8.a. it is the battery's terminal potential difference in open circuit.

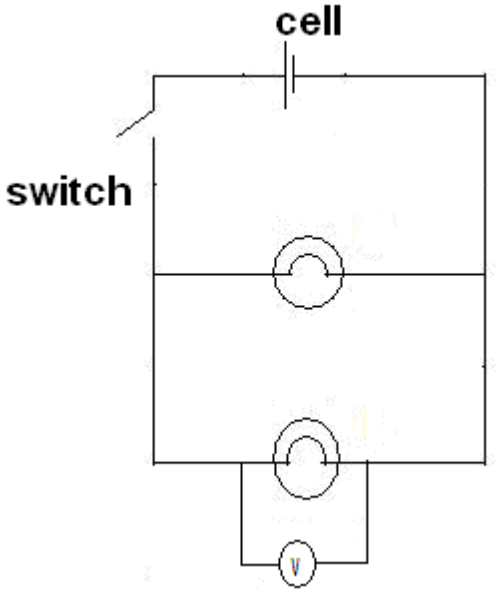
b. Investigation: Dependence of brightness of bulbs on voltage

Materials : cell (1), identical bulbs (2), voltmeter and switch

Procedure : a. set up the apparatus with the bulbs in series as shown below.



b. read the voltmeter and record the reading in the table of results.
c. set up the apparatus again, this time with the bulbs in parallel as shown below.



d. read the voltmeter and record the reading in the table of results.

TABLE OF RESULTS

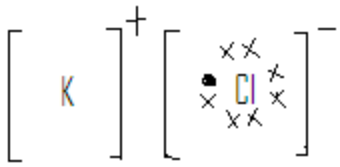
Circuit	Voltmeter reading	Brightness
Series		
Parallel		

The expected results: - in series circuit, there will be low voltage and the bulbs will be less bright (voltage is shared in series)
- in parallel circuit, there will higher voltage and the bulbs will be brighter (voltage is equal in parallel circuit)

Conclusion : the lower the voltage, the less bright the bulb, and the higher the voltage, the brighter the bulb.

2001

1. a. (i) 37 (atomic number + number of neutrons i.e 18 + 19)
(ii) - there will be no reaction
- because X is an inert gas (non reactive)
b. (i) KCl



(ii) - conducts electricity in molten or aqueous form
- it is soluble in water
- it has high melting and boiling points
- it is brittle
- it is hard
- it is a solid at room temperature

c. (i) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

(ii) Combustion

(iii) ethane and oxygen

d. (i) 2 moles of Sulphuric acid.

Calculation

According to the equation, ${}^{n}H_2SO_4 / {}^{n}H_2O = ½$, therefore ${}^{n}H_2SO_4 = ½ \times {}^{n}H_2O = ½ \times 4 = 2mol$

Therefore 4 moles of H_2O needs 2 moles of H_2SO_4

(ii) 20g

Calculation

${}^{m}NaOH = Mn, = 40gmol^{-1} \times 0.5mol = 20g$

2. a. (i) When the coil is rotated, the wire windings on the sides AB and DC cut the field lines from north pole to south pole in the process inducing current.

(ii) 1. using strong magnets(this will increase the number of field lines hence increasing the strength of flux)

2. using many turns of the coil (this will increase the area of cutting of the field lines)

3. faster movement of the coil (this will increase the number of cuttings)

(iii) chemical energy from a person to kinetic energy of the coil to electrical energy generated in the wire to heat and light energy of the bulb (chemical → kinetic → electrical → heat + light)

(iv) There will be no effect

b. (i) negative

(ii) because for the ball point pen to be positive, it must have lost electrons to the hair, making the hair negative.

(iii) The positive charge on the pen will repel the positive charges in the paper to the side away from it and attract the negative charges towards itself. The paper becomes negatively charged on the side close to the pen and is attracted because unlike charges attract.

(iv) 1. by rubbing the pen more against the hair

2. by making the pieces of paper even smaller

3. by bringing the ball point pen even closer to the papers

c. because there are free electrons in the metal hence there can never be accumulation of charge at a specific place. Once the charge has reached the metal surface, it will be transferred to another area

3.a. (i) Is a reaction in which the products react to reform the reactants

(ii) 1. CH_3COOH / CH_3COO^-

2. H_3O^+ / H_2O

(iii) It means that reactants are favored at equilibrium. The rate at which the products reform the reactants is higher than the rate at which the reactants react to form products

b. (i) **Effect:** the equilibrium will shift to the right

reason: number of collisions between acetic acid and water molecules will increase and are more energetic as to break easily and favor the formation of the products.

(ii) **Effect:** the equilibrium will shift to the right

Reason: there will be more acetic acid molecules to react with water molecules hence more acetate and hydronium ions formed

c. (i) It is a liquid that allows current to pass through.

(ii) high concentration provides more ions which are responsible for conduction hence high conductivity. Low concentration provides less ions responsible for conduction hence low conductivity.

d. (i) It is the amount of heat required to raise the temperature of a 1 kg mass by 1 ^{0}C

(ii) The new temperature is 20^{0}C.

Calculation

J = CMΔT, which implies that ΔT = J/CM = 4000J /(400J/Kg^{0}C x 2kg) = 5^{0}C. But ΔT =T_f – T_i =5^{0}C,

Then T_f =5^{0}C + T_i= 5^{0}C +15^{0}C = 20^{0}C

4. a. (i) the bus accelerated uniformly from A to B and moved with constant speed from B to C. From C to D, the bus decelerated uniformly.

(ii) acceleration: 10 m/s^{-2}

Calculation

a = (V-U) / t = (30m / s - 0m / s) / 3s = (30m / s) / 3s = 10m / s^2

(iii) total distance: 135 m

Calculation

total distance = area under the graph(area of a trapezium). i.e graph from 0s to 6s.

area = ½ (sum of opposite sides)h = ½ (3+6)x30 = 135m

b. (i) - the coin

- because it has a large mass as compared to its volume.

(ii) 1. weight
2. friction
3. upthrust

(iii) 1. weight
2. upthrust

c. (i) they will cancel each other to become zero.

(ii) because there will be equal forces acting in opposite directions.

5. a. (i) $Mg_{(s)} + CuSO_{4(aq)} \rightarrow MgSO_{4(aq)} + Cu_{(s)}$

(ii) Cu^{2+} is an oxidizing agent and Mg is the reducing agent

(iii) Mg, Zn and Cu

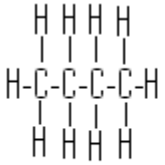
(iv) -Mg/Cu

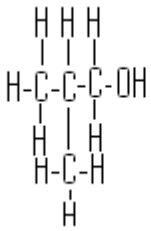
-Because the concentration of ions which are responsible for voltage in a given time will be higher than in Mg/Zn combination.

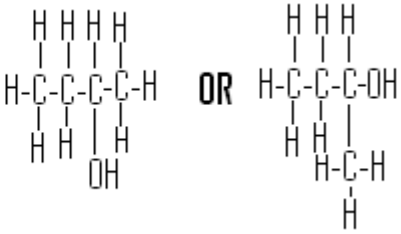
b. (i) butanol

(ii) carboxylic/ alkanoic acids

(iii) **n-butanol** **2-methylpropanol** **butan-2-ol**







(iv) $2CH_3CH_2CH_2CH_2OH + 2Na \rightarrow$ **$2CH_3CH_2CH_2CH_2ONa + H_2$**

(v) first method: dip litmus paper in the solutions of A and B. It will turn red when dipped in solution of B and there will be no change when dipped in solution of A

Second method: dropwisely, add solution A and B into sodium hydroxide + phenolphthalein solution respectively. The sodium hydroxide + phenolphthalein solution (pink), will eventually turn coulorless when B is added and it will remain the same i.e pink when A is added.

(vi) 21.6 %.

Calculation

In the compound, $^{m}O = 1x16g$, $^{m}C_4H_9O = 74g$, therefore, %O = (16g/74g) x100%= 21.6%

6. a. (i) 10A

Calculation

P = I V , this implies that I = P / V = 2200W/ 220V = 10A

(ii) 22 Ω

Calculation

R =V/I = 220V/ 10A = 22Ω

(iii) 660000 J

Calculation

P=E/t. this implies that E=Pt = 2200J/s X 300s = 660000J). Note that the time is first converted to seconds.

(iv) k52.80

Calculation

2200W = 22KW. for 8 hrs, kiliwatthours consumed will be 2.2KW x8hrs = 17.6KWH. Cost: 17.6KWH x K3.00 /KWH = K52.80

(v) In case of short circuit (shock) , the charges, instead of damaging things, they pass into the ground.

b. (i) it is the distance between the optical centre of the lens and the focal point.

(ii) 1. rough method
2. graph method
3. mirror method
4. lens formula method.

(iii) M = 1

Calculation

V =U and M = V/U = 1. Note that when the object is at 2F the image is always at 2F.

(iv)1. a real image is formed on the other side as the object while a virtual image is formed on the same side as the object

2. a real image is inverted while a virtual image is upright.
3. a real image can be either magnified or diminished while a virtual image is always magnified.

7. a. it is a solution of known concentration

b. PREPARING A SOLUTION FROM A STANDARD SOLUTION (250ml, 0.2M HCl solution from a 2M HCl solution)

Materials: measuring cylinder (100ml), volumetric flask (250ml) with a stopper, distilled water, standard solution (2M HCl solution)

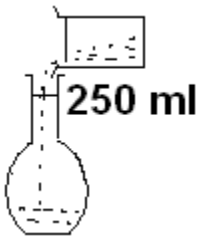
Procedure: a. find the volume of the standard solution to be diluted to give the molarity required. i.e. use the dilution formula,

$V_1 = C_2V_2/C_1 = 0.2M \text{ X } 250ml / 2M = 25ml$

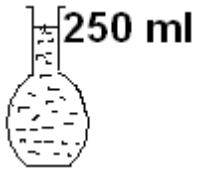
b. measure the volume of the standard solution found from the calculation (25ml) using the measuring cylinder.

c. transfer the 25ml solution from the measuring cylinder into the volumetric flask.

i.e.



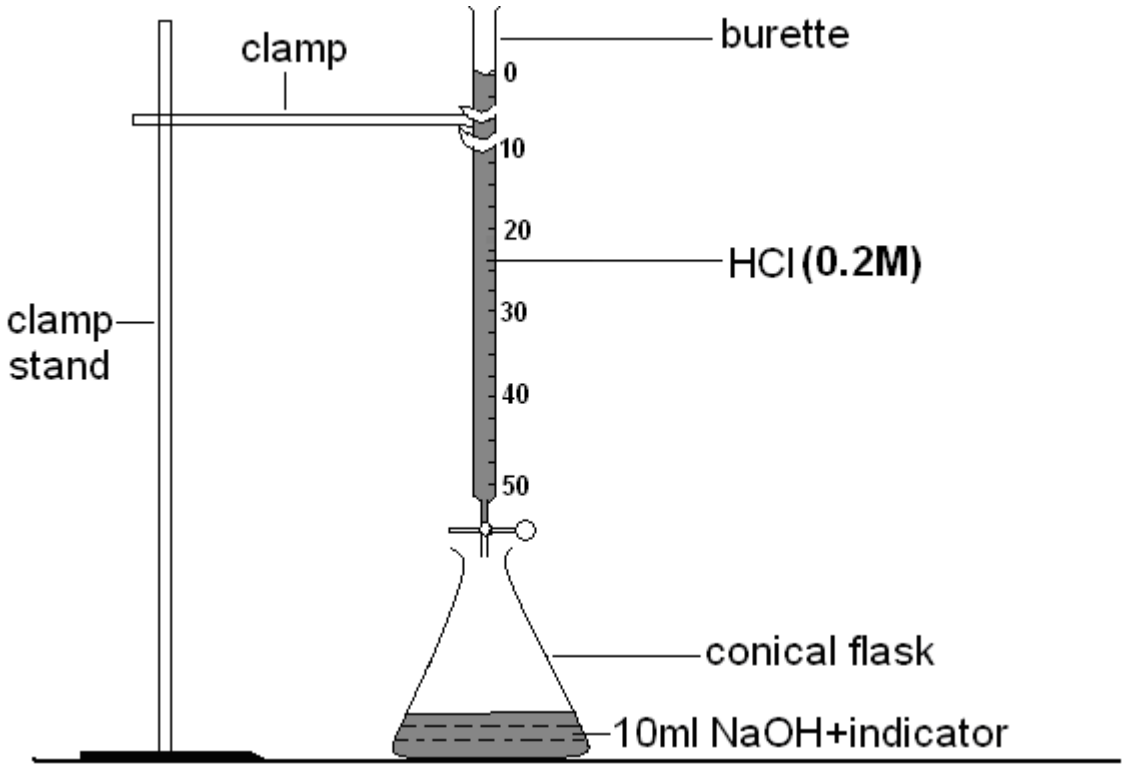
d. add distilled water up to the mark (the solution prepared has volume of 250ml and is 0.2M)
i.e.



c. DETERMINING THE CONCENTRATION OF NaOH USING TITRATION METHOD

Materials: burette, clamp and clamp stand, measuring cylinder, conical flask, phenolphthalein indicator, sodium hydroxide solution (NaOH) of unknown concentration and hydrochloric acid (0.2M HCl)

Procedure: a. Set up the apparatus as shown in the figure below.



b. Fill the burette to the mark with the hydrochloric acid (HCl).
c. Record the volume of HCl.
d. Measure 10 ml of the NaOH using the measuring cylinder and transfer it into the conical flask.
e.Add two drops of phenolphthalein indicator into the conical flask.
f. Add the HCl gradually, in small amounts, from the burette into the conical flask.
g.Shake the conical flask as you gradually add the HCl.

h.Stop adding the HCl when a colour change is observed in the flask (note that only one drop of the acid is
responsible for colour change).

i. Record the volume of the HCl remaining in the burette.

j. Subtract the final volume of the HCl from the initial volume and record in the spaces below.

Initial volume of HCl = _____

Final volume of HCl = _____

Volume of HCl used = _____

The balanced equation for the reaction: $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

The concentration of NaOH is calculated using the formula below:

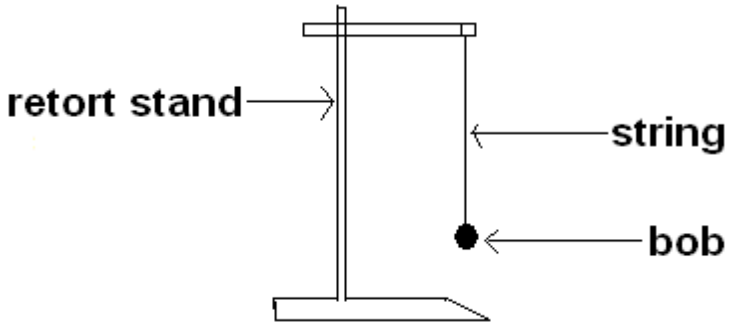
$C_1V_1/n_1 = C_2V_2/n_2$ this implies that the conc. of NaOH, $C_2 = n_2C_1V_1/n_1V_2$

8. a INVESTIGATING THE EFFECT OF LENGTH ON FREQUENCY OF VIBRATION OF A PENDULUM

MATERIALS: Stop watch, Piece of string, bob (mass), clamp, Ruler

PROCEDURE:

a. Set up a pendulum with the bob using a string such that the string is 50cm long as illustrated in the diagram below:



b. pull the bob sidewards by a small amount (about 15cm) and release it to oscillate; start the stop watch at once.

c. Note the time taken for 20 oscillations (cycles) and write it down in the space in the table below.

d. Calculate the period (T) and frequency (f) of the oscillations and record it in the table

e. repeat steps (b) to (d) with the following lengths of the string 40cm, 30cm, 20cm, 10cm

TABLES OF RESULTS

Length of string (cm)	Time for 20 oscillations (s)	Period (T)=time/20 (s)	Freq. (f)=1/T
50			
40			
30			
20			
10			

If the frequency changes as the length of the string is changed, it means that there is an effect of the length on
the frequency of an oscillating pendulum. The relationship is that as length of the string increases, the
frequency decreases. To visualise the relationship clearly, a graph of frequency against length of the string
(cm) can be drawn

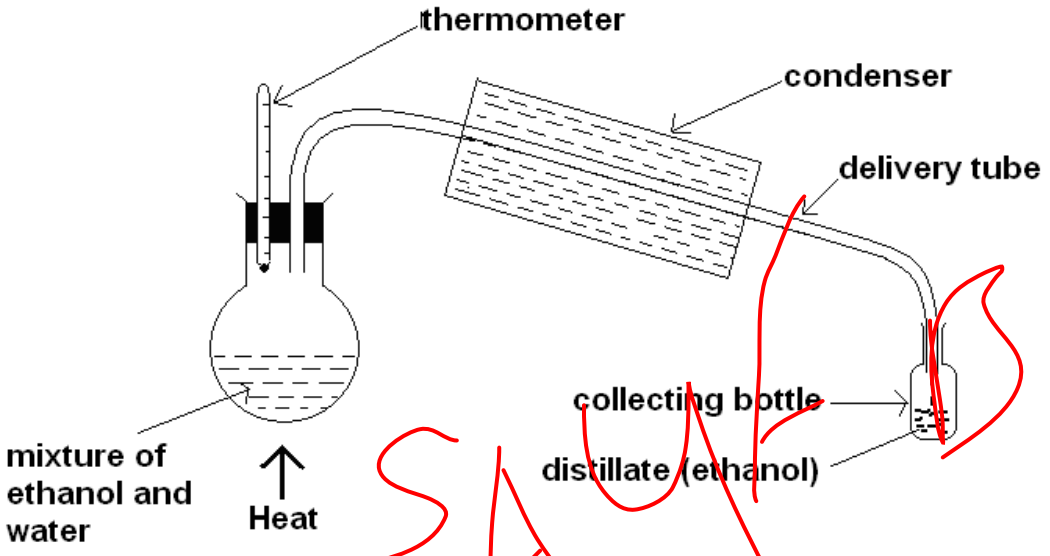
b. amplitude is the maximum displacement of an oscillating object from its equilibrium position.

c. amplitude of a vibrating pendulum decreases with increase in time because some energy is lost to the surrounding
as heat and sound due to friction.

d 1. by applying more force to the bob i.e. pushing the bob even more when it is already oscillating.
2. by pulling the bob sidewards by a large amount before releasing it to oscillate

2002

1. a. (i) **apparatus used to separate ethanol and water**



(ii) water will also evaporate and condense along with the alcohol, hence the distillate is the mixture of ethanol and
water.

b. (i) Morality is the concentration of a solution expressed in moles per cubic decimeter or liter.

(ii) 0.085M

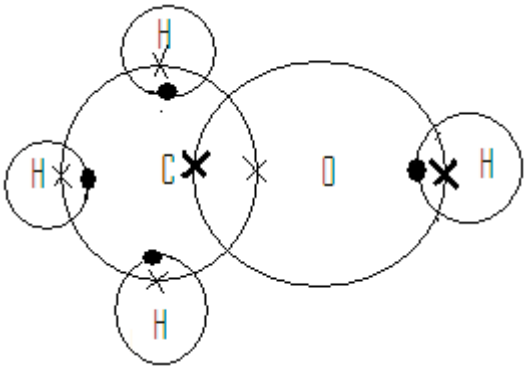
Calculation

C =n/V, n= m/M= 5gmol/58.5g = 0.085mol, V= 1*l* therefore C= n/V =
0.085mol/ 1*l*= 0.085mol/*l* = 0.085M

(iii) 0.0085 mol (the number of moles would not change, it would be the same as the one which was in one liter since
it is only water which will evaporate)

a. (i) SO_2 and CH_3OH (in both, there is sharing of electrons and they involve non metals only).

(ii) Dot and cross diagram of CH_3OH



d. (i) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

(ii) combustion

2. a. (i) S open: ammeter reading will be 1.7A

Calculation

$R_T = 3\Omega + 4\Omega = 7\Omega$, $I_T = V/R = 12V/7\Omega = 1.7A$

S closed: ammeter reading will be 2.22A

Calculation

$R_T = 3+[(6 \times 4) / (6+4)] = 5.4\Omega$, $I = V/R = 12V/5.4\Omega = 2.22A$

(ii) voltage across the 4Ω resistor will be 5.28V

Calculation

$V = IR = 2.2 \times 2.4 = 5.28V$

b. (i) step-down transformer (since it has more turns in the primary: where there is power supply, it is the primary)

(ii) Output voltage will be 12V

Calculation

$N_s = 400N$, $N_p = 8000N$, $V_p = 240V$. $V_s/V_p = N_s/N_p$ which implies that $V_s = N_sV_p/N_p$..

$= (400N \times 240V) / 8000N = 12V$

(iii) 1. it is easy to step up or down AC, but it is hard to step direct current up or down.

2. line losses are lower for alternating current than direct current for a given wattage delivery and wire diameter.

c. (i) it states that the force acting on an object of constant mass is directly proportional to the acceleration of the object.

(ii) $3ms^{-2}$

Calculation

$a = (v-u)/t = (15m/s-0m/s) / 5s = 15m/s/5s = 3m/s^2$

(iii) 1500N

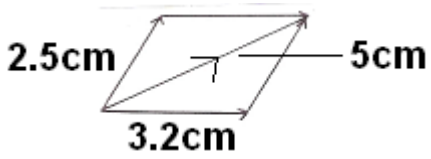
Calculation

$F = ma = 500kg \times 3m/s^2 = 1500kgms^{-2} = 1500N$

d. (i) because it has both magnitude and direction.

(ii) scale diagram to represent a resultant force.

Scale : 1cm to 100cm



Therefore, the resultant = 5cm x 100N/cm = 500N

3. a. (i) it is the number of protons

(ii) it is the number and arrangement of electrons in an atom.

b. (i) $1.8 g/cm^3$

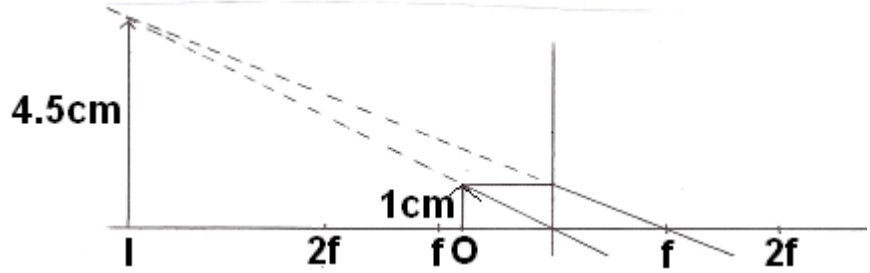
(ii) As the atomic number increases in each period, the density of gases is zero, then increases for metals and
decreases for nonmetals
(iii) Al
(iv) 4

c. (i) - loss of oxygen (any one of the following is correct)
- decrease in charge
- decrease in oxidation number
- gain of electrons
- loss of hydrogen ion
(ii) 1. displacement reaction
2. Na, Mg, Fe, Pb, Cu

d. (i) - to prevent the mixing of the two solutions
- to allow the passage of current (ions) thereby completing the circuit.
(ii) $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$
(iii) more copper ions will have been turned into atoms which coat the inside of the copper container, so there will
be less copper ions to receive the electrons coming from the zinc rod hence low current, which eventually leads
to weaker brightness of the bulb.

4. a. (i) - both have light sensitive parts. Retina in the eye and film in the camera.both use converging lenses
- both have black inside surfaces
- in both, light entering is controlled. Eye uses iris and camera uses shutter and diaphragm

(ii) 1. it is the distance between the optical centre of the converging lens and the focal point.
2. it is the meeting point of a beam of light rays after passing through a convex lens.(is the point where light
rays parallel to the principal axis converge
b. (i) ray diagram (Scale : 1cm to 2cm)



(ii) - upright
- virtual
- magnified
(iii) M = 4.5
Calculation
$h_i = 4.5cm, h_o = 1cm, M = h_i/h_o = 4.5cm/1cm = 4.5$

c. (i) long sight/ hypermetropia
(ii) converging lens (convex lens)

5. a. (i) strong acids ionizes completely in water producing more hydrogen ions while a weak acid ionizes partially in

water producing less hydrogen ions

(ii) 1. HCl

2. CH_3COOH

b. (i) hydrogen gas and metal salts

(ii) $HCl_{(aq)} + Zn_{(s)} \rightarrow H_{2(g)} + ZnCl_{(aq)}$

c. (i) anode

(ii) because it has to dissolve to release copper ions which replenish the copper ions in solution, which get reduced to form copper atoms which coat the cathode (the cathode will be all copper).

(iii) One electrode will be eaten up and the other one will form a coat.

(iv) The coating and the dissolving of the electrodes (mass of the cathode increases and that of anode will decrease).

(v) more copper ions, which are responsible for the colour, will still be there.

d. (i) -surface area

(ii) -temperature
-concentration of HCl
-pressure

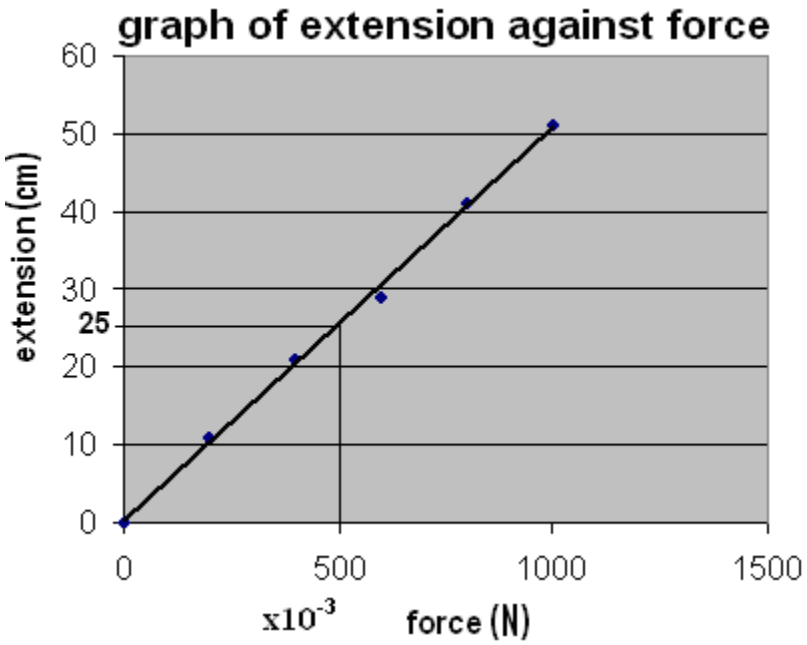
(iii) 4 cm^3 of CO_2 per minute

6. a. it states that the extention of a spring is directly proportional to the force applied.

b. (i)

Mass (g)	0	20	40	60	80	100
Length of spring (cm)	110	121	129	139	151	161
Extension (cm)	0	11	**19**	29	**41**	51

(ii)



(iii) 25cm

(iv) 20 N/m

Calculation

Force constant = force / extension = (500 x10^{-3})N / 25cm = 0.5N / 25cm = 0.02N / cm or 2N / m

c. (i) C, B, A and D

(ii) B

7. a. C_8H_{18}

Calculation

the empirical formula is C_4H_9, the mass of the empirical formula is (4 x 12) + (9 x1) =

48 + 9 = 57. Empirical units = 144/57 = 2. Therefore, the formula is $C_{4 x 2}H_{9 x 2} = C_8H_{18}$

8. a. (i) 1. water waves, light, radio waves, ultraviolet rays, infrared radiation, gamma Rays, X-rays, TV waves, etc

2. sound waves,

(ii) 1. velocity is 0.15 m/s

Calculation

V = s/t = 0.3m/2s = 0.15m/s

2. frequency is 0.05 Hertz

Calculation

$V = f\lambda$, $f = V/\lambda$ = 0.15ms^{-1} / 3.0m = 0.05/s = 0.05 Hertz

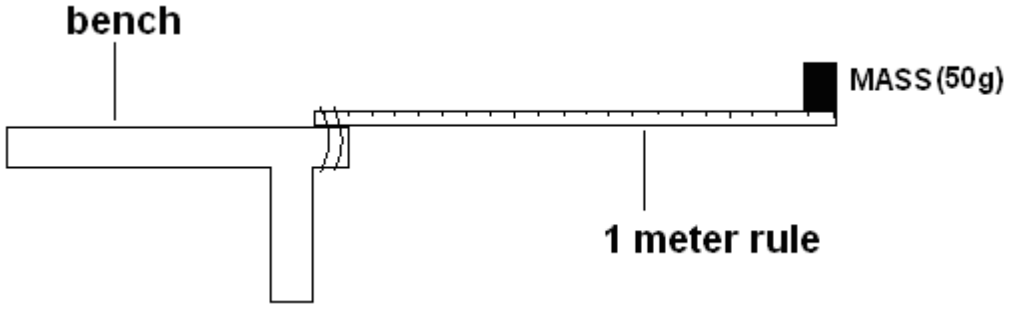
b. INVESTIGATING THE EFFECT OF MASS ON FREQUENCY OF VIBRATION OF A CANTILEVER

MATERIALS: Stop watch, Masses (50g, 40g, 30g, 20g, 10g,), clamp,

Ruler (1 metre) and Bench

PROCEDURE:

a. Clamp the ruler to the bench with the 50g mass at the end as illustrated in the diagram below:



b. pull the mass upwards by a small amount (about 15cm) and release it to oscillate; start the stop watch at once.

c. Note the time taken for 20 oscillations (cycles) and write it down in the space in the table below.

d. Calculate the period (T) and frequency (f) of the oscillations and record it in the table

e. Maintaining the length of the ruler extending from the bench and the amplitude, repeat steps (b) and (d) with the following masses 40g, 30g, 20g, 10g.

TABLES OF RESULTS

mass (g)	Time for 20 oscillations (s)	Period (T)=time/20 (s)	Freq. (f)=1/T
50			
40			
30			
20			
10			

If the frequency changes as the mass at the end of the ruler is changed, it means that there is an effect of the

mass on the frequency of an oscillating cantilever. Expectedly, the mass will affect the frequency of the

oscillating cantilever. The relationship is that as length of the string increases, the frequency decreases. To

visualise the relationship clearly, a graph of frequency mass (g) can be drawn

2003

1. a. (i) Electrical energy which is then converted into heat energy

(ii) 16200 J or 16.2 KJ

Calculation

$P=I^2R = 1.5^2 x 12\Omega = 27J/s$. $E= pt = 27J/s \times 600s = 16200J$ or 16.2KJ.

b. (i) 60 km

(ii) 5 hrs (1pm – 6pm)

(iii) The cyclist moved with a constant velocity of 10 km/ hr from 2 pm to 3 pm, then stopped for 30 minutes. From 3:30 pm to 4:30 pm, he moved with constant velocity of 15 km/hr.

(iv) 15km/hr

Calculation

Average speed = total distance/ total time = (20 + 10)km / (1+1)hr = 30km/ 2hr =15km/hr.

(v) -it is a scalar quantity

-it has magnitude only (it does not have direction)

c. (i) -disturbance causing the wave is at right angle to the direction of the wave in transverse waves while in longitudinal waves, it is parallel to the direction of the wave.

-transverse waves can travel through vacuum (e.g light from the sun travels through space) while a longitudinal wave always needs a medium (e.g sound waves travel through air)

-transverse waves produce crests and troughs while longitudinal waves roduce compressions and rarefactions.

(ii) -amplitude (a)
-wavelength (λ)
-period (T)
- equilibrium (e)
-frequency (f)
-velocity (v)

2. a. isotopes are atoms of the same element with different mass numbers due to difference in number of neutrons

b. (i) 20

Calculation

Number of neutrons = mass number – atomic number = 37 – 17 = 20

(ii) 35.5 amu

Calculation

average atomic mass = total mass of all the atoms of the natural ratio / total number of atoms = (3x35+ 1x37) / 4 = 142/4 = 35.5

c. -they will be the same

-they have the same number of electrons, which determine the activity (atomic number = number of electrons).

d. (i) it is the random spontaneous disintegration of heavy atomic nucleus into lighter atomic nuclei with the emission of different types of radiation such as alpha (α), beta (β), and/or gamma rays (γ-rays), and nuclear energy.

(ii) (1) alpha particle ($_2^4He$)

(2) the mass of the decaying atom is the same as the sum of the masses of the products.

(3) helium nucleus, ^4_2He

e. gamma rays are emitted after beta or alpha decay. After beta or alpha decay, the nucleus that remains is in excited state and it is unstable. When the protons and neutrons of the unstable nucleus are rearranging themselves so that they become stable, gamma rays are emitted.

f. -in radiotherapy (treatment of cancer)

g. By using-photographic plates
-electroscope
-ionization chamber
-scintillation counter and spinthariscope
-bubble chamber
-solid-state detector
-spark counter
-Geiger Muller tube
-cloud chamber
-semiconductor

3. a. (i) it is an amount of a substance containing 6.02×10^{23} particles

(ii) 2 M

Calculation

$^{m}NaOH = 8g$, $^{V}H_2O = 100cm^3 = 0.1dm^3$. $^{n}NaOH = m/M = 8g/40gmol^{-1} = 0.2mol$. $C = n/v = 0.2mol/0.1dm^3 = 2M$

b. (i) it means the element is neutral

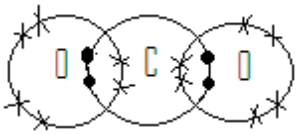
(ii) -oxidizing agent is Ag^+
-reducing agent is Cu^0

(iii) $Cu^0_{(s)} + 2e^- \rightarrow Cu^{2+}_{(aq)}$
$Ag^+_{(aq)} \rightarrow Ag^0_{(s)} + e^-$

c. (i) 14 (because it is the 14th element in the table)

(ii) K (2,8,8,1)

(iii) Dot and cross diagram of CO_2



(iv) by losing 3 electrons (electron configuration of Al is Al(2,8,3). If it loses the last 3 electrons. The configuration will be Al(2,8) noble gas configuration)

(v) as atomic number increases, charges also increase and this in turn increases the intermolecular forces.

4. a. (i) it is temperature expressed in Kelvin scale

(ii) 298.15 K

Calculation

$K = {}^{o}C + 273.15 = (25 + 273.15)K = 298.15K$

b. (i) -volume will decrease
-pressure will increase

(ii) - volume will decrease because the gas will occupy a smaller space (squeezed) after the piston has been pressed down
-pressure will decrease because there will be many particles in a smaller space, making them collide with each other and with the walls of the tube frequently

(iii) 300 Pa

Calculation

h = V/A = $9cm^3/3cm^3$ = 3cm= 0.03m, d=1g/cm^3 = 1000kg/m^3, g =10m/s^2. P = P =hdg = 0.03m x 1000kg/m^3 x 10m/s^2 = 300$kgm^{-1}s^{-2}$ = 300pa

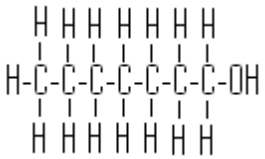
(iv) -in water supply systems
-in hydraulic machines

c. When candle wax particles are supplied with heat energy, their kinetic energy increases and this makes them vibrate vigorously. The vibrations weaken the intermolecular forces such that the particles start sliding over each other.

5. a. (i) heptanol

(ii) **general formula of heptanols** **$C_nH_{2n+1}OH$**

(iii)



b. (i) distillation

(ii) ethanol

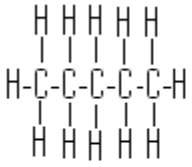
(iii) (1) the turning of sugar into alcohol by the act of an enzyme, yeast.
(2) sugar (glucose) → carbon dioxide + alcohol

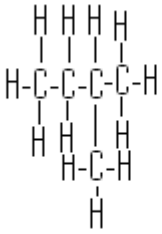
c. (i) esterification

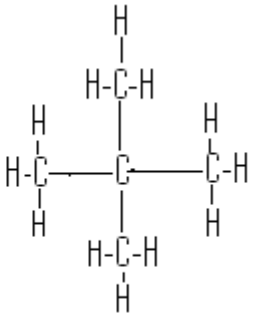
(ii) water and ethylethanoate

(iii) -food/drink flavouring
-in manufacture of perfumes

d. **isomers of pentane and names**







n-pentane **2-methylbutane** **2,2-dimethylpropane**

6. a. because their particles are in constant contact with each other which makes it possible for them to pass the heat energy from one to the other so easily.

b. (i) Bromine (melting point is below 25°C and boiling point is above 25°C)

(ii) because it has the biggest number of shells

(iii) -1

(iv) -react with metals to form metal halides
-react with hydrogen to form hydrogen halides
-react with alkanes to form halogenoalkanes
-react with alkenes to form halogenoalkanes
-are involved in displacement reactions

c. (i) -sulphur beds (in form of hydrogen sulphide,H_2S)
-metal ores (e.g copper pyrites,$CuFeS_2$; zinc blende,ZnS;e.t.c)
-natural gas
-crude oil

(ii) -vulcanizing rubber
-manufacture of matches
-manufacture of sulphuric acid
-manufacture of fungicides
-used in medicine
-used as a sterilizing agent
-manufacture of fertilizers
-manufacture of gun powder
-used in fire works

d. (i) it is a chemical formula of a substance showing the lowest ratio of atoms

(ii) CH_2O:

Calculation

Element	**% mass**	**atomic ratio**	**simplest atomic ratio**
C	40/12	3.33	3.33/3.33 =1
H	6.67/1	6.67	6.67/3.33 =2
O	53.33/16	3.33	3.33/3.33 =1

Therefore empirical formula CH_2O

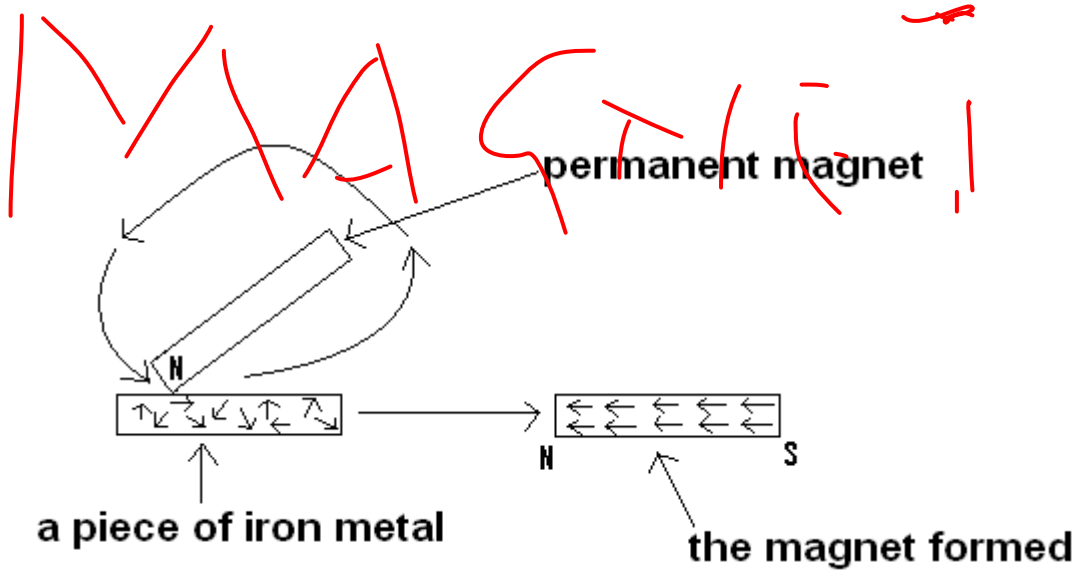
e. - covalent compounds are made up of nonmetals only while as ionic substances are made up of nonmetals and metals

- covalent compounds have low melting and boiling points while ionic compounds have high melting and boiling points.

- covalent compounds are formed by sharing of electrons while ionic compounds are formed by electrostatic combination of ions.

7. a. A piece of iron metal can be magnetized by sliding the tip of a permanent magnet over the iron metal repeatedly in one direction using the same pole (after a stroke the permanent magnet is lifted to avoid back strocking which deranges the already arranged magnetic domains in the iron metal).

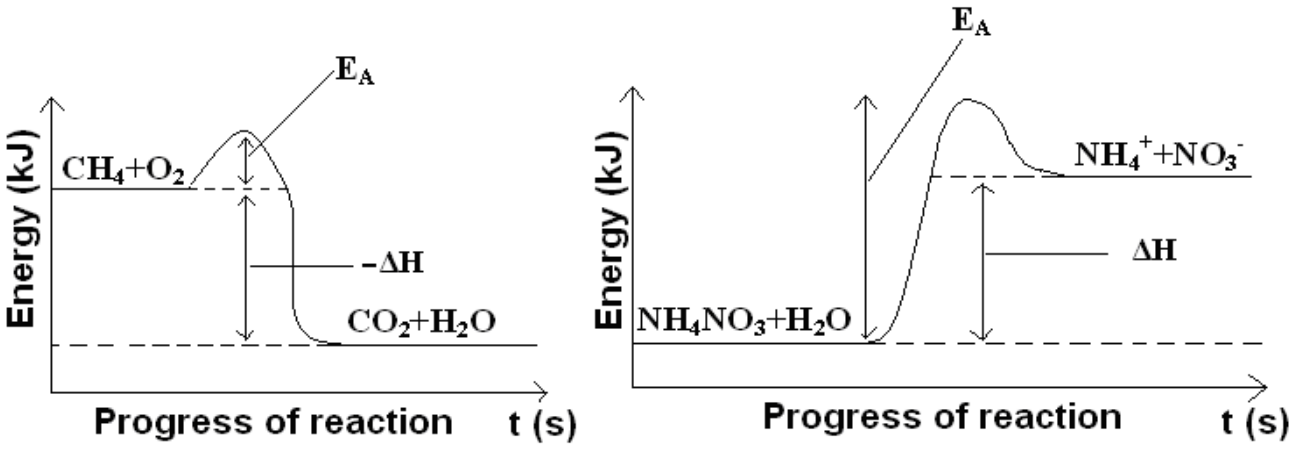
i.e.



b.(i)a step up transformer has few turns of primary coil and more of the secondary coil. When the flux spreads from
the primary coil, it cuts more secondary turns hence inducing high electromotive force into the coil. It is called
step up transformer because there is low EMF in the primary and high EMF in the secondary i.e EMF is increased
or stepped up
(ii) -by oil cooling the transformer. This is to avoid heating which increases resistance in the coil which in turn reduce
out put current
- by decreasing the distance between the primary coil and secondary coil. This is to avoid leakage of field
lines/flux.(one way is by winding the primary coil on top of the secondary coil)
-by using laminated core made of sheets, insulated from each other. This increases resistance of the core so that
eddy currents are also reduced hence avoiding sharing of field lines between the core and the coil.

8. a. an exothermic reaction releases heat energy to the surrounding while an endothermic reaction absorbs heat energy
from the surrounding

b. **for reaction between CH_4 and O_2** **for dissolving of NH_4NO_3**



c. **PREPARATION OF 250CM3 OF 1M COPPER SULPHATE SOLUTION**
Materials ; triple beam balance, hydrated copper sulphate crystals, beaker(20cm^3),

volumetric flask(250cm^3), distilled water

Procedure : a. calculate the number of moles which is going to be contained in 250cm^3 of 1M copper sulphate solution by following the steps below:

- find the percentage mass of $CuSO_4$ in the compound;

  160/250 x100% = 64%

- then find the mass of $CuSO_4$ needed for the 250 cm^3. 1M solution

  $^{n}CuSO_4$ = 1mol/l x 0.25l = 0.25mol

  $^{m}CuSO_4$ = Mn = 160g/mol x 0.25mol

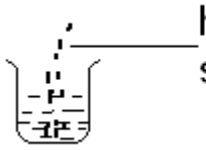
  = 40g

- if 40g is 64% of the mass of the compound , the mass of the whole compound will be found as follows;

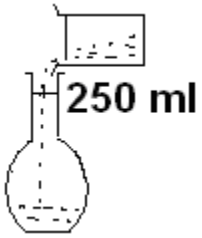
  $^{m}CuSO_4.5H_2O$ =100/64 x40g = 62.5g

b.weigh 62.5g of $CuSO_4.5H_2O$ using the triple beam balance

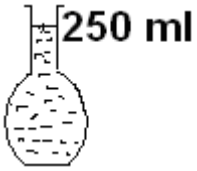
c. dissolve it using a little distilled water in a small beaker



d. transfer the solution into the 250cm^3 volumetric flask



e. add distilled water to the volumetric flask up to the mark



The solution made is a 250ml of 1M copper sulphate solution

2004

1.a. (i)

Element	Proton /s	Neutrons	Electron /s	Mass number
Hydrogen	1	0	1	1
Carbon	6	6	6	12
Nitrogen	7	7	7	14
Sodium	11	12	11	23

(ii) Sodium

(iii) Because it easily loses one electron (ionizes) to gain stability.

(iv) 16g

Calculation

C= 12, H= 1, C=1x12=12, H=4x1= 4, adding we get 12 + 4 =16g

(v)Covalent

(vi) There is sharing of electrons and only nonmetals are involved.

b. (i) $CaCl_2$

(ii) Ca atom needs to lose 2 electrons to gain stability/ Ca atom has lost 2 electrons .

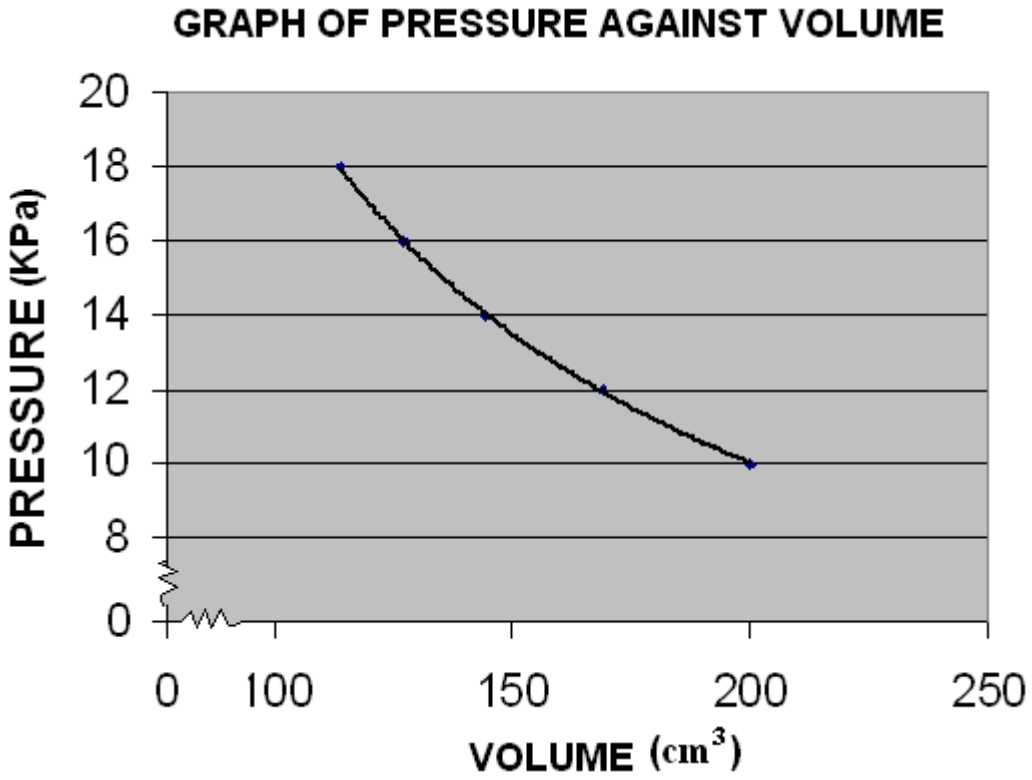
c. (i) R^{2+}

(ii) Y

(iii) Z

(iv) It is already stable since it has 8 outermost electrons.

2. a (i). graph of pressure against volume



(ii). As volume decreases pressure increases (indirect relationship)

(iii). Temperature,

b.(i).5m

Calculation

density of water =1000kgm^{-3},g =10ms^{-2}, p =50000pa. P = hdg. This implies that

h=p/ dg=50000kgm^{-1}s^{-2} / (1000kgm^{-3} x10ms^{-2}) = 5m

(ii). since liquid pressure increases with depth, the base of a dam must be made thicker to absorb the high pressure so that it does not get damaged

(iii). Mercury will exert higher pressure at the base of the jar than water because density of mercury is higher than that of water i.e there is a larger mass of mercury per unit area of the base than that of water

c.(i). manometer

(ii)25mmHg (55mmHg – 30mmHg)

(iii). 785mmHg

Calculation

pressure of the gas = atmospheric pressure + pressure due to liquid column =
755mmHg + 03mmHg =785mmHg

3a.(i).- production of carrier bags
- production of PVC pipes

(ii). For energy production in both plants and animals

b. recycling, reusing, landfilling, incineration, using biodegradable plastics and using photodegradable plastics

c.i. (1) But-2-ene / 2-butene
(2) Cyclobutane

ii. 1 and 3

d. (i) A and E (they contain hydrogen and carbon atoms only)

(ii). B and C (they are polar as water)

(iii). A and E (their boiling points are below room temperature)

(iv). There is hydrogen bonding in D which increases IMF which is not available in E

(v). ACID TEST: put a base and phenolphthalein indicator in two test tubes. Add compound C in one test tube and D
to the other. Compound C will decolorize the solution while D will not

4. a.- An ammeter is connected in series because it measures the current so it must be put where current passes while a
voltmeter is connected in parallel because it measures the pd of a particular part of the circuit. i.e. between two
points only.
- ammeter has very low (negligible) resistance such that it does not affect the flow of current while voltmeter has
very high resistance such that if connected in series it can affect the flow of current (can even break the circuit)

b. 15Ω (±5%)

Calculation

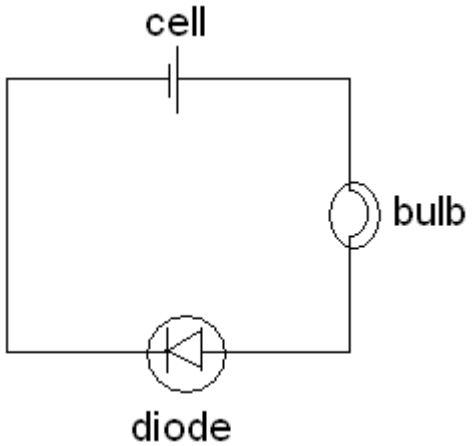
brown=1 (first digit), green=5 (second digit), black= 0 (number of knoughts), gold = (±5%)
therefore the resistance of the resistor is 15Ω(±5%)

c.(i). In electric motor, energy changes from electrical to kinetic energy while in electric generator, energy changes
from kinetic to electric energy.

(ii). -the rate at which the coil is rotated (number of turns of the coil)
-Strength of magnet
-Type of wire

d.(i) it is a material that allows current to pass through under certain conditions

(ii).



(iii). Doping is the addition of a small amount of an impurity to a semi-conductor to improve conductivity

(iv). Used as an electric switch / an electric current amplifier.

e.(i). In parallel

(ii). because when one lamp is not working the other one continues working, a thing that happens in parallel and not in series circuits.

5. a. oscillation is the repeated to and fro movement of an object from its equilibrium (rest) position tracing the same path

b.(i) . 1 speed increases

2 speed decreases

(ii). zero

(iii). Amplitude and frequency decreases as time increases.

(iv). From A to B potential energy is changed to kinetic energy

From B to C kinetic energy is changed back to potential energy

(v). when the length of a string is changed, the frequency of vibration also changes because frequency increases with decrease in length and decrease with increase in length

a. (i) 15cm

Calculation

U = 7.5cm, h_o=2cm, f= 5cm. 1/f =1/U + 1/V, 1/V= 1/f -1/U. which implies 1/V = U-f/fU.

Therefore V= Fu / U – f = (5 x 7.5) / (7.5 – 5) = 15cm

(ii) The image will be magnified, inverted and real.

(iii) M=2

Calculation

M = V/U = 15 / 7.5 =2

6a.-one should not be close to the substance (use long handlers/tongs)

- put on protective clothing

-Use minute amounts

b. **Alpha particles**

the alpha particle is represented as $^{4}_{2}He$ since it is a helium nucleus. It has a charge of +2 and it has slight penetration power to such an extent that it is stopped by a thick sheet of paper. This is so because it is relatively heavy. It is also deflected in a magnetic field due to its charge. The same charge makes it cause more ionization of air particles

Beta particles

Beta particles is also known as beta radiation. Beta particles represented as $^{0}_{1}e$ are streams of high energy electrons which are negatively charged and mass less. They have greater penetration power to such an extent that they can be stopped by a few millimeters of aluminium. They cause more ionization of air particles because they are charged. Due to the same charge, they are easily deflected in a magnetic or electric field

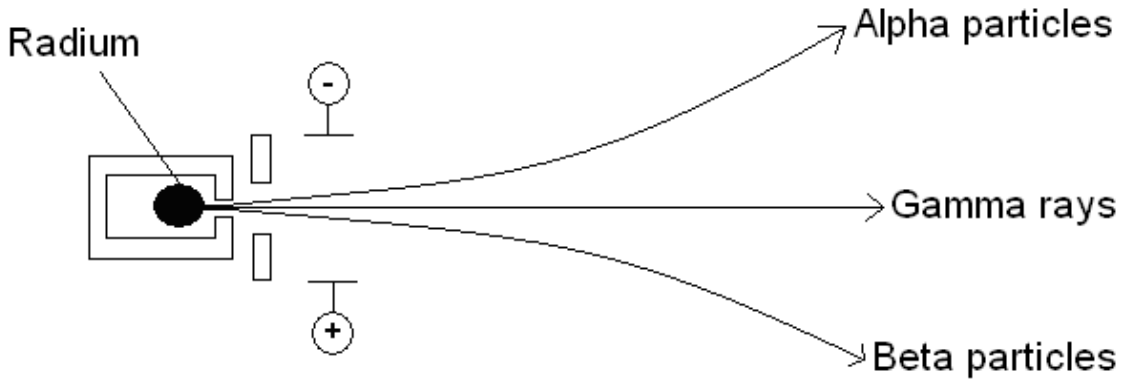
Gamma particles

Gamma rays are represented as $^{0}_{0}\gamma$. They have neither mass nor charge and they are the most penetrating. High energy gamma rays can penetrate at least 30cm of lead, 2 km of air and can be absorbed by concrete. Since they have no charge, they can not be deflected in a magnetic or electric field. Due to their neutral state, they cause very little ionization of air particles. They accompany either alpha or beta radiation e.g ceasium-137 emits beta and gamma radiation besides Barium-137

(ii). Because they are high energy waves which kill cells and have the greatest penetration power

c. (i) $^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$

(ii)



(iii) alpha particles are positively charged that is why they are attracted by negative charge, while beta particles are negatively charged that is why they are attracted by positive charges. Gamma rays are neutral that is why they are not deflected to any one of the charges

7. a. the water is evaporated and the solid salt remaining is weighed to determine its mass.the number of moles of the salt

is then found by dividing the mass of the salt by its molar mass. The concentration is then calculated by dividing the

moles by the volume in dm^3,ie $0.02dm^3$.

b. 1. measurement of the volume
2. weighing of the solid salt
3. systematic errors
4. mathematical errors

c. 8 g/l

Calculation

$C_1V_1=C_2V_2$, $C_2=C_1V_1/ V_2 = (100cm^3 \times 20g/l) / 250cm^3 = 8$ g/l

8. a. DETERMINING THE AVERAGE SPEED OF AN ATHLETE

Materials: tape measure, whistle, stop watch, the athlete.

Procedure: a. determine the distance to be covered by the athlete using the tape measure.

b. blow the whistle for the athlete to start running and start the stopwatch at once.

c. blow the whistle and stop the stop watch at once when the athlete reaches the end of the distance

d. find the speed of the athlete by dividing the distance (m) by the time(s) taken for the athlete to cover the distance

b. 1. measurement errors
2. systematic errors
3. mathematical errors
4. timing of blowing the whistle

2005

1 a. (i) It is the movement of particles from a region of high concentration to a region of low concentration.

(ii) gas

(iii) There are large spaces between gas particles, which makes it more permeable

b. (i) gas from ammonia solution

(ii) lighter substances move faster than heavier ones, and in the diagram, the gas which has moved faster is the gas from ammonia.

(iii) On a sunny day, the temperature is high and this speeds up the movement of particles hence the

HCl gas and

NH_3 gas will travel fast and this reduces time of meeting so the cloud is formed fast after they have met

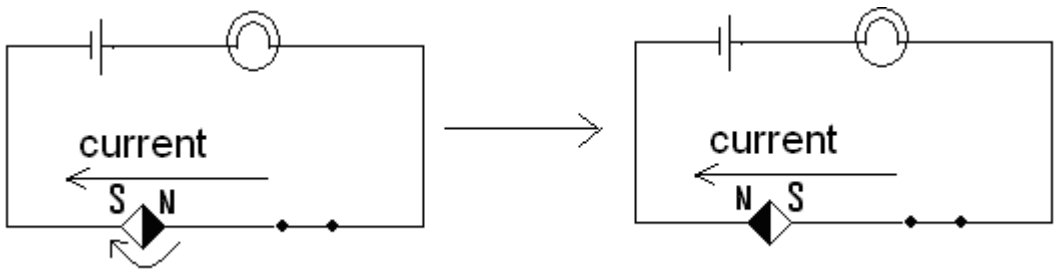
c. 12atm

Calculation

$V_1 = 6m^3$, $P_1 = 4atm$, $T_1 = 27^oC = 27+273.15 = 300.15K$, $V_2 = 3m^3$, $T_2 = 177^oC = 177+273.15 = 450.15K$, $P = ?$.

$P_2 = P_1V_1T_2/T_1V_2 = (4atm \times 6m^3 \times 450.15K) / (300.15K \times 3m^3) = 11.998atm = 12atm$

d. (i)



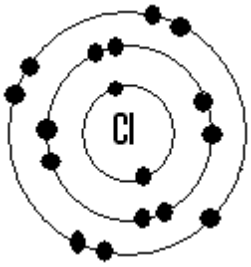
(ii) 1: the direction of the campus needle will reverse

2: there will be no effect

e. - electric bell

-relay,etc

2. a. Atomic structure of C*l*



b. (i) group 4 (X (2,8,4) the last number represents group)

-Because the element has four electrons in its outer most shell

(ii) Si

c. (i) Al_2O_3

(ii) ionic bond because it involves a metal and a non-metal

d. are different physical forms of an element in the same state with different chemical properties.

e. rhombic sulphur and monoclinic sulphur.

f. (i) chlorine

(ii) Iodine and bromine

g. (i) when going down the group, size increases and charges also increase. When charges increase, attractive forces(IMF) also increase hence it becomes harder to separate them, in other ways, melting and boiling points are high.

(ii) nothing would happen because bromine is more reactive than iodine as such iodine can not displace bromine in

solution

3 a. An acid is a proton donor

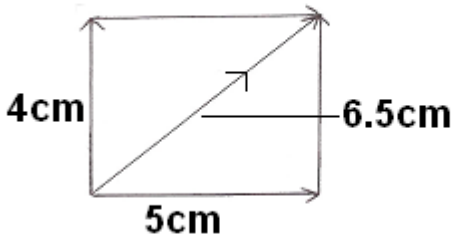
b. (i) phenolphthalein is used as an indicator to detect the end point of the reaction.
(ii) sodium hydroxide was the standard solution. This is because its concentration was known.
(iii) $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$
(iv) 0.25M

Calculation

$C_1V_1/n_1 = C_2V_2/n_2$, $C_1 = n_1C_2V_2/n_2V_1 = (1 \times 0.2M \times 25cm^3) / (1 \times 20cm^3) = 0.25M$

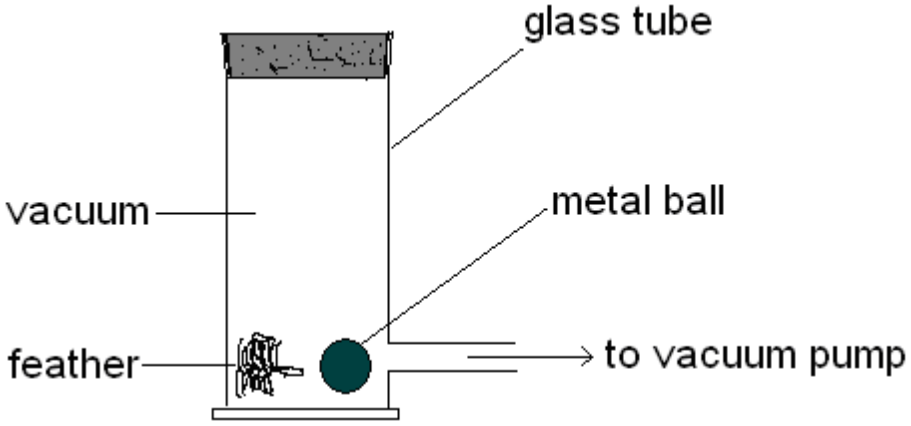
4. a. **scale diagram**

Scale : 1cm to 10N



Therefore, the resultant = 6.5cm x 10N/cm

b. (i) weight
(ii) downward
(iii)



(iv) because their acceleration will be the same. Mass will have no effect on the acceleration.

c. (i) 1.25g

Calculation

$t_{½} = 3hrs$, $N_o = 20g$, $t = 12hrs$. $N_t = (½)^{t / t_{½}} N_o = (½)^{12/3} \times 20g = (½)^4 \times 20g = = (1/16) \times 20g = 1.25g)$

(ii) radioisotopes of short half lives would be preferred since one would not want something radioactive hanging around for a long time(it may have hazardous effects to other things). It has to do its work and disappear.

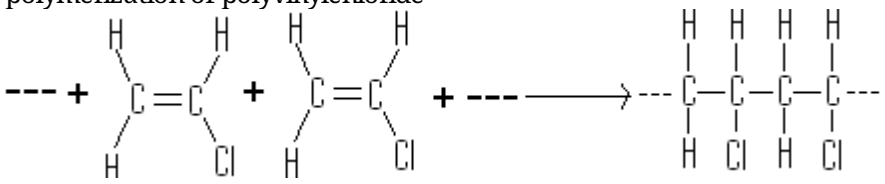
(iii) it is used to generate electric power which is used to operate important machines in industries

d. (i) because they are atoms of the same element (have same atomic number), hence the same number of electrons which determine reactivity

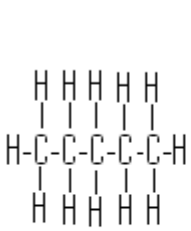
(ii) isotopes
(iii) period three (electron configuration, Y(2,8,7).The number of figures represents period i.e 3)
(iv) because they have three shells.

5.a (i) 1. CO_2
2. distillation
3. oxidation
(ii) potassium dichromate/potassium permanganate
(iii) it functions as an oxidizing agent

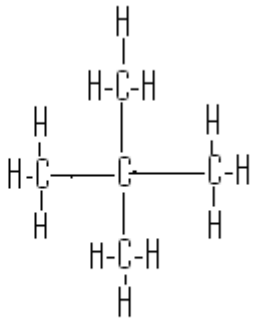
b. (i) 2-methylbutane
(ii) C ; because it is polar and the proportion of -OH is bigger.
(iii) A, D and E
(iv) E, because it is small
(v) polymerization of polyvinylchloride



(vi) addition polymerization
(vii) Production of PVC pipes
(viii) gas
(ix) bromine test: add few drops of bromine to E and to D. D will decolorize the bromine while E will not.
(x) isomers of A



n-butane



2,2-dimethylpropane

c. - they can be easily recycled (can be easily moulded)
- they are flexible
- they can be easily colored (using dyes)

6. a. transverse wave
b. 0.12m

Calculation

S = 60cm = 0.6m, λ = distance / number of waves = 0.6m / 5 = 0.12m

c. 4Hz

Calculation

f = number of cycles / time = 4cycles / 1s = 4Hz. Four crests means 4 cycles.

d. 0.48m/s

Calculation

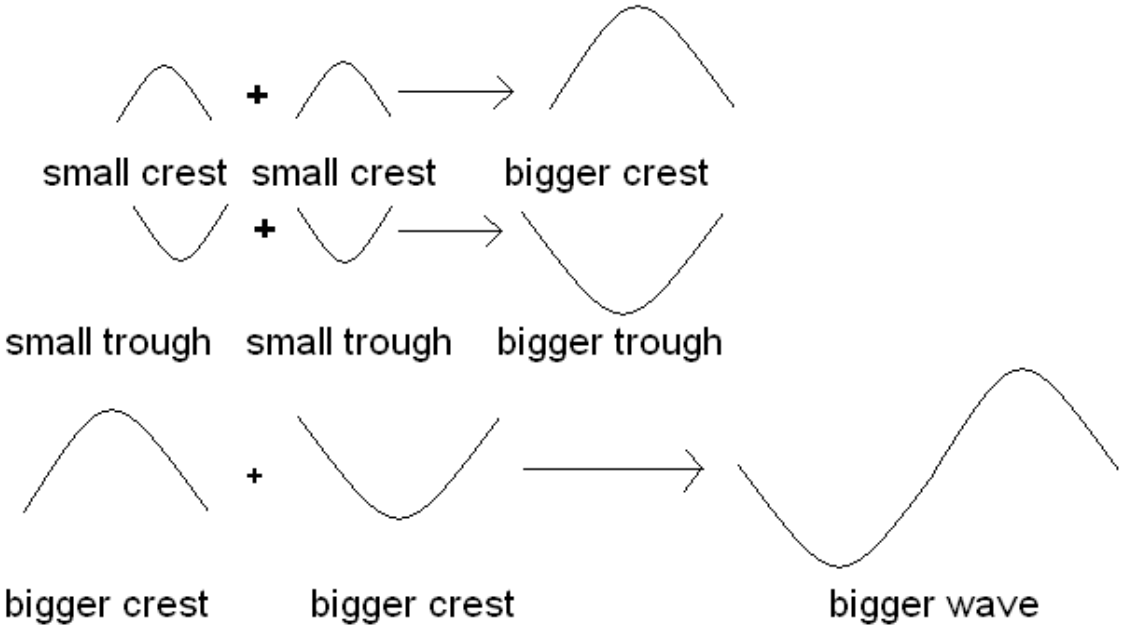
V = f λ = 4Hz x 0.12m = 0.48m/s

e. the wave length decreases

f. because the amplitude is larger in deep water due to absence of obstacles in a considerable distance downwards.high pressure down the water makes the trough to be pushed forward a long distance. There is a shorter distance

downwards in shallow water hence amplitude is small, and the low pressure in the shallow water pushes the trough
forward a short distance

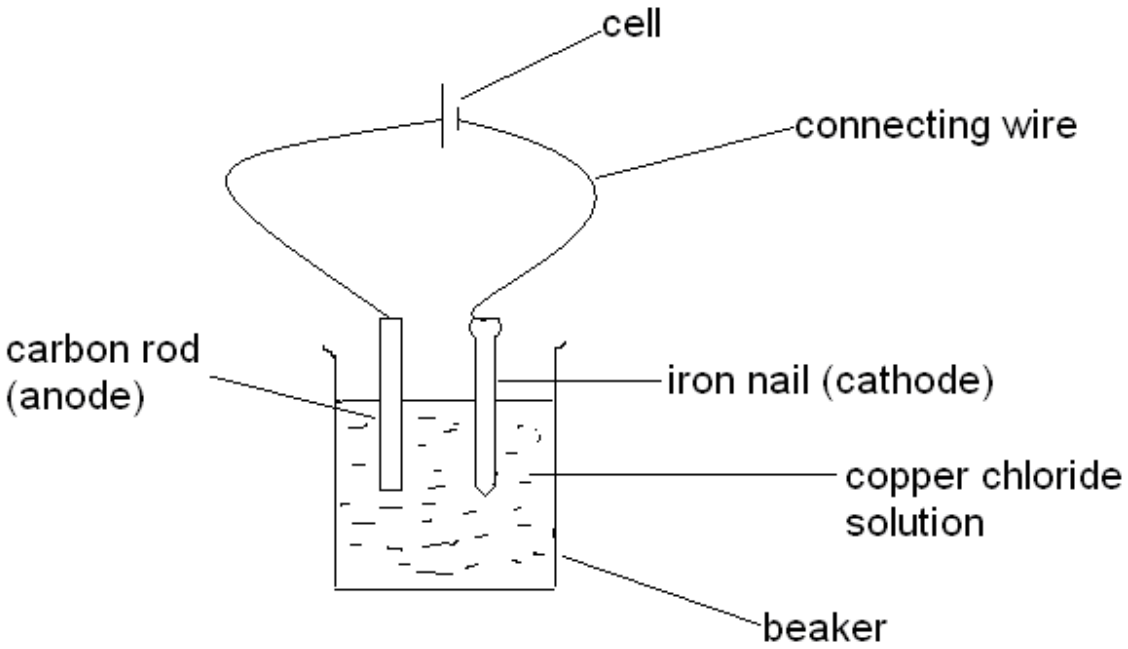
g. when crests of two waves meet they reinforce each other to form a bigger crest and when the troughs of two waves
meet they also reinforce each other to form a bigger trough. When a bigger trough and crest are formed a bigger
wave is formed
i.e



h.- longitudinal waves have rarefactions and compressions while transverse waves have troughs and crests
- disturbance causing the wave moves perpendicular to the direction of the wave in transverse waves while in
longitudinal waves, it moves parallel to the direction of the wave.
- some transverse waves can travel through vacuum while no longitudinal wave can travel through the vacuum

i. transverse waves

7. a.



b. electroplating is the process in which a metal is used to coat a metal. In this case, the metal to be coated is iron nail

and the metal to be used in coating is copper. The solution used as an electrolyte is copper chloride. The iron nail

which is made of cathode, receives electrons from the negative terminal of the cell or battery, hence it is negatively

charged. Copper ions in solution (positively charged) will be attracted to the iron nail (cathode) where it will receive

the electrons to be reduced i.e. $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu^0(s)$. the copper atoms(s) will then coat the iron nail (electroplating).

At the anode, the chloride ions in solution will preferentially lose electrons to the anode (the electrons which move to

the external circuit), i.e. they become oxidized according to the equation, $2Cl\text{-}(aq) \rightarrow Cl_{2(g)} + 2e^-$. The chlorine gas

will thus escape from the beaker

8. a. 30 kw

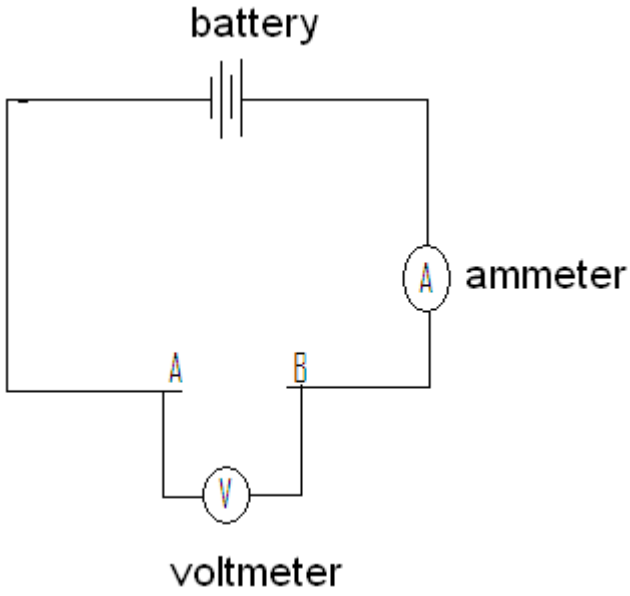
Calculation

$P = 6KW,\ R = 3\Omega,\ V = 300V.\ P = V^2/R = 300^2/\ 3 = 90000 / 3 = 30000\ W = 30KW$

b. **INVESTIGATING THE EFFECT OF LENGTH ON RESISTANCE**

Materials : nichrome wire (100cm), Ammeter, Voltmeter, connecting wires(5), cells (2)

Procedure : a. set up the apparatus as shown below



b.measure the 80cm nichrome wire and connect it on the gap AB
c.read the voltmeter and ammeter and record the readings in the table of results
d. repeat steps (b) and (c) for lengths 60cm, 40cm and 20cm

TABLE OF RESULTS

Length of wire(cm)	Voltmeter reading	Ammeter reading	Resistance
80			
60			
40			
20			

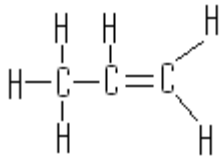
If the resistance changes when the length of wire is changed, it means that the length of a wire affects its resistance. Expectedly, the resistance will increase as the length of the wire increases. This is so because the moving electrons in the wire will meet more obstances (cations) in the longer wire than in the shorter wire.

To visualise the relationship clearly, a graph of length of nichrome wire against the resistance can be drawn.

2006

1. a. (i) Q:Alkanes
S: Carboxylic acids / alkanoic acids
(ii) P and Q (they contain carbon and hydrogen atoms only)

(iii)

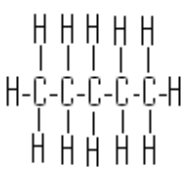


(iv) propene

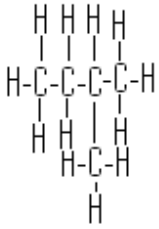
-By using solubility test for members with less than 5 carbon atoms

-By using sodium test. R will react with sodium while Q will not.

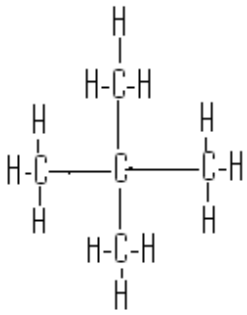
b. (i) **Structural isomers of pentane**



n-pentane



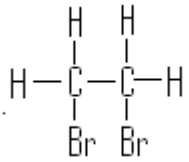
2-methylbutane



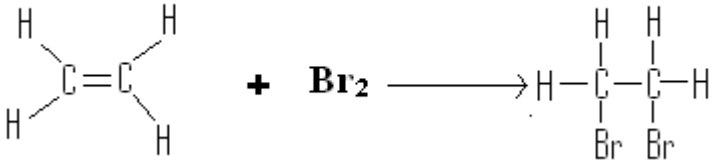
2,2-dimethylpropane

(ii) 1. n-pentane
2. 2-methylbutane
3. 2,2-dimethylpropane

c. (i)



i.e.



(ii) dibromoethane

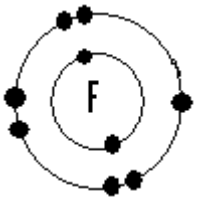
(iii) -they are used in the manufacture of PVC pipes
-they are used in the manufacture of alkanols
-they are used in the manufacture of alkanes
-haloalkanes

2.a. (i) LiBr, NaBr or KBr
(ii) LiCl, NaCl or KCl
(iii) LiI, NaI or KI

b. -brittle
-insulators
-low melting and boiling points (melting and boiling points increase with increase in size)
-darken in colour with size

-decrease in reactivity with size
-increase in density with size
-bad conductors of heat
-react vigorously with alkali and alkaline earth metals
-exist as diatomic molecules
-form molecular compounds with other nonmetals

c. fluorine atom

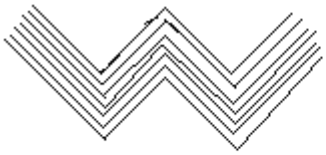


d. I, Br and Cl

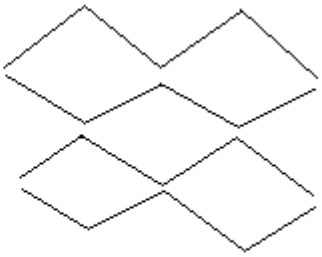
e. Chlorine is the most reactive because it has the smallest radius, which makes it easier for an electron to be attracted since the attractive forces between the nucleus and the outermost shell is great. The iodine is the least reactive because there are the weakest attractive forces between the nucleus and the outermost shell, which makes it harder to attract an electron. Bromine is intermediate.

f. -react with oxygen to form sulphur dioxide
-react with metals to form metal sulphides e.g $Mg + S \rightarrow MgS$
- react with hydrogen to form hydrogen sulphide (H_2S)

g.



rhombic sulphur



monoclinic sulphur

As shown in the diagrams above, in monoclinic sulphur, molecules are spacely packed as such, it is easy to separate the molecules. While in rhombic sulphur, the molecules are more spacely packed as such they are more stable hence it becomes difficult to separate them

3. a it is the nuclear reaction in which a heavy nucleus splits into lighter nuclei and in the process releasing energy

b. protons and neutrons

c. (i) A: gamma rays
B: alpha particles
(ii) because it is big and heavy

d. (i) X: Alpha particles
Y: gamma rays
Z: beta particles
(ii) because it is negatively charged

e. $33.5g/cm^3$ or $13300kg/m^3$

Calculation

P =101000Pa, h = 0.76m, g =10m/s^2, p= hdg hence d = p / hg =
101000 kg $m^{-1}s^{-2}$ / (0.76m x10ms^{-2}) = 13289.5kgm^{-3} = 13300kgm^{-3} = 13.3gcm^{-3}

e. (i) 25000 Pa

Calculation

F= 50N, A = 20cm^2 = 0.002m^2, P= F / A =50N / 0.002m^2 = 25000Pa

(ii) 25000 Pa (P on piston A is equal to P on piston B because pressure from the out side is transmitted through the liquid)

4.a. (ii) X: Battery

(ii) 15Ω

Calculation

R_T = [30 x (10+20)] / [30 +(10+20)] =15Ω

(iii) 0.2A

Calculation

V_T = IR = 0.4A x 15Ω = 6V, $I_{(30Ω)}$ = V / R = 6V / 30Ω = 0.2A

(iv) 2V

Calculation

$I_{(10\ Ω)}$ = 0.4A -0.2A = 0.2A, $V_{(10Ω)}$ = IR= 0.2A x 10Ω = 2V

b.(i) it is the electrical energy used by a 1 kilowatt appliance in 1 hour

(ii) 1.5 KWH

Calculation

P = 150W = 0.15KW, t =10hrs. total energy used = Pt = 0.15KW x 10hrs = 1.5KWhrs

(iii) K15.00

Calculation

total time = 2 x 10hrs = 20hrs. P = 0.15KW, total energy used = Pt = 0.15KW x 10hrs
=3.0kwh. Cost = 3.0kwh x K5.00 / kwh = K15.00

5 a (i) hydronium ion / hydrogen ion (H_3O^+ / H^+)

(ii) because it produces few hydrogen ions in water as compared to hydrochloric acid

b. 20Cm^3

Calculation

$C_1V_1 = C_2V_2$, $V_2 = C_1V_1 / C_2$ = (20cm^3 x 0.1M) / 0.1M = 20cm^3

c.(i) the reaction is reversible

(ii) 1. $HSO_4^-{}_{(aq)} + H_2O_{(l)} \quad H_3O^+{}_{(aq)} + SO_4^{2-}{}_{(aq)}$

2. $H_3PO_{4(aq)} + NH_{3(l)} \quad NH_4^+{}_{(aq)} + H_2PO_4^-{}_{(aq)}$

d.(i) Copper will not react with magnesium sulphate solution

(ii) magnesium is more reactive than copper hence it can not be displaced

(iii) Na

(iv) because it loses electrons readily and has little tendency to gain electrons

e. (i) 1.$Ag^+{}_{(aq)} + e^- \rightarrow Ag_{(s)}$

2. $Na_{(s)} - e^- \rightarrow Na^+{}_{(aq)}$

(ii) reducing agent: Na

Oxidizing agent: Ag^+

6 a. it is an increase in velocity.

b. (i) 5m/s^2

Calculation

$a = (V-U) / t = (60-80)ms^{-1} / 4s = -20ms^{-1} / 4s = -5ms^{-2}$, hence deceleration is $5ms^{-2}$

(ii) 16s

Calculation

$a = (V-U) / t$, $-5ms^{-2} = (0-80)ms^{-1} / t = -80ms^{-1} / t$,

$t = -80ms^{-1} / -5ms^{-2} = 16s$

c. (i) 0.4 m

Calculation

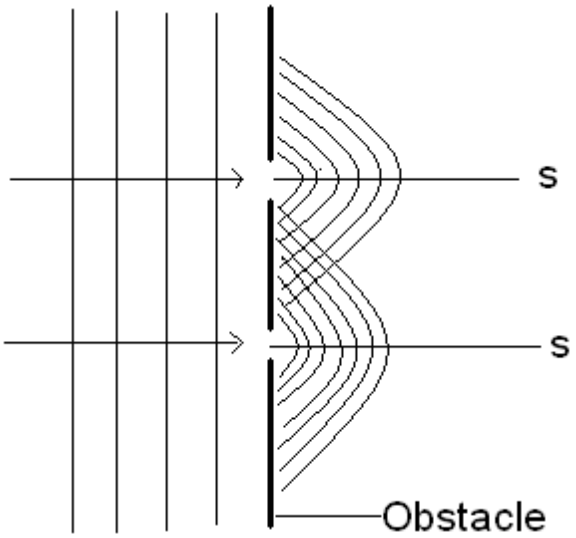
λ = distance / number of cycles = 1.8m / 4.5cycles = 0.4 m/cycle

(ii) 4 m/s

Calculation

f = number of cycles / time = 20 cycles / 2s =10cycles / s, $V = f\lambda$ = 10cycles/s x 0.4m/cycle = 4 m/s

d. (i)



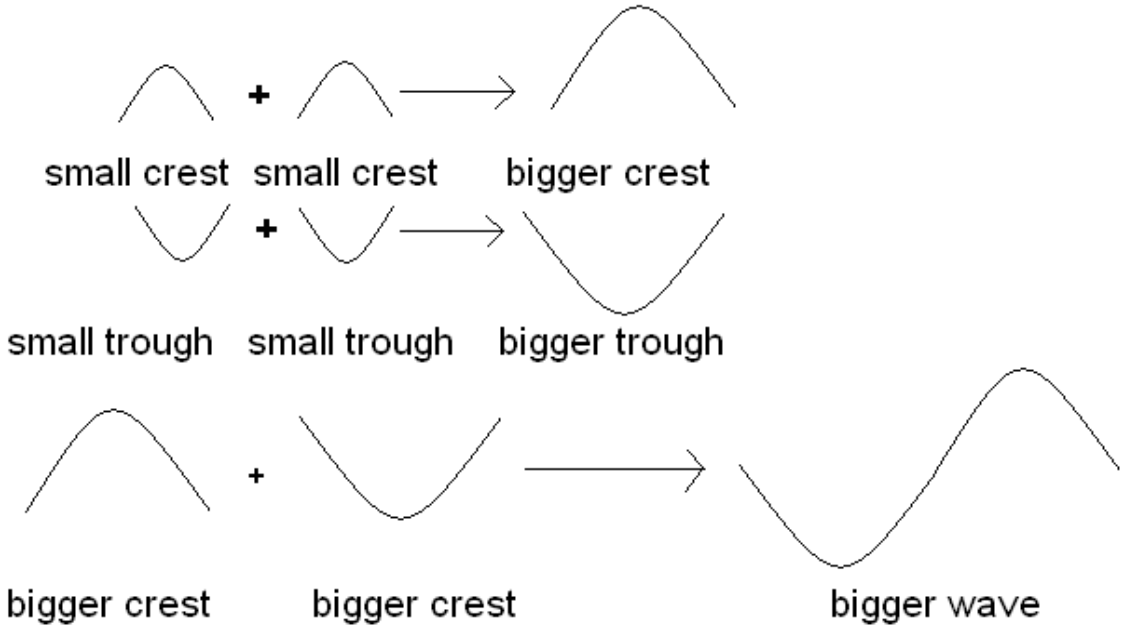
(ii) - diffraction
- interference

(iii) there would be less curving of the waves (wide spreading)

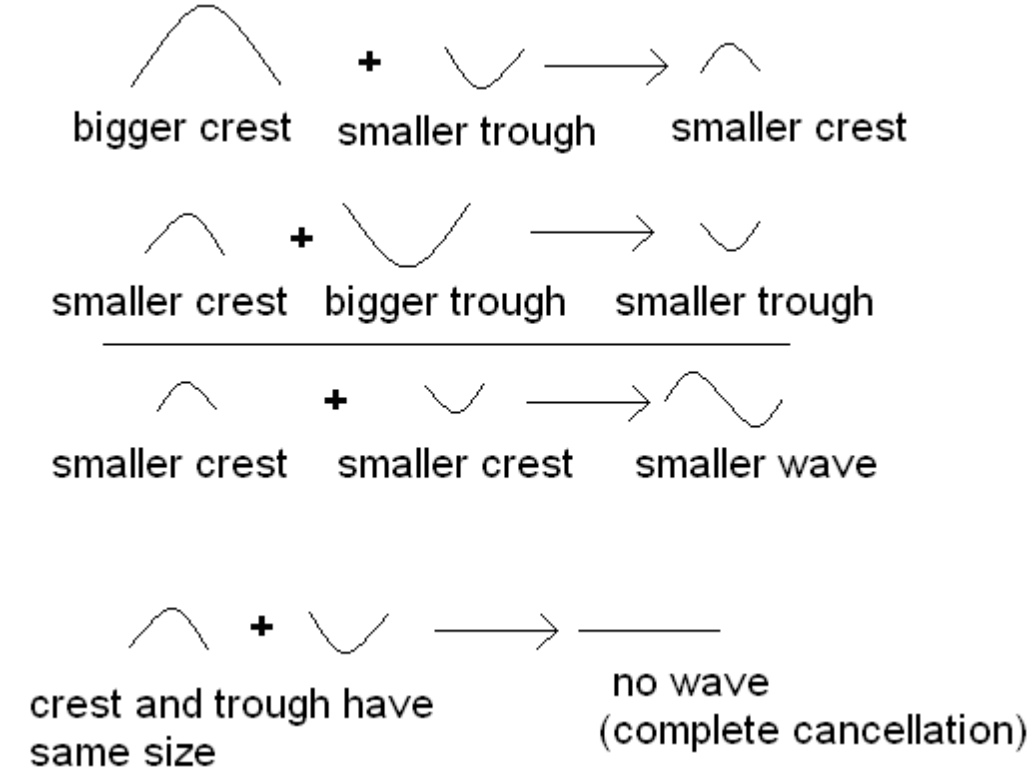
7.a since different radiation have different penetration powers, the thickness of plastics can be determined by the degree of penetration of a certain radiation e.g. beta particles.

b. constructive interference occurs when two crests or two troughs from different waves meet and destructive interference occurs when a crest from one wave meets a trough of another wave.

CONSTRUCTIVE INTERFERENCE .



DESTRUCTIVE INTERFERENCE



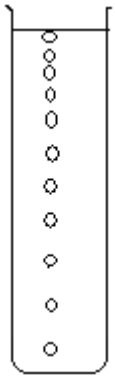
8. a. just after being released into the oil, the ball accelerates i.e. weight > friction + upthrust. It then suddenly starts

decelerating i.e. weight < friction + upthrust until the downward and upward forces (weight and friction + upthrust)

equal each other and at this point the ball moves with constant velocity known as terminal velocity. The ball

continues to move with terminal velocity until it reaches the bottom of the tube. The diagram below

shows what happens.



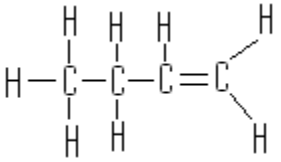
b. **Deriving a formula to show the dependence of liquid pressure on its density and depth.**

Density, d = m/v ----------(i)
Rearranging, m = dv ----------(2)
Force, F = ma ----------(3)
Subst. (2) into (3), F = dva ----------(4)
Volume, V = hA ----------(5)
Subst. (5) into (4), F = dhAa ----------(6)
Pressure, P = F/A = dhAa/A = dha
Note that **a** in the formula is acceleration due to gravity which is represented by g, hence Pressure, P = dhg
Since acceleration due to gravity for any liquid is constant, the pressure depends on depth, here in represented by **h,** and density of the liquid.

2007

1. a. (i) addition polymerization
(ii) the double bonds in ethene molecules break creating a provision for other species to bond with them. They however bond with each other to form a long chain of the ethane molecules known as poly(ethene) popularly known as polythene
(iii) - polytetrafluoroethene (PTFE) / Teflon
- polythene
- polyvinylchloride (PVC)
- nylon
- perspex
- polystyrene
- acrilan
- Terylene (a polyester)

b. (i) A
(ii) B and E
(iii) because it contains free ions
(iv)



(v) butene

c. (i) - when heated, thermosetting polymers decompose while thermoplastic polymers soften.
- thermoplastic polymers can easily be recycled while thermosetting polymers can not.

- thermosetting polymers are made of cross-linked chains while in chermoplastic polymers, there is no cross-
linking.

(ii) - incineration
- recycling
- landfilling
- reusing
- using biodegradable plastics
- using photodegradable plastics

(iii) -they can be used as insulators while metals can not
-they can be easily recycled than metals
-plastics do not corrode but metals do / they are relatively non reactive
-plastics can be used to produce light, easy to carry, products while metallic products are heavier.
- plastics are cheaper than metallic products
- plastics can be easily dyed bright colours than metals

2. a. - mass on end
- material of spring i.e. force constant of the spring.

b. (i) crest

(ii) 0.5 Hertz

Calculation

f = 1 cycle / 2s = 0.5 cycle / s = 0.5 Hertz

(iii) 25 m/s

Calculation

$V = f\lambda = 0.5 / s \times 50 m = 25 m/s$

c. (i) **SIMILARITIES**
- both have light sensitive parts. Retina in the eye and film in the camera.
- both use converging lenses
- both have black inside surfaces

DIFFERENCES
- focal length of the lens of a camera is fixed while that of an eye changes.
- the camera is normally closed except when taking pictures while an eye is normally open.
- for a camera, image distance changes but for an eye it does not change.

(ii) To allow light to enter the camera

f. (i) 30 cm

Calculation

U = 15cm, f = 10cm, V = ?. $1/f = 1/U + 1/V$, $1/V = 1/f - 1/U$, $V = Fu / (U-f) = (10 \times 15) / (15-10) = 150 / 5 = 30cm$

(ii) 2

Calculation

$M = V/U = 30cm / 15 cm = 2$

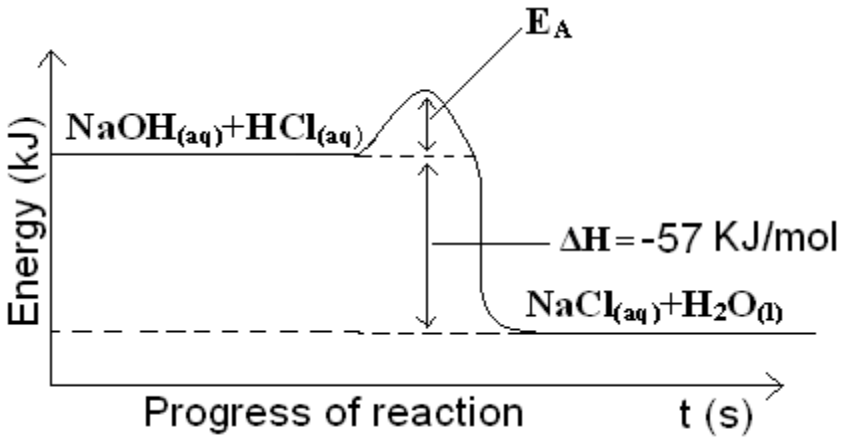
(iii) -inverted
-real
-magnified

3. a. (i) It is a substance that ionizes completely in water to produce $OH^-_{(aq)}$ ions.

(ii) $NH_{3(l)} + H_2O_{(l)} \rightarrow NH_4^+{}_{(aq)} + OH^-_{(aq)}$

(iii) H_2O / OH^-
NH_4^+ / NH_3

b. (i) **Energy Level Diagram**



(ii) exothermic
(iii) because it releases heat energy to the surroundings i.e. ΔH is negative.
(iv) (aq) means aqueous and (*l*) means liquid

c. (i) 0.002 mol

Calculation

m = 300mg = 0.3g , M = 180gmol^{-1}, n = m/M = 0.3g / 180gmol^{-1}
= 0.00166mol = 0.002 mol.

(ii) 0.2M

Calculation

V = 10ml = 0.01 *l*, n = 0.002 mol. C = n / V = 0.002mol / 0.01*l* = 0.2mol/*l* = 0.2M

4. a. (i) 120Ω

Calculation

V = 240v, I = 2A. R = V/I = 240v / 2A = 120 Ω

(ii) 480 watts

Calculation

P = VI = 240v x 2A = 280 watts

(iii) k 7.20

Calculation

t = 3hrs, cost / kwh = k5.00, P = 480w = 0.48 kw, total energy used = 0.48kw x 3h
= 1.44kwh, total cost = 1.44kwh x k5.00 / kwh = k7.20

b.(i) - alternating current is easily stepped up or down while direct current is not easily stepped up or down

- line loses for are easily minimized when AC is used than when DC is used for a given wattage delivery and wire diameter.
- Alternating current can be used to produce a changing flux in a transformer to induce EMF which gives rise to alternating current in the secondary coil. DC can not be used to do the same, hence it can not be used to induce EMF in a practical transformer.

(ii) 1. eddy currents
2. leakage of field lines/flux
3. resistance of wire windings

(iii) 1. laminating the iron core and using a core of high resistance
2. proper designing of the transformer
   i. decreasing the distance between the primary and secondary coils
   ii. Winding the primary coil on top of the secondary coil
3. using a coolant in the transformer

c. (i) S_1 closed, S_2 open - the ammeter reading will be 3A

Calculation

I = V/R = 12v / 4Ω = 3A
- voltmeter reading will be 12v (voltage in parallel is the same)

(ii) there will be no change

(iii) voltage in parallel is always the same.

5. a. (i) F

(ii) C and D

(iii) because they can easily lose the 2 outermost electrons other than gaining 6 for them to be stable.

(iv) D

- it is non-reactive
- it is a colourless gas at room temperature
- it exists as a monoatomic molecule
- it has very low density
- it has very low melting and boiling points
- it does not conduct heat
- it does not conduct electricity

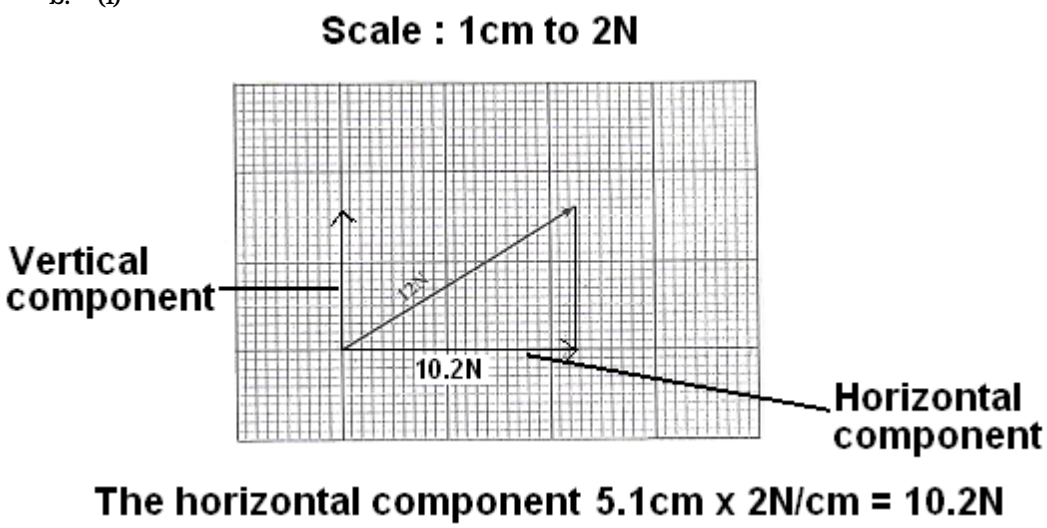
b. (i) From A to B the car accelerated uniformly and then decelerated uniformly from B to C before it started moving at a constant speed to D.

(ii) 1000m

Calculation

$S = [(V + U) / 2] t = [(75m/s + 25m/s) / 2] x 40s = 50m/s x 40s = 2000m$

b. (i)



(ii) 10.2N

6. a. -liquid pressure increases with depth

- pressure at one depth acts equally in all directions
- a liquid finds its own level.
- pressure exerted on a contained liquid is transmitted undiminished throughout the liquid, acting in all directions and perpendicular to tne walls of the container.

b. 200 Pa

Calculation

$d = 1gcm^{-3} = 1000kgm^{-3}$, $h = 20cm = 0.2m$, $g = 10ms^{-2}$. $P = dhg = 1000kgm^{-3} \times 0.2m \times 10ms^{-2} = 2000kgm^{-1}s^{-2} = 2000Pa$

c. - hydraulic brakes

- hydraulic jacks
- hydraulic fork lift truck

d. (i) it is temperature expressed in Kelvin scale.

(ii) 272.85 ^0C

Calculation

$^oC = K - 273.15 = 546 - 273.15 = 272.85K\ ^oC$

e. (i) Magnesium (Mg) and Aluminium (Al)

(ii) Mg and Al are more reactive than zinc (they are higher in the reactivity series)

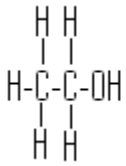
f. (i) $2AgNO_{3(aq)} + Mg_{(s)} \rightarrow 2Ag_{(s)} + Mg(NO_3)_{2(aq)}$

(ii) reducing agent : $Mg_{(s)}$ (it is oxidised)

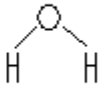
Oxidizing agent : $Ag^{+}_{(aq)}$ (it is reduced)

7. a. **STRUCTURES OF ETHANOL AND WATER**

ETHANOL



WATER



b. The boiling point of water will be higher than that of ethanol because the ratio of -OH, which is responsible for hydrogen bonding is greater in water than in ethanol. The hydrogen bonding increases the strength of intermolecular forces.

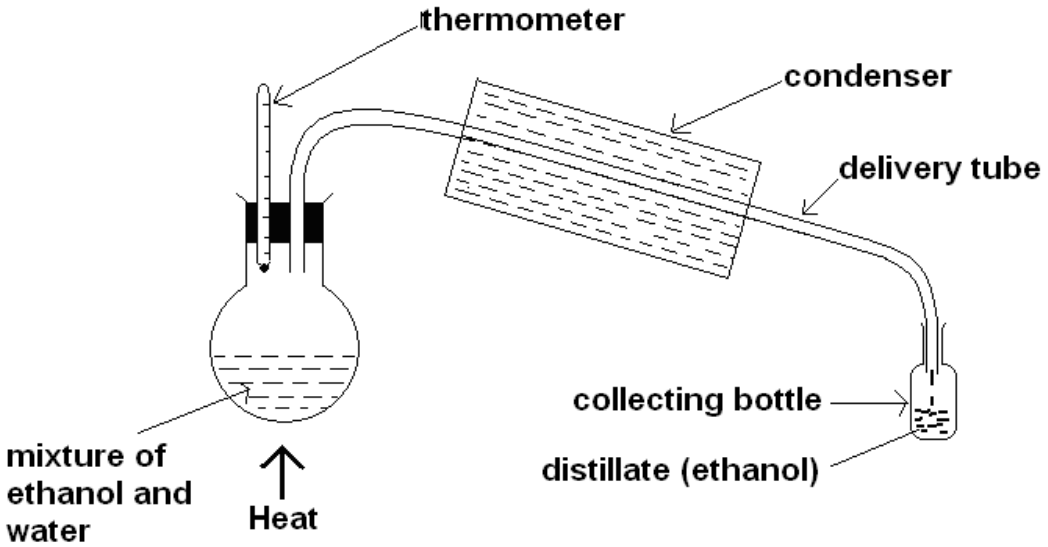
c. SEPARATING A MIXTURE OF ETHANOL AND WATER

MATERIALS: source of heat, wire gauze on a stand, flask, the mixture of ethanol and water, 2-holed stopper, thermometer, delivery tube, condenser, collector bottle.

PROCEDURE: a. put the mixture into the flask.

b. stopper the flask and fix the thermometer and the delivery tube in the holes of the stopper.

c. direct the delivery tube into the collector bottle through the condenser as shown below.



d. apply heat onto the flask until all the alcohol is vapourised, condensed and collected in the collector bottle. When the thermometer reads just above 78°C, all the alcohol is gone and what is remaining is water only.

8. **Alpha particles**

the alpha particle is represented as $^{4}_{2}He$ since it is a helium nucleus. It has a charge of +2 and it has slight penetration power to such an extent that it is stopped by a thick sheet of paper. This is so because it is

relatively heavy. It is also deflected in a magnetic field due to its charge. The same charge makes it cause more ionization of air particles

Beta particles

Beta particles is also known as beta radiation. Beta particles represented as $^{0}_{1}e$ are streams of high energy electrons which are negatively charged and mass less. They have greater penetration power to such an extent that they can be stopped by a few millimeters of aluminium. They cause more ionization of air particles because they are charged. Due to the same charge, they are easily deflected in a magnetic or electric field

Gamma particles

Gamma rays are represented as $^{0}_{0}\gamma$. They have neither mass nor charge and they are the most penetrating. High energy gamma rays can penetrate at least 30cm of lead, 2 km of air and can be absorbed by concrete. Since they have no charge, they can not be deflected in a magnetic or electric field. Due to their neutral state, they cause very little ionization of air particles. They accompany either alpha or beta radiation e.g ceasium-137 emits beta and gamma radiation besides Barium-137

2008

1. a. (i) 19 (atomic number)

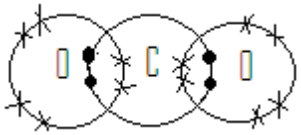
(ii) The reaction, $X + H_2O \rightarrow XOH + H_2$, would take place.

(iii) X has one electron in its outermost shell, hence it is an alkali metal, and alkali metals react with water to give an alkaline solution and hydrogen gas.

b. (i) magnesium: 2
chlorine : 1

(ii) $MgCl_2$

c. (i)



(ii) Covalent

(iii) Because there is sharing of electrons and it involves nonmetals only.

d. (i) B

(ii) a filament has to resist high temperature, hence it should have a high melting point

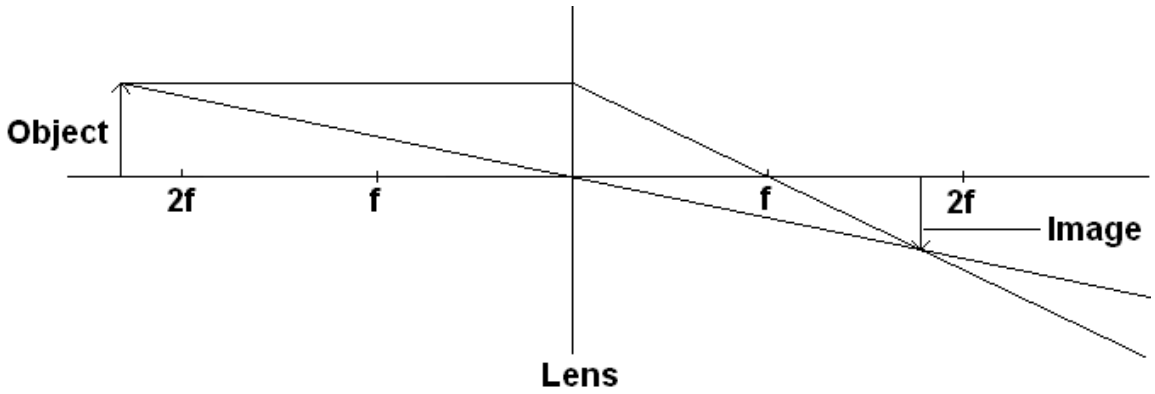
e. (i) C, H_2O and SO_2

(ii)
- used in car batteries
- used in the manufacture of fertilizers
- used as a dehydrating agent
- used to manufature SO_2

2. a. (i) It is the distance between the optical center of the convex lens and the focal point.

(ii)
- using rough method
- using lens formula
- using graph method
- using mirror method

(iii)



Position of the image: between f and 2f

b. (i) 10 cm (distance AB or BC)

(ii) B

(iii) At A, there is zero kinetic energy and maximum potential energy. From A to B, potential energy decreases while kinetic energy increases and at B, there is zero potential energy and maximum kinetic energy. From B to C, potential energy inceases while kinetic energy decreases, and at C, there is zero kinetic energy and maximum potential energy.

(iv) Some energy is being converted, gradually, into heat and sound energy due to friction.

3. a. It is the union of light nuclei to form heavier ones and in the process releasing heat and gamma radiation.

b. (i) Helium and neutron

(ii) Fusion

c. (i) stage 1: Alpha particles (there is a decrease in mass by 4, which is the mass of helium)
stage 2 : beta particles (there is no change in mass but an increase in atomic number which means a neutron has lost an electron to become a proton)

(ii) gamma rays and heat

d. 1. putting on protective clothing
2. avoid closeness to the substance i.e use long tongs, forceps, etc
3. using minute amounts

e. 4 minutes

Calculation

$N_t = (½)^{t/t½} N_o$, $t_{1/2} = [t \log (1/2)] / \log (N_t / N_O) = (16 \times -0.301) / \log (8/128) = -4.816 / \log 0.0625 = -4.816 / -1.204 = 4$ minutes

f. 11.25 g/ cm^3

Calculation

$C_1 = 15g / cm^3$, $V_1 = 60cm^3$, $V_2 = 80cm^3$, C_2 ? $C_1V_1 = C_2V_2$, $C_2 = C_1V_1/V_2 = (15gcm^{-3} \times 60cm^{-3}) / 80cm^{-3} = 11.25gcm^{-3}$

g. C_2H_6O

Calculation

element	mass(g)	number of moles(m/M)	simplest mole ratio
C	48	$48g/12gmol^{-1} = 4mol$	4mol / 2mol = 2
H	12	$12g/1gmol^{-1} = 12mol$	12mol / 2mol = 6
O	32	$32g/16gmol^{-1} = 2mol$	2mol / 2mol = 1

The ratio C: H:O = 2: 6: 1 hence the empirical formular is C_2H_6O

4.a. (i) step-down transformer

(ii) there are more turns in the primary than in the secondary

(iii) 11.5 V

Calculation

Np = 1000, Ns = 50, Vp = 230v, Vs ? Vs/Vp = Ns/Np, Vs = NsVp/Np = 50 x 230v / 1000 = 11.5v)

b. (i) – they are materials that allow current to pass through under certain conditions.

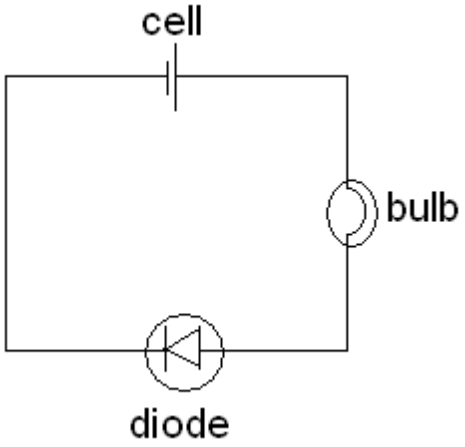
(ii) raising temperature of a semiconductor provides enough energy for electrons to Jump from valence band into the conduction band through the forbidden gap hence increasing conductivity.

c. (i) X : base
Y : collector

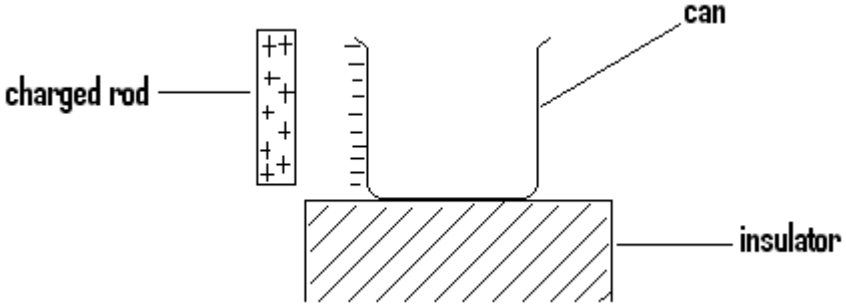
(ii) 1. used as a current amplifier
2. used as an electronic switch

d. (i) because they convert alternating current to direct current.

(ii)



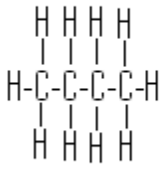
e. (i)



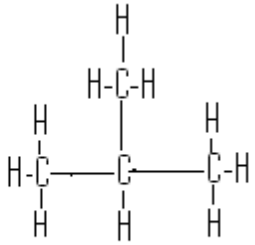
(ii) To avoid charges getting transferred from the can to the ground

5. a. Isomers are compounds of the same element having different structural formulae but the same molecular formula

b. (i) Isomers of C_4H_{10}



n-butane



2-methylpropane

(ii) isomer A : n-butane
Isomer B : 2-methylpropane

c. (i) fermentation

(ii)

$$C_6H_{12}O_6 \xrightarrow{Yeast} 2C_2H_5OH + 2CO_2$$

d. 1. pollute environment
2. expensive to produce

e. (i) As the sizes increase, there is addition of charges, which in turn increases the attractive forces between molecules, IMF.

(ii) It has a higher ratio of – OH group which is responsible for solubility in water.

f. (i) $CH_4 + Cl_2 + CH_3Cl + HCl$

(ii) substitution reaction

(iii)
- fuel
- rubricating oils
- raw materials for producing other chemicals eg. Alkenes, haloalkanes, etc.
- waxes (heavier ones) e.g. candle wax

6. a. - mass
- shape

b. (i) F_1 : upthrust
F_2 : weight

(ii) F_1 would be equal to F_2

c. It states that force for an object of constant mass is directly proportional to its acceleration i.e. F = ma

d. (i) 5 ms^{-2}

Calculation

U = 0ms^{-1}, V = 20ms^{-1}, t = 4s, a = (V-U)/t = (20ms^{-1} – 0ms^{-1}) / 4s = 20ms^{-1} / 4s = 5ms^{-2}

(ii) 1000N

Calculation

F = ma = 200kg x 5ms^{-2} = 1000kgms^{-2} = 1000N

7. a. Investigation : Distinguishing octane from octene

Materials : octane (10ml) and octene (10ml) in separate beakers, bromine in a Dropper bottle.

Procedure : a. add a few drops of bromine in the beaker containing octane,
b.observe what happens and record the results
c. add a few drops of bromine in the beaker containing octene,
d. observe what happens and record the results.

TABLE OF RESULTS

Solution	**Observation/s**
Octane + bromine	
Octene + bromine	

If the liquid turns from brown to colourless, it means the liquid under test is octane and if the liquid remains brown (the colour of bromine), it means the liquid is octane.

b. Oxidation is loss of electrons while reduction is gain of electrons.

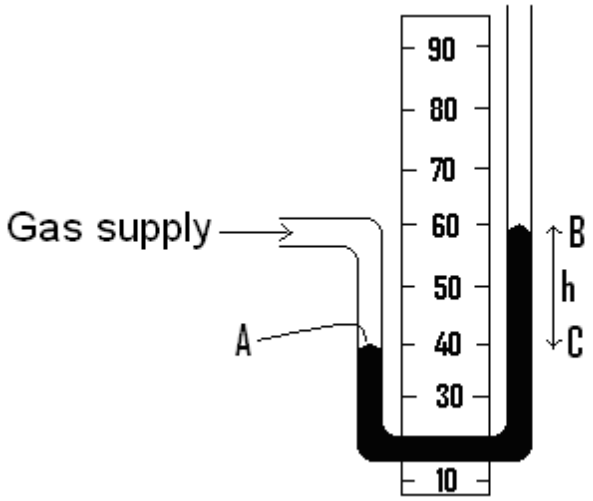
c. (i) painting
- it prevents water and air from getting into contact with the iron/steel material that has been painted.

(ii) galvanizing
zinc corrodes and loses electrons to the iron ions, so instead of iron ions reacting with water to give rust, it is oxidized back into iron atoms, hence no rusting

8. a. The candle wax particles are supplied with kinetic energy so that they vibrate more and this weakens

the
intermolecular forces. This makes the particles break free from their fixed positions and start moving freely, sliding
over each other. (this is a liquid form).

b. MEASURING GAS PRESSURE USING A MANOMETER



Each surface of the liquid is acted upon equally by atmospheric pressure and the levels are the same. If one side is connected to gas supply, the gas exerts a pressure on surface A and level B rises until pressure of gas is equal to the sum of atmospheric pressure and pressure due to liquid column BC. The pressure of the liquid column BC therefore equals the amount by which the gas pressure exceeds atmospheric pressure. It equals ghd (in Pa) where **g** is acceleration due to gravity, **h** is vertical height BC (in m) and **d** is the density of the liquid (in kg/m^3)

2009

1.a. It is the number and arrangement of electrons in an atom.

b. (i) 6

(ii) according to the graph, its atomic number is 8 and its electron configuration is O(2,6). The last number of the
configuration represents a group)

(iii) There is an increase in the number of shells from 2 to 3

(iv) F is more reactive than Cl. This is because F has a smaller radius which translates to a small distance between the
nucleus and the outermost shell. This makes it easy for the atom to attract an electron from outside than does the
Cl, which has a larger radius.

(v) - The bonding in lithium metal involves attraction between freely moving electrons and cations (positive ions)
while bonding in chlorine gas involves sharing of electrons between the chlorine atoms bonding.

- There are free electrons in lithium bonding while electrons in chlorine bonding are localised.

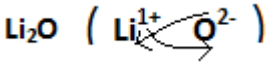
c. (i) -vulcanizing rubber
-manufacture of matches
-manufacture of sulphuric acid
-manufacture of fungicides
-used in medicine
-used as a sterilizing agent
-manufacture of fertilizers
-manufacture of gun powder
-used in fire works

(ii)- high melting and boiling points
- Insoluble in water
- Does not conduct electricity
- Solid at room temperature
- Yellow at room temperature
- Low density

d. (i) By gaining three electron

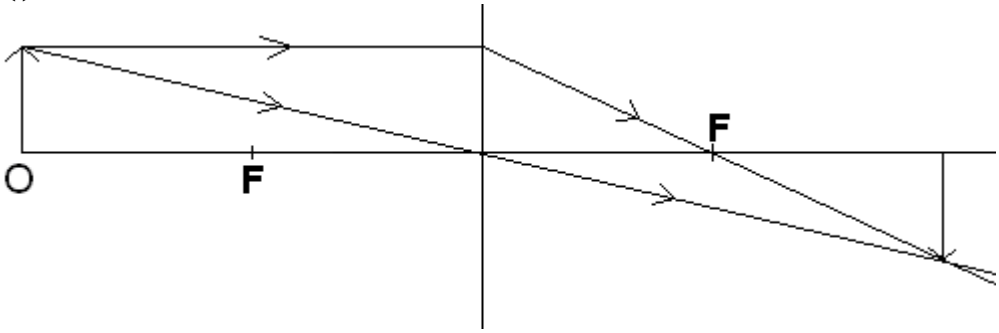
(ii) If it gains three electrons, the outermost electrons will add up to 8, which is the inert gas configuration.

(iii)



(iv) Be^{2+}

2.a (i)



(ii) 1 (U = V, M=V/U = 1)

b.(i) Transverse wave

(ii)- refraction
- Reflection
- Interference
- Diffraction

(iii) 2m

(iv) 4m/s

Calculation

Speed , V = f λ = 2Hz x 2m = 4 m/s

c. (i) - the concave mirror reflects the light forward and focuses it onto the condenser lens
- the condenser lens is used to converge and direct light rays onto the slide (film)

(ii)- upright

- Magnified

- Real

3. a. it is the random spontaneous disintegration of heavy atomic nucleus into lighter atomic nuclei with the emission
of different types of radiation such as alpha (α), beta (β), and/or gamma rays (γ-rays), and nuclear energy.

b. Alpha, beta and gamma radiations

c. -photographic plates
-electroscope
-ionization chamber
-scintillation counter and spinthariscope
-bubble chamber
-solid-state detector
-spark counter
-Geiger Muller tube
-cloud chamber
-semiconductor

d. (i) The chemical properties are the same.
(ii) Chemical properties are determined by the number of electrons and these isotopes have the same number of electrons.

e. -radioactive rocks (greater over rocks such as graphite)
-air (there is radioactive radon in air)
-cosmic rays from outer space
-fallout and other artificial effects
-human bodies (radioacive potassium-40 and carbon-14)
-X-rays from television screens
-radioactive contamination of apparatus

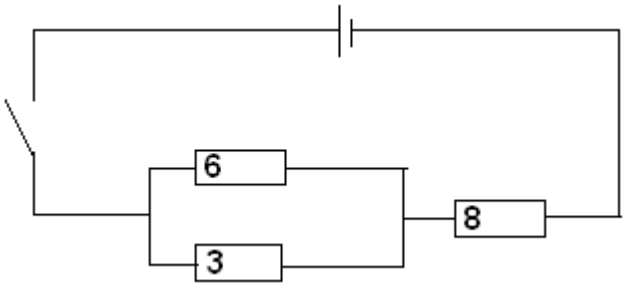
f. 1/16

Calculation

$N_t = (½)^{t/t½} N_o = (½)^{120/30} N_o = (½)^4 N_o = 1/16\, N_o$

Therefore the fraction left is 1/16)

4. a. (i) Capacitor
(ii) rheostat / Variable resistor



b. (i)
(ii) 10 Ω

Calculation

$R_T = (6X3)/(6+3) + 8 = 18/9 + 8 = 2+8 = 10\ Ω$

c. (i) Parallel circuit
(ii) – when one bulb stops working, the other bulbs are not affected (in series, the other bulbs also stop working i.e. the circuit is broken)
- The bulbs are very bright (brighter than in series) because voltage in parallel is the same (in series, it is shared)

(iii) It breaks the circuit when there is short circuit in so doing avoiding damage of property.

(iv) plug

d. (i) 15 Ω (5%)

(ii) It tolerates a small amount of deviation from the normal (actual resistance)

5. a. - formation of esters e.g. ethylethanoate/vinyl acetate
- formation of salts e.g. sodium ethanoate
- formation of laboratory reagents e.g. acetic anhydride
- manufacture of dyes
- manufacture of perfume
- used as food presevative
- used for food flavouring
- manufacture of a fibre (acetate rayon)

b. It has low conductivity of electric current [It ionises slightly giving out few ions for conduction]

c. $CH_3COOH_{(l)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+$

d. It has the same functional group, -OH, as water which is responsible for chemical reactions.

e. (i) It means that iron atom has lost 2 electrons.

(ii) 0

(iii) Silver ion (Ag^+)

(iv) Its oxidation number has decreased from +1 to 0

f. (i) $C_nH_{2n+1}COOH$

(ii) HCOOH
- Methanoic acid / formic acid

(iii) The boiling point of the carboxylic acid will be greater than that of butane

(iv) In carboxylic acids, there is hydrogen bonding which further increases the intermolecular forces hence increasing the boiling points even more. There is no hydrogen bonding in butane.

g. - recycling
- landfilling
- reusing
- incinerating

6. a. It is a vector that is equivalent to two or more vectors acting from different directions at one point.

b. Speed is scalar quantity because it has magnitude without direction while velocity is vector because it has both magnitude and direction.

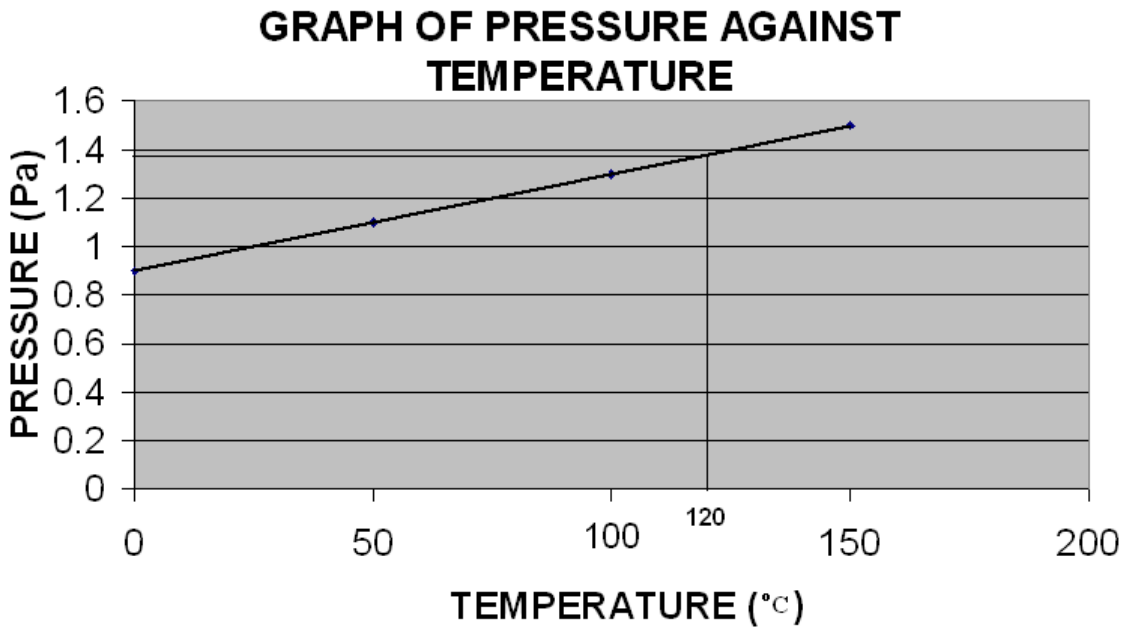
c. scale diagram

d. (i) It is a force exerted by gas particles per unit area.

(ii) - It keeps vehicle / bicycle tyres turgid.
- It is used in generation of electricity
- It is used in breathing
- It is used to make flying objects float in air e.g aeroplanes

(iii) When gas particles are heated, they move with high speed bumping into each other and the walls of the container frequently. This increases the pressure of the gas.

e. (i)



(ii) 1.38 Pa (the answer can be within the range 1.37 – 1.39)

7. a. - when heated, thermoplastic polymers soften.
- thermoplastic polymers can easily be recycled
- there is no cross-linking in Thermoplastic polymers

b. - recycling organic compounds helps in reducing pollution
- when organic compounds are recycled, they act as cheap law materials for other products.

c. thermosetting plastics do not soften but decompose when heated. As such, the pieces after decomposition can not be put together again to produce another product i.e it can be moulded just once.

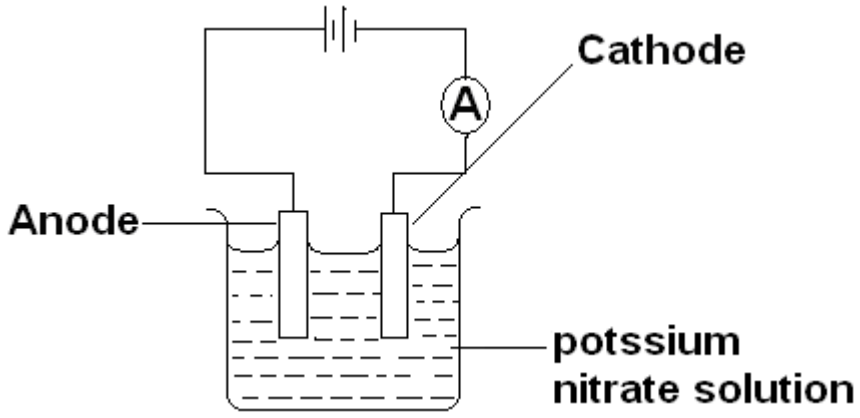
8 .a. It is a substance that conducts an electric current when in molten state or solution.

b. ELECTRICAL CONDUCTIVITY OF POTASSIUM NITRATE SOLUTION AND POTASSIUM CHLORIDE SOLUTION

MATERIALS: potassium nitrate solution, potassium chloride, beakers(2), carbon rods(2), power supply (2 cells), ammeter

PROCEDURE

a. Connect the circuit as shown in the figure below



b. Read and record the ammeter reading in the appropriate space in the table of results.
c. Replace potassium nitrate solution with potassium chloride solution
d. Read and record the ammeter reading in the appropriate space in the table of results

Table of results

Solution	Ammeter reading
Potassium nitrate solution	
Potassium chloride solution	

The solution whose ammeter reading is larger has higher electrical conductivity as compared to the other one

END BY SAJAN - B