MSCE '03 - '13

PHYSICAL SCIENCE

PAST PAPERS QUESTIONS SOLUTIONS & ANALYSIS

Introduction

National examinations in Malawi, **JCE and MSCE, are tough.** Students as well as teachers must cover syllabi of many subjects that contain a large number of topics. On the other hand, **to let students have fun of Math and Science** is one of missions for us, **Japan Overseas Cooperation Volunteers.** However, we have been facing **challenges** that we can't secure the time to carry out the mission because of the coverage of the syllabi.

"How can we cover the syllabi efficiently?"

"How can students learn effectively?"

In order to conquer the challenges, we have produced this series, **"JCE/MSCE Past Papers: Questions, Solutions & Analysis".**

FEATURES:

*** Questions and Answers in JCE / MSCE from 2003 to 2012**
*** Classified by topic, for learning / teaching effectively**
*** Graphs that show which topic is most often asked**
*** Actual exams of 2013 as achievement tests**

We wish that students can learn effectively and that teachers can teach efficiently when these are used correctly. **But don't forget! To enjoy Maths and Science is more important than just to get high marks.** Learning with joy and wonder will finally lead you to the bright future.

JICA Math & Science Teachers' Committee

* There are no solutions of MSCE BIO paper2 and P/S paper2 because those answers depend on environments, conditions and materials.

* Actual exams of 2013 have only questions.

Contents *~MSCE: Physical Science~*

Questions: P/S 1 (2003~2012)

Solutions: P/S 1 (2003~2012)

Questions: P/S 2 (2003~2012 *Only questions)

2013 MSCE P/S 1 Questions

(*Only questions)

2013 MSCE P/S 2 Questions

(*Only questions)

Acknowledgements

How to use

Analysis / Preparation

There is a graph made by analysing past-questions from 2003 to 2012. You will know which topic you should learn / teach intensively. And you will also find **FUNDAMENTAL** but **IMPORTANT TIPS** to get higher marks.

Questions / Solutions

Questions and solutions are classified and re-ordered by each topic. Therefore, **you can learn specific topics, or topics that you are weak in, selectively. Think deeply on your own before you check the answer!**

Questions of MSCE BIO, P/S paper2 (Only MSCE BIO, P/S books)

Questions are sorted by year. Although there are no solutions because those answers depend on schools and their conditions, **you can grasp the trend.** Similar questions repeatedly appear.

Actual exams of 2013

These questions aren't re-ordered. You can try this exam to check your current level as an achievement test. You must **follow fixed time length** when you try.

Preparation

We analysed questions from 2003 to 2012 and made this graph. This graph shows the average of marks of each topic. It means **it also shows which topic is most often asked.** In this case, the length of **"Organic chemistry" is longest: MOST ASKED TOPIC.** The length of **"Electricity, magnetism and electromagnetic induction II" is shortest: LEAST ASKED TOPIC.**

MOST ASKED TOPICS IN MSCE PHYSICAL SCIENCE (paper1)**:**

1. *Organic chemistry*
2. *Elements and chemical bonding*
3. *Oscillations and waves*
4. *Nuclear physic*
5. *Properties of matter*

Even apart from daily learning, we can still make marks better. **How you write exams is also important.**

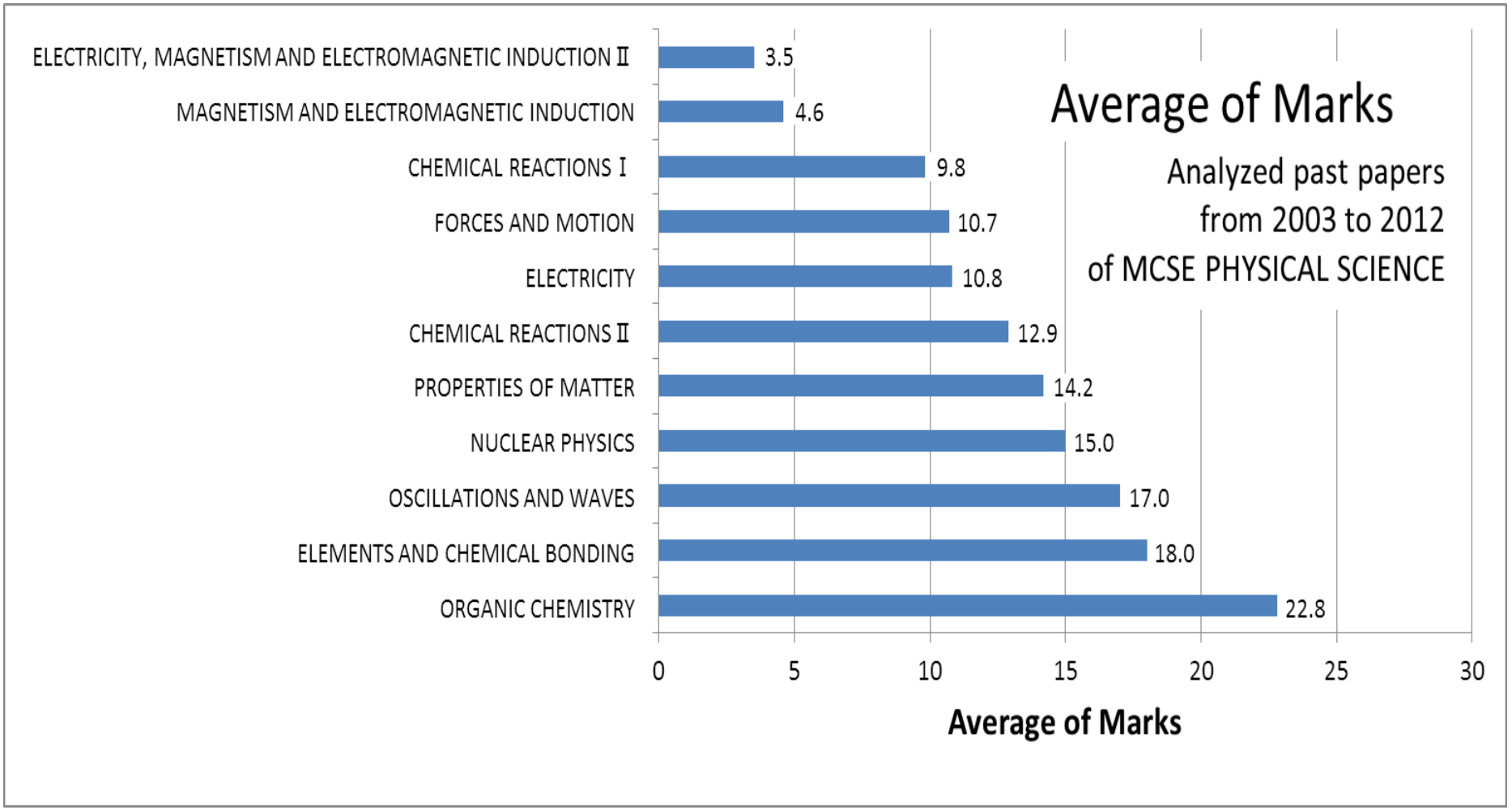
TIPS FOR GETTING HIGHER MARKS:

1. *Write your name correctly*
2. *Write your answers clearly and neatly*
3. *Try to solve all questions*
   (Time designation is also important)
4. *Don't leave blanks, write something*
   (Even if you don't know the answer, at least, you can mark one choice in multiple questions!)

IN ESSAY QUESTIONS:

5. *Don't itemise and number the sentences, write them in an essay form.*
6. *you don't have to rewrite "the question" in your answer essay.*

Analysis: MSCE PHYSICAL SCIENCE



MSCE: P/S1 QUESTIONS

1 Forces and motion

1. Force (vector)

2012-7.

b. Give two properties of vector quantities. (2marks)

c. Mention one method of adding vectors acting at an angle to each other. (1mark)

2010-3.

a.

(i) Mention any two examples of a scalar quantity. (2 marks)

(ii) Describe how vectors are represented on paper. (2 marks)

2009-6.

a. Define "resultant vector". (1mark)

b. Why is "speed" a scalar quantity while "velocity" a vector quantity? (2marks)

c. Two forces of magnitude 240 N and 420 N are being used to pull a boat at an angle of 60° each other. Find the resultant force by using a scale diagram.

(Use a scale of 1 cm to represent 100 N) (7marks)

2007-5.

c. Figure 4 shows a resultant of two forces.

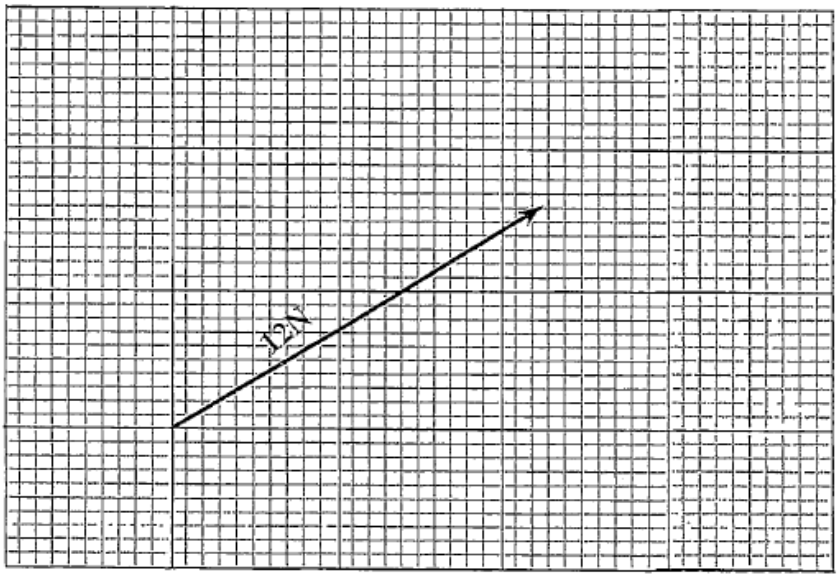


Figure 4

(i) Complete the diagram to show the vertical and horizontal components. (2marks)

(ii) Calculate the magnitude of the horizontal component. (4marks)

2005-4.

a. Forces of 40N and 50N are acting at right angles. Draw a scale diagram to find the resultant force.(Use a scale of 1cm to represent 10N). (5marks)

2. Velocity & acceleration

2012-7.

d. A car decelerates at a rate of $3m/s^2$ for 5 seconds. If the initial speed is 20m/s, calculate the final speed. (3 marks)

2011-1.

c. Figure1 is a velocity-time graph showing a journey made by a cyclist.

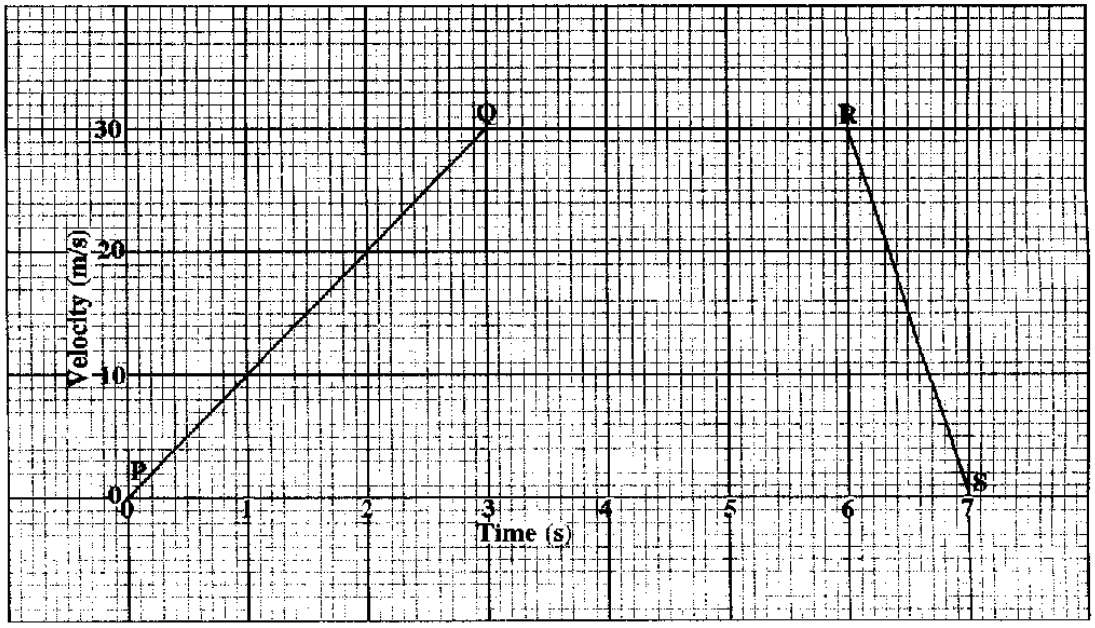


Figure 1

Calculate the acceleration from P to Q. (3 marks)

2008-6.

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

Calculate :

(i) acceleration of the object. (2 marks)

(ii) force required to produce the acceleration in 6.d.(i). (2 marks)

2007-5.

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

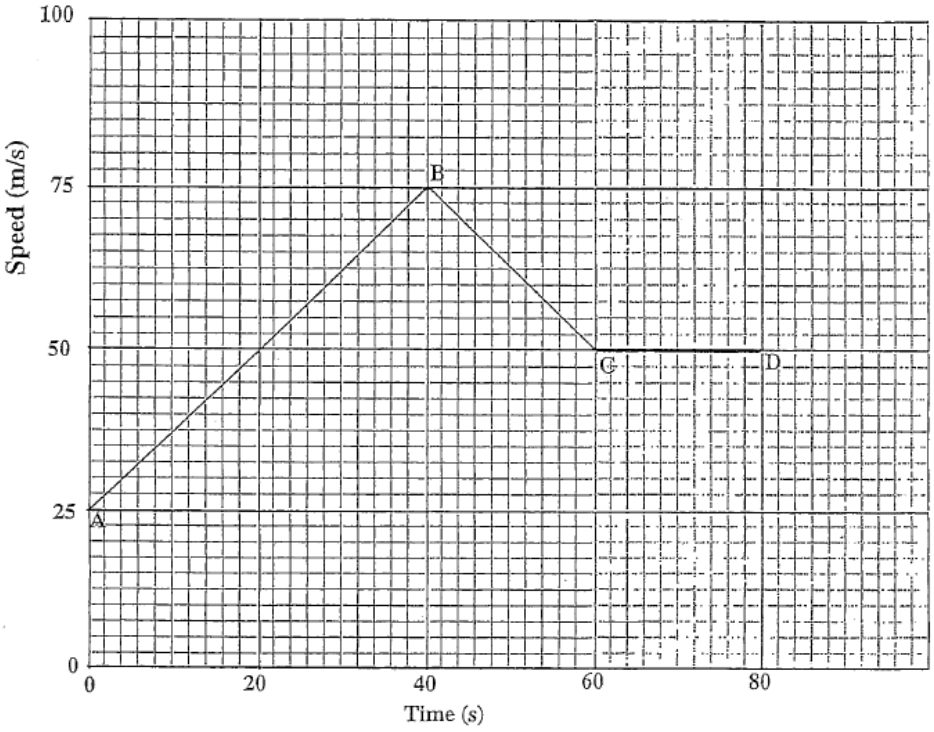


Figure 3

(i) Describe the motion of the car from point A to D. (3marks)

(ii) Calculate the distance covered when the car moves from point A to B. (3marks)

2006-6.

a. Define "acceleration". (1mark)

b. the speed of a runner dropped from 80m/s to 60m/s in 4 seconds.

(i) calculate the average deceleration of the runner. (4marks)

(ii) If the runner maintained the deceleration in 6.b.(i) after how long did the speed reach zero? (2marks)

2004-8.

a. Describe an experiment that could be done to determine the average speed of an athlete.

(13 marks)

b. State two sources of error in 8a. (2marks)

2003-1.

b. **Figure2** is a distance-time graph for a cyclist. Use it to answer the questions that follow.

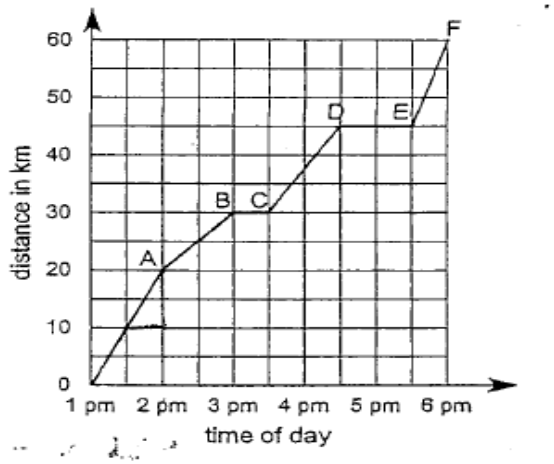


Figure 2

(i) What is the total distance traveled by the cyclist? (1mark)

(ii) How long did it take the cyclist to cover the distance? (1mark)

(iii) Describe the motion of the cyclist from 2:00 pm to 4:30pm (3marks)

(iv) Calculate the average speed of the cyclist during the first 2hours of the journey (3marks)

(V) State whether distance is a vector or scalar quantity. Give a reason for your answer (2marks)

3. Newton's law

2012-7.

a. State Newton's third law of motion. (1mark)

2011-1.

a. What is meant by "free fall" of an object? (2 marks)

b. State two forces that act on an object falling in the air. (2 marks)

2010-3.

b. Figure 3 is a diagram showing a person rowing a boat on a lake.

Figure 3

(i) Explain how rowing causes the boat to move. (3 marks)

(ii) Which Newton's law of motion is demonstrated in the diagram? (1 marks)

(iii) Mention any two forces acting on the boat. (2 marks)

2008-6.

a. State any two factors that affect the terminal velocity of a free falling object in air. (2 marks)

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

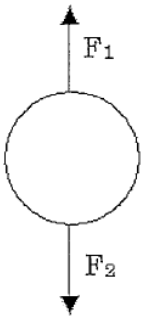


Figure 6

(i) Name the forces F_1 and F_2. (1 mark each)

(ii) What would be the relationship between the magnitude of F_1 and F_2 at terminal velocity? (1 mark)

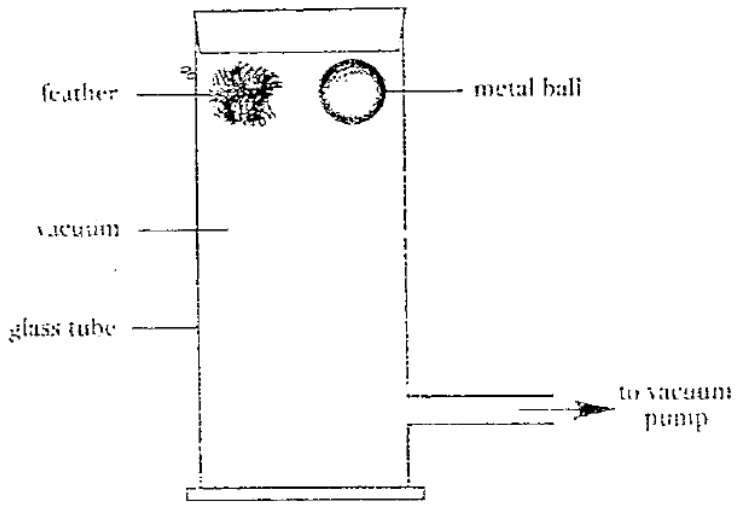
c. State Newton's second law of motion. (1 mark)

2006-8.

a. A metal ball is released on the surface of lubricating 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. (8marks)

2005-8.

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



(i) Name the resultant force acting on the ball. (1mark)

(ii) State the direction of the resultant force in b(i) . (2marks)

(iii) If the feather and the metal ball where allowed to fall at the same time. Draw in the diagram to show the positions of both the feather and metal ball before they reach the bottom of the tube. (1mark)

(iv) Explain your answer to b(iii) above. (2marks)

2 Electricity

1. Electrostatics

2010-6.

a. Mention any two appliances that use the principle of electrostatics. (2 marks)

2008-4.

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

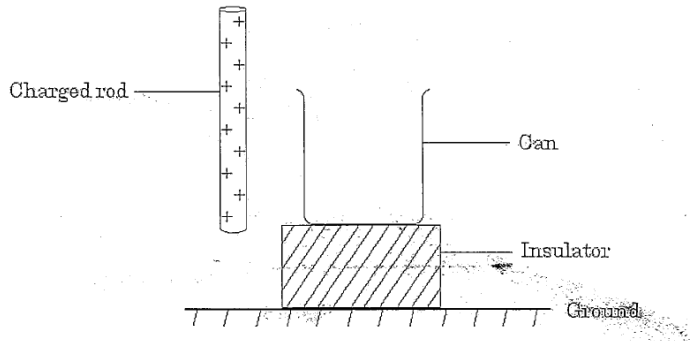


Figure 4

(i) Complete the diagram by indicating the induced charges on the can. (2 marks)

(ii) Why was the can on an insulator?

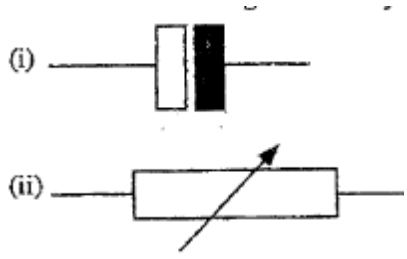
2. Electrical resistance

2011-2.

b. Explain the difference in total resistance between similar resistors connected in series and parallel. (4 marks)

2009-4.

a. What do the following electrical symbols stand for? (1mark)



b. In a circuit, a 6Ω resistor and a 3Ω resistor are connected in parallel and an 8Ω resistor is connected in series with them.

(i) Draw a circuit diagram using the given information. (2marks)

(ii) Calculate the total resistance in the circuit. (5marks)

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

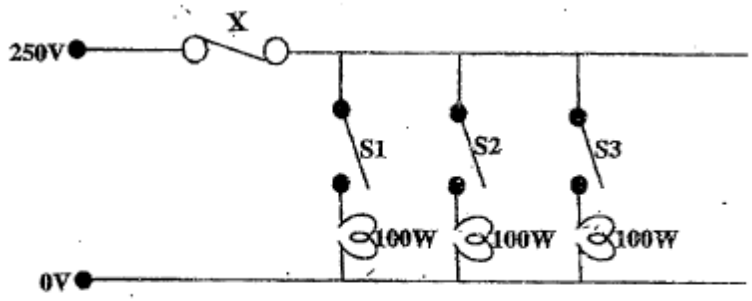


Figure 5

(i) What type of circuit is shown in the diagram? (1mark)

(ii) Give two reasons why this type of circuit is preferred for wiring houses. (2marks)

(iii) Explain the importance of including the device labeled X in the circuit in Figure 5. (3marks)

(Iv) Give any one appliance where device X is used. (1mark)

2007-2.

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

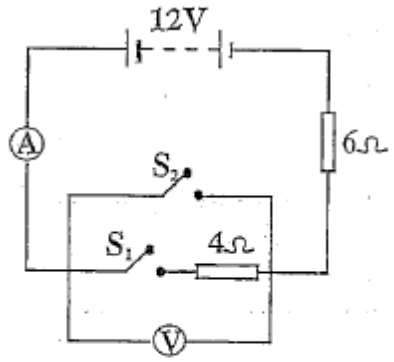


Figure 2

(i) If S_1 is closed and S_2 is open, calculate the reading of the ammeter and voltmeter.

Ammeter: (3marks)

Voltmeter. (3marks)

(ii) What will be the effect on the voltmeter if both switches are closed? (1mark)

(iii) Give a reason for the answer to 4.c.(ii) (1mark)

2006-4.

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

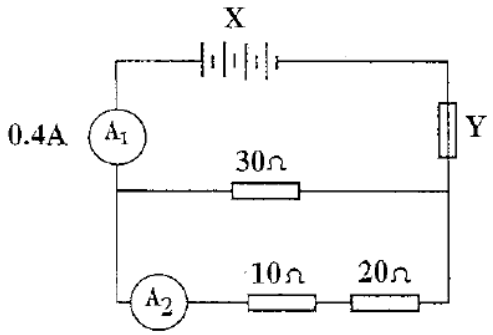


Figure 3

(i) Name the components labeled X and Y. (1mark each)

(ii) Calculate the total resistance in the circuit. (5marks)

(iii) Calculate the current in the 30Ω resistor. (2marks)

(iv) Work out the voltage across the 10 Ω resistor. (2marks)

2005-8.

b. describe an experiment that could be done to find out if electrical resistance of a wire varies directly proportional to its length (11marks)

2004-4.

a. Explain why a voltmeter is connected in parallel while an ammeter is connected in series. (4 marks)

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

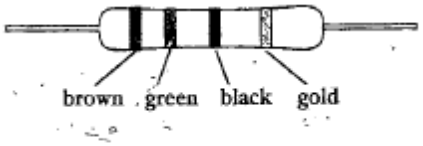


Figure 2

What is the resistance of the resistor? (3 marks)

2004-4.

e.

(i) Are the headlamps of a motor car connected in series or in parallel? (1 mark)

(ii) Give a reason for the answer to 4.e(i). (1 mark)

3. Power and cost of electricity

2012-2.

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

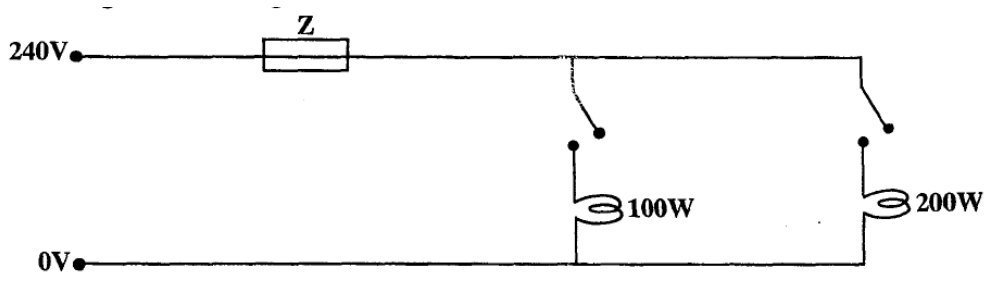


Figure 2

(i) What is the function of the part labelled **Z**? (2marks)

(ii) State any two advantages of the circuit in **Figure 2**. (2marks)

(iii) Which bulb would use more current if both switches were closed? (1mark)

(iv) Give a reason for the answer in 2.c.(iii). (1marks)

d. Calculate the power dissipated in an electric heater in which 4A of current flows when connected to a 230V supply. (3marks)

2010-6.

c. Define "electrical power". (1 mark)

d. An electric bulb is marked 240V, 60W.

(i) What is the meaning of "240V, 60W"? (2 marks)

(ii) Calculate the heat dissipated by the bulb, in joules, if it operates for 8 minutes. (3 marks)

2007-4.

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

(i) resistance of the element, (2marks)

(ii) power displaced by the heater, (2marks)

(iii) Cost of running the heater for 3 hours if the cost of electrical energy is K5 per kWh. (4marks)

2006-4.

b.

(i) Define "Kilowatt hour" (2marks)

(ii) The power rating of a television is 150W. How much power in Kilowatt hours will it use if it is on for 109 hours? (3marks)

(iii) If the cost of power is K5.00 per kilowatt hour, that will be the cost of running the television in 4.d.(ii) for 10 hours per day for 2 days. (4marks)

2005-8.

a. 6kW of power is fed to a transmission cable of resistance 3 ohms. Calculate the power wasted in the cable if power is transmitted at 300V. (4marks)

2003-1.

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

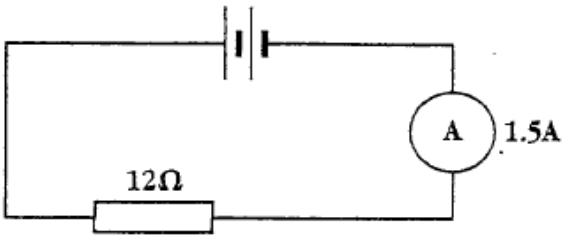


Figure 1

(i) What kind of energy is produced in the 12Ω resist or as electric current flows though it? (1mark)

(ii) Calculate the amount of energy produced in the resistor if electric current flows . (3marks)

3 Magnetism and electromagnetic induction

1. Magnetism

2012-8.

e. Explain how a piece of steel could be magnetized by single touch stroking method. (2marks)

2011-2.

c. Give any one method of demagnetizing a permanent magnet. (1 mark)

2003-7.

a. Briefly explain how a piece of iron can be magnetized by stroking. (5marks)

2. Electromagnetic Induction

2012-2.

a. State two ways of inducing electromotive force(emf). (2marks)

b. Mention any one application of an electromagnet. (1mark)

2011-2.

d. Figure 2 is a diagram showing an experiment on electromagnetism in which a current carrying wire passed through the centre of a card on which iron fillings were sprinkled.

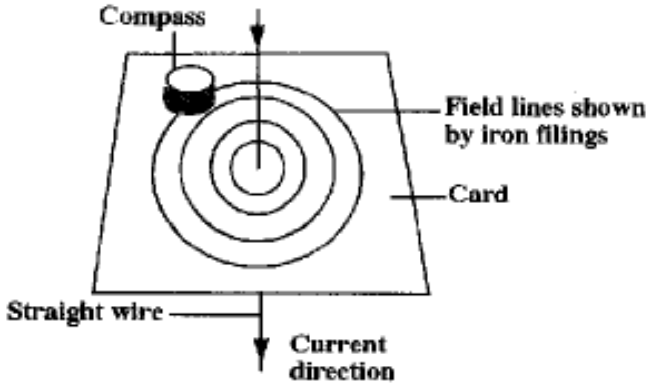


Figure 2

(i) Draw an arrow in the compass to show the direction of field lines. (1 mark)

(ii) What would happen to the direction of the compass needle if the direction of current was reversed? (1 mark)

(iii) Give a reason for the answer in 2.d.(ii). (1 mark)

2010-6.

b. **Figure 4** is a diagram of an electric circuit.

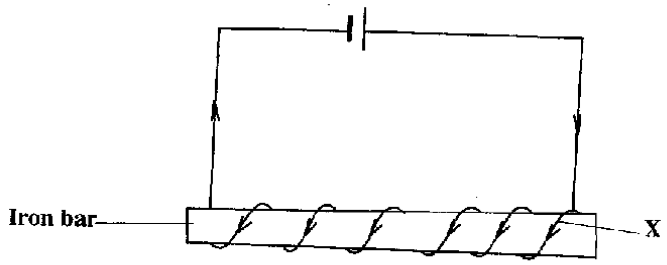


Figure 4

(i) Name the part labelled **X**. (1 mark)

(ii) What would happen if the part labelled X is brought close to iron fillings? (1 mark)

(iii) Give a reason for the answer in 6.b.(ii). (2 marks)

(iv) What is the role of the iron bar in the circuit? (1 mark)

e. A step down transformer has 1200 turns in the primary coil and 50 turns in the secondary coil. Calculate the voltage in the secondary coil if the voltage in the primary coil is 240V. (3 marks)

2008-4.

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

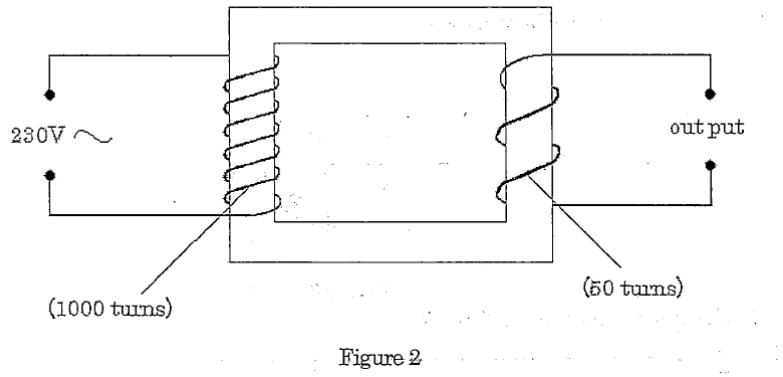


Figure 2

(i) Name the type of transformer shown in the diagram. (1 mark)

(ii) Give a reason for the answer to 4.a.(i). (1 mark)

(iii) Calculate the output voltage of the transformer. (3 marks)

2007-4.

b.

(i) give one advantage of alternating current over direct current. (1mark)

(ii) state any two causes of energy loss in a transformer. (2marks)

(iii) How can each cause of energy loss mentioned in 4.b.(ii) be reduced? (2marks)

2005-1.

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

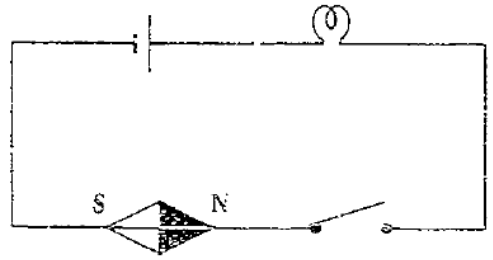


Figure 2

(i) Draw arrows on the diagram to show, when the switch is closed. The direction of movement of:

(1) The compass needle.

(2) The current (2marks)

(ii) What effect would the following changes have on the movement of the compass needle?

(1) reversing the cell. (1mark)

(2) Increasing the number of cells. (2marks)

e. Mention two devices which use electromagnets. (2marks)

2004-4.

c.

(i) Explain the difference between an electric motor and an electric generator. (2 marks)

(ii) State any two factors which affect the amount voltage produced by a generator. (2 marks)

2003-7.

b.

(i) Describe how a step up transformer works. (6marks)

(ii) Explain two ways in which energy losses in a transformer are minimized. (4marks)

4 Electricity, Magnetism and Electromagnetic Induction II

Electronics

2011-2.

a. Give two types of semiconductors. (2 marks)

2011-8.

a. In terms of the band theory, explain why resistance of a semiconductor decreases when temperature increases. (4 marks)

b. With the aid of labeled diagrams, explain the difference between waves passing through narrow and wide gaps. (6 marks)

2008-4.

b.

(i) What are "semiconductors"? (1 mark)

(ii) Explain how raising the temperature of semiconductors affects their electrical conductivity. (2 marks)

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

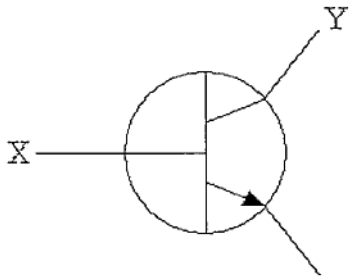


Figure 3

(i) Name the parts marked **X** and **Y**. (1 mark each)

(ii) Give any two uses of transistors. (2 marks)

d.

(i) Why are "diodes" sometimes referred to as "rectifiers"? (2 marks)

(ii) Draw a circuit diagram consisting of a cell, a bulb and a diode such that the diode is forward biased. (8 marks)

2004-4.

d.

(i) What is a "semiconductor"? (1 mark)

(ii) Draw a circuit diagram in which a bulb, a cell and a diode are connected in series such that the diode is forward biased. (2 marks)

(iii) What is meant by the term “doping” in relation to a semi-conductor? (2 marks)

(iv) State two functions of transistors. (2 marks)

5 Oscillations and Waves

1. Oscillations

2012-4.

a. Define "oscillation".

2010-6.

h.

(i) State any two factors which affect frequency of an oscillating pendulum. (2 marks)

(ii) Mention two characteristics of an oscillating system. (2 marks)

2008-2.

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 points **A** and **C** through the rest position, **B**.

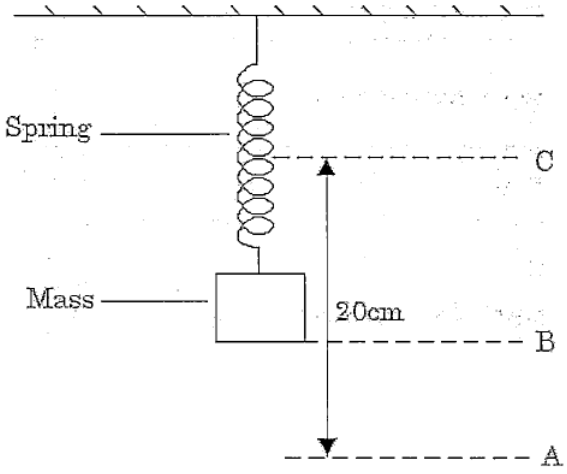


Figure 1

(i) Calculate the initial amplitude of the vibration. (2 marks)

(ii) At which point does the vibrating mass have the highest kinetic energy? (1 mark)

(iii) Describe how potential energy and kinetic energy change as the mass is vibrating from A to C. (4 marks)

(iv) Give two reasons why the mass would eventually stop vibrating. (2 marks)

2004-5.

a. Define the term "oscillation" in relation to a swinging pendulum. (2 marks)

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

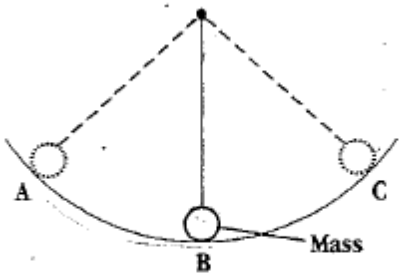


Figure 3

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

(1) **A** to **B**? (1 mark)

(2) **B** to **C**? (1 mark)

(ii) What is the speed of the mass at **C**? (1 mark)

(iii) What happens to the frequency and amplitude of oscillation of a pendulum as time increases? (2 marks)

(iv) State the energy changes of the mass as it changes from **A** to **C**. (2 marks)

(v) What happens to the frequency of vibration of a pendulum when the length of the string is changed? (2 marks)

2. Waves

2012-4.

b.

(i) What type of wave is produced by a vibrating string? (1mark)

(ii) Calculate the frequency of a wave with a wavelength of 2m and speed of 6m/s. (3marks)

c. State the difference between "interference" and "diffraction" of waves. (2marks)

2012-8.

a. With the aid of a diagram, explain how destructive interference in water waves occurs. (4marks)

b. Explain why waves refract when travelling from one medium to another. (2marks)

2011-7.

a, State the difference between a 'transverse'' and a "longitudinal" wave. (2 marks)

2011-8.

b. With the aid of labeled diagrams, explain the difference between waves passing through narrow and wide gaps. (6 marks)

2010-8.

a. Explain how constructive interference occurs in waves. (3 marks)

2009-2

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

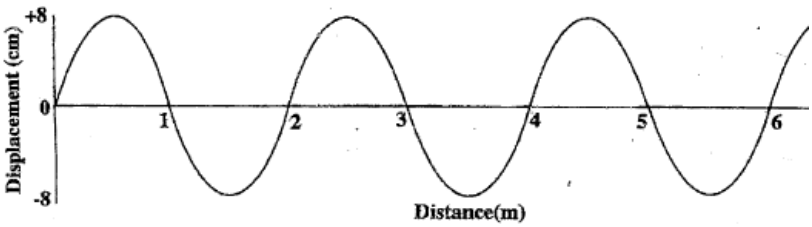


Figure 3

(i) Name the type of wave shown in figure 3. (1mark)

(ii) Give any two properties of the wave. (2marks)

(iii) What is the wavelength of the wave. (1marks)

(iv) Calculate the speed of the wave. (2 marks)

2007-2.

a. Give two factors that affect the frequency of a vibrating spring. (2marks)

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

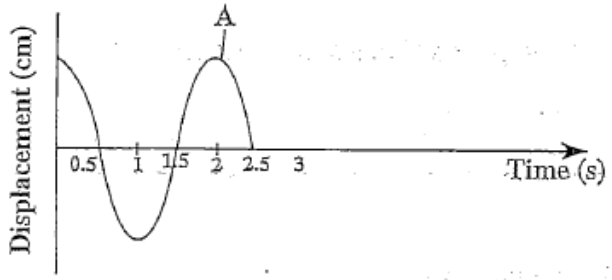


Figure 1

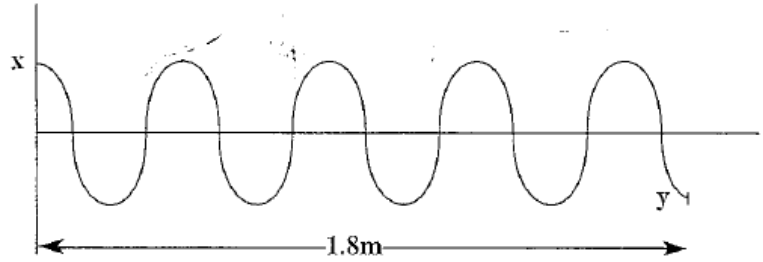
(i) Name the part labeled **A**. (1mark)

(ii) Calculate the frequency of the wave. (2marks)

(iii) Calculate the velocity of the wave if its wavelength is 50m. (2marks)

2006-6.

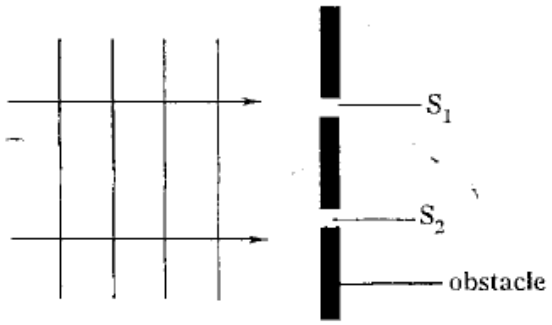
c. **Figure 4** is a diagram showing waves n a rope **xy**.



(i) Calculate the wave length of this wave. (3marks)

(ii) If the rope **xy** is swung up and down 20 times in 2 seconds, calculate the average speed of the wave. (4marks)

d. **figure 5** is a diagram showing water wave 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. (3marks)

(ii) State two properties of waves that are demonstrated in the completed diagram. (2marks)

(iii) What would happen to the waves emerging on the other side of the obstacle if the widths of S_1 and S_2 were increased? (1mark)

2006-7.

b. explain with the help of diagrams, the difference between constructive interference and destructive interference. (10marks)

2005-6.

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

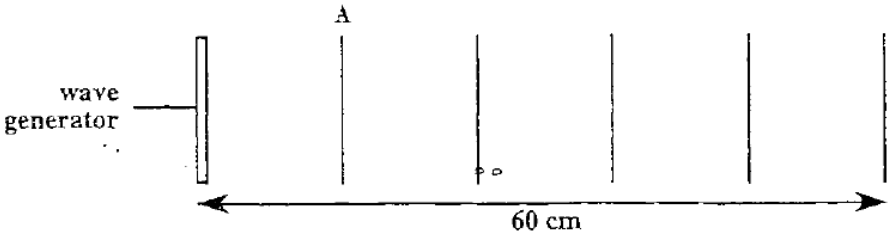


Figure 6

a. What kind of waves is represented by the crests? (2marks)

b. What is the wavelength of the ripples if there are 5 complete waves in a distance of 60 cm? (2marks)

c. What is the frequency of the ripples if four crests pass through point A in one second? (1mark)

d. Calculate the speed of the waves. (3marks)

e. What would happen to the wave length if the waves moved from deep water to shallow water?

f. explain the answer to (e). (5marks)

g. describe "constructive interference" in water waves. (2marks)

h. what is the difference between "longitudinal" and "transverse" waves? (2marks)

i. what type of waves are radio waves? (1mark)

2003-1.

c.

(i) What is the difference between a transverse wave and a longitudinal waves? (4marks)

(ii) Give any two characteristics of a wave. (2marks)

3. Light

2011-7.

b. Explain how the focal length of a convex lens can be determined using a distant object. (3 marks)

c. State any two differences between a "camera" and a "human eye". (2 marks)

2010-6.

g.

(i) State any three differences between a real image and a virtual image. (3 marks)

(ii) An object 6 cm long is placed 30 cm in front of a converging lens of focal length 10 cm. Use the lens formula to calculate;

(1) image distance (4 marks)

(2) magnification of the object (2 marks)

2010-7.

a. Explain how an image is formed by a convex lens. (4 marks)

2009-2

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

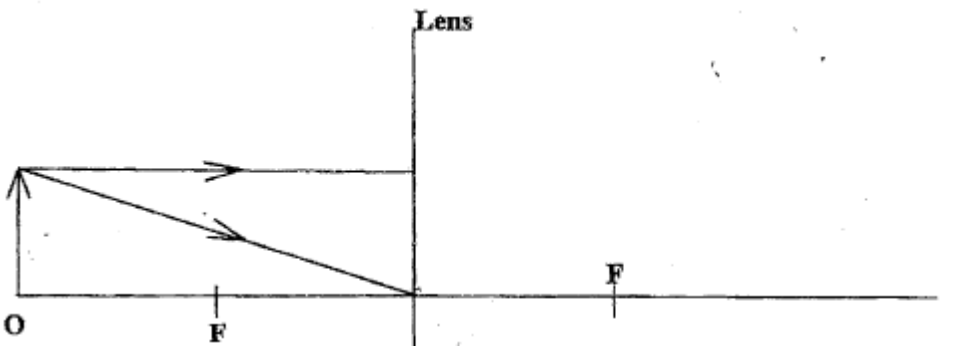


Figure 2

(i) Complete the ray diagram to show the position of the image. (3marks)

(ii) Calculate the magnification of the image. (4marks)

2009-2.

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

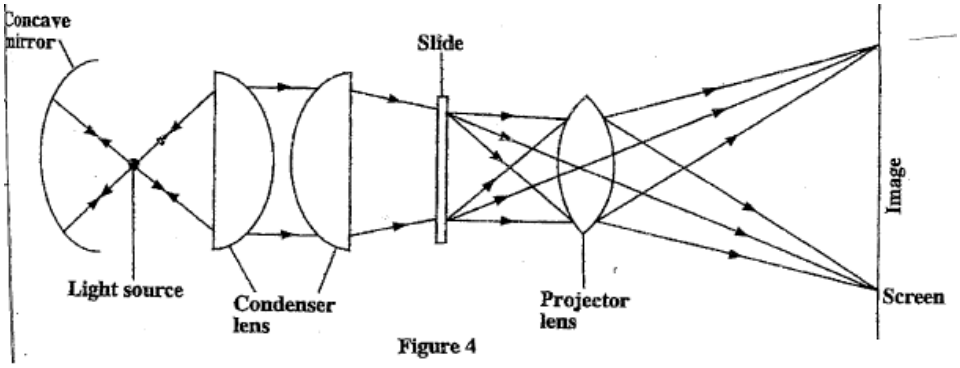


Figure 4

(i) State the function of each of the following:

Concave mirror: (1mark)

Condenser lens: (1mark)

(ii) Describe the nature of the image formed on the screen. (3marks)

2008-2.

a

(i) Define "focal length" of a convex lens. (2 marks)

(ii) State any two ways of determining the focal length of a convex lens. (2 marks)

(iii) An object 10 cm high 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) (6 marks)

2007-2.

c.

(i) State any three similarities between a camera and a human eye. (3marks)

(ii) What is the function of an aperture in a camera? (1mark)

d.

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

(i) Using the lens formula, calculate the image distance. (4marks)

(ii) Calculate the magnification of the image. (2marks)

(iii) What is the nature of the image produced? (3marks)

2004-5.

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. (4 marks)

(ii) Describe the image formed. (3 marks)

(iii) Calculate the magnification of the image. (2 marks)

6 Nuclear physics

2012-6.

d.

(i) Name two types of radioactivity. (2marks)

(ii) Define "half- life" of a radioactive element. (1mark)

(iii) Mention any three properties of an alpha particle. (3marks)

2012-8.

d. Explain any two uses of nuclear radiation. (4marks)

2011-7.

d.

(i) Define "nuclear fission". (1mark)

(ii) Write down two symbols representing isotopes of hydrogen. (2 marks)

e. Explain why a charged leaf electroscope is not suitable for detecting beta radiation. (2 marks)

f. Thorium $(^{232}_{90}Th)$ decays by alpha emission to radium $(^{228}_{88}Ra)$.

(i) What do the numbers 228 and 88 represent in $(^{228}_{88}Ra)$?

228: (1 mark)

88: (1 mark)

(ii) Write the nuclear equation for the decay of thorium $(^{232}_{90}Th)$. (3 marks)

2010-5.

a.

(i) Name two particles found in the nucleus of an atom. (2 marks)

(ii) State two characteristics of a radioactive substance. (2 marks)

(iii) State any two uses of nuclear radiation. (2 marks)

b. **Table 1** shows the activity of a radioactive element with time.

Table 1

Activity (Disintegrations per second)	40	30	20	10
Time (days)	0	4	8	16

(i) Plot a graph of activity against time. (5 marks)

(ii) Use the graph to find the time taken for the activity to drop from 30 to 15 disintegrations per second. (2 marks)

c. Name the particles emitted when radium $(^{226}_{88}Ra)$ decay to radon $(^{222}_{86}Rn)$. (2 marks)

2009-3.

a. Define “radioactivity". (2marks)

b. Name three types of radiation. (3marks)

c. Mention any two instruments that are used to detect radiation. (2marks)

d.

(i) How do chemical properties of the isotopes of uranium, $^{238}_{92}U$ and $^{234}_{92}U$ compare? (1mark)

(ii) Give a reason for the answer to 3.d.(i). (2marks)

e. Mention any one natural source of radiation. (1mark)

f. A radioactive source has a half-life of 30 minutes. Calculate the fraction left after 2 hours. (4marks)

2008-3,

a. Define “nuclear fusion”. (2 marks)

b. The equation below shows the fusion of heavy hydrogen

$^{2}_{1}\text{H} + ^{2}_{1}\text{H} \rightarrow ^{3}_{2}\text{He} + ^{1}_{0}\text{n}$

(i) Name the products:

$^{3}_{2}\text{He}$ (1 mark)

$^{1}_{0}\text{n}$ (1 mark)

(ii) Identify the type of radioactive decay. (1 mark)

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

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

Stage 2; $^{234}_{90}Th \rightarrow ^{234}_{91}Pa$

(i) Which particles are emitted at each stage?

Stage 1; (1 mark)

Stage 2: (1 mark)

(ii) Apart from the particles mentioned in 3.c.(i), what else is emitted at each stage? (1 mark)

d. State any three safety precautions that must be followed when handling radioactive substances. (8 marks)

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. (6 marks)

2007-8.

Describe the following radioactive processes: alpha decay, beta decay and gamma emission. In the description include atomic numbers, penetration power, ionizing ability and behavior in magnetic and electric fields.

Alpha decay: (5marks)

Beta decay: (5marks)

Gamma emission: (4marks)

2006-3.

a. Define "nuclear fission". (2marks)

b. Name two particles found in the nucleus of an atom. (2marks)

c. Two radioactive samples showed the following characteristics.

Sample	Effect on gold 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. (1mark each)

(ii) Why does the particle emitted by sample B get blocked by the card board? (2marks)

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

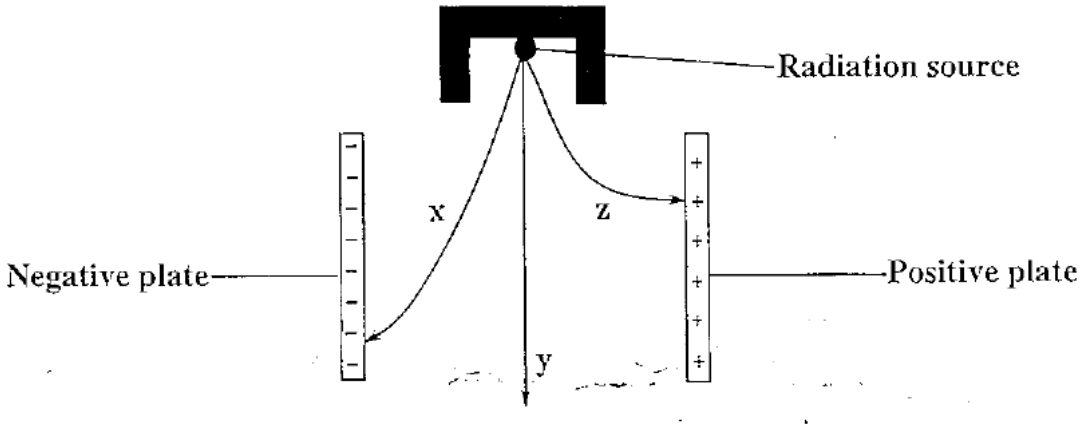


Figure 1

(i) Name the particles taking paths **X**,**Y** and **Z**. (1mark each)

(ii) Explain why particle **Z** will deflect towards the positive plate. (3marks)

2005-4.

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? (4marks)

(ii) Why is it important to use radioisotopes with a short half life as tracers in Agriculture? (2marks)

(iii) Explain why fission is a useful process in industry. (3marks)

2004-6.

a. State any two safety precautions to be taken when handling radioactive substances. (2 marks)

b.

(i) Describe the "alpha particles" and "beta particles"

alpha particles

beta particles (6 marks)

(ii) Explain why gamma radiation is used in sterilization of medical equipment. (3 marks)

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). (3 marks)

(ii) **Figure 4** is a diagram showing radiation passing through ax; electric field. Draw and label in the diagram the paths taken by the alpha-particles and the beta-particles. (2marks)

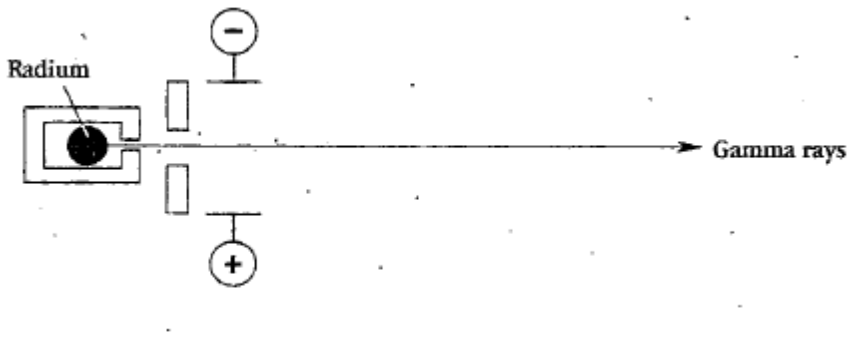


Figure 4

(iii) Explain Why the behavior of particles is as shown in 6c(ii). (4marks)

2003-2.

a What are isotopes? (2marks)

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

(i) Give the number of neutrons in the nucleus of $^{35}_{17}\text{Cl}$ (1mark)

(ii) Give that the two isotopes are present in ordinary chlorine in the ratio of three atoms of $^{35}_{17}\text{Cl}$ to one atom of $^{37}_{17}\text{Cl}$, Calculate the average atomic mass of chlorine. (4marks)

c. How would the chemical properties of the two isotopes compare? Give a reason for your answer (2marks)

d.

(i) What is radioactivity? (2marks)

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

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

(1)Besides radon, what other particle is produced when radium decays? (1mark)

(2)How does the mass of the decaying atom compare with the masses of the Products? (1mark)

(3)Name the alpha particle in this equation? (1mark)

e. Explain how gamma rays are emitted. (4marks)

f. Give one use of gamma rays. (1mark)

g. Give one way of detecting radioactive particles. (1mark)

7 Properties of matter

1. Kinetic theory

2012-1.

a. State the kinetic theory of matter. (2marks)

2012-8.

c. In terms of the kinetic theory of matter, explain why ice melts when put in the sun. (3marks)

2010-8.

b. Explain using kinetic theory of matter, why clothes dry faster on a sunny day than on a cloudy day. (4 marks)

2008-8.

a. Explain why candle wax melts when it is heated. (3 marks)

2003-4

c. In terms of kinetic theory of matter explain why increase in temperature causes candle wax to melt (3marks)

2. Gas laws

2012-1.

b. **Figure 1** is a diagram of an apparatus used to measure the pressure exerted by a gas.

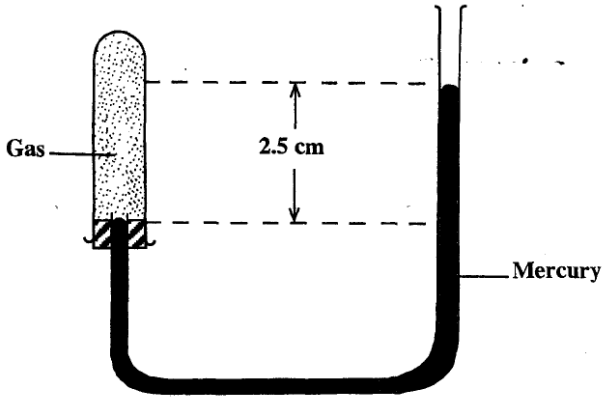


Figure 1

Calculate the pressure exerted by the gas if the atmospheric pressure is 756 mmHg. (4marks)

2011-6.

a. State any two factors that affect gas pressure. (2 marks)

2010-1.

b.

(i) Define "absolute zero". (1 mark)

(ii) A gas occupies a volume of 200 cm^3 at 273K. Calculate the temperature of the gas, in Kelvins, if its volume increases to 300cm^3 at constant pressure. (3 marks)

2009-6.

d.

(i) Define "gas pressure". (1mark)

(ii) Give any three uses of gas pressure.

(iii) Why does as pressure in a closed container increase when the temperature of the gas is increased? (4marks)

e, **Table 2** shows results of an experiment that was done to demonstrate a gas law.

Table 2

Pressure (Pa)	0.9	1.1	1.3	15
Temperature (°C)	0	50	100	150

(i) Plot a graph of pressure against temperature. (3marks)

(ii) Use the graph to find pressure of the gas when temperature was 120°C. (1mark)

2007-6.

d.

(i) Define the term "absolute temperature" . (1mark)

(ii) Convert 546 K to degrees Celsius. (3marks)

2006-3.

e. At atmospheric pressure a mercury barometer reads 0.76m. If one atmosphere equals to 10100Pa. calculate the density of mercury. (3marks)

2005-1.

c.

The volume of air in a container is 6 cm^3 and has a pressure of 4 atmospheres(atm) when the temperature is 27 C^o. Calculate its pressure when the volume is reduced to 3cm^3 and its temperature raised to 177 C^o. (4marks)

2004-2.

a. **Table 3** shows results in an experiment to verify a 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? (1 mark)

(iii) Which variables would be kept constant in this investigation? (2 marks)

2003-4.

a.

(i) Explain the term "absolute temperature (2marks)

(ii) Convert 25 degrees Celsius to Kelvin (2marks)

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

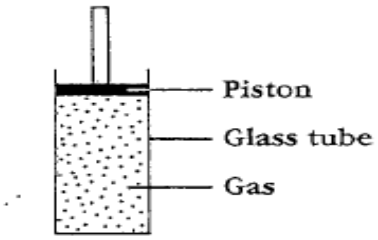


Figure 3

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

Volume: (1mark)

Pressure: (1mark)

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

3. Liquid pressure

2011-6.

b. Explain why walls of a dam are built thicker at the bottom. (3 marks)

c. A rectangular container whose base area is 9 cm^2 is filled with 27 g of water. Calculate the pressure exerted by the water at the bottom of the container in N/cm^2. (Acceleration due to gravity = 10 m/s^2). (4 marks)

2010-1.

a.

(i) Why are liquids used in hydraulic machines? (3 marks)

(ii) Give any two examples of hydraulic machines. (2 marks)

2008-8.

b. With the aid of a well labelled diagram, describe how a manometer works to measure gas pressure. (12 marks)

2007-6.

a. Give any two properties of liquid pressure. (2marks)

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

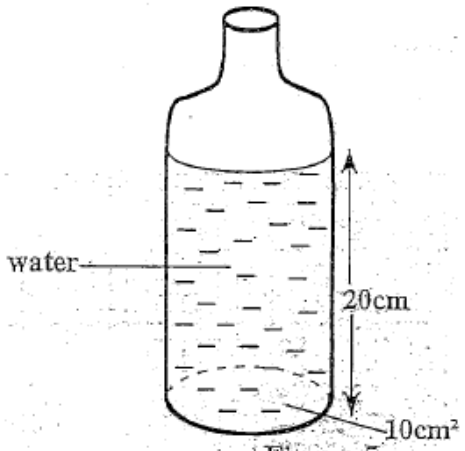


Figure 5

Calculate the pressure of water at the bottom of the bottle. (density of water = 1 g/cm^3) . (5marks)

c. Mention any two devices which make use of liquid pressure. (2marks)

2006-3.

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**.

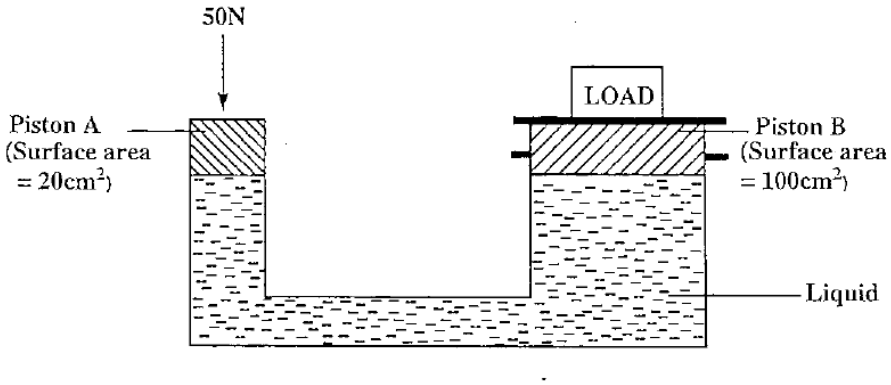


Figure 2

(i) Calculate the pressure piston **A** exerts on the liquid. (2marks)

(ii) How much pressure does the liquid exert on piston **B**? (1mark)

2006-8.

b. Derive a formula to show that the pressure of a liquid depends on its density and depth. (7marks)

2004-2.

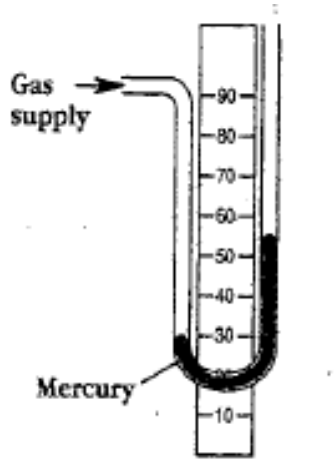
b.

(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 = 1 000 kg/m^3; g = 10 ms^{-2}). (3 marks)

(ii) Explain why the base of a dam is thicker at the bottom than the top. (2 marks)

(iii) Two identical gas jars were filled with liquid mercury (density 13.6 g/cm^3) and water respectively. Explain the difference in pressure exerted at the base of the jars by the two substances. (2 marks)

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



(i) Name the instrument. (1 mark)

(ii) Read the pressure difference in mm Hg. (1 mark)

(iii) Whit is the pressure of the gas supply if the atmospheric pressure is 755 mm Hg and the pressure difference is 30 mm Hg? (2 marks)

2003-4.

b.

(iii) A container with a cross sectional area of 3cm^2 is filled with 9cm^3 of water.
Calculate the pressure at the bottom of the container. (Density of water is 1g/cm^3) (5marks)

(iv) Give any two uses of liquid pressure in everyday life. (2marks)

4. Thermal expansion of solid

2010-8.

e. Describe how expansion and contraction of metals is used in shrink fitting. (3 marks)

8 Elements and chemical bonding

1.Stable electronic configurations and valency

2012-6.

a. The Table below shows electron configurations of elements **R**, **S**, **T**, **U** and **V**.

Element	Electron Configuration
R	2, 7
S	2, 8, 6
T	2, 8, 2
U	2, 4
V	2

(i) Which elements in the Table belong to period 2 of the periodic table? (2marks)

(ii) Give a reason for the answer in 6.a.(i). (1mark)

2011-4.

a. (i) State three ways in which atoms attain stability. (3 marks)

b. **Table 1** shows atomic numbers and boiling points of some elements represented by letters **D**, **Q**, **T**, **X** and **Z**.

Table 1

Element	Atomic Number	Boiling Point (°C)
D	3	1342
Q	13	2467
T	16	445
X	18	-186
Z	19	760

(i) Identify any two letters that represent elements which belong to period 3 in the periodic table. (2 marks)

(ii) Which element is in gaseous state at room temperature (25°C)? (1 mark)

(iii) What type of bonding would exist when element **Q** reacts with element **T**'? (1 mark)

(iv) Write down the chemical equation for the reaction that would occur between **D** and **T**. (3 marks)

2010-1.

e. Explain why helium, which has 2 valance electrons, is taken as a group 8 element.

2009-1.

a. Define "electron configuration? (1mark)

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

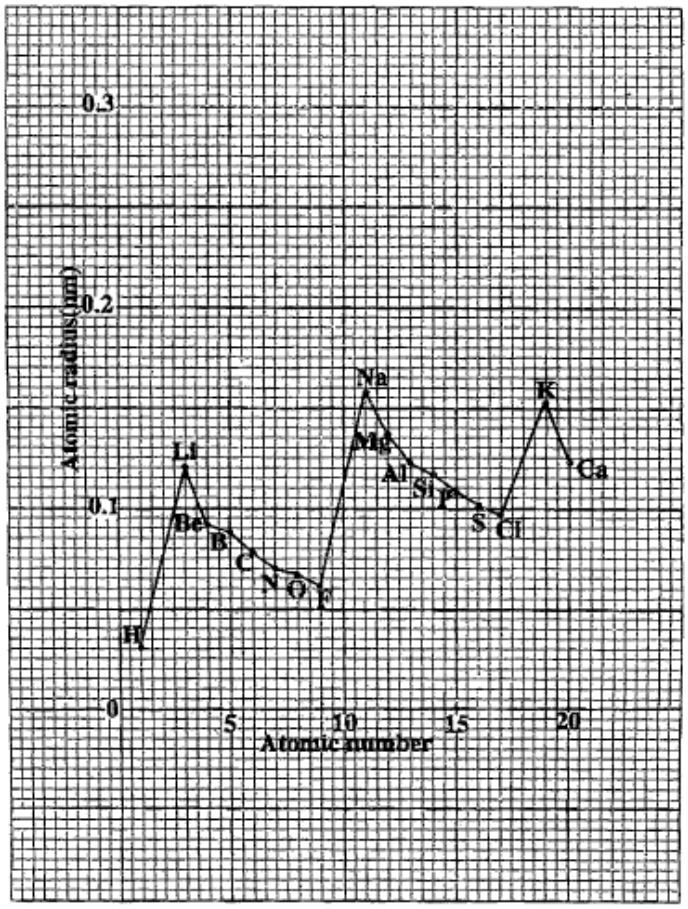


Figure 1

(i) To which group does element O belong? (1mark)

(ii) Give a reason for the answer to 1.b.(i). (1mark)

(iii) Why is there a sudden increase in atomic radius from F to Na? (2marks)

(iv) In terms of atomic radius, explain the difference in reactivity between F and CI. (4marks)

(v) Give two differences between the type of bonding in Lithium metal (Li) and chlorine gas (Cl_2) (2marks)

2009-1.

d. **Table 1** shows the number of valence elections and valences of some elements.

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? (1mark)

(ii) Give reason for the answer to 1.d.(i). (1mark)

(iii) What is the formula of a compound that is formed between Li and O? (1mark)

(iv) Give the charge on a Be ion. (1mark)

2008-1.

a. Element **X** has a mass of 89 amu and atomic number 19.

(i) How many protons are in the atom? (1 mark)

(ii) What would happen if element **X** was mixed with water? (1 mark)

(iii) Give a reason for the answer to 1.a.(ii). (1 mark)

2007-5.

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. (1mark)

(ii) Which two elements can form positive ions? (2marks)

(iii) Give a reason for the answer to 5.a.(ii). (2marks)

(iv) Give any three properties of element **A**. (3marks)

2005-2.

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. (3marks)

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

(i) To which group does X belong? Give a reason. (2marks)

(ii) Identify element **X** in Periodic Table.

2005-4.

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

Figure 4

(i) Explain why these atoms react in the same way. (3marks)

(ii) What are atoms of this type called? (1mark)

(iii) To which period of the periodic table could each belong? (1mark)

(iv) Explain the answer to d(iii). (1mark)

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 the missing numbers. (4 marks)

(ii) Which element in the table will easily form anionic compound? (1 mark)

(iii) Give a reason for the answer to 1.a.(ii) . (2marks)

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.

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**. (1 mark)

(ii) Give the letter of the element in the table which belongs to the halogen family. (1mark)

(iii) Give the latter of an element in the table that would not react with another element. (1mark)

(iv) Give a reason for the answer to 1c(iii) (1 mark)

2003-3.

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

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

(i) Write down the atomic number of Si (1mark)

(ii) Work out the electron configuration of K given that its atomic number is 19 (1mark)

(iii) Draw an electron dot and cross diagram of CO_2 (2marks)

(iv) How can aluminum (Al) attain an inert gas configuration? (1mark)

(v) Explain why the melting points of group VII elements increase with increasing atomic number.

2.Types of bonds and their properties

2012-6.

a. The Table below shows electron configurations of elements **R**, **S**, **T**, **U** and **V**.

Element	Electron Configuration
R	2, 7
S	2, 8, 6
T	2, 8, 2
U	2, 4
V	2

(iii) Give a pair of elements that would form an ionic compound when they react. (2mark)

(iv) Draw an electron dot and cross diagram for the compound formed when **S** combines with **U**. (3marks)

2011-4.

a. (ii) Explain how ionic bonding occurs. (3 marks)

2010-1.

c. (i) State any three properties of metals. (3 marks)

d. **Figure 1** is a diagram of atomic nuclei of elements **R** and **Q**.

Figure 1

(i) Write down the electronic configurations of elements **R** and **Q**. (1 mark each)

(ii) To which period and group of the periodic table does element **R** belong? (1 mark each)

(iii) Draw a dot and cross diagram of the component that would be produced when **R** reacts with **Q**.

2008-1.

b. Magnesium and chlorine can be represented as $^{24}_{12}Mg$ and $^{35.5}_{17}\mathrm{Cl}$, respectively.

(i) What are the valencies of magnesium and chlorine? (1 mark each)

(ii) What is the molecular formula of the compound formed as a result of magnesium reacting with chlorine? (2 marks)

c.

(i) Draw an electron dot and cross diagram of carbon dioxide ($C0_2$) given that carbon is in group 4 and oxygen in group 6 of the periodic table. (4 marks)

(ii) What type of bonding exists in carbon dioxide? (1 mark)

(iii) Give a reason for the answer to 1.c,(ii). (1 mark)

2005-2.

c.

(i) Write the chemical formula of the compound formed between Al and O. (1mark)

(ii) What type of bound exists between Al and O atoms in the compound formed in C(i)? Give a reason. (2marks)

2004-1.

a.

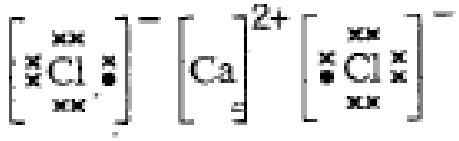
(iv) Work out the molecular mass of methane (CH_4). (2marks)

(v) What kind of chemical bonds are involved in methane? (1 mark)

(vi) Explain the answer to 1.a(v) (3 mark)

b.

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



(i) Write the chemical formula of calcium chloride. (1 mark)

(ii) Explain the meaning of the sign 2+ on the Ca atom. (1 mark)

2003-6.

a. Why are metals good conductors of heat? (2marks)

e. State two differences between ionic compounds and covalent compounds. (2marks)

<u>3.Selected elements and their compounds (halogen, nitrogen, sulphur)</u>

2012-6.

b. State any three physical properties of halogens. (3marks)

c. Explain what happened if chlorine is mixed with potassium bromide solution. (2marks)

2010-1.

c. (ii) Explain why potassium is more reactive than sodium (2 marks)

f. State any two uses of sulphates.

2009-1

c.

(i) Mention any two uses of sulphur. (1mark)

(ii) Give any two physical propaties of sulpur. (2marks)

2008-1.

e.

(i) Sulphuric acid (H_2S0_4) can be used as a dehydrating agent. Name the products in the dehydration of sucrose ($C_{12}H_{22}O_{11}$). (1 mark)

(ii) Give any four uses of sulphuric acid. (4 marks)

2006-2.

a. Halogens such as bromine, chlorine and iodine 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. (1mark each)

(i) Br_2 :

(ii) Cl_2 :

(iii) I_2 :

b. State any two properties of halogens. (2marks)

c. Draw an electron shell diagram for a fluorine atom ($^{19}_{9}F$) (2marks)

d. Arrange the elements $^{127}_{53}I$ $^{35.5}_{17}Cl$ and $^{80}_{35}Br$ in order of increasing reactivity. (3marks)

e. Explain the difference in reactivity of the elements in 2.d. (5marks)

f. state any chemical property of sulphur. (1mark)

g. explain, with the aid of diagrams , why rhombic sulpher is more stable than monoclinic sulphur. (4marks)

2005-2.

d. Define the term "allotropes" (1mark)

e. State two allotropes of sulfur. (2marks)

f. Give the halogen used for :

(i) Sterilizing drinking water. (1mark)

(ii) Photography. (1mark)

2003-6.

b. **Table2** shows the atomic numbers, melting points, boiling points and atomic radius of some halogens.

Name of element	Atomic number	Melting point (°C)	Boiling point (°C)	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°C? (1mark)

(ii) Why does iodine have the biggest radius? (1mark)

(iii) Work out the effective nuclear charge for fluorine. (2marks)

(iv) Mention nay two chemical properties of halogens. (2marks)

9 Chemical reaction I
(stoichiometry and heats of reaction)

1. Stoichiometry (mole concept, concentration)

2012-5.

d.

(i) Define "concentration" of a solution. (1mark)

(ii) The volume of sodium hydroxide solution (NaOH) of concentration 20g/l is increased from 60cm^3 to 600cm^3 by adding distilled water. Calculate the concentration of the new solution g/l. (3marks)

2011-3.

a

(i) Define "molar volume" of a gas. (2 marks)

(ii) Calculate the number of moles of sulphur dioxide occupying 120dm^3 at room temperature and pressure. (Molar volume at room temperature and pressure is 24 dm^3). (3 marks)

2008-3.

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

g, Calculate the empirical formula of an organic compound containing 48.0g of carbon, 12.0 g of hydrogen and 32.0 g of oxygen. (RAM of C= 12, H= l and O =16). (7 marks)

2007-3.

c. A 300mg tablet of a drug was completely dissolved in 10ml 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 and O=16) (4marks)

(ii) Calculate the concentration of the solution in moles per liter. (3marks)

2006-5.

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

2005-3.

b. In a titration, 20 $cm^3$of hydrogen chloride solution reacted completely with 25 $cm^3$of 0.2M sodium hydroxide solution mixed with phenolphthalein solution.

(i) Explain the function of phenolphthalein in the titration. (2marks)

(ii) Which was the standard solution in the titration? Give a reason. (2marks)

(iii) Write a balanced equation for the reaction between sodium hydroxide and hydrochloric acid.

(iv) Calculate the concentration of the acid. (4marks)

2004-7.

a. Describe how the concentration of 20cm^3 of sodium chloride solution can be determined by evaporation method. (10 marks)

b. State two sources of error in 8a. (2marks)

2003-3.

a.

(i) What is a "mole"? (1mark)

(ii) A solution was made by dissolving 8*g* of sodium hydroxide in 100cm^3 of water. Calculate the molarity of the solution. (RAM : Na=23, O=16, H=1) (5marks)

2003-6.

d.

(i) What is meant by "empirical formula of a compound"? (1mark)

(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, 0=16) (6marks)

2003-8.

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

(The molar mass of $CuSO_4$ - $5H_2O$ is 250g) (7marks)

2. Heats of reaction (endothermic, exothermic)

2012-5.

e. **Figure 3** is an energy level diagram for the reaction between magnesium (Mg) and oxygen gas(O_2).

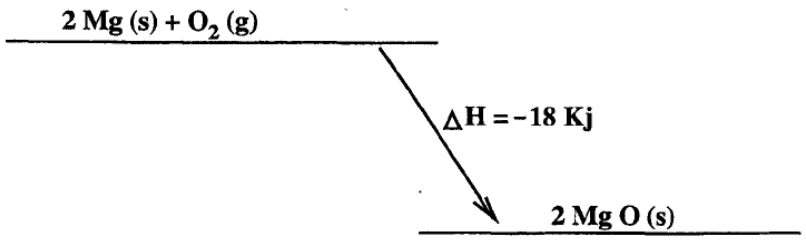


Figure 3

(i) Is the reaction exothermic or endothermic? (1mark)

(ii) Give a reason for the answer in 5.e.(i). (2marks)

(iii) State the meaning of the arrow in the diagram. (1mark)

2011-3.

c. Explain why bond breaking is endothermic while bond making is exothermic. (4 marks)

2007-3.

b.

(i) Draw an energy level diagram for the following chemical reaction: (3marks)

$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$. $\Delta H = -57$ kJ/mol

(ii) Is the reaction in 3.b.(i) endothermic or exothermic? (1mark)

(iii) Give a reason for the answer to 3.b.(i) endothermic or exothermic? (1mark)

(iv) What is the meaning of (*aq*) and (*l*) in the equations? (2marks)

2003-8.

a. What is the difference between an exothermic reaction and an endothermic reaction? (2marks)

b. Given that the reaction between methane (CH_4) and oxygen (O_2) to produce Carbon dioxide (CO_2) and water (H_20) is exothermic and the dissolving of ammonium nitrate (NH_4NO_3) is endothermic, draw energy level diagrams to illustrate the difference mentioned in 8a. (6marks)

10 Chemical reaction II
(Electron and Proton transfer reactions)

1. Electron transfer reactions

2012-5.

a. Define "electroplating". (2marks)

b. Iron(Fe) displaces copper(Cu) from copper sulphate solution($CuSO_4$).

(i) Write down a balanced chemical equation for the reaction. (3marks)

(ii) What is the reducing agent in the reaction? (1mark)

(iii) Give a reason for the answer in 5.b.(ii). (1mark)

c. What is the difference between "oxidation" and "reduction"? (2marks)

2011-3.

d.

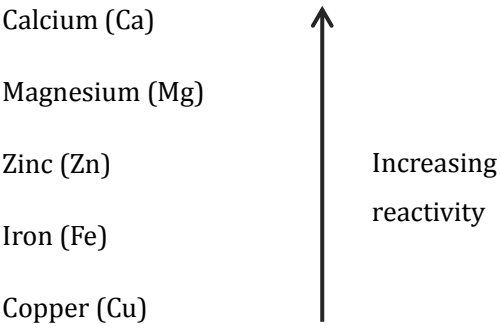
(i) Mention any two ways of preventing corrosion in metals. (2 marks)

(ii) Calculate the oxidation number of nitrogen (N) in a nitrate ion (NO_3^-) given that the oxidation number of oxygen (O) is –2. (3 marks)

2010-2.

a. State any two advantages of electroplating a metal.

b. Below is part of a displacement series of metals.



(i) Which metal would displace all other metals from their solution? (1 mark)

(ii) Give a reason for the answer in 2.b.(i). (1mark)

(iii) What would happen if a piece of magnesium metal was placed in copper sulphate solution? (2 marks)

d. Define "oxidation" in terms of oxygen content in a substance. (1 mark)

e. The chemical equation below shows displacement reaction between zinc (Zn) and lead nitrate ($Pb(NO_3)_2$).

$Zn + Pb(NO_3)_2 \rightarrow Zn(NO_3)_2 + Pb$.

Name the reducing and oxidising agents in the reaction.

Reducing agent: (1 mark)

Oxidising agent: (1 mark)

f. **Figure 2** is a diagram showing the set-up of an experiment to investigate conditions for rusting of iron.

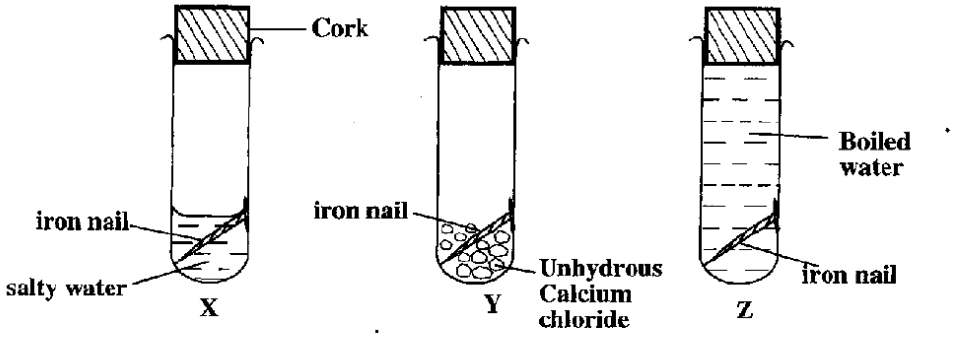


Figure 2

(i) Why was unhydrous calcium chloride used in tube Y? (1 mark)

(ii) Why was water in tube **Z** boiled? (1 mark)

(iii) State any two condition necessary for rusting of iron. (2 marks)

2010-7.

b. With the aid of a labelled diagram, explain how a silver spoon could be electroplated using copper. In the explanation, include the half equation for the reaction at the cathode. (11 marks)

2009-5.

e. Silver ions $(Ag^+(aq))$ react with iron (Fe) according to the following equation:

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

(i) what is the meaning of (2+) of $Fe^{2+}(aq)$? (1mark)

(ii) What is the oxidation number of silver before reaction? (1mark)

(iii) Which substance has been reduced? (1mark)

(iv) Give a reason for the answer in 5.e.(iii). (1mark)

2009-8.

a. What is an "electrolyte"? (2marks)

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.

(13marks)

2008-7.

b. What is the difference between "oxidation" and "reduction" in terms of electron transfer? (1 mark)

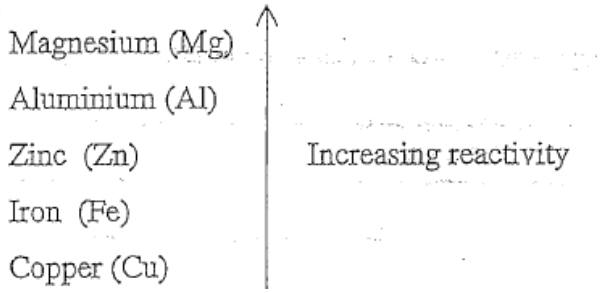
c. Explain how each of the following prevents resting of iron.

(i) painting (4 marks)

(ii) galvanizing (5 marks)

2007-6.

e. The following is part of a reactivity series.



(i) Which two elements will displace zinc (Zn) from its oxide? (2marks)

(ii) Give a reason for the answer to 6.e.(i). (1mark)

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

$$2Ag^{+}(aq)+2e \rightarrow 2Ag^{\circ}(s)$$

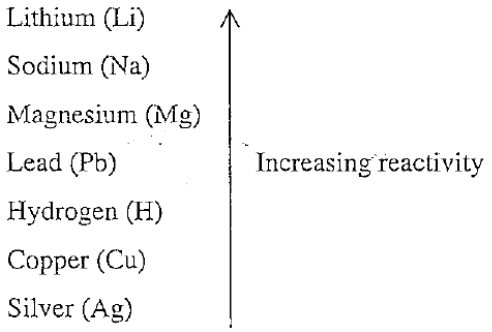
$$Mg^{\circ}(s)-2e \rightarrow Mg^{2+}(aq)$$

(i) Write a full chemical equation for the reaction. (2marks)

(ii) Name the reducing and oxidizing agents in 6.f.(i). (2marks)

2006-5.

d. the following is part of an activity series.



(i) State whether copper (Cu) will react with a solution of magnesium sulphate ($Mg\ SO_4$) (1mark)

(ii) Explain the answer to 5.d.(i). (2marks)

(iii) Which element is the most electropositive in the activity series? (1mark)

(iv) Give a reason for the answer to 5.d.(iii). (2marks)

e.

(i) Write half equations for the reaction between silver nitrate ($AgNO_3$) and Sodium (Na). (2marks)

(ii) Name the reducing and oxidizing agents in 5.e.(i). (2marks)

2005-7.

a. Draw a labeled diagram of the apparatus that would be used to electroplate an iron nail with copper using copper chloride as an electrolyte. (4marks)

b. Explain what happens during the process of electroplating of the iron nail in (a). Support the explanation with relevant chemical equations. (11marks)

2003-3.

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

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

(i) What is the meaning of the zero sign(0) in Cu^o (s)? (1mark)

(ii) Pick out the oxidizing agent and the reducing agent from the equation.

Oxidizing agent : (1mark)

Reducing agent : (1mark)

(iii) Write the two half equations for the reaction. (4marks)

2. Proton transfer reactions

2011-3.

b.

(i) Define an "acid" according to Lowry/Bronsted theory. (1 mark)

(ii) Describe how a hydronium ion (H_3O^+) is formed. (2 marks)

2010-2.

c. Water reacts with the carbonate ion according to the following chemical equation.

$$H2O(l) + CO_3^{2-}(aq) \leftrightharpoons OH^-(aq) + HCO_3^-(aq)$$

Give one conjugate acid-base pair in the reaction. (3 marks)

2007-3.

a. Ammonia is an example of a strong base.

(i) What is a "strong base"? (1mark)

(ii) Write a chemical equation to show the ionization of ammonia in water. (3marks)

(iii) Identify one conjugate acid-base pair from the equation in 3.a.(ii). (1mark)

2006-5.

a.

(i) Name the ion responsible for the acidic properties of a substance. (1mark)

(ii) Why is carbonic acid a weak acid while hydrochloric acid a strong acid? (2marks)

2006-5.

c.

(i) What does the symbol $\rightleftharpoons$ mean in a chemical equation? (1mark)

(ii) Complete the following chemical equations:

1. $HSO_4^-(aq) + \_\_\_\_\_ \rightleftharpoons H_3O^+(aq) + \_\_\_\_\_ (aq)$ (2marks)

2. $H_3PO_4(aq) + NH_3(l) \rightleftharpoons \_\_\_\_\_ + H_2PO_4^-(aq)$ (1mark)

2005-3.

a. Define "acid" according to Bronsted Lowry theory. (1mark)

11 Organic chemistry

1. Functional group chemistry (alkane, alkene, alchanol, carboxylic acid)

2012-3.

The following are general formulae of organic compounds **A** and **B**.

A. $C_nH_{2n+1}COOH$

B. $C_nH_{2n+1}OH$

a. To which family does compound **B** belong? (1mark)

b. Mention any three properties of compound **A**. (3marks)

c. State any three uses of compound **B**. (3marks)

d. Mention the products formed when compounds **A** and **B** react. (2marks)

e. Work out molecular formula of compound **A** if **n** is **5**. (3 marks)

f. Describe how compounds **A** could be distinguished from compound **B**. (5 marks)

2011-5.

b. Mention any two properties of alkanols. (2 marks)

c. Ethanol (CH_3CH_2OH) changes to ethanoic acid (CH_3COOH) in the presence of atmospheric oxygen (0_2).

(i) What is the function of atmospheric oxygen in the reaction? (1 mark)

(ii) Write a balanced chemical equation for the reaction. (3 marks)

2010-4.

b.

(i) Give three properties of carboxylic acids. (3 marks)

(ii) Mention any two natural sources of carboxylic acids. (2 marks)

d.

Ethanol (C_2H_5OH) reacts with ethanoic acid (CH_3COOH) according to the following chemical equation.

$$CH_3COOH + C_2H_5OH \underset{H_2SO_4}{\overset{\text{Concentrated}}{\rightleftharpoons}} \_\_\_\_\_ + H_2O$$

(i) Complete the equation. (1 mark)

(ii) Name the process in which ethanol reacts with ethnoic acid. (1 mark)

2010-8.

c. Explain why propanoic acid (C_2H_5COOH) conducts electricity when dissolved in water while propanol (C_3H_7OH) does not.

2009-5.

a. State any three uses of ethanoic acid. (3marks)

b. Why is the ethanoic acid regarded as a weak electrolyte? (1mark)

c. Write down the ionization equation of ethanoic acid (CH_3COOH) in water(H_2O). (4marks)

d. Why does sodium metal react with ethanol in the same way as it does with water? (1mark)

f.

(i) Write down the general formula for carboxylic acids. (1mark)

(ii) What is the formula and name of the smallest carboxylic acid? (2marks)

(iii) How would the boiling point of butane compare with that of a carboxylic acid of similar size? (1mark)

(iv) Explain your answer to 5.f.(iii). (3marks)

2008-5.

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

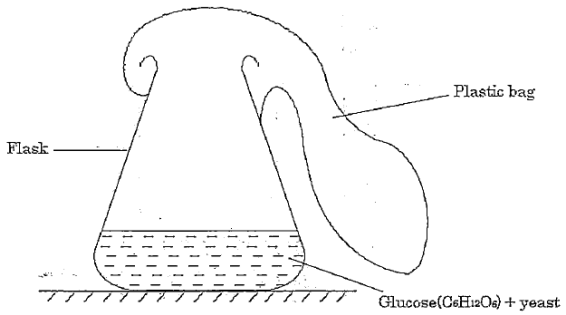


Figure 5

(i) Name the process that could occur in the flask. (1 mark)

(ii) Write down a balanced equation of the process named in 5.c.(i). (3 marks)

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

Name	Boiling point (°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. (3 marks)

(ii) Explain why ethanol is more soluble in water than propanol. (8 marks)

f.

(i) Complete the following equation to show the reaction between methane and chlorine.

$CH_4 + Cl_2 \rightarrow$ _____ + _____ (2 marks)

(ii) Name this type of reaction. (1 mark)

(in) Give any one use of alkanes. (1 mark)

2008-7.

a. Describe an experiment that can be done to distinguish octane from octene. (5 marks)

2007-1.

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. (1mark)

(ii) Which compounds belong to the same homologous series? (1mark)

(iii) Explain why a solution of compound **C** conducts electricity. (2marks)

(iv) Draw a full structure of compound **D**. (1mark)

(v) Name compound **D**. (1mark)

2007-7.

a. Draw full structures of ethanol (C_2H_5OH) and water (H_2O). (2marks)

b. Explain the difference in boiling points between ethanol and water. (5marks)

c. With the help of a labeled diagram, describe an experiment that can be done to separate a mixture of ethanol and water. (8marks)

2006-1.

a. Give below is 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**. (1mark each)

(ii) Which general formulae represent hydrocarbons? (2marks)

(iii) Draw the structure of a compound with three carbon atoms in homologous series **P**. (2marks)

(iv) Name the compound drawn in 1.a. (iii). (1mark)

(v) Explain how a compound of homologous series **Q** could be distinguished from a compound of homologous series **R**. (1mark)

c.

Ethene (C_2H_4) reacts with bromine (Br_2) in an addition reaction.

(i) Draw the structure of the product formed. (1mark)

(ii) Name the product formed in 1.c. (i). (1mark)

(iii) Why are addition reactions important in industries? Give two reasons. (2marks)

2005-5.

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

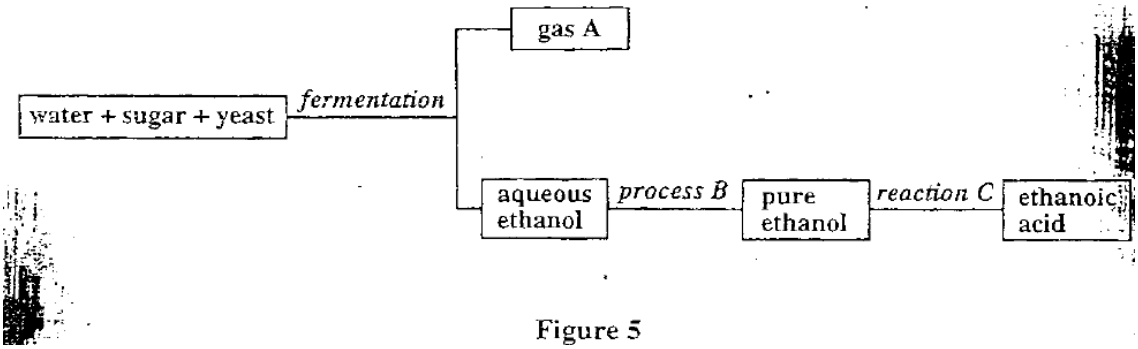


Figure 5

(i) Give the names of

(1) Gas A; (1mark)

(2) Process B; (1mark)

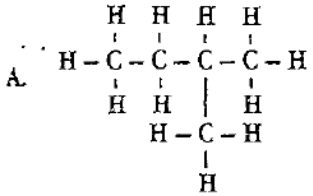
(3) Reaction C. (1mark)

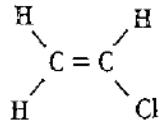
(ii) Name the substance that is used in reaction C. (1mark)

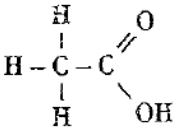
(iii) What is the function of the substance in a (ii)? (1mark)

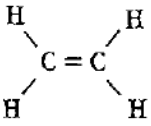
2005-5.

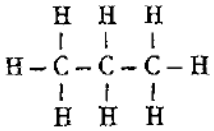
b. the following is structures of some organic compounds.

A. 

B. 

C. 

D. 

E. 

(i) Name compound **A**. (1mark)

(ii) Which compound is soluble in water? Give a reason. (2marks)

(iii) Write letters representing any three compounds that would not react with potassium, a group 1 metal element. (3marks)

(iv) Which one of the two compounds **A** and **E** would have a lower boiling point? Give a reason. (2marks)

(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**.

2004-3.

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

Table 4

COMPOUND	MOLECULAR FORMULA	BOILING POINT (°C)
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? (2 marks)

(ii) Which compounds in the table are soluble in water? (2 marks)

(iii) Which compounds in the table are gases at room temperature? (2 marks)

(iv) Explain why the boiling point of compound **D** is higher than the boiling point of compound **E**. (4marks)

(v) Describe a test which can be done to distinguish the compounds **C** and **D**. (4 marks)

2003-5.

a.

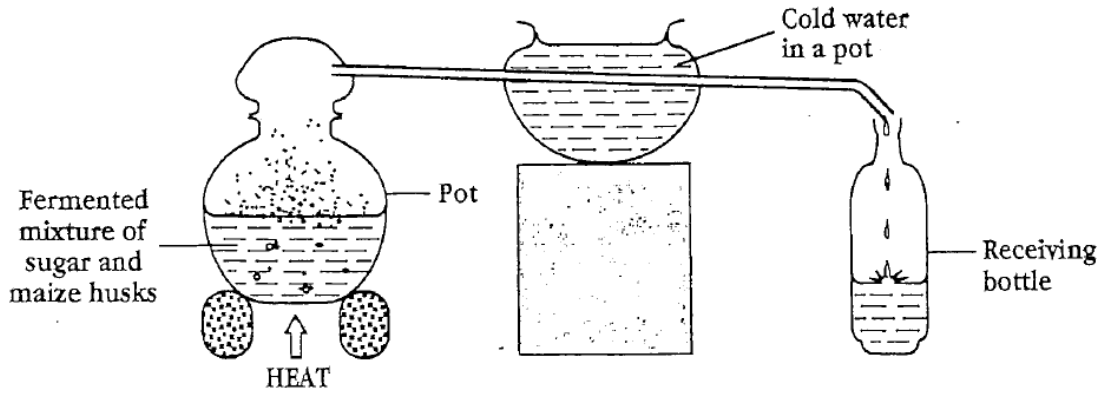
(i) Name the compound $C_7H_{15}OH$ (1mark)

(ii) What is the general formula of the compound in 5.a(i)? (1 mark)

(iii) Draw the structure of the compound $C_7H_{15}OH$ (1 mark)

b.

Figure4 shows one indigenous way of preparing alcohol.



(i) Name the process illustrated in **Figure4**. (1 mark)

(ii) Name the alcohol collected in the receiving bottle (1 mark)

(iii) The alcohol collected in figure4 is produced by fermentation.

(1) Define "fermentation". (2 mark)

(2) Write a word equation for the fermentation of sugar. (3marks)

c. Ethanoic acid (CH_3COOH) reacts with ethanol (C_2H_50H) according to the following equation.

$$CH_3COOH(l) + C_2H_5OH(l) \xrightarrow[\text{Heat}]{\text{Conc. } H_2SO_4} CH_3COOC_2H_5(l) + H_2O(l)$$

(i) What is the name of this reaction? (1mark)

(ii) Name the two products of this reaction. (2marks)

(iii) Give one use of $CH_3COOC_2H_5$. (1mark)

2. Isomerism

2011-5.

d. **Figure 3** shows structures of some organic compounds **P**, **Q**, **R** and **S**.

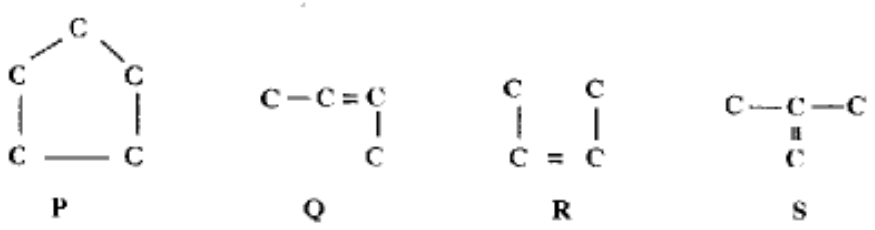


Figure 3

(i) Name the organic compounds labeled **P** and **Q**. (1 mark each)

(ii) Identify the structure which is an isomer of compound **Q**. (1 mark)

(iii) Give a reason for the answer in 5.d.(ii). (1 mark)

(iv) Explain how compound **P** could be distinguished from compound **R** using bromine solution. (3 marks)

2010-4.

c.

(i) Define "isomers". (2 marks)

(ii) Draw structural formulae for the four isomers of butanol (C_2H_9OH). (4 marks)

(iii) Write down the condensed formula of pentane. (2 marks)

2008-5.

a. Define "isomers".

b.

(i) Draw structural formulas for the two isomers of butane (C_4H_{10}).

(ii) Name the isomers draw in 5.b.(i). (1 mark each)

2006-1.

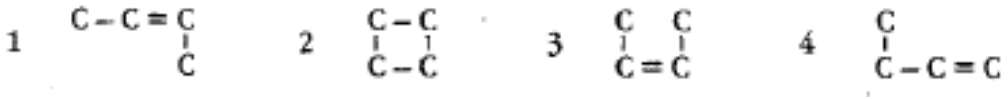
b.

(i) Write down all structural isomers of pentane. (3marks)

(ii) Name the isomers in 1.b. (i). (3marks)

2004-3.

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



(i) Name the molecules **1** and **2**. (1 mark)

(ii) Which two structures are conformations of each other? (1 mark)

2003-5.

d. Draw and name all the isomers of pentane(C_5H_{12}). (6marks)

3. Polymerisation

2011-5.

a.

(i) Give any two properties of polymers. (2 marks)

(ii) Explain how “condensation polymerization" occurs. (2 marks)

2010-4.

a.

(i) What are “polymers”? (1 mark)

(ii) Mention any two uses of polythene. (2 marks)

(iii) Give any three properties of plastics. (3 marks)

2010-8.

d. Explain how polythene is formed. (3 marks)

2009-5.

g. State any ‘three ways of managing plastic wastes. (3marks)

2009-7.

a. Explain any three characteristics of thermoplastics. (6marks)

b. Explain any two advantages of recycling organic compounds. (4marks)

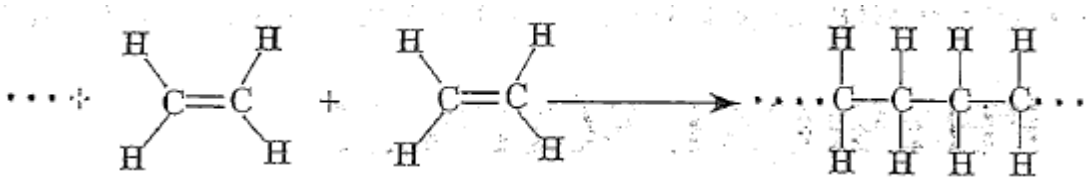
c. Explain why thermosetting plastics can be heated and moulded only once. (5marks)

2008-5.

d. State any two disadvantages of synthetic polymers. (2 marks)

2007-1.

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



(i) Name the polymerization represented by the equation. (1mark)

(ii) Describe how the polymer is formed from ethene molecules. (3marks)

(iii) Give two examples of artificial polymers. (2marks)

c.

(i) Give three differences between thermosetting and thermoplastic polymers. (3marks)

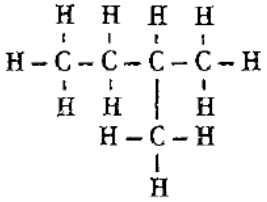
(ii) State two ways of disposing of plastic waste to avoid pollution. (2marks)

(iii) Give three advantages of plastic materials over metallic materials. (3marks)

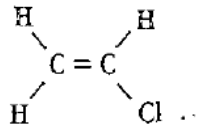
2005-5.

b. the following is structures of some organic compounds.

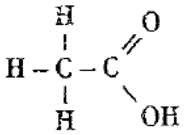
A.



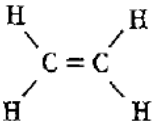
B.



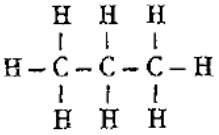
C.



D.



E.



(v) Compound B is a monomer. Write an equation to show its polymerization. (2marks)

(vi) Give the name of the kind of polymerization in b(v). (1mark)

(vii) Give one use of the substance formed in the polymerization of compound. (1mark)

(x) Write the other isomers of substance A. (2marks)

c. Give two advantages of thermoplastics. (2marks)

2004-3.

a. State one use of each of the following polymers.

(i) plastic

(ii) carbohydrate (2 marks)

b. State any two ways of disposing of plastics to avoid polluting the environment. (2 marks)

MSCE:P/S1 SOLUTIONS

1 Forces and motion

1. Force (vector)

2012-7.

b. The length of the line represents the magnitude of the vector / The direction of the line shows the direction of the vector.

c. By scale diagram

2010-3.

a.

(i) Any two from the following: mass, speed, distance, power, time, frequency, density

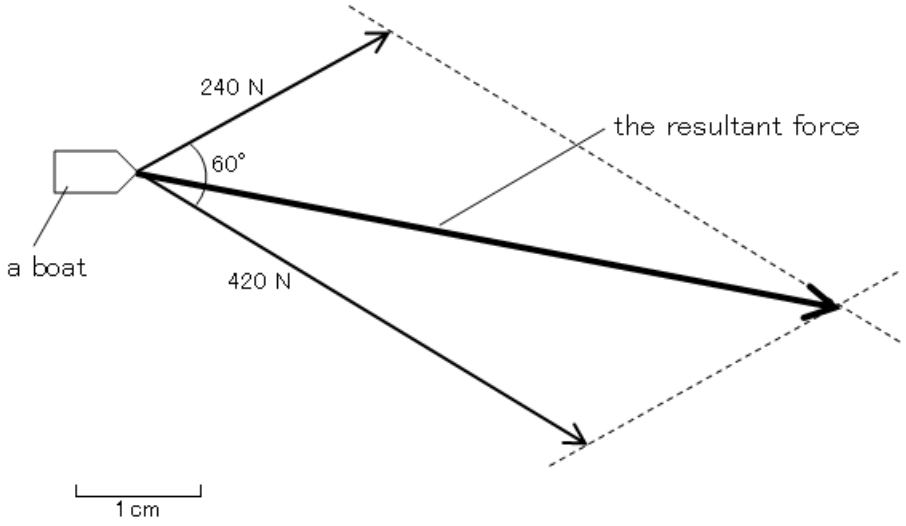
(ii) Vectors are represented by arrowed lines. The length of the line indicates the magnitude, and the direction of the arrow indicates the direction of the quantity.

2009-6.

a. A resultant vector is a single vector which is equivalent to the combined effect of two or more component vectors acting at the same point.

b. Velocity has a size and a direction while speed has only a size.

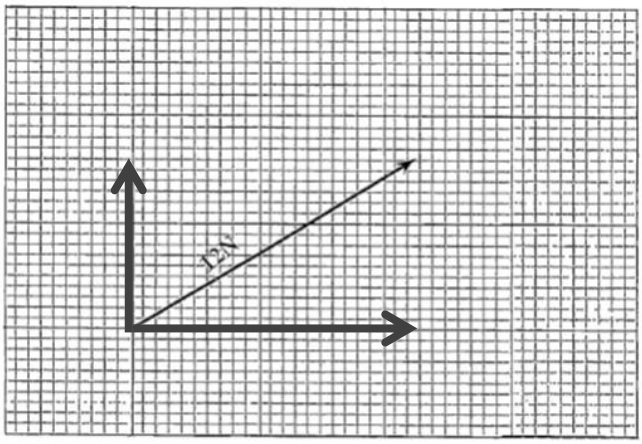
c.



2007-5.

c.

(i)



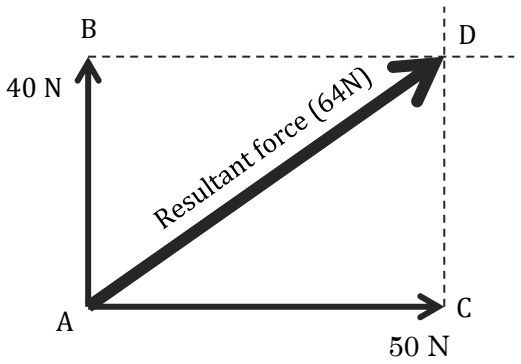
(ii) From the resultant force, it shows that 1cm represents 2N.

Horizontal length=5cm

$\therefore$ Horizontal force $= 5 \times 2 = 10$N

2005-4.

a.



AB // CD

AC // BD

ABDC is parallelogram.

$\therefore \overrightarrow{AD}$ is resultant force of two forces of 40N and 50N.

$AD^2 = AB^2 + AC^2$

$= 40^2 + 50^2$

$= 4100$

$\therefore AD \cong 64$

The magnitude of resultant force $\overrightarrow{AD}$ is 64N.

2. Velocity & acceleration

2012-7.

d.

The speed of object decreases 3[m/s] per 1second.

final speed is :

$20[m/s] - 3[m/s^2] \times 5[s] = 5[m/s]$

2011-1.

c.

$$\text{Acceleration} = \frac{\text{final velocity(v)} - \text{initial velocity(u)}}{\text{time taken(t)}} = \frac{(30-0)\ [m/s]}{3\ [s]} = 10\ [m/s^2]$$

2008-6.

d.

(i)

$$\frac{20[m/s]}{4[s]} = 5[\text{m}/s^2]$$

(ii)

$$\text{F} = \text{ma}$$
$$= 200[\text{kg}] \times 5[\text{m}/s^2]$$
$$= 1000\ [\text{N}]$$

2007-5.

b.

(i) From A to B there was uniform acceleration.

From B to C there was uniform deceleration (retardation) of 1.25m/s^2.

From C to D there was zero acceleration (constant speed) of 50 m/s

(ii) Distance covered=Area under the graph

$$= \frac{1}{2}(\text{base} \times \text{height}) = \frac{1}{2} \times 40 \times (75-25) = \frac{1}{2} \times 40 \times 50 = 1000\text{m}$$

2006-6.

a. It is the rate of change of velocity. Or it is the change in speed (velocity) per unit time.

b.

(i)

$$\text{a} = \frac{\text{v} - \text{u}}{\text{t}} = \frac{60\text{m/s} - 80\text{m/s}}{4\text{s}} = -5\text{m/s}^2$$

∴ Average deceleration is 5m/s^2

(ii)

$$\text{a} = \frac{\text{v} - \text{u}}{\text{t}}$$

$$-5\text{m/s}^2 = \frac{0\text{m/s} - 80\text{m/s}}{\text{t}}$$

$$\text{t} = \frac{-80\text{m/s}}{-5\text{m/s}^2}$$

t=16s

2004-8.

a. Measure the distance the athlete traveled and the time taken.

Average speed of the athlete can be calculated as:

distance the athlete traveled / the time taken.

b. error for measuring distance / error for measuring time taken

2003-1.

b.

(i) 60Km

(ii) 5hours

(iii)

Velocity from A to B is 10 km/h,

from B to C is 0 km/h,

from C to D is 15 km/h.

(iv)

$$\text{Average speed} = \frac{\text{total distance}}{\text{time taken}} = \frac{30\text{ km}}{2\text{ hours}} = 15\text{ km/h}$$

(v) It is a scalar quantity because it has no direction.

3. Newton's law

2012-7.

a. For every force of action acting on a body, there is an equal and opposite force of reaction by the body.

2011-1.

a Free fall occurs when an object falls with uniform acceleration under the force of gravity if air resistance is negligible.

b Air resistance (friction force) and Force of gravity.

2010-3.

b.

(i) By rowing, the person exerts force on water backwards. Then the force from water reacts on the oar forward, which accelerates the boat.

(ii) Newton's third law

(iii) Resistance due to water; Reaction of water through the oar

2008-6.

a. Air resistance, Weight of the object

b.

(i) F1: air resistance F2:weight or gravitational force

(ii) F1 is the same as F2.

c. It states that the rate of change of momentum of an object is directly proportional to the force acting on the object.

2006-8.

a. At the start the weight (W) of the ball makes it fall vertically downwards under gravity and is greater than the upward viscous force opposing its motion. As the ball speeds up, the upward force (fluid friction) increases and eventually equals weight W of the ball. The forces acting on the ball then balance and it moves with constant speed (terminal speed); the ball reaches the bottom of the tube with this constant speed,

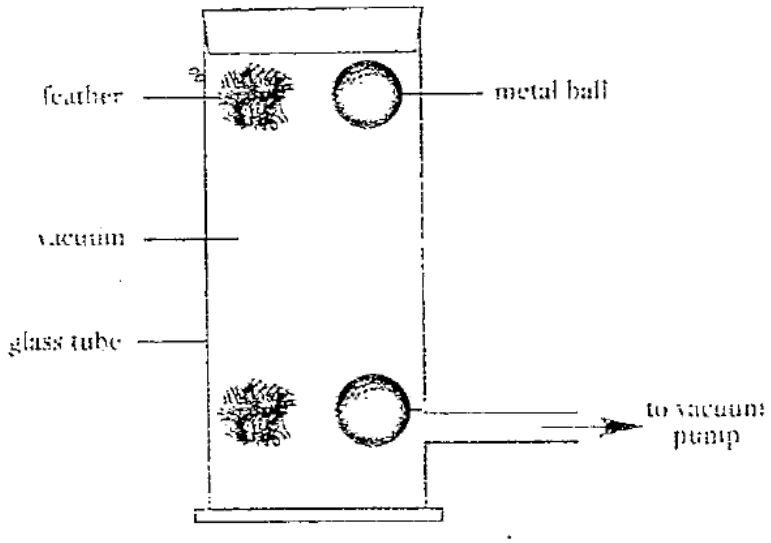
2005-8.

b.

(i) gravitational force

(ii) downwards

(iii)



(iv) Because the falling motion does not depend on mass of the object in case of the condition which has no air resistance in vacuum condition.

2 Electricity

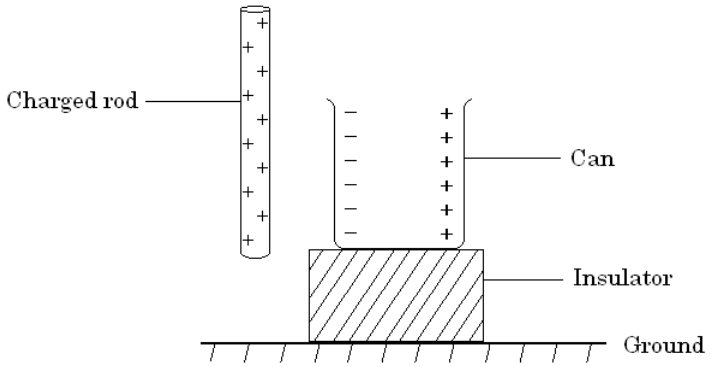
1. Electrostatics

2010-6.

a. Photocopying machines / Capacitors

2008-4.

(i)



(ii) Without an insulator, the charge flows away to ground.

2. Electrical resistance

2011-2.

b. When resistors are in series, the combined resistance is the sum of the individual resistance and is greater than any individual resistance. In case of connecting resistors in parallel, the combined resistance is the sum of the reciprocal of all resistances, and is thus less than the resistance of the smallest individual resistor.

2009-4.

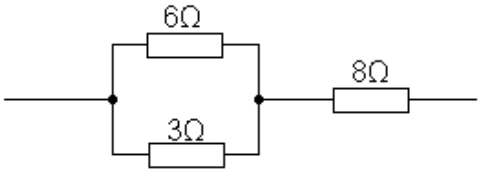
a.

(i) electrolytic capacitor

(ii) rheostat (or variable resistor)

b.

(i)



(ii) combined resistance in parallel:

$$\frac{1}{R}=\frac{1}{6}+\frac{1}{3}=\frac{1+2}{6}=\frac{3}{6}=\frac{1}{2}$$

$$\therefore R=2\Omega$$

combined resistance in total:

$$R=2+8=10\Omega$$

c.

(i) parallel circuit

(ii)

- Voltage across each component can be equal.
- Each component is controlled by its own switch.

(iii) Device X is a fuse. The fuse can avoid that overload current. If a fault occurs and too much current flows, the fuse wire melts before anything else is damaged or starts a fire.

(iv) *Choose one answer from below.

- cooker, kettle, iron, oven

d.

(i) $15 \times 10^0 = 15$ $\underline{15\Omega}$

(ii) Resistor P can give more accurate resistance than Q.

2007-2.

c.

(i)

Ammeter; $V = 12V, R = 6\Omega + 4\Omega = 10\Omega$

$$I=\frac{V}{R}=\frac{12V}{10\Omega}=1.2A$$

$\therefore$ Ammeter reading is 1.2A

Voltermeter: $I = 1.2A, R = 4\Omega$

$V = IR = 1.2A \times 4\Omega = 4.8V$

$\therefore$ Voltmeter reading is 4.8V

(ii) The voltmeter will read the same, i.e. 4.8V.

(iii) This is because the voltage in parallel circuit (components) is the same

2006-4.

a. (i) X: Battery Y: fuse

(ii) In series:

$R = 10\Omega + 20\Omega = 30\Omega$

In parallel:

$$R=\frac{R_1R_2}{R_1+R_2}=\frac{30\times30}{30+30}=\frac{900}{60}=15\Omega$$

$\therefore$ Total resistance in the circuit is 15Ω

(iii) $V = IR = 0.4A \times 15\Omega = 6V$

$\therefore$ Current in the 30Ω resistor

$$I = \frac{V}{R} = \frac{6V}{30\Omega} = 0.2A$$

(iv) $V = RI = 0.2A \times 10\Omega = 2V$

2005-8.

b.

Prepare 2 different length of nicrome wire.

Let electricity flow and measure voltage and current of those two wires by using voltmeter and ammeter.

Calculate the resistances by using formula of resistance = voltage / current.

Draw a graph for the length of wire against its resistance.

It should show directly proportional.

2004-4.

a. Because voltmeter is for measuring a pressure of electricity flow which needs to measure two different points. Whereas ammeter is measuring an amount of electricity flow which needs to measure only one point. Therefore voltmeter is connected in parallel while ammeter is connected in series.

b. $15\Omega \pm 5\%$

e.

(i) parallel

(ii) Same voltage with a buttery can provide to two or more headlamps.

3. Power and cost of electricity

2012-2.

c.

(i) it prevents the high current flows in electrical circuit

(ii) same voltage can be applied both bulbs

(iii) 200W bulb

(iv) Because 200W bulb consumes larger electrical energy than 100W bulb when same voltage are applied.

d.

Electrical power = voltage × current.

So, Electrical power = 230V × 2A = 460W

2010-6.

c. Electric power is the rate of energy consumption in an electrical circuit.

d.

(i) "240V" indicates voltage for use and "60W" indicates electrical energy

(ii)

8 minutes = 480 seconds.

Electrical energy [J] = Electrical power [W] × time[s]

= 60[W] × 480[s]

= 28,800 [J]

2007-4.

a.

(i) I=2A, V=240V,

$$R = \frac{V}{I} = \frac{240V}{2A} = 120\Omega$$

(ii) $P = IV = 2A \times 240V = 480W$

(iii)

$$\text{Electrical energy} = P \times t = \frac{480}{1000}kW \times 3h = 1.44kWh$$

$$\text{Cost of electrical energy} = k5.00 \times 1.44 = K7.20$$

2006-4.

b.

(i) It is the electrical energy used by a 1 kW appliance in 1 hour.

(ii)

$$P = 150W = \frac{150}{1000}kW = 0.15kW$$

t=10 hrs

$\therefore$ Electrical energy $= 0.15kW \times 20hrs = 3kWh$

$\therefore$ Cost $= K5.00 \times 3 = K15.00$

2005-8.

a.

P = 6 kW = 6000W, R = 3Ω, V = 300V.

Electrical current passing through the cable is:

I = P/V = 6000W/300V = 20 A

Power wasted in the cable is:

$P = I^2R = 20^2 \times 3 = 1200W$

2003-1.

a.

(i) Heat energy

(ii)

V=IR, $V = 12 \times 1.5 = 18V$

Electrical power P is:

P=VI, $P = 18 \times 1.5 = 27W$

3 Magnetism and electromagnetic induction

1. Magnetism

2012-8.

e. The domains inside of steel are rearranged toward same direction of stroking. Therefore it can be magnetized.

2011-2.

c. Heating it strongly (red hot) / Leaving a magnet in the solenoid while the current is reduced to zero.

2. Electromagnetic induction

2012-2.

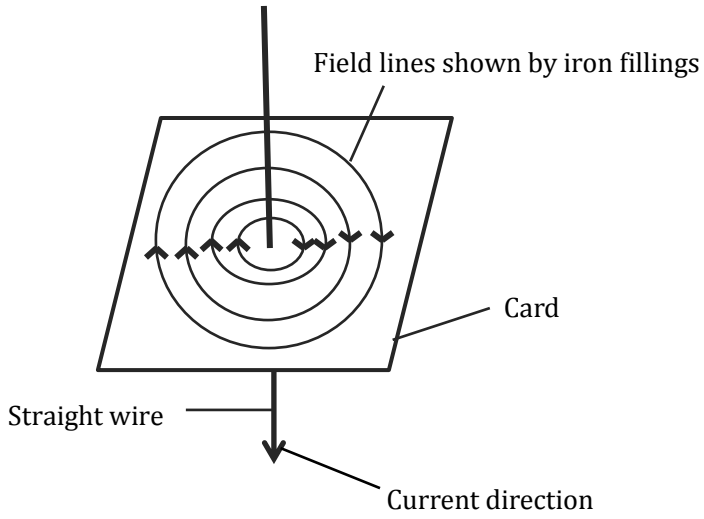
a. using electromagnetic induction/ using a cell connecting complete circuit

b. electric motor / dynamo / ammeter

2011-2.

d.

(i)



(ii) The compass needle points in the opposite direction.

(iii) When the direction of current reverses, the direction of the field reverses too. Therefore the compass needle also reverses.

2010-6.

b.

(i) Solenoid

(ii) Iron fillings would be attracted to the iron bar.

(iii) The iron bar gets magnetised due to the electric current.

(iv) It increases the strength of the magnetic field.

e.

$$\frac{240[V]}{1200} = \frac{V}{50}$$

$\therefore$ V = 10V

2008-4.

a.

(i) step-down transformer

(ii) It is because the number of turn in the output coil is less than the number of turns in the input coil.

(iii)

$$\frac{N_1}{N_2} = \frac{V_1}{V_2}$$

$$V_2 = \frac{V_1 \times N_2}{N_1} = \frac{230 \times 50}{1000} = 11.5$$

11.5 V

2007-4.

b.

(i) It can be transmitted over long distances.

It can be easily stepped up or down.

Line losses are minimized for a given wattage delivery and wire diameter.

(ii) Heat energy lost due to resistance in the wire windings

Eddy's currents

Flux leakage

(iii) Resistance in the windings can be reduced by using thicker copper wires which have low resistance. Coolants can also be used to cool down the transformer.

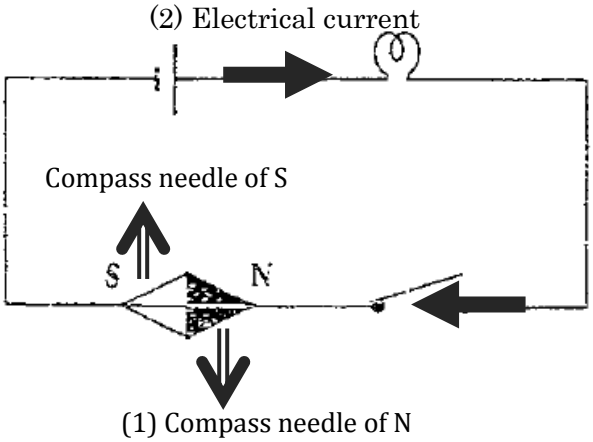
Eddy's currents can be reduced by using laminated iron core, i.e. iron is layered to increase resistance.

Flux leakage can be reduced by good designing of the transformer. This is achieved by winding primary on top of the secondary and having a 'closed' iron core.

2005-1

d.

(i)



(ii)

(1) The direction of compass needle will be reversed.

(2) There is no movement.

e. Speaker / electrical bell

2004-4.

c.

(i) Electric motor is a device to create a rotating movement using electricity. Whereas an electric generator is a device to create electricity using a rotation movement.

(ii) strength of magnet / number of turn of coil

2003-7.

b.

(i) A step up transformer has a more number of turns on the secondary coil than that of primary coil. When current is applied to the primary coil, it produces magnetic field magnetic field which is cut by the secondary coil. Then the secondary coil induces secondary current and voltage. The ratio of number of turns on primary and secondary coil is equal to the ratio of primary voltage and secondary voltage, respectively.

(ii) Using oil in a transformer to cool it down.

Using thick irons covers to have high resistance.

4 Electricity, Magnetism and Electromagnetic Induction II

Electronics

2011-2.

a. P-type and N-type semiconductors.

2011-8.

a. A semiconductor conducts better when some heat energy is supplied to it (or its temperature is increased) because in so doing the electrons are promoted (excited) from the valence band to the conduction band. This decreases the resistance of a semiconductor, and electrons easily flow in the material.

2008-4.

b.

(i) Semiconductors are solids which conduct electricity better than insulators but not as well as conductors.

(ii) As the temperature rises, the electrical conductivity increases.

c.

(i)

X: base

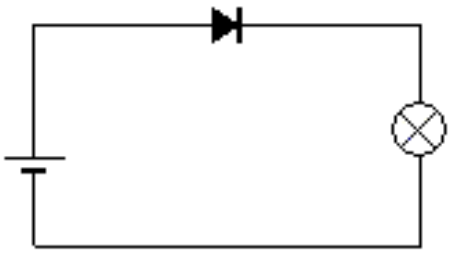
Y: collector

(ii) switching / amplifying of an electric current

d.

(i) Diodes can remove all the current flowing in one direction from alternating current.

(ii)

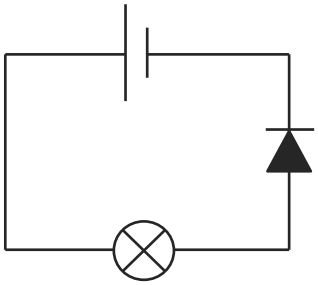


2004-4.

d.

(i) It is a materials that allow current to pass through under certain conditions.

(ii)



(iii) Doping improves conductivity of a semiconductor.

(iv) Transistors can amplify current, can control current as an electronic switch

5 Oscillations and Waves

1. Oscillations

2012-4.

a. Oscillation is regular movement between one position and another position.

2010-6.

h.

(i) The length of the string; Acceleration due to gravity.

(ii) The vibrating material moves to and fro about a fixed position; The sum of its kinetic, potential and strain energy is constant.

2008-2.

b

(i) $20\text{cm} \div 2 = 10\text{cm}$

(ii) B

(iii) At point A, the mass has potential energy only. From point A to B, potential energy decreases and kinetic energy increases. At point B, the mass has kinetic energy only. From point B to C, kinetic energy decreases and potential energy increases. At point C, the mass has potential energy only.

(iv) *Choose two answers from below.

A part of kinetic energy changes to heat energy.

A part of kinetic energy changes to sound energy.

All energy is changed to heat as a result of overcoming air resistance.

2004-5.

a. Oscillation is regular movement of a swinging pendulum from one side to another side.

b.

(i)

(1) increases

(2) decreases

(ii) Speed at C is zero.

(iii) Frequency do not change. Amplitude decreases.

(iv) The energy changes from potential energy to kinetic energy as the mass moves from A to B.

The energy changes from kinetic energy to potential energy as the mass moves from B to C.

(v) As the length of the string decreases, frequency increases.

2. Waves

2012-4.

b.

(i) transverse wave

(ii)

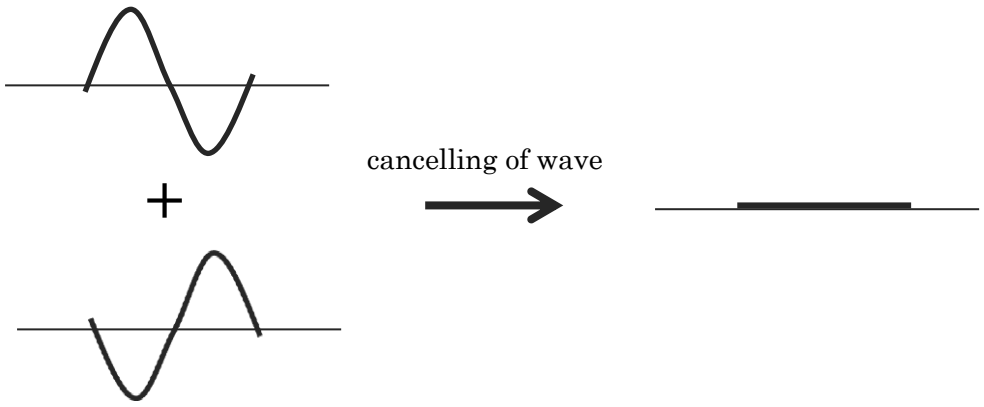
frequency = speed ÷ wavelength

So, frequency = 6m/s ÷ 2m = $3s^{-1}$

c. Interference occurs when the waves travel in the same region resulting in either reinforcement or cancelling of each other. While diffraction occurs when straight wave hit an obstacle with a gap, the waves become curved on the other side and spread beyond the edges of the gap,

2012-8.

a.



Destructive interference occurs when identical waves meet out of phase resulting in cancelling of each other and stopping of all movements.

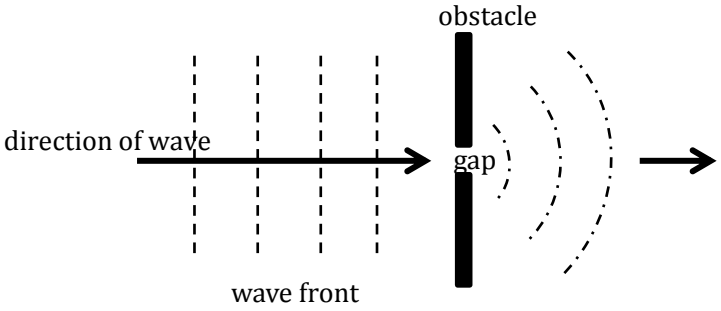
b. Because speed of wave is different between different mediums.

2011-7.

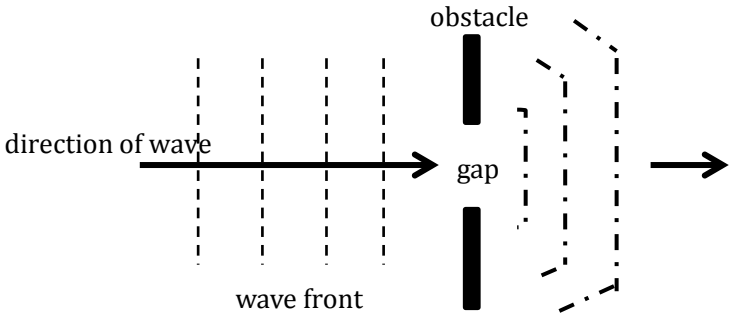
a A transverse wave is that the direction of the disturbance (vibrating particles) is at right angles to the direction of travel of the wave. A longitudinal wave is that the particles of the transmitting medium vibrate to and fro along the same line as that of wave motion.

2011-8.

b When waves pass through a narrow gap, they spread out more, i.e. more diffraction as demonstrated in the first diagram.



When waves pass through a wide gap, there is less diffraction (spread out less) as shown in the second diagram.



2010-8.

a. When two or more waves meet in phase, the resultant wave has greater amplitude. This interference is called constructive interference.

2009-2.

b.

(i) transverse wave

(ii) *Choose two answers from below.

- refraction, reflection, diffraction, interference

(iii) 2m

(iv)

wave speed = wavelength × frequency

= 2 m × 2 Hz

= 4 m/s

4 m/s

2007-2.

a.

(i) Mass on the spring

(ii) Material of the spring

b.

(i) Crest

(ii)

$$\text{Frequency} = \frac{\text{number of complete cycles}}{\text{time taken}} = \frac{1\text{cycle}}{2\text{s}} = 0.5 \text{ Hz}$$

(iii)

$$\text{Velocity} = \text{frequency} \times \text{wavelength} = 0.5\text{Hz} \times 50\text{m} = 25 \text{ m/s}.$$

2006-6.

c.

(i)

$$\text{Wavelength} = \frac{\text{distance travelled by a wave}}{\text{number of comlete waves}}$$

$$= \frac{1.8\text{m}}{4\,{}^{1}/_{2}}$$

=0.4m

(ii)

$$\text{Frequency} = \frac{\text{number of complete cycles}}{\text{time taken}}$$

$$= \frac{20}{2} = 10 \text{ Hz}$$

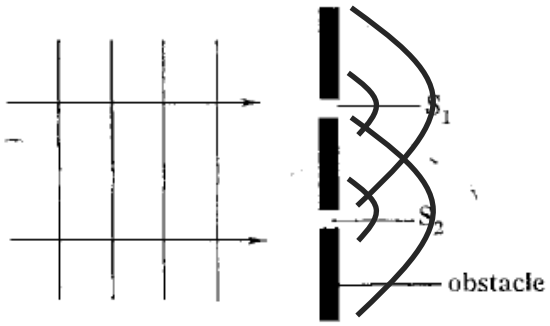
$$\text{Speed of a wave} = \text{frequency} \times \text{wave lengh}$$

$$= 10\text{Hz} \times 0.4\text{m}$$

$$= 4\,\text{m/s}$$

d.

(i)



(ii) Diffraction and interference

(iii) Diffraction will be insignificant, i.e. not much diffraction will take place.

2006-7.

b. At the point where a crest from one source arrives at the same time as crest from another source, a bigger crest is formed and the waves are said to be in phase. When the waves are in phase, it means there is constructive interference. This also happens when two troughs collide.

At the point where a crest and a trough arrive together, the waves are exactly out of phase and they cancel out (if their amplitudes are equal). When the waves are out of phase there is destructive interference.

2005-6.

a. transverse wave

b. wave length = 60cm/5 = 12 cm = 0.12 m

c. frequency = 4 / 1 second = 4 Hz

d.

Speed = frequency × wave length

$4\ \text{Hz} \times 0.12\text{m} = 0.48\ \text{m/s}$

e. The wave length would decrease.

f. When waves enter the shallower water, then speed of wave would decrease but frequency of wave doesn't change. So, wave length would decrease.

g. constructive interference is produced where crest and crest meets at same region. It makes the crests bigger.

h. In a transverse wave, the objects move up and down about fixed position at right angle to the direction of movement of the wave. While in a longitudinal wave, the objects move in the direction of the wave.

i. transverse wave

2003-1.

c.

(i)

Transverse waves can travel through a vacuum while longitudinal waves cannot.

Transverse waves produce crests and though while longitudinal waves create compression and rare faction.

Oscillations of transverse waves are at right angle in the direction of the waves while that of longitudinal waves are in line with direction of the waves.

(ii)

Amplitude, wave length, frequency, velocity,(write any two of these)

3. Light

2011-7.

b Sunlight rays arrive in parallel beams. Using the window as an object, one can form a sharp, inverted image on a sheet of white card or white wall (acting as screen) by adjusting the convex lens between sunlight through window and the screen is the focal length.

2011-7.

c -The focal length of the human eye lens changes while that of the camera is fixed.

-The human eye has a fixed image distance while the camera has an image distance that changes.

2010-6.

g.

(i)

- A real image is the image projected through a lens, while a virtual image is not projected and observed through a lens
- A real image is upside down, while a virtual image is upright.
- A real image cannot be observed using concave lenses, while a virtual image can.

(ii)

(1)

$$\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$$

where $f = 10\text{cm}, u = 30\text{cm}$, hence the image distance $v = 15\text{cm}$

(2)

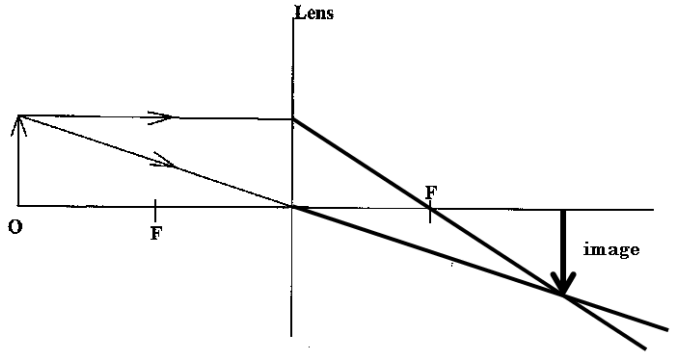
$$\text{Magnification} = \frac{\text{image distance}}{\text{object distance}} = \frac{15}{30}$$

2010-7.

a. Light rays from an object are bent towards the principal axis when passing through the convex lens. They converge at a certain point, where the image is produced.

2009-2.

a.(i)



(ii) the length of the object, h_1 : 2cm

the length of the image, h_2 : 2cm

magnification, m is

$$m = \frac{h_2}{h_1} = \frac{2cm}{2cm} = 1$$

2009-2.

c

(i)

concave mirror:

It reflects back the light rays that are directed away from Light source so that the slide can get the brighter lights.

condenser lens:

It can converge and condense as much light as possible onto the slide, so as to illuminate it very well.

2008-2.

a.

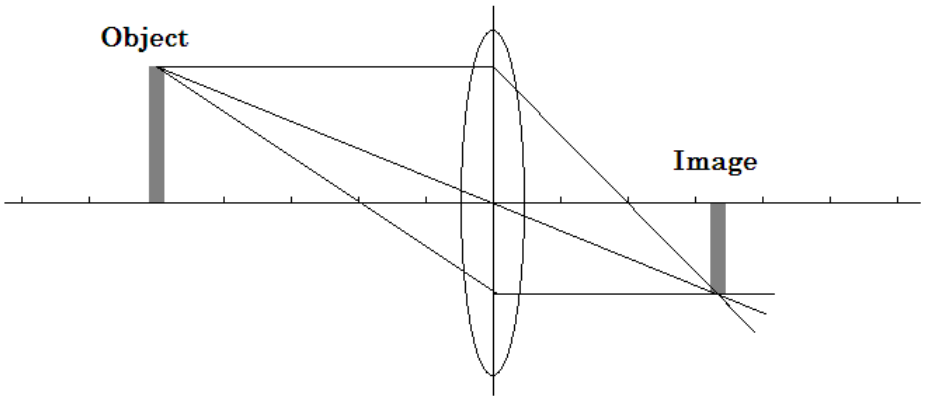
(i) Focal length is the distance between the optical centre and the principal focus.

(ii)

A convex lens forms a real image of a real object. If you measure the image distance (v : the distance from image position to centre of lens) and the object distance (u : the distance from object position to centre of lens), the focal length can be determined by using the following equation: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$.

f: focal length, v: image distance, u: object distance

(iii)



2007-2.

c.

(i)

An eye uses a light sensitive retina as its screen and a camera uses a light sensitive film as its screen.

An eye has a converging lens (convex) and a camera has a converging lens too.

The iris controls light entering the eye and the shutter/diaphragm controls light entering a camera.

Both use light in their operations.

Inside surface area of an eye is black (dark) just the same as in the camera.

(ii) It is a hole in the diaphragm that lets in light.

d.

(i) Object distance(u)=15cm, focal length (f)=10cm

$$\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$$

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{10}-\frac{1}{15}=\frac{1}{30}$$

$$\frac{1}{v}=\frac{1}{30}$$

∴ Image distance is 30cm

(ii)

$$\text{Magnification}=\frac{v}{u}=\frac{30\text{cm}}{15\text{cm}}=2$$

(iii) Magnified, real and inverted (upside down)

2004-5.

c.

(i)

Lens formula is

$$\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$$

where *f* is focal length, *u* is object distance and *v* is image distance.

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{5}-\frac{1}{7.5}$$

$$=\frac{3}{15}-\frac{2}{15}=\frac{1}{15}$$

$$\frac{1}{v}=\frac{1}{15}$$

$\therefore \mathrm{v}=15\mathrm{cm}$

6 Nuclear physics

2012-6.

d.

(i) alpha particles / beta particles / gamma rays

(ii) Half-life is the time it takes for half the atoms in the sample to decay.

(iii) It is much heavier than other radioactivity. / It has positive charge. / It interact strongly with the materials.

2012-8.

d.

The measurement of amount of remaining radioisotope of carbon can tell the date at which the plant or animal last stopped taking in the carbon and therefore the date when it existed, science animals and plants stop taking carbon when they die.

The heat energy which is produced by nuclear fusion is used to boil water to make steam at high pressure and its energy are converted to electrical energy in nuclear power plant.

2011-7.

d.

(i) Nuclear fission is a process in which a highly unstable nucleus splits (disintegrates) into two or more nuclei.

(ii) ${}_{1}^{1}H$ and ${}_{1}^{2}H$

e. It is not suitable for detecting beta radiation because beta particles cause insufficient ionisation of the air. For a charged leaf electroscope to work better, the nuclear radiations should cause the air around the cap to be fully ionised.

f.

(i) '228' : the mass number, '88' : the atomic number or proton number

(ii) ${}_{90}^{232}Th \rightarrow {}_{88}^{228}Ra + {}_{2}^{4}\alpha$ *or* ${}_{90}^{282}Th \rightarrow {}_{88}^{228}Ra + {}_{2}^{4}He$

2010-5.

a.

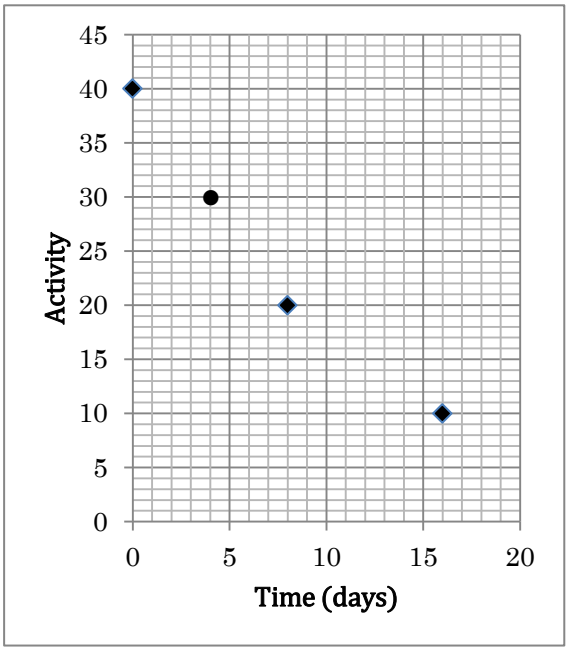
(i) Protons and neutrons

(ii) They undergo a radioactive decay; They have an unstable ratio of protons to neutrons

(iii) Archaeological dating; Power generation

b.

(i)



(ii) 8 days (The half-life is 8 days)

c. An alpha-particle

2009-3.

a. Radioactivity is a property of some unstable nuclei, whereby they break up spontaneously into nuclei of other elements and emit radiation.

b.

- alpha particles
- beta particles
- gamma rays

c. *Choose two answers from below.

- photographic plates
- scintillation counter
- spark counter
- cloud chamber
- Geiger-Muller tube (or GM-tube)

d.

(i) They have the same chemical properties.

(ii) It is because their electrons are arranged in exactly the same way.

e. *Choose one answer from below.

- uranium ore
- radium ore
- thorium ore

f. after 30 minutes the fraction left is $\frac{1}{2}$

after 1 hour the fraction left is $\frac{1}{4}$

after 1 hour and 30 minutes the fraction left is $\frac{1}{8}$

after 2 hours the fraction left is $\frac{1}{16}$

The fraction left after 2 hours is $\frac{1}{16}$.

2008-3.

a. Nuclear fusion is the collision and joining together of two light nuclei to form a heavier, more stable nucleus.

b.

(i) ${}^{3}_{2}He$: Helium-3 ${}^{1}_{0}n$: neutron

(ii) beta decay

c.

(i)

Stage 1: alpha particles

Stage 2: beta particles

(ii) gamma particles

d.

- We never hold it near the eyes.
- They must be kept in the boxes when not in use.
- Handle with long tongs and transported in thick lead containers.

e.

<u>method 2</u>:

$$N = N_0\left(\frac{1}{2}\right)^{\frac{t}{T}}$$

$$8 = 128\left(\frac{1}{2}\right)^{\frac{16}{T}}$$

$$\frac{1}{16} = \left(\frac{1}{2}\right)^{\frac{16}{T}}$$

$$\left(\frac{1}{2}\right)^{4} = \left(\frac{1}{2}\right)^{\frac{16}{T}}$$

$$4 = \frac{16}{T}$$

$$4T = 16$$

$$T = 4$$

<u>Ans. 4 minutes</u>

2007-8.

Alpha decay:

Each alpha particle has 2 protons (atomic number is 2) and 2 neutrons and it is identical to Helium -4 nucleus with a charge of +2. Alpha particles have strong ionising effect, that is to say, alpha particles have a better ability to remove electrons from shells of other atoms. Alpha particles are not very penetrating; they are easily stopped by thick sheet of paper or by skin, or a few centimetres of air. Alpha particles are deflected by magnetic and electric fields (to the negative side/charge).

Beta decay:

The beta particle is an electron and it has a relative charge of -1 since they are smaller than alpha particles. Beta particles have weak ionising effect. Beta particles are more penetrating than alpha particles, but can be stopped by a few milimetres of aluminium or any other metals.

Beta particles are deflected by magnetic and electric fields (to the positive side/charge). The beta particles have higher speed than alpha particles, i.e. an average speed of light.

Gamma emission;

When a gamma radiation occurs, high energy electromagnetic waves are emitted from the atomic nucleus. Gamma rays have a very weak ionising effect, that is, gamma rays have a very little ability to remove electrons from their paths in the atoms. Gamma rays are very penetrating; never completely blocked or stopped, though lead and concrete can reduce the intensity of penetrating. Gamma rays are not deflected by magnetic or electric fields since they have no charge.

2006-3.

a. This is a process in which a nucleus split into two or more nucleus split into two or more nuclei due to the penetration of a particle making a nucleus highly unstable.

b. Protons and neutrons

c.

(i) A: Gamma rays / B: Alpha particles

(ii) It is relatively bigger and heavier than the other particles.

d.

(i) X: Alpha particles / Y: Gamma rays / Z: Beta particles

(ii) Z is a beta particle and it is negatively charged, i.e. an electron; As a result it is attracted to the plate that has an opposite charge, i.e. positive plate.

2005-4.

c.

(i)

Mass of remain substance is represented :

$$20g \times \left(\frac{1}{2}\right)^{\frac{12\text{ hours}}{3\text{ hours}}}$$

$$= 20g \times \left(\frac{1}{2}\right)^{4} = 20g \times \frac{1}{16} = 1.25\ g$$

(ii) The short life-time radioisotopes decay into stable substance rapidly in the plants. As a result, use of short life-time radioisotope can only affect minimum damage for plant cells.

(iii) Useful in the production of nuclear energy.

2004-6.

a.

- Wear protectors
- Use forceps
- Enclose the waste in steel containers which are taken buried in concrete bunkers

b.

(i)

Alpha particles : They consist two protons and two neutrons. It is the nucleus of a helium atom: ${}^{4}_{2}He$.

Beta particles: Beta particles are electrons that move at very high speed.

(ii) Because gamma rays cuts DNA and kills cells of bacteria and virus.

c.

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

(ii)

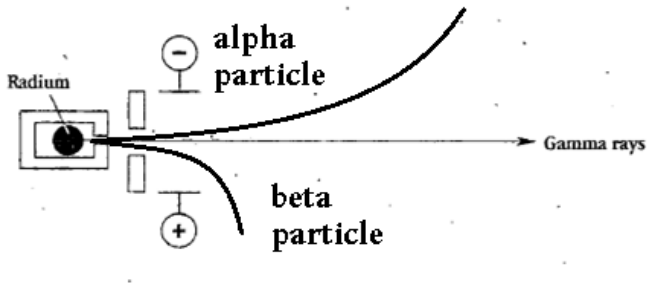


Figure 4

(iii) Alpha particles are positively charged so they are attracted towards the negative charged object. Beta particles are negatively charged so they are attracted towards the positive charged object. Beta particles are deflected more than alpha particles because beta particles have no mass.

2003-2.

a. Isotopes have the same atomic numbers but the different mass numbers.

b.

(i)

Number of neutrons = Number of nucleus – Number of protons

= 35 – 17 =18 Ans. 18

(ii) (35×3/4)+(37×1/4) = 35.5 Ans. 35.5

c.

Chemical properties are the same because the numbers of protons which is determinant of chemical properties are the same.

d.

(i)

It is a random spontaneous disintegration of certain atomic nucleus with the emission of three different types of radiation such as alpha, beta and gamma rays.

(ii)

(1) Helium

(2) The sum of the masses of products is the same to the mass of reactants.

(3) Helium

e. Gamma rays can be emitted by decaying of heavy atoms such as cobalt.

f. Treatment for cancer (killing cancer cells)

g. electroscope, cloud chamber

7 Properties of matter

1. Kinetic theory

2012-1.

a. Kinetic theory of matter is idea that particles in matter move or vibrate

2012-8.

c. Because water molecules in ice receive kinetic energy from sun light. It overcomes intermolecular forces. As a result ice melt into water.

2010-8.

b. On a sunny day, clothes get more heat energy through radiation, so water molecules on the surface gain energy enough to overcome intermolecular forces faster.

2008-8.

a. When it is heated, thermal motion of particles gets more active and overcome intermolecular forces. Then particles can move easier than before.

2003-4.

c. When heat is applied the molecules of candle wax gain kinetic energy. The kinetic energy can cut the intermolecular force and it leads the change of state from solid to liquid.

2. Gas laws

2012-1.

b.

The height difference is 2.5 cm = 250 mm.

The gas pressure equals the sum of atmospheric pressure and pressure of the mercury column for height difference.

So, the gas pressure is 765 + 250 = 1015 mm Hg.

2011-6.

a Temperature and volume

2010-1.

b.

(i) Absolute zero is the lowest possible temperature theoretically achievable, at which molecules have the minimum energy and pressure. It is equivalent to $-273℃$.

(ii)

$$\frac{200[\mathrm{cm}^3]}{273[\mathrm{K}]} = \frac{300[\mathrm{cm}^3]}{\mathrm{T}}$$

$200 \times T = 300 \times 273$

hence $T = 409.5$ [K]

2009-6.

d

(i) Gas pressure is perpendicular force exerted by molecules of the gas striking the sides of a container.

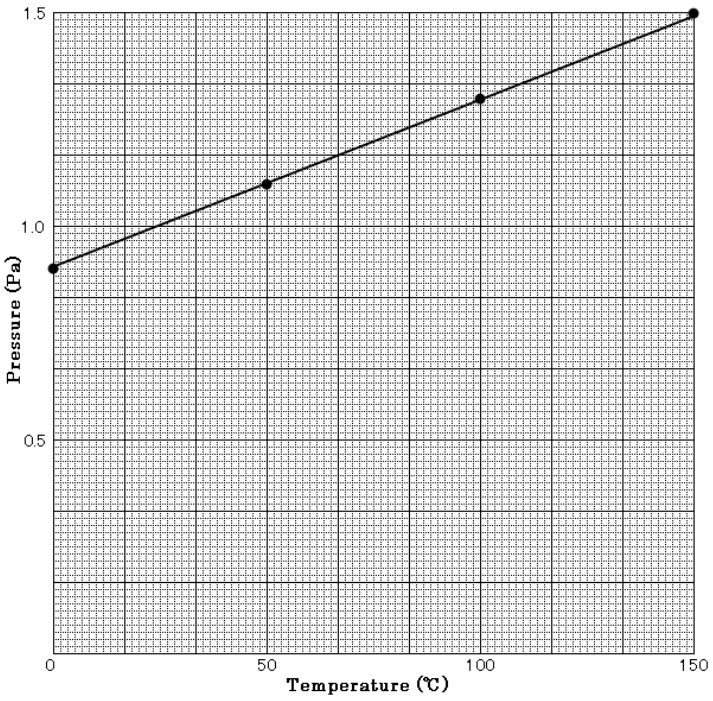
(ii) *Choose three answers from below.

- drinking with a straw
- pump
- breath
- tire
- syringe

(iii) When the temperature of the gas is increased, the average speed of its molecules increases. In this case, the volume of the container does not change. Therefore its pressure increases due to more frequent and more violent collisions of the molecules with the walls.

e.

(i)



(ii) 1.4 Pa

2007-6.

d.

(i) It is a temperature measured with respect to absolute zero on the Kelvin scale.

(ii)

$°C = K - 273$

$= 546 - 273$

$\therefore 273°C$

2006-3.

e.

h=0.76m, p=101000kg $m^{-1}s^{-2}$

g=10m/s^2

P=dgh

$$d = \frac{P}{gh} = \frac{101000 kgm^{-1}s^{-2}}{10\ m/s^2 \times 0.76m} = 13289.47\ kg/m^3 = 13.28947\ g/cm^3$$

$\therefore$ density of mercury $= 13.29\ g/cm^3$(to 2 d. p).

2005-1.

c.

V_1=6cm^3 , P_1=4atm, T_1=27+273=300K

V_2=3cm^3 , P_2=?atm, T_2=177+273=450K

Using,

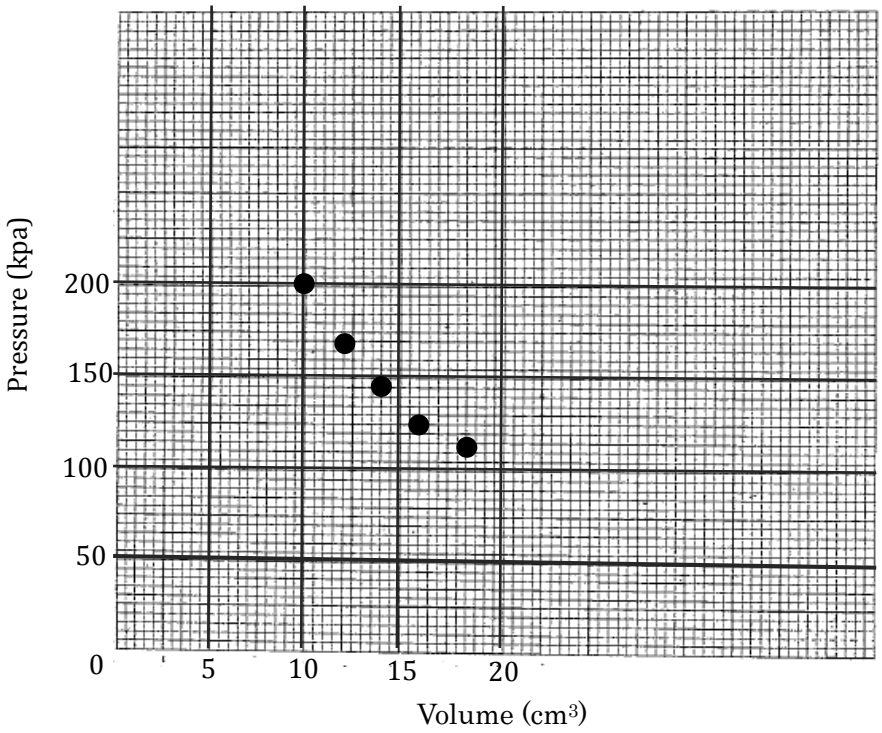
$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$P_2 = \frac{P_1V_1T_2}{T_1V_2} = \frac{4[atm] \times 6[cm^3] \times 450[K]}{300[K] \times 3[cm^3]} = 12\ atm$$

$\therefore$ The pressure is 12 [atm]

2004-2.

a. (i)



(ii) As the volume increase, the pressure decreases.

(iii) Temperature

2003-4.

a.

(i) It has the lowest possible temperature of –273C°. 0C° is 273K.

(ii)

Kelvin = °C +273

Therefore, 25+273=298[K]

b.

(i)

Volume: Decreases

Pressure: Increases

(ii) Volume of gas decreases by the force pressing down the gas. The relationship between gas volume and pressure is inversely proportional as constant temperature. Therefore, volume decreases then pressure increases.

3. Liquid pressure

2011-6.

b. Liquid pressure increases with depth, so to withstand greater pressure at the bottom, the walls of a dam are built thicker.

c.

Mass of water in $kg = \frac{27}{1000} = 0.027\ [kg]$

Weight of water $= 0.027[kg] \times 10\left[\frac{m}{s^2}\right] = 0.27\left[kg\frac{m}{s^2}\right] = 0.27\left[kg\frac{m}{s^2}\right] = 0.27[\text{N}]$

Base area $= 9cm^2$

$\therefore$ Pressure of water $= \frac{Force(weight)}{Area} = \frac{0.27[N]}{9[cm^2]} = 0.03\ [N/cm^2]$

2010-1.

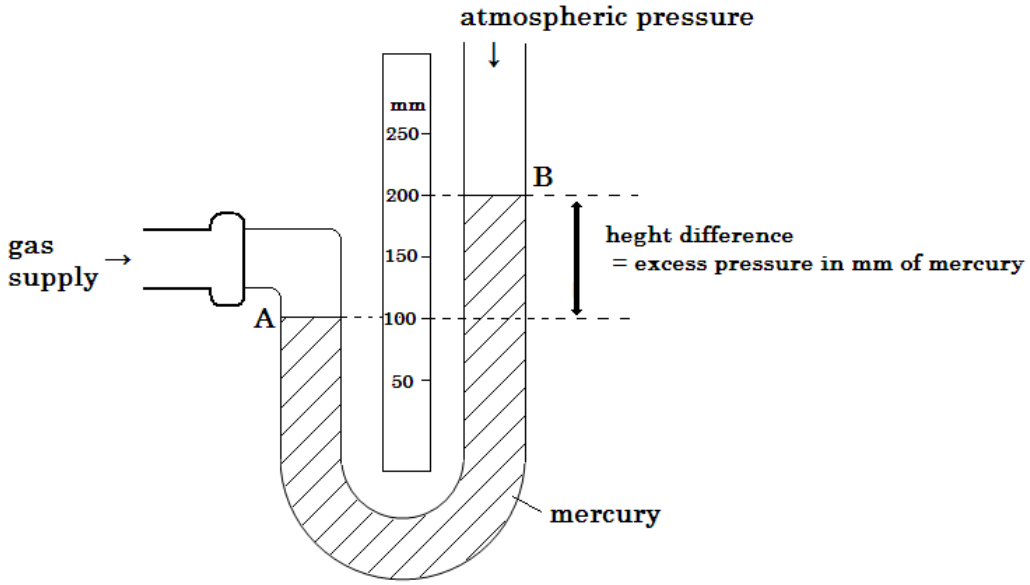
a.

(i) Since a pressure in a confined liquid is transferred equally, hydraulic machines can increase a small force to a bigger force.

(ii) Car brakes; Car jack

2008-8.

b.



A manometer consists of the u-tube glass which contains mercury and a scale.

Before supplying gas, the height A and B are at the same level.

Then you supply gas which you want to measure its pressure.

The supplied gas pushes down the surface of mercury A, and pushes up the surface B.

The difference between A and B is called height difference.

This difference equals to excess pressure in mm of mercury, so you can measure the gas pressure by the following calculation:

gas pressure = atmospheric pressure + excess pressure in mm of mercury

2007-6.

a. Pressure in a liquid increases with depth.

Pressure at one level(depth) acts equally in all direction.

Pressure depends on the density of a liquid.

b. Pressure = dhg

$g = 10\text{m/s}^2$, $d = 1\text{g/cm}^3 = 1000\text{kg/m}^3$,

$$h = \frac{20}{100} = 0.2\text{m}$$

$$\therefore \text{Pressure} = (1000 \times 0.2 \times 10)\text{Pa} = 2000\text{Pa}$$

c.

(i) Hydraulic brakes

(ii) Syringes

(iii) Hydraulic lift truck

(iv) Water supply system

2006-3.

f.

(i) Force=50 N, Area $=20\text{cm}^2=0.002\text{m}^2$

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{50\text{ N}}{0.002\text{ m}^2} = 25000\ \text{N/m}^2$$

(ii) $25000\ \text{N/m}^2$ (The pressure exerted on piston A acts on a second piston B of a larger area.)

2006-8.

b.

Volume of a liquid = base area × depth = Ah

Mass of a liquid = density × volume = dAh

Weight of a liquid = mass × g(acceleration of free fall) = dAhg

∴ Force on the base = dAhg

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{\text{dAhg}}{\text{A}} = \text{dhg}$$

This means pressure of a liquid depends only on depth(h) and density(d) since g(acceleration of free fall) is constant, i.e. 10m/s^2

2004-2.

b.

(i)

5000Pa = 5000N/m^2.

Pressure = density × height × g

Height = Pressure/(density × g)

$$\text{Height} = \frac{\text{Pressure}}{\text{density} \times \text{g}} = \frac{5000[\text{N/m}^2]}{1000[\text{kg/m}^3] \times 10[\text{m/s}^2]} = 5[\text{m}]$$

∴ Height is 5 m.

(ii) Because there is more water pressure at the bottom than the top.

(iii) Bottom of the gas jar with liquid mercury receives more pressure than that of the jar with water in.

c.

(i) monometer

(ii) 25 mmHg

(iii) gas pressure = 755 mmHg + 30 mmHg = 785 mmHg

2003-4.

b.

(iii)

The mass of 9cm^3 is 9g since density of water is 1g/cm^3.

9g is equivalent of 0.09N.

3cm^2 is equivalent of 0.0003m^2.

Therefore, pressure at the bottom of the container is

0.09N/0.0003m^2 = 300N/m^2

(iv)

Car brake / jack

4. Thermal expansion of solid

2010-8.

e. When a rim is heated, it expands and exceeds another metal which is slightly larger than the rim at low temperature. Then the rim can easily be put onto the other metal. After the rim is cooled, it contracts and fits the other metal very tightly.

8 Elements and chemical bonding

1.Stable electronic configurations and valency

2012-6.

a.

(i) R and U

(ii) Period 2 elements have two electron shells.

2011-4.

a.(i) By donating its outer shell electrons. / By accepting or gaining electrons. / By sharing electrons with other atoms.

b.

(i) Q

(ii) X

(iii) Ionic bonding or Electrovalent bonding

(iv) $2\mathrm{D} + \mathrm{T} \rightarrow D_2T$

2010-1.

e. The outer shell of helium is filled with electrons like other Group 8 elements. Due to the electron configuration, helium is unreactive and monoatomic. Thus helium has similar properties to other Group 8 elements and is taken as a Group 8 element.

2009-1.

a. Electron configuration is the number and arrangement of electrons in an atom.

b.

(i) group 6

(ii) It is because element O has 6 valence electrons.

(iii) It is because element Na has one more shell than element F.

(iv) Atomic radius means the distance between the nucleus and the valence electrons. The closer the distance between the nucleus and the electrons is, the more strongly the nucleus attracts the electrons. Since fluorine has smaller atomic radius than chlorine, fluorine nucleus attracts the electrons more strongly than chlorine. Therefore fluorine is more reactive than chlorine.

(v) The metallic bond in lithium metal is the attraction between fixed lithium ions and the free electrons while the covalent bond in chlorine gas is formed by sharing electrons between two chlorine atoms.

The metallic bond is formed with metals while the covalent bond is formed with non-metals.

2009-1.

d.

(i) It can attain a stable configuration by gaining three more electrons.

(ii) The N atom can get stability when it has 8 valence electrons.

(iii) Li_2O

(iv) +2

2008-1.

a.

(i) 19 protons

(ii) It reacts with water to give hydrogen gas.

(iii) Element X is potassium, so this reaction can be shown by the following chemical equation:

$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$

2007-5.

a.

(i) F

(ii) C and D

(iii) They can easily lose out their outermost electrons.

(iv) It is non-metal.

It is a gas at room temperature,

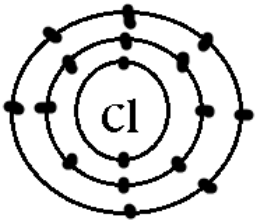
It is non-reactive (dose not take part in a chemical reaction)

It is colourless.

It dose not conduct heat and electricity.

2005-2.

a.



b.

(i) Because it's atomic number is 14 which means it has 4 electrons on the most outer shell. Therefore it is in 4^{th} group.

(ii) Si

2005-4.

d.

(i) These atoms have same number of electrons in most outer shell. The number of electron in most outer shell can determines the chemical properties. That's way these atoms react in the same way.

(ii) Isotopes

(iii) Period 3

(iv) The electron configuration of these atom is 2, 8, 7. So it has 3 shells. The number of shells is equal to the periodic number. Therefore period is 3.

2004-1.

a.

(i)

ELEMENT	PROTONS	NEUTRONS	ELECTRONS	MASS NUMBER
Hydrogen (H)	1	0	1	1
Carbon (C)	6	6	6	12
Nitrogen (N)	7	7	7	14
Sodium (Na)	11	12	11	23

(ii) Sodium

(iii) Sodium has 11 electrons and the valance shell will contain only one electron which will easily be lost, so that an anionic compound will be formed.

c.

(i) R^{+2}

(ii) Y

(iii) Z

(iv) Z is belonged in Group VIII element which is stable since most outer electron shell is full.

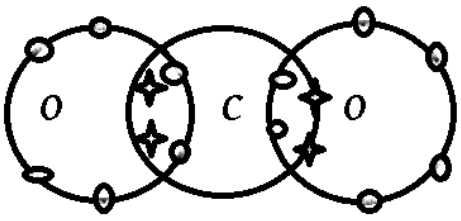
2003-3.

c.

(i) 14

(ii) 2,8,8,1

(iii)



(iv) By losing three electrons.

(v) The ore the atomic number increases, the more the mass increases. As the mass increases, inter molecule force increases. Therefore the melting points increases.

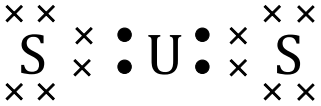
2.Types of bonds and their properties

2012-6.

a.

(iii) S and T

(iv)



2011-4.

a.(ii) Ionic bonding occurs when metal atoms donate or lose their outer shell electrons to non-metal atoms. The metal atoms become positively charged whereas the non-metal atoms become negatively charged. The attraction between the opposite charges forms an ionic bond.

2010-1.

c.

(i)

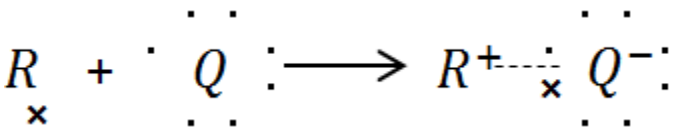
- They are malleable.
- They conduct electricity.
- They can be stretched.

d.

(i) R: 2. 8. 1, Q: 2. 8. 7

(ii) Period 3, Group I

(iii)



2008-1.

b.

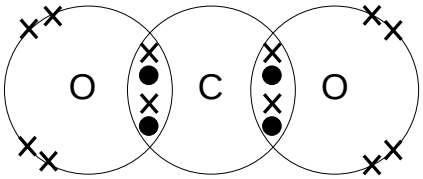
(i) Magnesium:2 / Chlorine: 1

(ii) $MgCl_2$

2008-1.

c.

(i)



(ii) covalent bond

(iii) Both carbon and oxygen are non-metals. Covalent bond occurs between non-metals.

2005-2.

c.

(i) Al_2O_3

(ii) Ionic bond because this compound is made of metal atoms and non metal atoms.

2004-1.

a.

(iv)

Relative atomic mass of C is 12

Relative atomic mass of H is 1

$12 + 1 \times 4 = 16$

(v) Covalent bounds

(vi) Because one carbon atom and 4 hydrogen atoms are bounded by sharing electrons in CH_4

b.

(i) $CaCl_2$

(ii) It mean the Ca atom is positive charged for +2.

2003-6.

a. Closeness of metal particles to each other makes metals in high density and that makes them good conductors.

e.

Ionic compounds have higher melting and boiling points, they are good electrolytes, they are soluble in water and they have strong electrostatic force compare to covalent compounds.

Ionic compounds are bonded by electrical attrition whereas covalent compounds are bonded by sharing of electrons.

3.Selected elements and their compounds (halogen, nitrogen, sulphur)

2012-6.

b. They forms diatomic molecule. / They have smell. / They are only slightly soluble in water.

c. chlorine replaces bromine and formed potassium chloride.

2010-1.

c.

(ii) Since potassium's electrons in the outer shell are further apart from the nucleus than sodium's, they are held less strongly by the nucleus.

f.

- Ammonium sulphate is used as fertiliser.
- Barium sulphate is used for X-ray examinations.

2009-1.

c.

(i) *Choose two answers from below.

- making sulphuric acid
- plastics
- pesticides
- sterilisation
- matches
- fireworks

(ii) *Choose two answers from below.

- Sulphur is an brittle yellow solid.
- Sulphur has low melting point.
- Sulphur does not conduct electricity.
- Sulphur is insoluble in water.

2008-1.

e.

(i) carbon and water

(ii) *Choose four answers from below.

- fertilizers
- battery acid
- drying agent
- paint
- detergents

2006-2.

a.

(i) Br_2 : NaBr or KBr

(ii) Cl_2 : NaCl or KCl

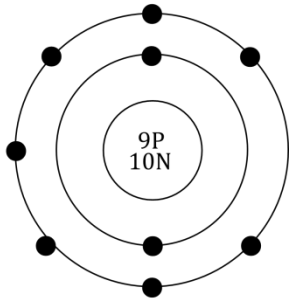
(iii) I_2 : NaI or KI

b.

– They are all coloured, colours darken as we go down the group.

– They react with metals to form metal halides.

c.



d. $^{227}_{53}I$, $^{88}_{35}Br$, $^{35.5}_{17}Cl$

e. The order of reactivity decreases on going down the group. When these elements react they gain one election per atom to attain the stable electron configuration of a nobel gas. Chlorine is more reactive than bromine because the incoming electron is being more strongly attracted into the outer energy level of the smaller atom. The attraction force on it will be greater than in case of bromine and iodine since the outer energy level of chlorine is closer to the nucleus.

f.

– Sulphur reacts with oxygen to form sulphur dioxide.

– Sulphur reacts with metals to form metal sulphides, i.e. $S(s) + Mg(s) \rightarrow MgS(s)$

– Sulphur reacts with hydrogen to form hydrogen sulphade (H_2S)

g.

In rhombic sulphur the molecules are packed more closely than in the monoclinic form. This explains why rhombic sulphur is stable below 96°C and monoclinic sulphur is stable above 96°C

2005-2.

d. One element can exist in more than one physical form in the same state is called allotropes.

e. Rhombic sulfur / monoclinic sulfur.

f.

(i) Chlorine

(ii) Iodine and Bromine

2003-6.

b.

(i) Bromine

(ii) Because it has most number of electron shells.

(iii) –1

(iv) They exist as diatonic molecules. / They react with hydrogen. / They react with metal

9 Chemical reaction I (stoichiometry and heats of reaction)

1. Stoichiometry (mole concept, concentration)

2012-5.

d.

(i) The amount of a substance in a solution per unit volume

(ii)

60[cm^3] = 0.06[l]

and 600[cm^3]=0.6[l]

The amount of NaOH in solution is:

20[g/l] ×0.06[l] = 1.2[g]

The concentration of new solution is:

1.2[g]÷0.6[l] = 2.0[g/l]

2011-3.

a.

(i) Molar volume of a gas is the volume occupied by 1 mole of any gas. It is 24 dm^3 at room temperature and pressure (rtp) and it is 22.4 dm^3 at standard temperature and pressure (stp).

(ii)

$$\text{Number of moles of } SO_2 = \frac{\text{volume of } SO_2}{\text{molar volume}} = \frac{120 dm^3}{24 dm^3} = 5[\text{mol}]$$

2008-3.

f

Mass of solute in the first solution

$60cm^3 \times 15g/cm^3 = 900g$

Concentration of the new solution:

$900g \div 80cm^3 = 11.25\ g/cm^3$

<u>11.25 g/cm^3</u>

g.

	mass	ratio of atoms	simplest atom ratio
C	48.0 g	48.0/12=4.0	2
H	12.0 g	12.0/1=12.0	6
O	32.0 g	32.0/16=2.0	1

So, the empirical formula is C_2H_6O

2007-3.

c.

(i) Mass = 300mg =0.3g

Relative formula mass $= (9 \times 12) + (8 \times 1) + (4 \times 16) = 108 + 8 + 64 = 180$ g/mol

$$\text{Number of moles} = \frac{\text{mass}}{\text{RFM}} = \frac{0.3\text{g}}{180\text{g/mol}} = 0.00167\text{mol}$$

(ii)

$$\text{Volume} = 10\text{ml} = \frac{10}{1000} = 0.01\text{ l}$$

Number of moles $= 0.00167$mol

$$\text{Cincentration} = \frac{\text{Numver of moles}}{\text{Volume}} = \frac{0.00167\text{ mol}}{0.01\text{ l}} = 0.166\text{ mol/l } = 0.17\text{mol/l}$$

2006-5.

b.

$C_bV_b = C_aV_a$

$$V_b = \frac{C_aV_a}{C_b} = \frac{0.1\text{ M} \times 20\text{ cm}^3}{0.1\text{ M}} = 20\text{cm}^3$$

$\therefore$ Volume of NaOH $= 20\text{cm}^3$

2005-3.

b.

(i) Phenolphthalein is used to check the existence of sodium hydroxide.

(ii) Sodium hydroxide is the standard solution because it has known concentration .

(iii) $HCl+NaOH \longrightarrow NaCl+H_2O$

(iv)

20 cm^3 : x mol = 25 cm^3 : 0.2M

25 x = 20×0.2

x = (20×0.2)/25 = 0.16 M

2004-7.

a. Take 20 cm^3 of sodium chloride solution, put it in a beaker. Heat it gently till all the solution changes in to sodium chloride crystals. Measure the mass of these crystals, then, divide it with the molar mass or relative formula mass of sodium chloride. This will give you the number of moles. Divide this number of moles by 0.02dm^3(20cm^3). The result gives you the concentration of sodium chloride in 20cm^3.

b. error for measuring volume of solution / error for measuring mass of sodium chloride

2003-3.

a.

(i)

Mole is defined as the amount of substance. 1 mole of substance has 6.02×10^{23} atoms of molecules.

(ii)

Mass of 1 mol of NaOH is 23+16+1 = 40g,

8g of NaOH is 8/40=0.2mol.

It is dissolved in $100cm^3$ of water which is 0.1L.

The molarity of this solution is

0.2mol/0.1L = 2 mol/L

2003-6.

d.

(i) It shows the simplest ratio of atoms in a compound

(ii)

	C	H	O
% by mass	40	6.67	53.33
In 100g	40g	6.67g	53.33g
Moles	40/12	6.67/1	53.33/16
	=3.33	=6.67	=3.33
Ratios of moles	1	2	1

Empirical formula is CH_2O

2003-8.

c.

Number of moles of copper sulphate in $250cm^3$ of 1 M copper sulphate solution is

$250\ cm^3 = 0.25\ L$

$0.25\ L \times 1M = 0.25\ mol$

1 mole of $CuSO_4\text{-}5H_2O$ contains 1 mole of $CuSO_4$.

0.25 mol of $CuSO_4\text{-}5H_2O$ contains 0.25 mole of $CuSO_4$.

Molar mass of $CuSO_4\text{-}5H_2O$ is

$(64\times1)+(32\times1)+(16\times4)+5\times((1\times2)+(16\times1)) = 250\ g/mol$

So,

Mass of 0.25 mol of $CuSO_4\text{-}5H_2O$ is

$250g/mol \times 0.25\ mol = 62.5\ g$

Therefore, you measure 62.5g of $CuSO_4\text{-}5H_2O$ by using beam balance.

Then, it should be move into a beaker.

After that, add the distilled water until the volume of $250cm^3$ and stair it slowly.

This solution prepared is 1M copper sulphate solution.

2. Heats of reaction (endothermic, exothermic)

2012-5.

e.

(i) exothermic reaction

(ii) Difference of energy between reactants and product is released into outside

(iii) The allow means the direction of reaction

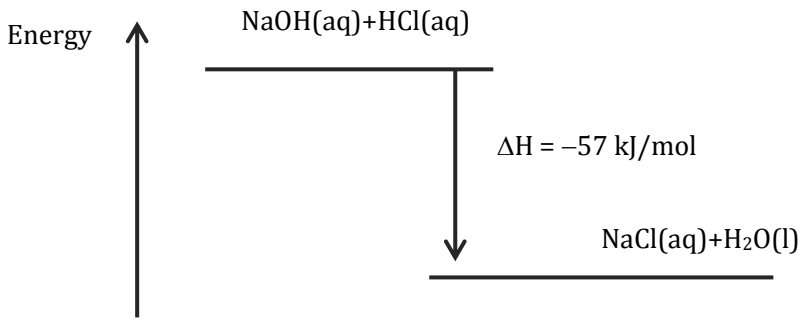
2011-3.

c. Bond breaking involves gaining of energy in order to break the old bonds, so endothermic. Bond making or formation involves releasing of energy as new bonds are made, so exothermic.

2007-3.

b.

(i)



(ii) Exothermic reaction

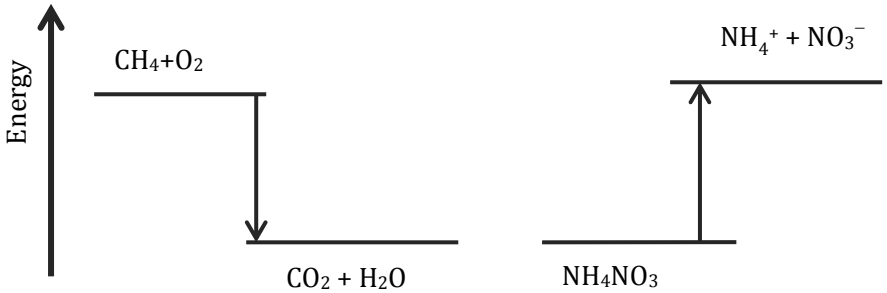
(iii) Heat energy is lost to the surrounding, i.e. heat of reaction (ΔH) is negative.

(iv) (aq)-aqueous solution / (l)-liquid

2003-8

a. Exothermic reaction gives out energy to surroundings, whereas endothermic reaction absolves energy from surrounding.

b.



Exothermic reaction Endothermic reaction

10 Chemical reaction II
(Electron and Proton transfer reactions)

1. Electron transfer reactions

2012-5.

a. Electroplating is defined as the covering of one metal by another by means of electrolysis.

b.

(i) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

(ii) Fe

(iii) Because Fe causes the reduction of Cu in this chemical reaction.

c. Oxidation is to increase the oxidation number, while reduction is to decrease oxidation number.

2011-3.

d.

(i) Painting the metals. / Oiling and greasing. / Electroplating. / Galvanising. / Covering with plastic.

(ii) Oxidation number of NO_3^- is -1.

Let the oxidation number of N be x,

$$x + 3 \times (-2) = -1$$
$$x - 6 = -1$$
$$x = +5$$

$\therefore$ The oxidation number of N is $+5$

2010-2.

a.

- To protect metals from corrosion
- To get a harder surface so that the metal cannot be worn easily
- To improving appearance

b.

(i) Calcium

(ii) Calcium is more reactive than any other metals.

(iii) Copper would be displaced by magnesium.

d. Oxidation is a reaction in which an element or a compound gains oxygen.

e. Reducing agent: zinc. Oxidising agent: lead nitrate.

f.

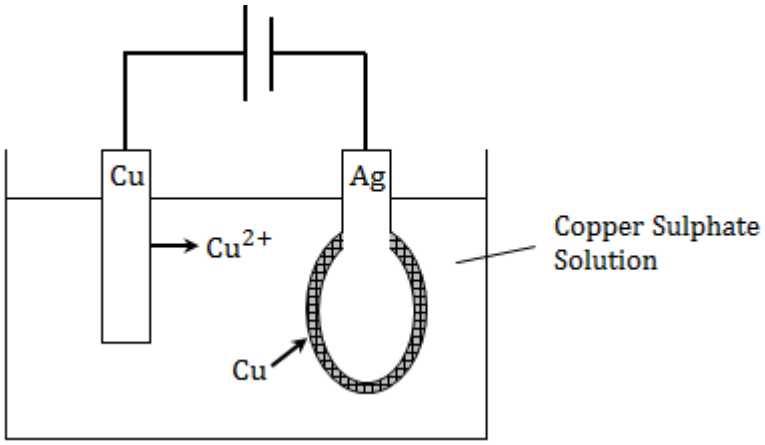
(i) To remove water in the test tube.

(ii) To remove air in the test tube.

(iii) The presence of water; The presence of oxygen

2010-7.

b.



In the diagram above, the silver spoon is used as the anode and a copper plate is used as the cathode. At the cathode, copper plate is ionised, releasing electrons according to the half equation: $Cu \rightarrow Cu^{2+} + 2e^{-}$. Cu^{2+} ions are attracted to the anode and gain electrons according to the half equation: $Cu^{2+} + 2e^{-} \rightarrow Cu$. Hence the silver spoon is covered by the copper produced.

2009-5.

e.

(i) "2+" means that the ion is 2 positively charged.

(ii) +1

(iii) silver

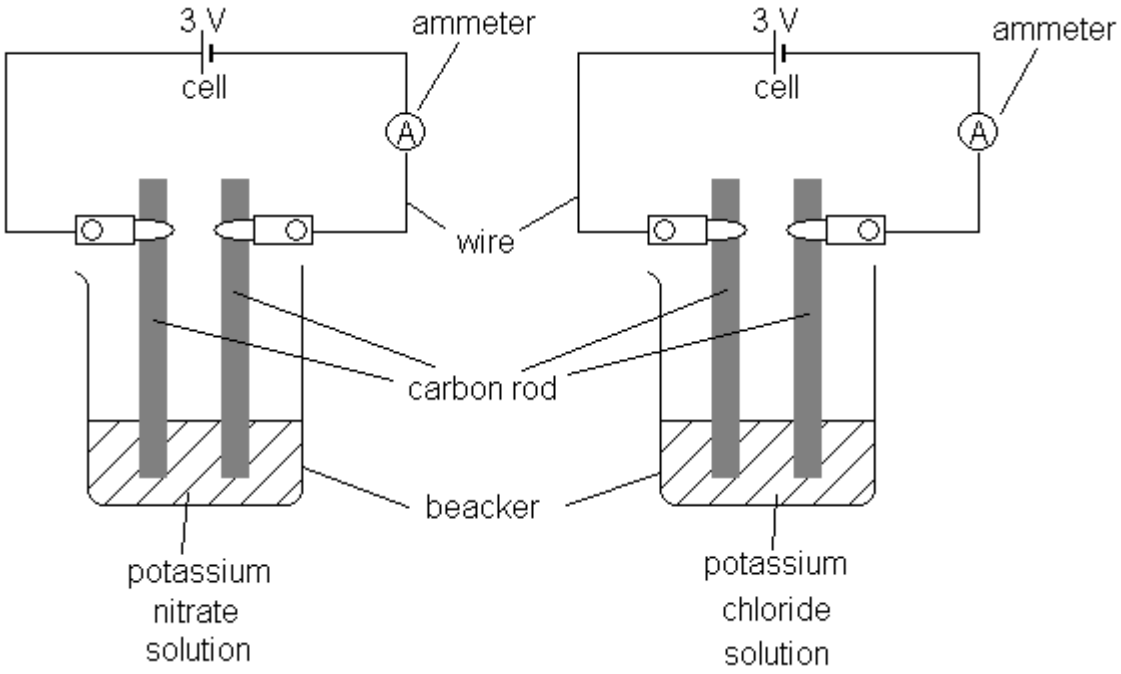
(iv) It is because the oxidation number of silver has been decreased in this reaction from +1 to 0.

2009-8.

a.

An electrolyte is a substance that will conduct electric current by means of ions in the liquid state.

b.



Prepare two power sources, two ammeters, four carbon rods, two beakers and some connecting wires. Make potassium nitrate solution and potassium chloride solution of the same molarity and the same volume, and put them in each beaker. Arrange the materials as shown in the diagram above. Supply 3 V to each circuit and read the ammeters.

If the current flows through one circuit more than that through the other circuit, the solution in the first circuit has more electrical conductivity than the other solution.

2008-7.

b.

Oxidation is regarded as a process which involves the loss of electrons by a substance, while reduction is regarded as a process which involves the gain of electrons by a substance.

c.

(i) When painting something such as ships, lorries, cars and bridges, they are covered whole body which contact with air and water.

(ii) Galvanising involves dipping the object into molten zinc. The thin layer of the more reactive zinc metal coating the steel object slowly corrodes and loses electrons to the iron, thereby protecting it.

2007-6.

e.

(i) Magnesium (Mg) and Aluminium (Al)

(ii) Mg and Al are more reactive than Zn as a result they can displace Zn from its solution.

f.

(i) $2Ag^{+}(aq) + Mg^{0}(s) \rightarrow 2Ag^{0} + Mg^{2+}(aq)$

(ii) $2Ag^{+}(aq)$: Oxidising agent / $Mg^{0}(s)$: Reducing agent

2006-5.

d.

(i) Copper will not react with a solution of $MgSO_4$.

(ii) Copper is less reactive than magnesium; as a result copper cannot displace the ions of magnesium in a solution of $MgSO_4$.

(iii) Sodium (Na)

(iv) Sodium easily and readily gives away its outermost electron as compared to the metals in the activity series.

e.

(i)

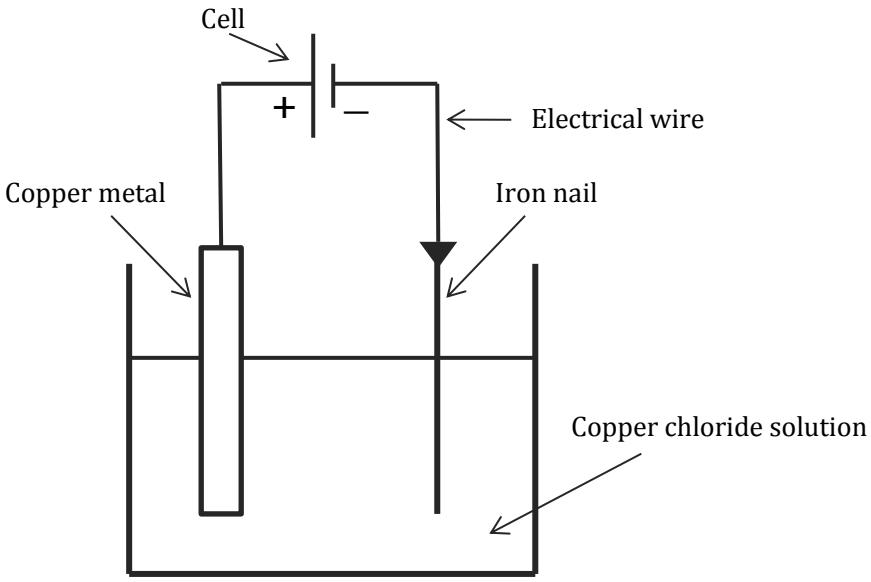
$Na(s) \rightarrow Na^{+}(aq) + e^{-}$

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

(ii) Na(s) is the reducing agent, $Ag^{+}(aq)$ is the oxidizing agent

2005-7.

a.



b.

Copper metal as anode ionizes according to the half equation:

$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$.

The electrons travel from anode to cathode through the electrical wire.

Copper ions in the solution are attracted to iron nail as cathode. The copper ions gain electrons on the surface of iron nail according to the half equation:

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$.

The copper atoms accumulate on the surface of iron nail. As the result, the iron nail becomes electroplated with copper.

2003-3.

b.

(i) It means it is neutral charged.

(ii) Oxidizing agent : Cu

Reducing agent : Ag

(iii)

$Cu^0(s) - 2e^- \rightarrow Cu^{+2}(aq)$

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

2. Proton transfer reactions

2011-3.

b.

(i) An acid is a proton donor.

(ii) A hydronium ion (H_3O^+) is formed when a water molecular (H_2O) gains a proton (hydrogen ion, H^+): $H_2O + H^+ \rightarrow H_3O^+$

2010-2.

c. CO_3^{2-} and HCO_3^-

2007-3.

a.

(i) A strong base is the one that accepts proton well and holds them strongly.

(ii) $NH_3(I) + H_2O(l) \rightarrow NH_4^+(aq) + OH^-(aq)$

(iii) NH_4^+/NH_3 , H_2O/OH^-

2006-5.

a.

(i) Hydrogen ion (H^+)

(ii) Carbonic acid partially ionises in water and releases a few hydrogen ions whereas hydrochloric acid completely ionises in water and releases a lot of hydrogen ions (protons).

b. $C_bV_b = C_aV_a$

$$V_b = \frac{C_aV_a}{C_b} = \frac{0.1\ M \times 20\ cm^3}{0.1\ M} = 20cm^3$$

$\therefore$ Volume of $NaOH = 20cm^3$

c.

(i) It means a reversible reaction.

(ii)

1 $HSO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_4^{2-}(aq)$

2 $H_3PO_4(aq) + NH_3(I) \rightleftharpoons NH_4^+(aq) + H_2PO_4^-(aq)$

2005-3.

a. Acid is a proton donor.

11 Organic chemistry

1. Functional group chemistry (alkane, alkene, alchanol, carboxylic acid)

2012-3.

a. alkanol

b. it is weak acid / It is soluble in water if n is small number / It has odors.

c. alcoholic beverages / fuels / solvents

d. Ester is formed when carboxylic acid(compound A) and alkanol (compound B).

e.

$C_5H_{11}COOH + C_5H_{11}OH \rightarrow C_5H_{11}COOC_5H_{11} + H_2O$

f. Dip the blue litmus paper into the both compounds and observe colour change. Compound A must make colour change from blue to red while compound B does not make colour change. Because compound A is acid and compound B is neutral. Therefore we can distinguish compound A by using litmus paper.

2011-5.

b

-Small-sized alkanols are soluble in water.

-Boiling and melting points of alkanols increase as the size (molecular size) increases.

-Alkanols undergo combustion reactions.

-Alkanols react with sodium metal to produce basic solution and hydrogen gas.

c.

(i) It is an oxidising agent.

(ii) $CH_4CH_2OH\ (l) + O_2(g) \rightarrow CH_3COOH\ (l) + H_2O\ (g)$

2010-4.

b.

(i) They are acidic; They react with alcohols to produce esters; They are soluble in water

(ii) Ants; Grapes

d.

(i) $CH_3COOH + C_2H_5OH \underset{H_2SO_4}{\overset{\text{Concentrated}}{\rightleftharpoons}} CH_3COOC_2H_5 + H_2O$

(ii) Esterification

2010-8

c. Carboxylic acids are ionised when dissolved in water, while alkanols are not.

2009-5.

a. *Choose three answers from below.

- vinegar
- making rayon
- printing
- textiles
- solvents

b. It is because ethanoic acid produces a low concentration of hydrogen ions in water.

c. $CH_3COOH \leftrightarrows CH_3COO^+ + H^+$

d. It is because ethanol has the OH functional group as water does.

f.

(i) $C_nH_{2n+1}COOH$

(ii) formula : HCOOH, name : methanoic acid

(iii) The boiling point of butane is lower than that of carboxylic acid of similar size.

(iv) Because the carboxylic acids have hydrogen bonds, the forces that hold molecules together are stronger than alkanes.

2008-5.

c.

(i) fermentation

(ii) $C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(l) + 2CO_2(g)$

e.

(i) As you go down the table, the number of carbon and hydrogen increase. Butanol has larger size and mass than methanol. Therefore butanol has stronger intermolecular forces than methanol. So its molecules connect each other stronger than methanol.

(ii) Ethanol has higher rate of polar than propanol.

f.

(i) $CH_4+Cl_2 \rightarrow CH_3Cl + HCl$

(ii) substitution reaction

(iii)

*Choose one answer.

fuels, waxes

2008-7.

a.

Prepare two test tubes. Pour octane and octene each test tube. Add a few drops of bromine solution. If its red/brown colour is disappeared, it is octene. If its red/brown colours remained, it is octane.

2007-1.

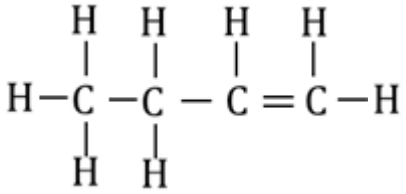
b.

(i) A: $CH_3CH_2CH_2CH_2OH$

(ii) B: $(CH_3CH_2CH_3)$ and $E(CH_3CH_2CH_2CH_3)$

(iii) Its solution has free ions which conduct electricity.

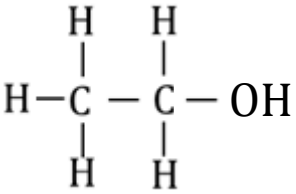
(iv)



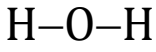
(v) n-butene, 1-butene

2007-7.

a.



C_2H_5OH



H_2O

b. The relative ration of –OH group to entire molecules is larger in H_2O than in C_2H_5OH. The –OH group is the one responsible in the hydrogen bonding and it is stronger in water (H_2O) than in ethanol (C_2H_5OH). As a result it requires a lot of heat energy to break intermolecular forces in water. This makes water have higher boiling point than ethanol.

c. This apparatus above could be used to separate a mixture of ethanol and water. Distillation relies upon the liquids having different boiling points. When an ethanol and water boil off at different temperatures and can be condensed and collected separately. Ethanol boils at 78°C whereas water boils at 100°.

When the mixture is heated the vapour produced is mainly ethanol. The ethanol vapour moves up the column and into the condenser, where it condenses into liquid ethanol and is received in the receiving breaker or flask. When all the ethanol has distilled over the temperature reading on the thermometer rises steadily to 100°C, showing that the steam is now entering the condenser. At this point the receiver can be changed and the condensing water can now be collected.

2006-1.

a.

(i)

Q: Alkanes

S: Carboxylic acids/ alkanoic acid

(ii) P(C_nH_{2n}) and Q (C_nH_{2n+2})

(iii) C_3H_6

(iv) Propene

(v)

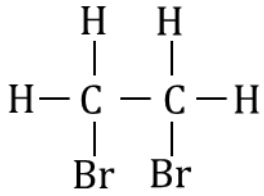
By carrying out solubility test

Solubility test:

A few drops of each sample are added to a few drops of distilled water separately. The mixtures are gently shaken. Where one layer is observed then it must be a compound of R, i.e. alkanols dissolve in water. The order will show two layers indicating that it is insoluble, i.e. alkanes are insoluble in water.

c.

(i)



(ii) Dibromoethane

(iii)

1 Used in the production of plastics, i.e. polythene

2 Used in the production of alkanols, alkanes and haloalkanes.

2005-5.

a.

(i) (1) Carbon dioxide (CO_2)

(2) Distillation

(3) Oxidation

(ii) Potassium permanganate ($KMnO_4$) or Potassium dichromate(KCl_2O_7)

(iii) It is strong oxidation agents that speed up the oxidation process.

b.

(i) 2,methyle-butane

(ii) Compound **C** is soluble because it has –OH function group.

(iii) **A**, **D** and **E**

(iv) **E** have a lower boiling point because it is smaller size of molecule as such the intermolecular force of E will be weaker than of **A**.

(viii) gas

(ix) A few drops of bromine solution are put in two test tube. To one test tube, a few drops of compound D are added, and to another, few drops of compund E. The colour of bromine wil be disapper for test tube added compound D.

2004-3.

d.

(i) A,B,C and E

(ii) B and C

(iii) A and E

(iv) Because water molecules are attracted by hydrogen bonding.

(v) Compound C is acid while compound D is neutral. When put blue litmus paper into compound C, then colour is changed from blue to red. While there is no colour change in case of compound D. Therefore we can distinguish compound C and D.

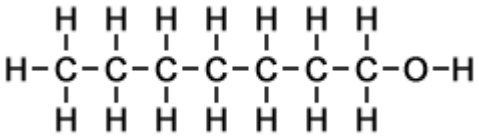
2003-5.

a.

(i) Heptanol

(ii) $C_nH_{2n+1}OH$

(iii)



b.

(i) Distillation

(ii) ethanol

(iii)

(1) It involves a series of biochemical reactions brought about by micro-organisms of enzymes.

(2) Glucose ⟶ ethanol + carbon dioxide

c.

(i) Esterification

(ii) Ethylethanoate and water

(iii)

Food flavoring / perfume

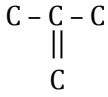
2. Isomerism

2011-5.

d.

(i) P: cyclohexane, Q: 2-butene (or But-2-ene)

(ii) Structure S



(iii) The two structures (Q and S) have the same molecular formula C_4H_8 but different structural formulae.

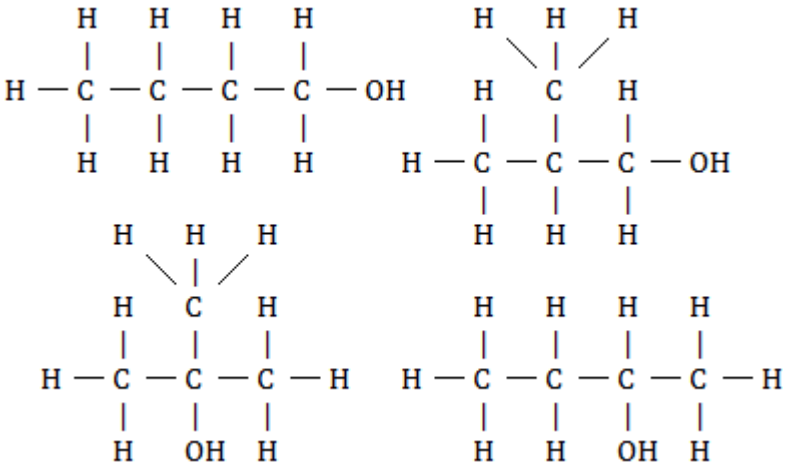
(iv) Put a few drops of bromine solution in two test tubes. Then, add the two samples separately and shake the mixture gently. If the one changes to colourless, bromine solution is compound R (an alkene).

2010-4.

c.

(i) Isomers are two or more compounds which have the same molecular formula but different arrangements of atoms in their molecules.

(ii)



(iii) $CH_3CH_2CH_2CH_2CH_3$

2008-5.

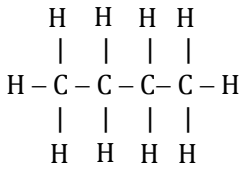
a.

Isomers are two or more compounds with the same molecular formulas but different arrangement of atom in their molecules.

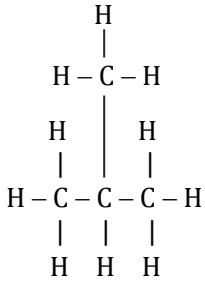
b.

(i)

Isomer A:



Isomer B:



(ii)

Isomer A: butane

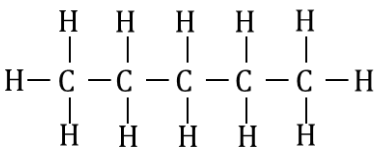
Isomer B: 2.metyl-propan

2006-1.

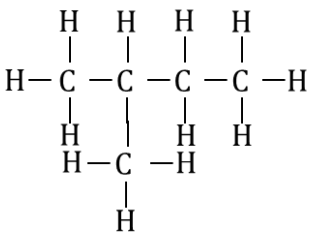
b.

(i)

1



2



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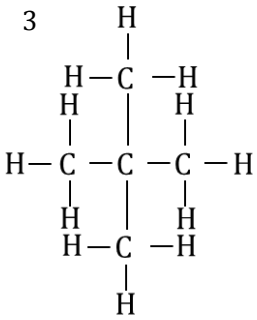


(ii)

1; n-pentane

2; 2-methlybutane

3: 2, 2-dimethylpropane

2004-3.

c.

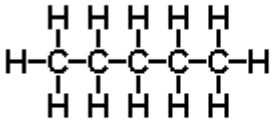
(i)

1. But-2-ene
2. cyclo-butane

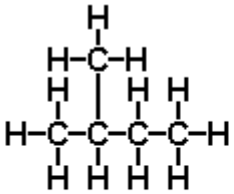
(ii) 1 and 3

2003-5.

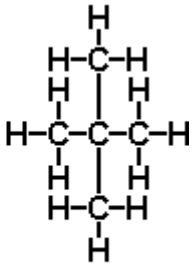
d.



n-pentane



2-metylbytane



2,2-dimetylpropane

<u>3. Polymerisation</u>

2011-5.

a.

(i) Do not conduct electricity. / Do not corrode (plastic polymers). / They are tough. / Do not easily affected by weather.

(ii) Condensation polymerisation is a type of polymerisation in which a small molecule (frequently water) is split off as each monomer unit is attached to the growing polymer.

2010-4.

a.

(i) Polymers are molecules which consist of many small molecules called monomers bonded together in a repeating sequence.

(ii) Any two from the following: plastic bags, electric insulation, wrapping films, fabric coating

(iii)

- They do not conduct electricity.
- They do not corrode.
- They are insoluble in water.

2010-8.

d. By breaking one of the double bond between carbons of ethene molecules, free bonds are formed. Then the free bonds of a large number of molecules join together and produce a polymer, which is called polythene.

2009-5.

g.

- incineration
- recycling
- using degradable plastics

2009-7.

a.

- Thermoplastics melt and flow when they are heated and become hard but with a different shape when they are cooled.
- Thermoplastics are flexible, can stretch and melt at lower temperatures.
- Thermoplastics can be remoulded after they are made.
- Thermoplastics can easily be recycled.

b.

- The polluting gases, which are given off in the process of burning organic compounds, can be reduced.
- Consumption of resources can be reduced.

c.

Thermosetting plastics have polymer chains which are linked or bonded to each other to give a cross linked structure, which thermoplastics do not have. Therefore the chains are held firmly in place and no softening takes place on heating.

2008-5.

d.

* Choose two answers from below.

- The amount of plastic waste during the household waste are increased.
- They are often difficult degradable to dispose of because they are non-biodegradable.
- They often produce toxic fumes.

2007-1.

a.

(i) Addition polymerisation

(ii) The ethane molecules are able to form chains like polythene because they possess carbon-carbon double bond. In this type of polymerization, ethane molecules undergo relatively high temperature and high pressure in the presence of a catalyst. The double bond breaks and molecules join to form a long chain.

(iii) Polythene, polyvinyl chloride (PVC), polytetrafluoro-ethene (PTFE), nylon, terylene

c.

(i)

Thermosetting polymers do not soften when heated while thermoplastic polymers soften when heated.

Thermosetting polymers do not melt when heated while thermoplastic polymers melt when heated.

Thermosetting polymers can be heated and moulded only once (usually by compression, moulding) while thermoplastics are easily moulded or formed into useful articles.

Thermosetting polymers have polymer chains which are linked or bonded to each other to give a cross-linked structure while thermoplastic polymers do not have polymer chains that give a cross-linked structure.

(ii) Recycling and incineration

(iii)

Quite cheap and easily made

Lighter than metallic materials

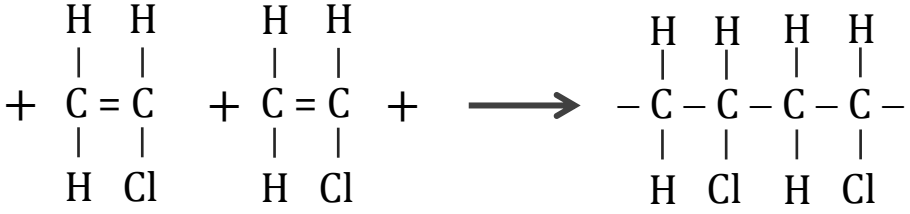
Unreactive (they do not corrode in the air or water)

Do not conduct heat or electricity, so can be used as insulators.

2005-5.

b.

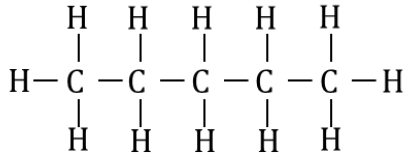
(v)

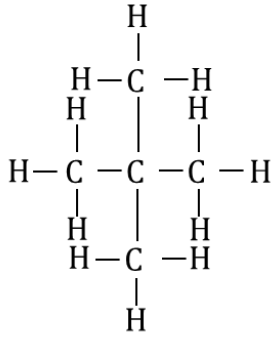


(vi) addition polymerisation

(vii) PVC pipe

(x)





c.

- Thermoplastics are reusable.
- Thermoplastics are lighter and cheaper than metallic materials.

2004-3.

a.

(i) Plastic bag

(ii) energy source

b. recycle / burn of plastic

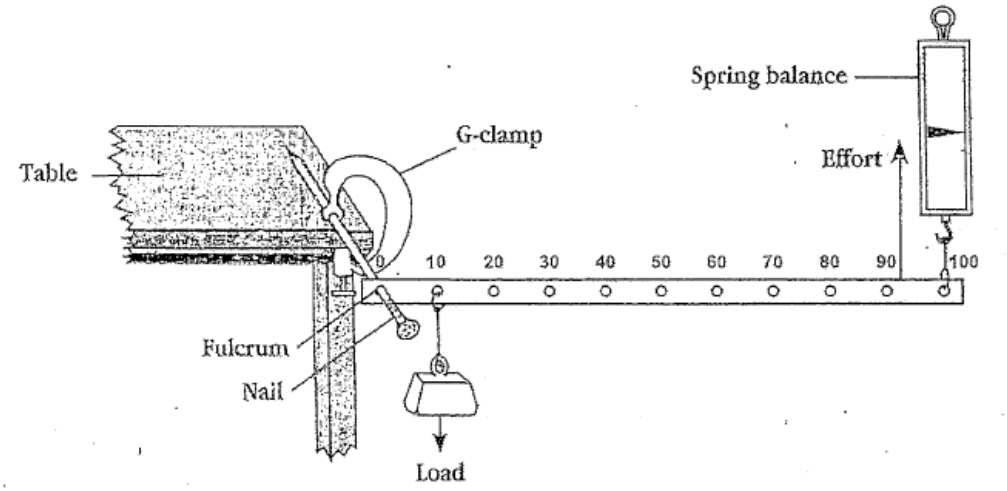
MSCE: P/S 2 QUESTIONS

2003

2003-1.

You are provided with a 500g mass, a clamp, a spring balance, a nail, a metre rule with holes drilled into it at regular intervals of 10cm and a wire hook or a string.

a. Arrange the apparatus as shown in the diagram.



b. Hook the 500g mass 10cm from the fulcrum.

c. Hook the spring balance on the last hole (100cm from the fulcrum)

d. Lift the spring balance so that the metre rule is in a horizontal position.

e. Record the reading on the spring balance in the appropriate space in the table. (2 marks)

Distance between mass and fulcrum (cm)	Effort (N)
10	
20	
30	
40	
50	
60	

f. Repeat procedures **b** to **e** using the distances shown in the Table.

g. Plot a graph of effort against distance between mass and fulcrum. (Scale: 2cm to represent 0.5N on the vertical axis and 2cm to represent 10cm on the horizontal axis.) (6 marks)

h. What is the relationship between the effort applied and the distance from the mass to the fulcrum? (1 mark)

2003-2.

You are provided with hydrated copper sulphate, an evaporating basin, a gas burner, a triple beam balance, a tripod stand and a wire gauze.

a. Weigh the evaporating basin on the triple beam balance and record the mass.(1 mark)

b. Add crystals of hydrated copper sulphate until the reading increases by approximately 5g.

c. Record the mass of the evaporating basin plus hydrated copper sulphate. (1 mark)

d. Mass of hydrated copper sulphate.=_____ (1 mark)

e Heat the evaporating basin gently until the hydrated copper sulphate turns into a white powder.

f. Weigh the evaporating basin plus white powder and record the results. (1 mark)

g. Subtract mass of empty evaporating basin from the mass of evaporating basin and white powder and record the results. (1 mark)

h. Mass of hydrated copper sulphate minus mass of white powder = _____ (1mark)

i. Calculate the percentage of water in the hydrated copper sulphate. (3 marks)

j. What name is given to water found in crystals? (1 mark)

k. Mention any **two** sources of error in this experiment. (2 marks)

2003-3.

The electrolysis of dilute sulphuric acid (H_2SO_4) is essentially the electrolysis of water. With the aid of a clearly labelled diagram show that this statement is true. Support your answer by giving relevant ionic equations and explanations for the reactions that take place at the anode and cathode during the electrolysis of dilute sulphuric acid. (13 marks)

2003-4.

a. A resistor with unknown resistance is connected in parallel to a 4ohm resistor. The voltage across the resistors and the total current in the circuit are measured.

(i) Draw a circuit diagram for this experiment. (3 marks)

(ii) Calculate the value of the unknown resistor if the effective resistance is 2ohms. (3 marks)

b.

(i) Draw an electric circuit comprising a diode, a cell and bulb such that the diode is forward diased. (3 marks)

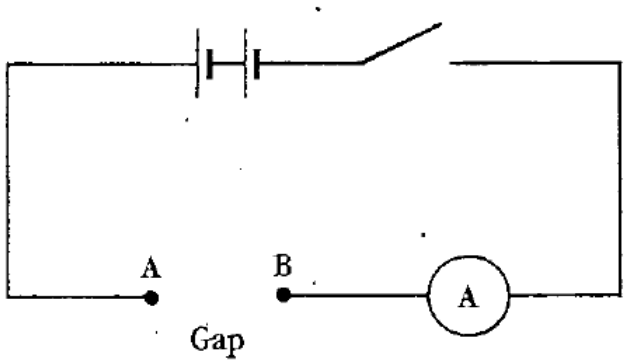
(ii) Explain the effect of reversing the cell on the bulb. (3 marks)

2004

2004-1.

You are provided with 2 cells, a 100 cm wire, an ammeter, a switch, connecting wires and a ruler.

a. Connect a circuit as shown in the diagram in the **figure** below.



b. Connect the ends of the wire (100 cm long) in the gap **AB**.

c. Record the reading of the ammeter in the table of results.

d. Disconnect the wire from the circuit.

e. Connect in turn 80 cm, 60 cm, 40 cm and 20 cm lengths of the wire in the gap.

f. Record in the table the readings of the ammeter for each length of wire. (5 marks)

TABLE OF RESULTS

LENGTH (cm)	AMMETER READING (A)
100	
80	
60	
40	
20	

g. Plot a graph of current against length. (6 marks)

h. Describe the relationship between current and length of wire. (1 mark)

2004-2.

You are provided with four unknown organic compounds labeled **P, Q, R** and **S** belonging to the following families: alkanes, alkenes, alkanol and carboxylic acid not necessarily in that order.

You are also provided with dilute sodium hydroxide, phenolphthalein and bromine solution in dropper bottles, four test tubes in a rack and distilled water in a wash bottle.

a. On each substance, perform the tests shown in the table below and record your observations in the appropriate space. Wash the test tubes after use. (9 marks)

Test / Substance	Add 1-2 drops of substance to 15 drops distilled water	Add 1 drop phenolphthalein to 15 drops NaOH then add 1 drop of substance	Add 1-2 drops of substance to 15 drops bromine
	RESULT	RESULT	RESULT
P			
Q			
R			
S			

b. Identify the families to which the compounds belong. (4 marks)

P _____

Q _____

R _____

S _____

2004-3.

a. With the help of a well labelled sketch diagram, explain how a convex lens would form a real image of a burning candle.

In your diagram show the position of the object, image, principal focus and principal axis. (11 marks)

b. What would happen to the image if the candle was moved further away from the lens? (2 marks)

2004-4.

A newly discovered element represented by the symbol **X** is suspected to belong to Group 1 of the Periodic Table.

(i). Describe an experiment you would do to prove that the element belongs to Group 1.

(9 marks)

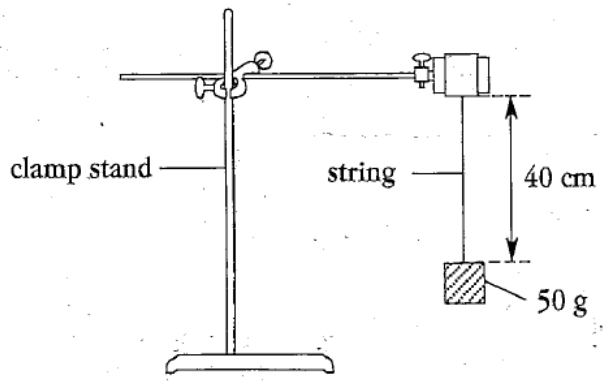
(ii). Write a balanced chemical equation for the reaction between **element X** and **water**. (3 marks)

2005

2005-1.

You are provided with a stop watch, metre rule, 50 g mass, clamp stand, clamp and a string.

a. Set up the apparatus as shown in the **figure below**.



b. Pull the mass to one side and leave it to vibrate freely.

c. Record the time taken to make 10 complete vibrations.

d. Calculate the number of vibrations performed in 1 second.

e. Record the readings in the appropriate space in **Table 1**. (6 marks)

Table 1

Length in cm	Time for 10 complete vibrations (sec)	Number of vibrations per second
40		
30		
20		
10		

f. Repeat the procedures (b) to (e) using lengths 30 cm, 20 cm and 10 cm.

g. Plot a graph of number of vibrations per second against length of string. (5 marks)

h. Using the graph, determine how the length of string affects number of vibrations per second. (1 mark)

i. Mention a variable that is kept constant. (1 mark)

2005-2.

You are provided with a thermometer, two test-tubes, a piece of magnesium ribbon, potassium hydrogen carbonate or sodium hydrogen carbonate, dilute hydrochloric acid solution, spatula or tea spoon and a measuring cylinder.

a. Pour 2 cm^3 (or 2 cm column) of hydrochloric acid into a test-tube.

b. Measure temperature of the acid and record it as initial temperature in **Table 2**.

c. Drop the magnesium ribbon in the acid and record the changes taking place as the reaction occur.

d. Record the final temperature reached in **Table 2**.

e. In the second test-tube, pour 2 cm^3 (or 2 cm column) of hydrochloric acid and record its temperature as its initial temperature in **Table2**.

f. Add $\frac{1}{4}$ spatula full of potassium hydrogen carbonate or sodium hydrogen carbonate to the acid, record the final temperature reached and other changes taking place as the reaction proceeds. (7 marks)

Table 2

Liquid in the test tube	Initial temperature (^oC)	Substance added	Final temperature reached during reaction (^oC)	Temperature change (^oC)	Other changes observed during reaction
Hydrochloric Acid		Magnesium ribbon			
Hydrochloric Acid		Potassium hydrogen carbonate or Sodium hydrogen carbonate			

g. Which one of the reactions above is an endothermic reaction? (1 mark)

h. Give a reason for the answer to (g). (2 marks)

2005-2.

Draw an energy level diagram for the reaction of hydrochloric acid and magnesium ribbon. (3 marks)

2005-3.

a. With the help of a labelled diagram, explain how a step down transformer works.

In your diagram, show the coils in primary and secondary circuits and current source. (8 marks)

b. Explain how a fuse works. (4 marks)

2005-4.

a. Define the following terms:

(i) "oxidation" (1 mark)

(ii) "reduction" (1 mark)

b. With the aid of well labelled diagrams, describe an experiment you would carry out to show that both air and water are necessary conditions for rusting. (10 marks)

2006

2006-1.

You are provided with sugar, a tin, tripod stand, wire gauze, a gas or ethanol burner, matches and balance.

a. Weigh the empty tin and record the mass in the table below.

b. With the tin still on the balance, add sugar until the mass increases by approximately 10 g.

c. Record the mass of sugar in the table below.

d. Heat the sugar in the tin until a dry, black solid (carbon) is formed.

e. Weigh the tin + black substance.

f. Heat and reweigh several times until the mass is constant.

g. Record the mass of tin + carbon in the table of results.

h. Calculate the mass of carbon (g – a).

i. Record mass of carbon in the table. (5 marks)

Table of Results

Item	Mass (g)
Empty tin	
Tin + Sugar	
Sugar	
Tin + Carbon	
Carbon	

j. Calculate the percentage composition by mass of carbon in sugar. (3 marks)

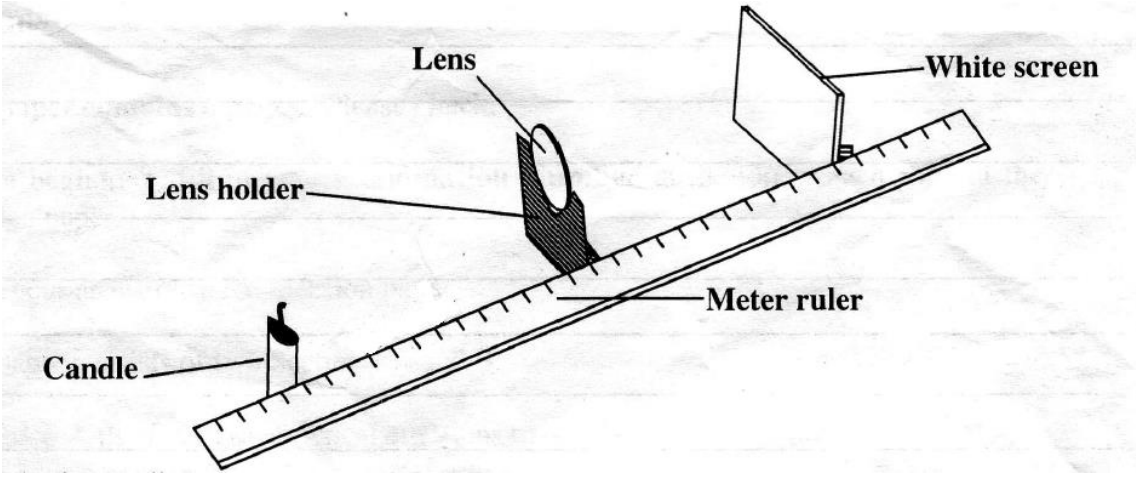
k. Calculate the number of moles of carbon produced (RAM of C = 12) (3 marks)

l. Mention any **two** sources of error in this experiment. (2 marks)

2006-2.

You are provided with a candle, matches, a lens holder, convex lens, a white screen and a meter rule.

a. Arrange the candle. convex lens and screen as shown below.



b. Light the candle.

c. With the candle at 22.5 cm from the lens, produce a well focussed image of the flame on the screen.

d. Measure and record the image distance in the table of results.

e. Repeat steps (c) and (d) for the object distances shown in the table. (5 marks)

Table of Results

Object distance (cm)	Image distance (cm)
22.5	
28.0	
37.5	
45.0	
52.5	

f. Draw a graph of image distance against object distance. (6 marks)

g. Using the graph, find the object distance when the image distance is 30 cm. (1 mark)

2006-3.

Describe an experiment that could be carried out in order to determine the length of nichrome wire that could be used to make a 1.5 Ω resistor. (13 marks)

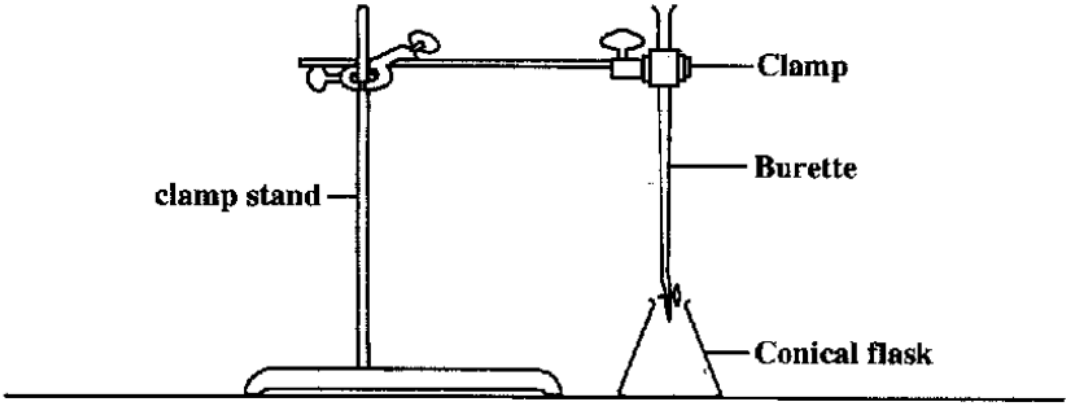
2006-4.

Using the following materials only: a balance, water of density 1 g/cm^3, cooking oil and a clear, empty bottle, describe an experiment that could be done to determine the density of cooking oil. (12 marks)

2007

2007-1. You are provided with a burette, clamp and clamp stand, measuring cylinder, conical flask, phenolphthalein indicator, 0.1 M sodium hydroxide (0.1 M NaOH) and hydrochloric acid (HCl) of unknown concentration.

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 0.1 M NaOH and transfer it into the conical flask.

e. Add 2 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 HCl when a colour change is observed in the flask.

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

j. Subtract the hinal volume of HCl from the initial volume and record.

Initial volume of HCl = _____ (1 mark)

Final volume of HCl = _____ (1 mark)

Volume of HCl used = _____ (1 mark)

k. Write a balanced equation for the reaction. (3 marks)

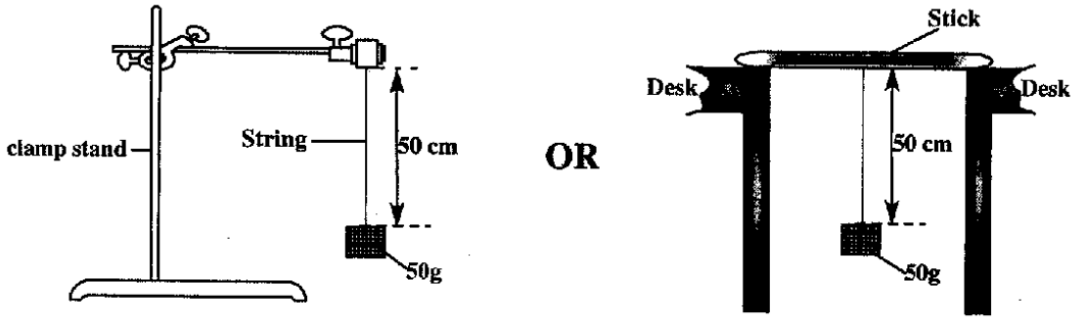
l. Calculate the concentration of HCl. (4 marks)

m. State any **two** sources of error in the experiment. (2 marks)

2007-2.

You are provide with a string, meter rule, stop watch and 4 masses (50g, 100g, 150g and 250g).

a. Arrange the apparatus as shown below.



b. Pull the mass to one side and leave it to vibrate freely.

c. Record the time taken to make 10 complete vibrations.

d. Repeat steps b and c using the 100g, 150g and 250g masses respectively.

e. Complete the column for number of vibrations per second in the table. (6 marks)

Table of Results

Mass (g)	Time for 10 complete vibrations (sec)	Number of vibrations per second (frequency)
50		
100		
150		
250		

f. Plot a graph of number of vibrations per second (frequency) against mass. (5 marks)

g. Using the graph, determine how mass affects the number of vibrations per second. (1 mark)

h. Give one variable that has been kept constant in the experiment. (1 mark)

2007-3.

Construct a flow diagram that could be used to identify acetic acid, ethanol hexane and hexane, using tests that make use of distilled water, bromine solution, sodium hydroxide solution and phenolphthalein indicator. (12 marks)

2007-4.

With the aid of a diagram, describe an experiment that could be done to identify unknown substances **W**, **X** and **Y** given that they are a diode, an insulator and a resistor but not necessarily in that order. (13 marks)

2008

2008-1.

You are provided with four test tubes, distilled water, bromine solution, sodium hydroxide solution and phenolphthalein indicator. You are also provided with unknown liquids labelled **W**, **X**, **Y** and **Z** which are hexane, ethanol, cyclohexene and ethanoic acid but not necessarily in that order.

a. Perform the tests given in the Flow diagram in **Figure 1** and complete the diagram by filling in the letters **W**, **X**, **Y** and **Z** in the appropriate boxes. (8 marks)

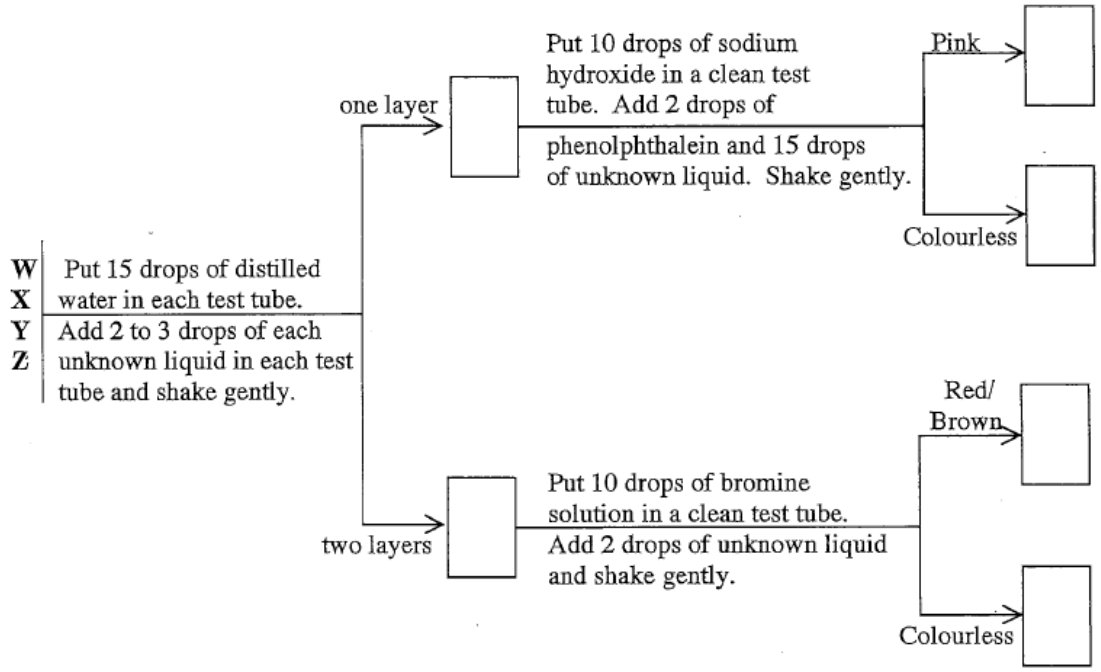


Figure 1

b. Identify liquids **W**, **X**, **Y** and **Z**. (4 marks)

W:_____

X: _____

Y: _____

Z: _____

2008-2.

You are provided with a nichrome wire, a metre rule, 2 cells, a cell holder, a voltmeter, an ammeter, a switch and connecting wires.

a. Connect the circuit shown in **Figure 2**.

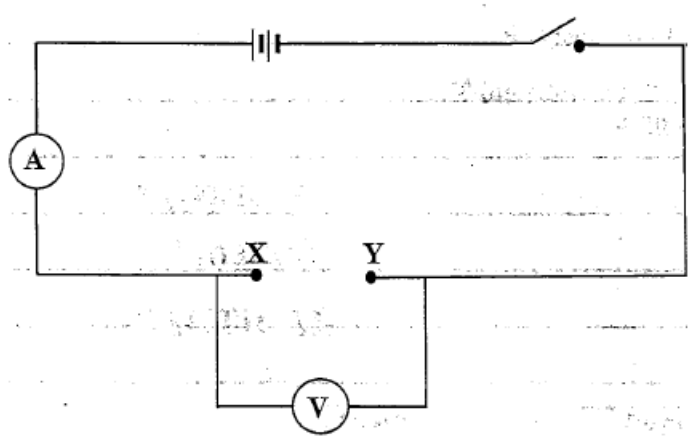


Figure 2

b. Measure 80 cm of the nichrome wire and connect it the gap **XY.**

c. Close the switch.

d. Read and record the ammeter and voltmeter readings in the appropriate spaces in **Table 1**.

e. Calculate resistance and record it in the appropriate space in **Table 1**.

f. Repeat steps (b) to (e) for the lengths of nichrome wire shown in **Table 1**. (6 marks)

Table 1

Length (cm)	Ammeter reading (A)	Voltmeter reading (V)	Resistance (V/I)
80			
60			
40			
20			

g. Plot a graph of length against resistance. (6 marks)

h. What is the relationship between length of wire and resistance? (1 mark)

2008-3.

a. Define a "standard solution" (1 mark)

b. Explain how 500 cm^3 of a 0.2 M sodium chloride solution can be prepared using sodium chloride crystals. The explanation should include all the necessary mathematical calculations. (Relative atomic mass of Na=23 and Cl=35). (12 marks)

2008-4.

a. Describe an experiment that could be carried out to determine the average speed of an athlete given the following materials: tape measure, stop watch and a whistle. (10 marks)

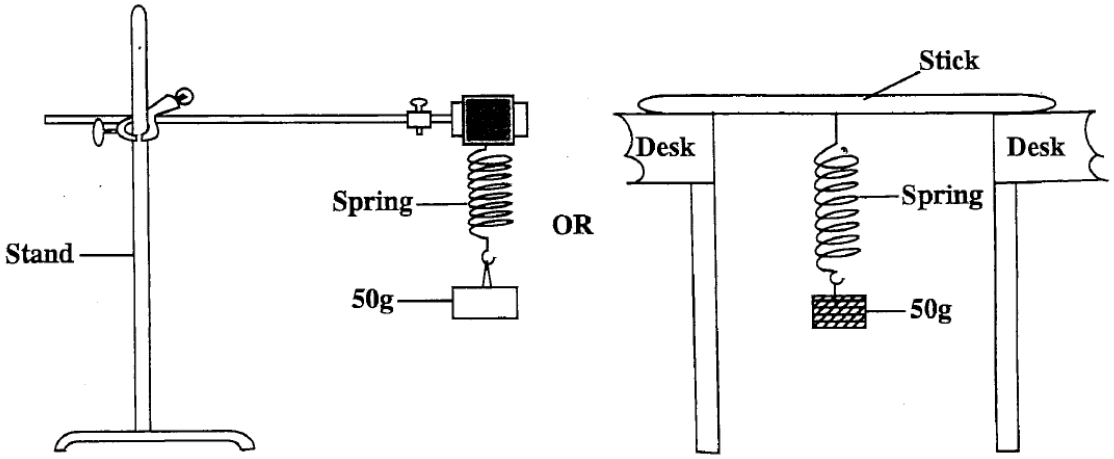
b. State any **two** possible sources of error in the experiment. (2 marks)

2009

2009-1.

You are provided with a spring, clamp and clamp stand, stop watch and 4 masses (50g, 100g, 150g and 200g).

a. Arrange the apparatus as shown below.



b. Pull the mass downwards by a small amount and leave it to vibrate freely.

c. Record the time taken to make 10 complete vibrations.

d. Repeat steps **b** and **c** using the 100g, 150g and 200g masses, respectively.

e. Complete the column for **number of vibrations per second** in the table. (6 marks)

Mass (g)	Time for 10 complete vibrations (sec)	Number of vibrations per second (frequency)
50		
100		
150		
200		

f. Plot a graph of number of vibrations per second (frequency) against mass. (5 marks)

g. Using the graph, determine how mass affects the number of vibrations per second. (1 mark)

2009-2.

You are provided with four beakers, distilled water, a measuring cylinder, sand paper and solutions of copper sulphate, zinc sulhate, iron sulphate and magnesium sulphate. You are also provided with pieces of copper, zinc, iron and magnesium metals.

a. Pour about 2 cm^3 of copper sulphate solution into each of the four beakers.

b. Clean the copper, zinc, iron and magnesium metals using sand paper.

c. Put a piece of each metal into each of the four beakers containing copper sulphate solution.

e. Record the results in the table below by indicating “Reactoin” or “No reaction”.

f. Rinse the beakers with distilled water.

g. Repeat steps (a) to (f) using solutions of zinc sulphate, iron sulphate and magnesium sulphate, respectively. (12 marks)

Table of Results

Metals / Solutions	Copper	Zinc	Iron	Magnesium
Copper sulphate				
Zinc sulphate				
Iron sulphate				
Magnesium sulphate				

h. Use the results to arrange the metals in order of increasing reactivity. (1 mark)

2009-3.

a. Mention any two properties of light. (2 marks)

b. With the aid of a labelled diagram, describe how a pure spectrum could be produced from white light. (11 marks)

2009-4.

With the aid of a clearly labelled diagram, describe how impure copper could be purified by electrolysis. The description should include relevant chemical equations. (12 marks)

2010

2010-1.

You are provided with a candle, matches, meter ruler, lens holder and a screen.

a. Arrange the apparatus as shown in **Figure 1**.

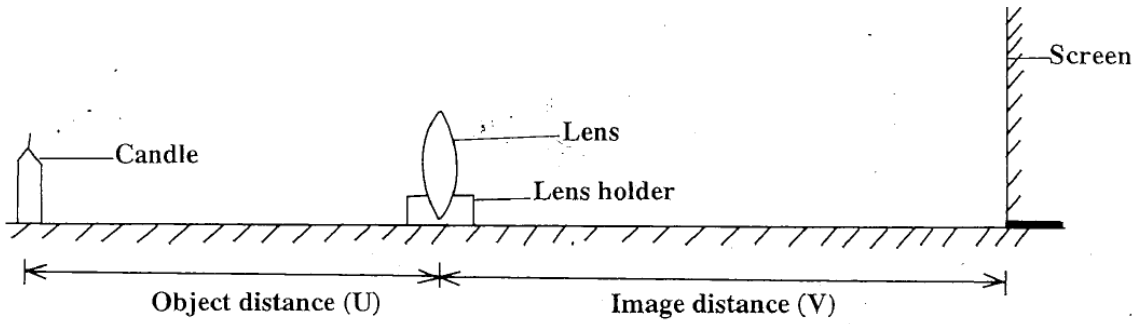


Figure 1

b. Light the candle.

c. Move the object (candle) until it is 20 cm from the lens.

d. Move the screen until a clear image of the object is formed on the screen,

e. Measure the image distance, **V** and record it in the table of results.

f. Repeat steps **c** to **e** for object distances shown in the table.

g. Complete the (**U** + **V**) column of the table. (5 marks)

Table of results

Object distance, U (cm)	**Image distance, V** (cm)	**U + V** (cm)
20		
25		
30		
40		
50		

h. Plot a graph of (**U** + **V**) against **U**. (6 marks)

(i) Use the graph to find the focal length of the lens. (2 marks)

2010-2.

You are provided with 2 test tubes in a rack, a measuring cylinder, thermometer, spatula, tap water, ammonium chloride and sodium hydroxide pellets.

a. Pour 5 cm^3 of water into each test tube.

b. Measure the initial temperature of water in each test tube and record the results in the appropriate spaces in the table.

c. Add half spatula of ammonium chloride (NH_4Cl) in one test tube and shake gently.

d. Measure the temperature of the ammonium chloride solution and record the results in the table.

e. Repeat steps **c** and **d** using sodium hydroxide (NaOH) pellets. (5 marks)

Table of results

Solution	Initial Temperature (°C)	Final Temperature (°C)	Temperature change (Final temperature – Initial Temperature) (°C)
Ammonium chloride (NH_4Cl)			
Sodium hydroxide (NaOH)			

f. State whether the change in each case is exothermic or endothermic.

Ammonium chloride: _____ (1 mark)

Sodium hydroxide: _____ (1 mark)

g. Draw energy level diagrams to illustrate the dissolving of ammonium chloride and sodium hydroxide. (4 marks)

h. State any **one** source of error in the experiment. (1 mark)

2010-3.

a. Give one advantage of local method of preparing alcohol over modern technology. (1 mark)

b. With the aid of a well labelled diagram, describe how alcohol (Kachasu) can be produced locally from cereals, sugar and water. (11 marks)

2010-4.

a. **Figure 2** is a diagram showing forces **A**, **B** and **C** acting on a ball which is falling through a liquid.

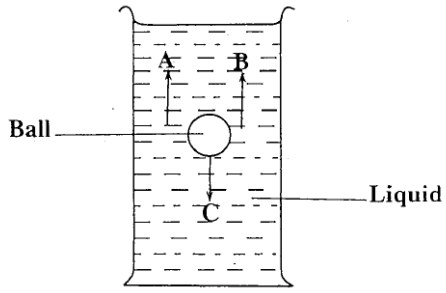


Figure 2

Name the forces **A**, **B** and **C**. (3 marks)

A: _____

B: _____

C: _____

b. With the aid of a well labelled diagram, describe an experiment that could be done to demonstrate that resistance of a media affects the speed of an object falling through the media. Your description should use: 2 identical ball bearings, water, oil and 2 transparent jars of the same size. (10 marks)

2011

2011-1.

You are provided with a voltmeter, an ammeter, a resistance wire, a cell and connecting wires.

a. Connect a circuit as shown in **Figure 1**.

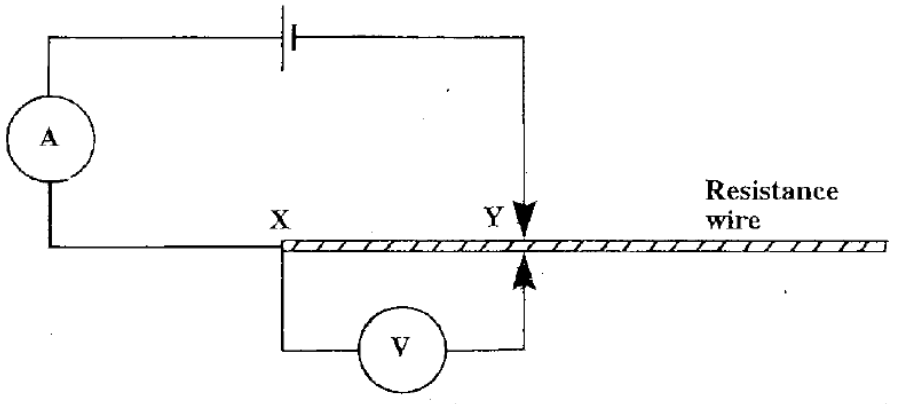


Figure 1

b. Move the crocodile clip **Y** along the resistance wire until the ammeter reads 0.9 A.

c. Measure the voltage across length **XY** of the resistance wire.

d. Record the voltmeter reading in appropriate space in **Table 1**.

e. Move the crocodile clip **Y** along the resistance wire until the ammeter now reads 0.7A.

f. Measure the new voltmeter reading across the new length **XY** of the wire.

g. Record the voltmeter reading in **Table 1** under 0.7A.

h. Repeat steps **e**, **f** and **g** for ammeter readings of 0.5A, 0.4A and 0.3A. (5 marks)

Table 1

Ammeter reading (A)	0.9	0.7	0.5	0.4	0.3
Voltmeter reading (V)					

i. Disconnect the circuit.

j. Plot a graph of voltage against current. (6 marks)

k. From your graph find the voltage when current is zero. (1 mark)

l. What can you say about the voltage in (k)? (1 mark)

m. Arrange the apparatus as you found it.

2011-2.

You are provided with a set of test tubes and unknown organic substances labelled **X**, **Y** and **Z**. You are also given the following reagents: Bromine solution, dilute NaOH, distilled water and Phenolphthalein indicator. On each unknown compound perform the tests shown in **Table 2** and record your observations in the appropriate spaces. Remember to wash the tube after each test. (9 marks)

Table 2

Test	Substance X	Substance Y	Substance Z
Add 2 drops of unknown substance to 15 drops of distilled water in a test tube.			
Add 2 drops of unknown substance to 15 drops of bromine solution in a test tube.			
To 15 drops of dilute NaOH in a test tube add 2 drops of phenolphthalein indicator. Now add 2 drops of unknown substance.			

On the basis of observations made, state the family of organic compounds to which each of the substances belongs. (3 marks)

X: _____

Y: _____

Z: _____

2011-3.

With the aid of a well labelled diagram, describe an experiment that could be done to show that the frequency of a vibrating pendulum increases with decrease in length of string.(12 marks)

2011-4.

a. What is the difference between "strong acid" and "weak acid"? (1 mark)

b. With the aid of a well labelled diagram, describe an experiment that could be done to distinguish a strong acid from a weak acid using the conductivity apparatus. (12 marks)

2012

2012-1.

You are provided with a string, a meter rule, mass, stop watch, clamp and clamp stand.

a. Arrange the apparatus as shown in **Figure 1**.

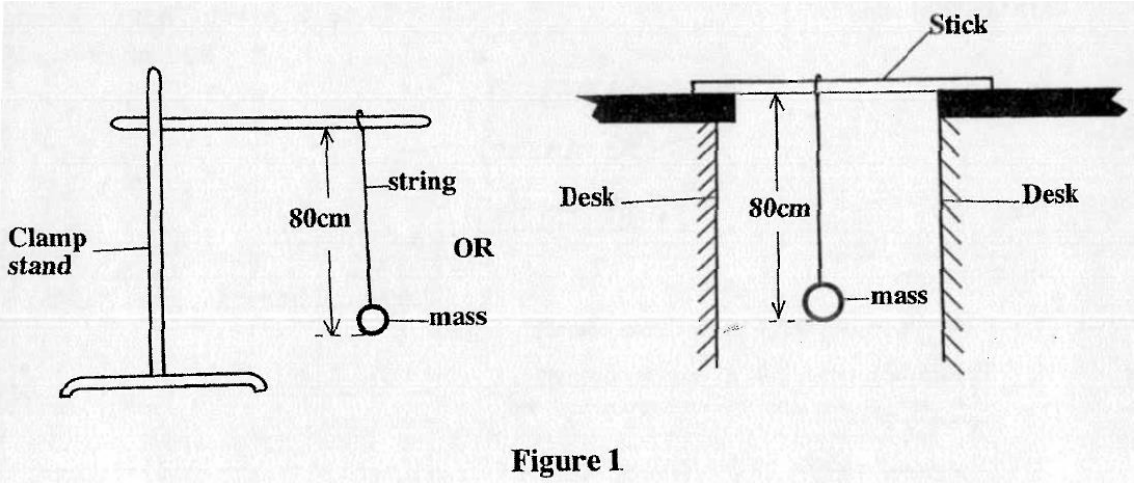


Figure 1

b. Pull the mass sidewards by a small amount and allow it to swing freely.

c. Record in the table of results the time taken to make 10 complete vibrations.

d. Calculate frequency and record it in the table.

e. Repeat steps **b**, **c** and **d** for the following lengths of the string: 60 cm, 40 cm and 20 cm. (6 marks)

Table of results

Length of pendulum (cm)	**Time for 10 vibrations** (s)	**Frequency** $\left\{\frac{\text{Number of vibrations}}{\text{Time (s)}}\right\}$
80		
60		
40		
20		

f. Plot a graph of frequency against length of pendulum. (5 marks)

g. Use the graph to describe the relationship between frequency and length of a pendulum. (2 marks)

2012-2.

You are provided with a burette, beaker or conical flask, a retort stand, a measuring cylinder, ethanoic acid (CH_3COOH), 0.1 M sodium hydroxide (0.1 M NaOH) and phenolphthalein indicator.

a. Set up the apparatus as shown in **Figure 2**.

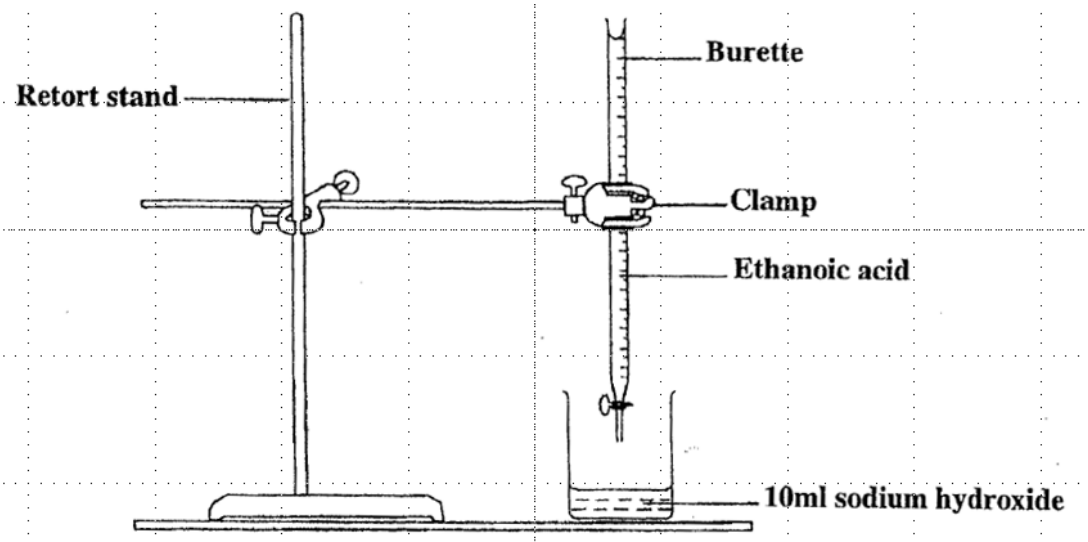


Figure 2

b. Measure 10 ml of the 0.1 M sodium hydroxide and pour it into a beaker.

c. Add 2 drops of phenolphthalein indicator into the beaker.

d. Pour 20 ml of ethanoic acid into the burette.

e. Slowly add the ethanoic acid from the burette into the beaker and shake until colour change is observed.

f. Record the results in the appropriate spaces in the table of results. (3 marks)

Table of Results

Initial volume of acid *(ml)*	**Final volume of acid** *(ml)*	**Volume of acid used** *(ml)*

g. Write a balanced chemical equation for the reaction. (3 marks)

h. Calculate the concentration of ethanoic acid used in the experiment. (4 marks)

i. Give two ways of reducing errors in the experiment. (2 marks)

2012-3.

In a laboratory, labels fell off from bottles containing an alkane, an alkene, an alkanol and a carboxylic acid. Describe an experiment that could be done to identify the contents of the bottles. (12 marks)

2012-4.

a. State any **three** properties of water waves. (3 marks)

b. Plain water waves are passed through two obstacles; one with a narrow gap and the other with a wide gap. With the aid of diagrams, describe the waves emerging from the gaps. (10 marks)

2013 MSCE

PHYSICAL SCIENCE 1

QUESTIONS

*ONLY QUESTIONS

1. a. Mention any **two** properties of liquid pressure.

_____

_____

(2 marks)

b. In terms of the kinetic theory of matter, explain why liquids evaporate.

_____

_____

_____

_____

_____

(3 marks)

c. A container with a cross-sectional area of 9 cm^2 is filled with 36 cm^3 of petrol. Calculate the pressure exerted by the petrol at the bottom of the container. (Density of petrol = 0.7 g/cm^3 and acceleration due to gravity (g) = 10 m/s^2).

(4 marks)

2. a. Mention any **one** difference between "polar" and "non polar" molecules.

_____

_____

(2 marks)

Continued/...

2. (Continued)

b. **Table 1** shows atomic numbers, melting points and boiling points of group 7 elements.

Table 1

Element	Atomic Number	Melting point (°C)	Boiling point (°C)
Flourine	9	-220	-188
Chlorine	17	-101	-34
Bromine	35	-7	59
Iodine	53	114	184

(i) Which elements are gases at room temperature?

_____

(2 marks)

(ii) Draw the atomic structure of chlorine (Cl).

(3 marks)

(iii) Why does iodine have a higher melting point than fluorine?

_____

_____

_____

(3 marks)

Continued...

2. b. (Continued)

(iv) Calculate the number of neutrons in an iodine atom if its atomic mass is 127.

(3 marks)

3. a. What is an "empirical formula"?

_____

_____

(1mark)

b. Calculate the empirical formula of copper oxide (CuO) with chemical composition of 32 g of copper and 8 g of oxygen.
(RAM: O = 16, Cu = 64)

(6 marks)

Continued/...

3. **(Continued)**

c. **Figure 1** is a diagram showing the set up of an experiment on titration.

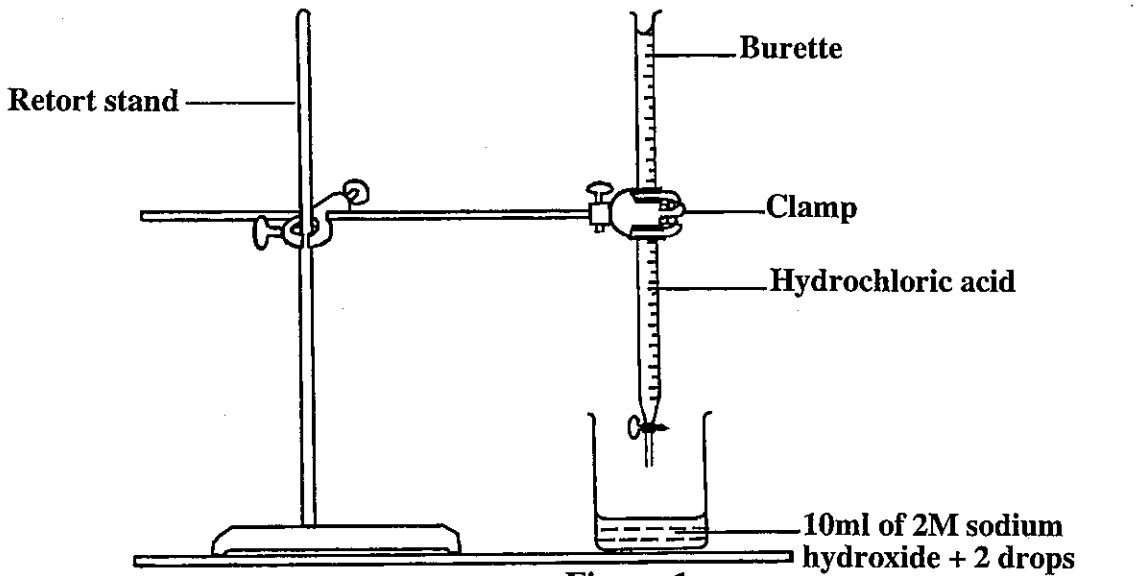


Figure 1

(i) What is the function of phenolphthalein indicator in the experiment?

_____

_____

(1 mark)

(ii) Name the standard solution in the experiment.

_____

(1 mark)

(iii) Give a reason for the answer in **3c(ii).**

_____

_____

(1 mark)

d. State any **two** ways of expressing the concentration of a solution.

_____

_____

_____

(2 marks)

Continued/...

3. (Continued)

e. (i) State any **two** ways of preventing rusting.

_____

_____

(2 marks)

(ii) Explain how rusting occurs.

_____

_____

_____

(3 marks)

4. a. Define "terminal velocity".

_____

_____

(1 mark)

b. Mention **three** factors that affect the terminal velocity of an object falling through a liquid.

_____

_____

_____

(3 marks)

Continued/...

4. (Continued)

c. **Figure 2** is a graph showing a journey made by a motorist.

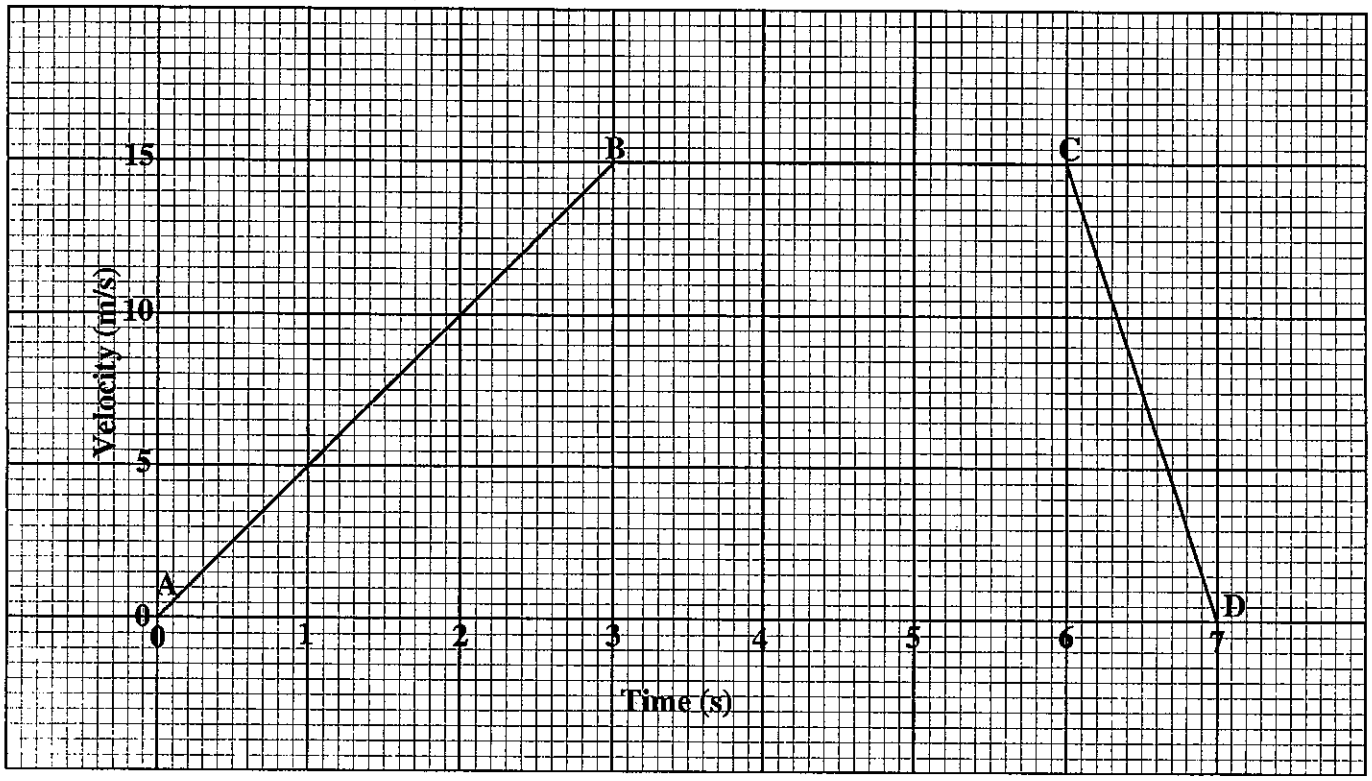


Figure 2

Calculate the distance covered by the motorist from **A** to **C**.

(3 marks)

Continued/...

5. a. **Figure 3** shows structures of some organic compounds **W**, **X**, **Y** and **Z**.

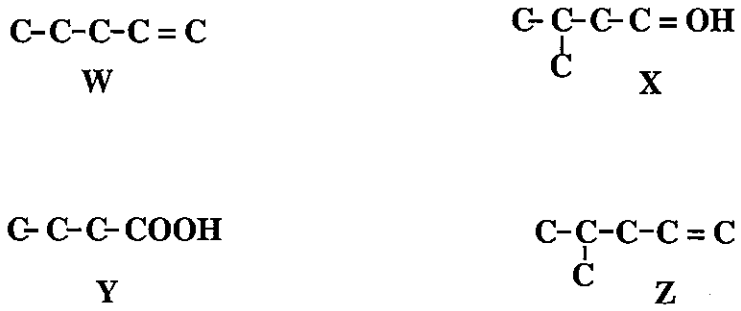


Figure 3

(i) To which homologous series do compounds **X** and **Z** belong?

X: _____ **(1 mark)**

Z: _____ **(1 mark)**

(ii) Mention any three chemical properties of compound **X**.

_____

_____

_____

(3 marks)

(iii) Write the general formula for compound **Y**.

_____

(1 mark)

(iv) Name **two** products that are formed when compounds **X** and **Y** react.

_____

(2 marks)

(v) Which compounds belong to the same homologous series?

_____

(2 marks)

(vi) Give a reason for the answer in **5a(v).**

_____

_____

(1 mark)

Continued/...

5. (Continued)

b. **Figure 4** is a diagram showing structures of plastics **A** and **B**.

Figure 4

(i) Which structure represents thermosetting plastics?

_____

(1 mark)

(ii) Give a reason for the answer in **5b(i).**

_____

_____

(2 marks)

c. Explain how ethanol (C_2H_5OH) could be distinguished from hexane (C_6H_{14}).

_____

_____

_____

(3 marks)

6. a. Mention **two** differences between convex and concave lenses.

_____

_____

_____

_____

(2 marks)

Continued/...

6. (Continued)

b. **Figure 5** shows part of a ray diagram.

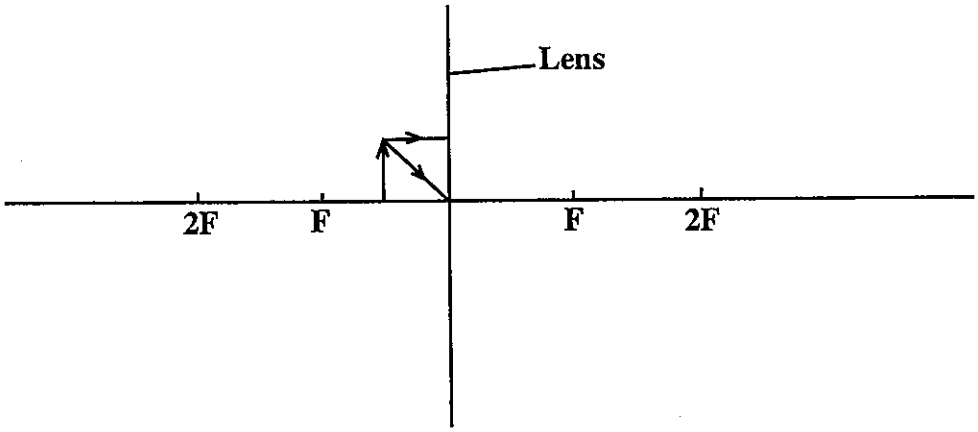


Figure 5

(i) Complete the ray diagram to locate the position of the image. **(4 marks)**

(ii) State the nature of the image formed.

_____

_____

(3 marks)

c. Mention any **two** similarities between the human eye and a camera.

_____

_____

_____

(2 marks)

d. Why are radio waves classified as transverse waves?

_____

_____

(2 marks)

Continued/...

6. (Continued)

e. Calculate the current flowing in the primary coil of a 100% efficient transformer that steps down voltage from 240 V to 20 V if current flowing in the secondary coil is 10A.

(4 marks)

7. a. State any **two** safety measures when handling radioactive substances at a school.

(2 marks)

b. Mention **two** particles that are formed when a neutron disintegrates.

(2 marks)

c. Explain how gamma emission occurs.

(3 marks)

d. A radioactive substance with an activity of 30 counts/second is disintegrating. Calculate the number of disintegrated atoms after 10 minutes.

(3 marks)

Continued/...

8. a. Mention any **two** factors that affect the efficiency of a transformer.

_____

_____

(2 marks)

b. With the aid of a labelled diagram, explain how a step-down transformer works.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(8 marks)

END OF QUESTION PAPER

NB: This paper contains 12 pages.

2013 MSCE

PHYSICAL SCIENCE 2

QUESTIONS

*ONLY QUESTIONS

Section A (25 marks)

1. You are provided with a candle, matches, meter ruler, lens, lens holder and a screen.

   a. Arrange the apparatus as shown in **Figure 1**.

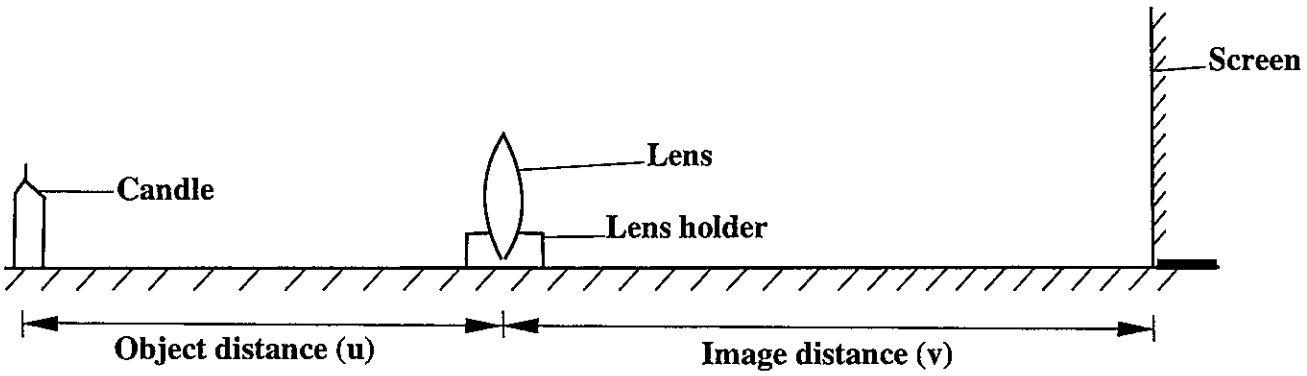


Figure 1

   b. Light the candle.

   c. Move the object (candle) until it is 50 cm from the lens.

   d. Move the screen until a clear image of the object is formed on the screen.

   e. Measure the image distance , v and record it in **Table I**.

   f. Repeat steps (c) to (e) for object distances shown in the table.

   g. Complete the $\frac{1}{v}$ and $\frac{1}{u}$ columns of the table.

Table I

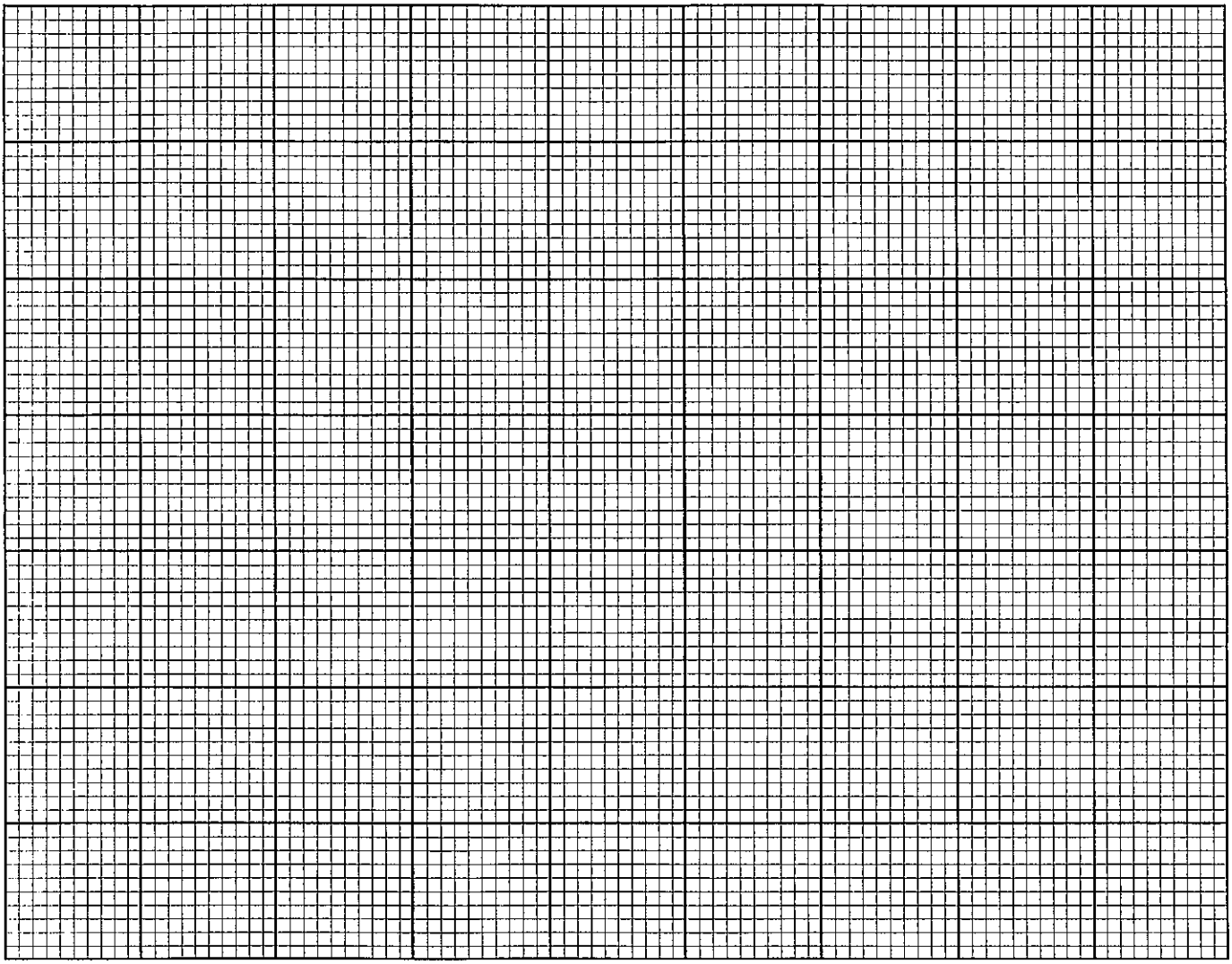
Object distance, u (cm)	**Image distance, v (cm)**	$\frac{1}{v}$	$\frac{1}{u}$
50			
40			
30			
25			
20			

(6 marks)

Continued/...

1. (Continued)

h. Plot a graph of $\frac{1}{v}$ against $\frac{1}{u}$.



(5 marks)

i. Use the graph to find the focal length of the lens.

_____

_____

(2 marks)

Continued/...

2. You are provided with 3 test tubes, distilled water, a test tube rack, copper sulphate solution, aluminium sulphate solution, iron sulphate solution, copper foil, aluminium foil and iron nails.

a. Pour 2 cm^3 of copper sulphate solution in each of the 3 test tubes.

b. Place a piece of copper foil, aluminium foil and an iron nail in each test tube.

c. Observe and record the results by indicating "reaction" or "no reaction" in the appropriate spaces in **Table 2**.

d. Rinse the test tubes using distilled water.

e. Repeat steps (a) to (d) using aluminium sulphate and iron sulphate solutions.

Table 2

Metal	Copper sulphate solution	Aluminium sulphate solution	Iron sulphate solution
Copper			
Aluminium			
Iron			

(9 marks)

f. Arrange the metals in order of their reactivity, with the most reactive metal at the top.

(2 marks)

g. Which of the metals is the strongest reducing agent?

_____

(1 mark)

4. Using concentrated solutions of ammonia and hydrochloric acid, describe an experiment that could be done to demonstrate that light particles travel faster than heavy particles. The description should include the following materials: glass tube, corks and cotton wool.

(13 marks)

END OF QUESTION PAPER

NB: This paper contains 6 pages.

Section B (25 marks)

3. With the aid of a labelled velocity-time graph, describe the motion of a sky diver dropped from an aeroplane in the sky before and after the parachute opens.

(12 marks)

Continued/...

Acknowledgements

It was a long journey. This project was completed thanks to the united efforts of a large number of people. Our great thanks to MANEB for permitting our using past-papers, many schools for lending us past-papers, JICA Malawi Office for their great support, members of Japan Overseas Cooperation Volunteers and Secondary School teachers who worked together to achieve this common goal.

Finally we thank to you, students and teachers, who are using this book and who will make future of Malawi more fruitful and more colourful!

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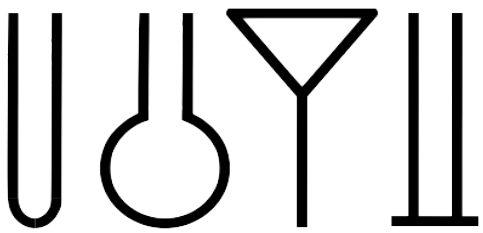

MSCE P. SCIENCE PAST PAPERS : QUESTIONS, SOLUTIONS & ANALYSIS

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