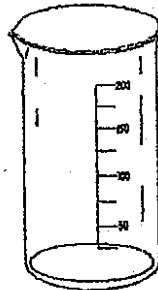
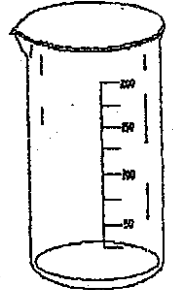


PHYSICAL SCIENCE



$$\begin{aligned}1 \times 1 &= 1 \\11 \times 11 &= 121 \\111 \times 111 &= 12321 \\1111 \times 1111 &= 1234321 \\11111 \times 11111 &= 123454321 \\111111 \times 111111 &= 12345654321 \\1111111 \times 1111111 &= 1234567654321 \\11111111 \times 11111111 &= 123456787654321 \\111111111 \times 111111111 &= 12345678987654321\end{aligned}$$



QUESTIONS

&

MODEL ANSWERS (MSCE)

by

FRANK KAZEMBE (Bsc(Ed))

(ST. MICHAELS' GIRLS' SECONDARY SCHOOL-MANGOCHI)

'Learn from yesterday, live for today and hope for tomorrow'





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THE SIMPLIFIED PATH TO THE SCIENTIFIC WORLD!!!





2011 QUESTIONS

1.
 - a. What is meant by "free fall" of an object? (2marks)
 - b. State two forces that act on an object falling in the air. (2marks)
 - c. Figure 1 is a velocity-time graph showing a journey made by a cyclist.

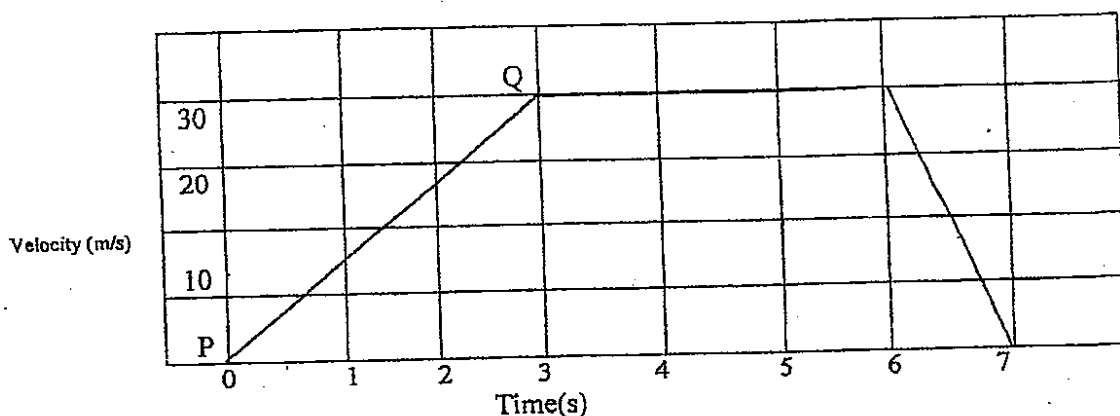


Figure 1

- a. Calculate the acceleration from P to Q. (3marks)
2.
 - a. Give two types of semi conductors. (2marks)
 - b. Explain the difference in total resistance between similar resistors connected in series and then in parallel. (4marks)
 - c. Give any one method of demagnetising a permanent magnet. (1mark)
 - d. Figure 2 is a diagram showing an experiment on electromagnetism in which a current carrying wire passes through the centre of a card on which iron fillings were sprinkled.

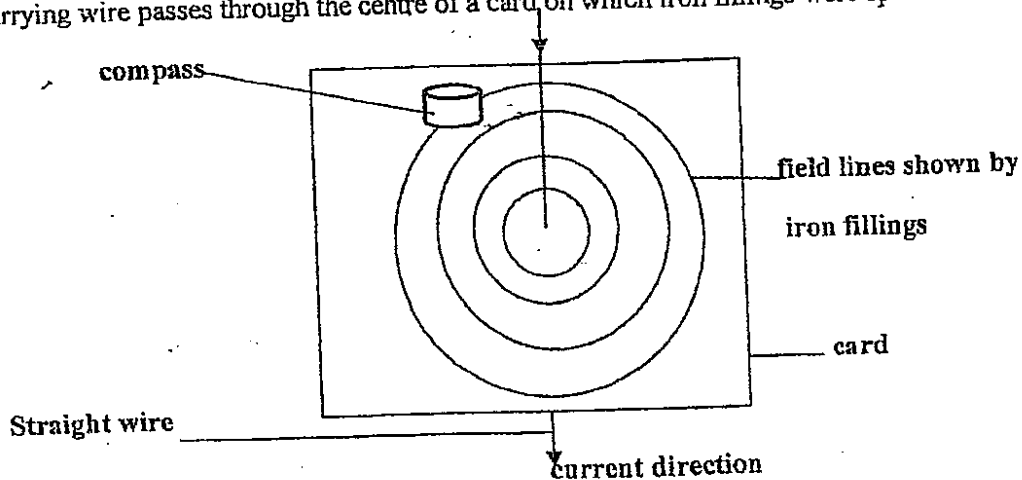


Figure 2

- (i) Draw an arrow in the compass to show the direction of field line. (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 your answer in 2d (ii) (1 mark)
3. a. (i) Define molar volume of a gas. (2 marks)
- (ii) Calculate the number of moles of sulphur dioxide occupying 120 dm^3 at room temperature and pressure. (Molar volume at room temperature and pressure is 24 dm^3). (3 marks)
- b. (i) Define an acid according to Lowry/Bronsted theory. (1 mark)
- (ii) Describe how a hydronium ion (H_3O^+) is formed. (2 marks)
- c. Explain why bond breaking is endothermic while bond making is exothermic. (4 marks)
- 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)
4. a. (i) State three ways in which atoms attain stability. (3 marks)
- (ii) Explain how ionic bonding occurs. (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
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 of 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)
- (i) Write down the chemical equation for the reaction that would occur between D and T. (1 mark)
5. a. (i) Give any two properties of polymers. (2 marks)
- (ii) Explain how condensation reaction occurs. (2 marks)
- b. Mention any two properties of alkanols. (2 marks)

- c. Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) changes to ethanoic acid (CH_3COOH) in the presence of atmospheric oxygen (O_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)

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

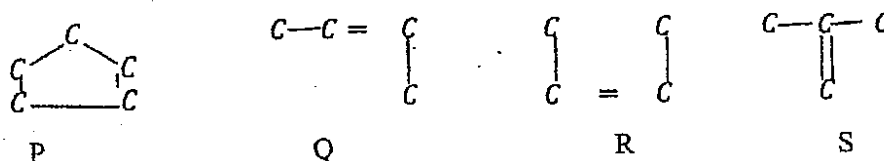


Figure 3

- (i) Name the organic compounds labeled P and Q. (2 marks)
- (ii) Identify the structure which is an isomer of compound Q. (1 mark)
- (iii) Give a reason for your answer in 5d (ii). (1 mark)
- (iv) Explain how compound P could be distinguished from compound R using bromine solution. (3 marks)
6. a. State any two factors that affect gas pressure. (2 marks)
- 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 at the bottom of the container in N/cm^2 . (Acceleration due to gravity, $g = 10 \text{ m/s}^2$). (4 marks)
7. a. State the difference between a transverse and longitudinal wave. (2 marks)
- 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)
- d. (i) Define "nuclear fission". (1 mark)
- (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 ($^{232}_{90}\text{Th}$) decays by alpha emission to radium ($^{228}_{88}\text{Ra}$).
- (i) What do the numbers 228 and 88 represent in $^{228}_{88}\text{Ra}$. (2 marks)
- (ii) Write the nuclear equation for the decay of thorium ($^{232}_{90}\text{Th}$). (3 marks)

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)

SOLUTIONS TO 2011 QUESTIONS

1. a. Falling of an object with gravity only and with uniform acceleration.
 b. Weight, fluid friction (air resistance)
 c. $a = (v - u)/t$

$$\frac{(30-0)\text{m/s}}{3\text{s}}$$

$$10\text{m/s}^2$$
2. a. Intrinsic (pure) and Extrinsic (impure) semiconductors
 b. The total resistance between similar resistors that are connected in series is always greater since the length is increased compared to the total resistance in parallel circuit which is low since thickness is increased.
 c. Heating or hammering or dropping repeatedly.
 d. (i) draw an arrow in clockwise direction in the compass.
 (ii) The direction of compass needle would also reverse.
 (iii) This is due to the reversing of direction of field lines since current direction was also reversed.
3. a. (i) Volume of a gas occupied by one mole of a gas at S.T.P or R.T.P.
 (ii) Number of mole of a gas = $\frac{\text{volume of gas (SO}_2\text{)}}{\text{volume of one mole of gas at r.t.p}}$

$$= \frac{120\text{dm}^3}{24\text{dm}^3/\text{mole}}$$

$$= 5 \text{ moles.}$$
- b. (i) It is defined as a proton donor.
 (ii) A hydronium ion is formed when a water molecule which acts as Lowry-Bronsted base accepts a proton donated by an acid.

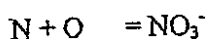


c. Bond breaking involves the taking in of heat from the surrounding to the system which is used to break the bonds hence endothermic while the formation of new bonds involves the releasing of heat energy to the surrounding from the system hence exothermic.

d. (i) Electroplating, oiling (greasing), covering with plastic, painting, galvanizing.

(any two of the above)

(ii) Oxidation number of Nitrogen in NO_3^-



$$\text{N} + 3(-2) = -1$$

$$\text{N} - 6 = -1$$

$$\text{N} = +5$$

4. a. (i) losing of outermost electrons

Gaining of electrons

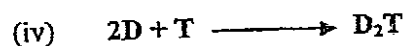
Sharing of outermost electrons.

(ii) Metals lose valence electrons and become positively charged ions while non-metals gain the electrons and become negatively charged ions. So ionic bonding occurs due to electrostatic attraction between the positively and negatively charged ions.

b. (i) Q, T and X

(ii) X

(iii) Electrovalent (Ionic) bonding



5. a. (i) poor conductor of electricity and heat

Do not corrode

Do not react with acids

(any two of these)

(ii) It occurs when two different monomers react and form a long chain polymer and a small molecule usually water is lost in the process.

b. React with sodium metal to produce hydrogen gas

React with oxygen

Soluble in water

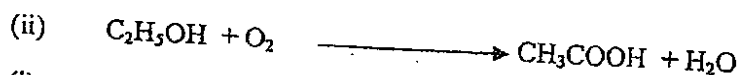
React with carboxylic acids to form ester



Does not conduct electricity.

(any two of these)

c. (i) To oxidize an ethanol.



d. (i) P = cyclopentane

Q = but-2-ene or 2-butene.

(ii) S.

(iii) They have the same molecular formula but different structures.

(iv) Compound R decolorizes bromine solution due to the presence of double bond while compound P does not change the colour of bromine solution.

6. a. Temperature and volume

b. The walls of a dam are thicker at the bottom than the top. This aims at withstanding greater pressure exerted by the water since pressure increases with depth.

c. $P = \frac{\text{Force exerted}}{\text{Area}}$

$$= \frac{\text{mass} \times \text{acceleration due to gravity}}{\text{area}} = \frac{27 \text{ g}}{1000} \times 10 \text{ m/s}^2 = \frac{0.27 \text{ N}}{9 \text{ cm}^2} = 0.03 \text{ N/cm}^2.$$

7. a. The transverse waves is the type of the wave in which the vibrations are at right angles to the direction of travel of the wave while longitudinal wave is the type of the wave in which the vibrations are along the same direction as wave is travelling. Or transverse waves produce crests and troughs while longitudinal waves produce rarefactions and compressions.

b. By focusing the image of a very far object on the screen and measure the distance from the lens to the screen and the measured distance is the focal length.

c. Focal length of a lens in a camera is fixed while that of a human eye changes.

Image distance of an eye is fixed while that of a camera changes.

Eye normally opens while a camera is closed except when taking picture. (any two of these)

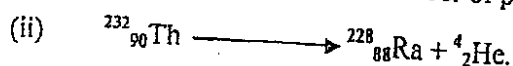
d. (i) Is the splitting of heavier nucleus of an atom to form light nuclei.

(ii) ${}^1_1\text{H}, {}^2_1\text{H}, {}^3_1\text{H}$ or H-1, H-2, H-3 (any two of these)

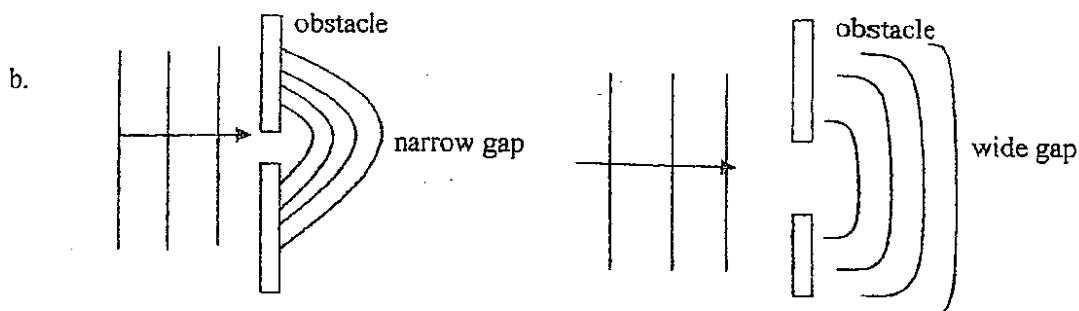
e. Beta radiation causes little ionisation of air hence cannot neutralise the leaf electroscope.

f. (i) 238 = Atomic mass or mass number or nucleon number.

88 = atomic number or number of protons



8. a. An increase in temperature in semiconductors makes the electrons that are in valence band to jump into the conducting band through the forbidden gap hence the number of electrons in the conducting band increases which reduces the electrical resistance.



Waves which are passing through a narrow gap are more curved (diffracted) than the waves passing through wider which are less curved (diffracted). At the same time the wavelength for waves passing through narrow gap is reduced while for wider gap is not affected.

2010 QUESTIONS

1. a. (i) Why are liquids used in hydraulic machines? (3 marks)
- (ii) Give any two examples of hydraulic machines. (3 marks)
- b. (i) Define 'absolute zero'. (1 marks)
- (ii) A gas occupies a volume of 200cm^3 at 273K . Calculate the temperature of the gas, if its volume increases to 300cm^3 at constant pressure. (3 marks)
- c. (i) State any three properties of metals. (3 marks)
- (ii) Explain why potassium is more reactive than sodium. (2 marks)
- d. Figure 1 is a diagram of nuclei of elements R and Q.

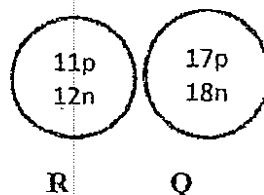


Figure 1

- (i) Write down the electronic configurations of elements R and Q. (2 marks)
- (ii) To which period and group of the periodic table does element R belong?

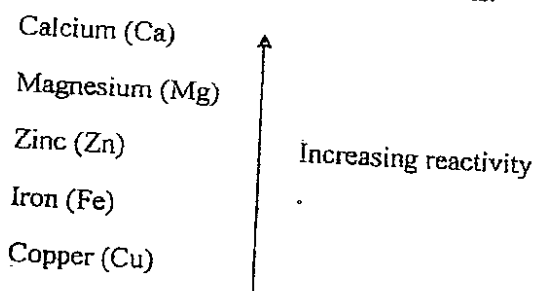
(iii) Draw a dot and cross diagram of the compound that would be produced when R reacts with Q. (4 marks)

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

f. State any two uses of sulphates. (2marks)

2. a. State any two advantages of electroplating a metal. (2 marks)

b. Below is part of displacement series of metals.

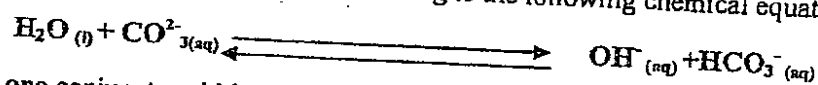


b. (i) which metal would displace all other metals from their solutions? (2 marks)

(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)

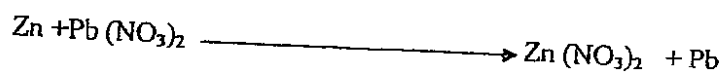
c. Water reacts with the carbonate ion according to the following chemical equation:



Give one conjugate acid-base pair in the reaction. (2marks)

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

e. The chemical equation below shows displacement reaction between zinc (Zn) and lead nitrate ($\text{Pb}(\text{NO}_3)_2$).



Name the reducing and oxidizing 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.

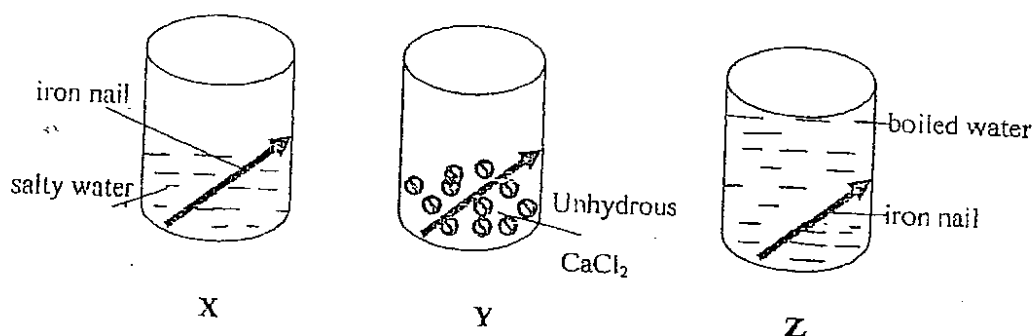


Figure 2

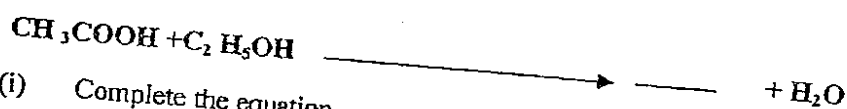
- (i) Why was anhydrous calcium chloride used in tube Y? (1 mark)
 - (ii) Why was water in tube Z boiled? (1 mark)
 - (iii) State any two conditions necessary for rusting of iron. (2 marks)
3. a. (i) Mention any two examples of scalar quantity. (2 marks)
- (ii) Describe how vectors are represented on paper. (2 marks)
- b. Figure 3 is a diagram showing a person rowing a boat on a lake.



Figure 3

3. b. (i) Explain how rowing causes the boat to move. (3 marks)
- (ii) Which Newton's law of motion is demonstrated in the diagram? (1 mark)
- (iii) Mention any two forces acting on the boat. (2 marks)

4. a. (i) What are polymers? (1 mark)
 (ii) Mention any two uses of polythene. (2 marks)
 (iii) Give any properties of plastics. (3 marks)
- b. (i) Give three properties of carboxylic acid. (1 mark)
 (ii) Mention any two natural sources of carboxylic acids. (2 marks)
- c. (i) Define "isomers". (2 marks)
 (ii) Draw structural formulae for the four isomers of butanol (C_4H_9OH). (4 marks)
- (iii) Write down the condensed formula of pentane. (2 marks)
- d. Ethanol (C_2H_5OH) reacts with ethanoic acid (CH_3COOH) according to the following chemical equation.



- (i) Complete the equation. (1 mark)
 (ii) Name the process in which ethanol reacts with ethanoic acid. (1 mark)

5. a. (i) Name two particles found in the nucleus of an atom. (2 marks)
 (ii) State two characteristics of radioactive substance. (2 marks)
 (iii) State any two uses of nuclear radiation (2 marks)
- b. Table 1 shows the activity of radioactive element with time. (2 marks)

Table 1

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

(5 marks)

- (i) Plot a graph of activity against time. (2 marks)
 (ii) Use the graph to find the total time taken for activity to drop from 30 to 15 disintegration per second (2 marks)

- c. Name the particles emitted when radium ($_{88}^{226}\text{Ra}$) decays to radon ($_{86}^{222}\text{Rn}$) (2 marks)
- a. Mention any two appliances that use the principle of electrostatics. (2 marks)

- b. Figure 4 is a diagram of electric circuit.

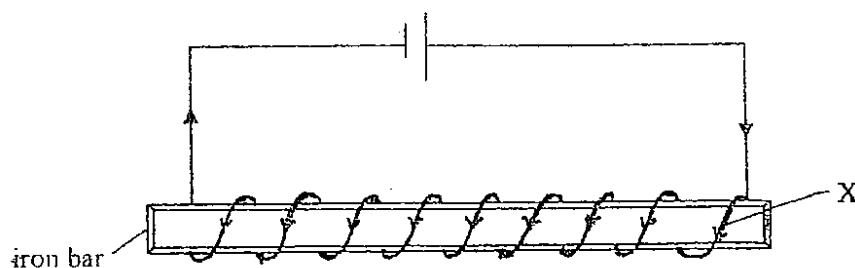


Figure 4

- (i) Name the part labeled X. (1 mark)
 - (ii) What would happen if the part labeled X is brought close to iron fillings? (1 mark)
 - (iii) Give reason for your answer in 6.b. (ii). (2 marks)
 - (iv) What is the role of the iron bar in the circuit? (1 mark)
- c. Define "electrical power". (1 mark)
- d. An electric bulb is marked 240v, 60w.
- (i) What is the meaning of '240v and 60W'? (2marks)
 - (ii) Calculate the heat dissipated by the bulb, in joules, if it operates for 8 minutes. (2 marks)
- 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 240 (3 mark)
- f. Explain how a transformer works. (4 mark)
- g. State any three differences between a real image and virtual image. (3 mark)
- g. (ii) An object 6cm long is placed 30cm in front of a converging lens of focal length 10cm. Use the lens formula to calculate:
- (1). Image distance (4 marks)
 - (2). Magnification of the object (2 marks)
- h. (i) State any two factors which affect frequency of an oscillating pendulum.
- (ii) Mention two characteristics of an oscillating system. (2 marks)
7. a. Explain how an image is formed by a convex lens. (4 marks)

- b. With the aid of a labeled 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)
8. a. Explain how constructive interference occurs in waves. (3 marks)
- b. Explain using kinetic theory of matter, why clothes dry faster on a sunny day than on a cloudy day. (4 marks)
- c. Explain why propanoic acid (C_2H_5COOH) conducts electricity when dissolved in water while propanol (C_3H_7OH) does not. (2 marks)
- d. Explain how polythene is formed. (3 marks)
- e. Describe how expansion and contraction of metals is used in shrink fitting. (3 marks)

SOLUTIONS TO 2010 QUESTIONS

1. a. (i) Liquid particles are close to each other such that they cannot be compressed hence pressure is transmitted through the liquid.
- (ii) Hydraulic brakes/hydraulic jack or hydraulic press or hydraulic fork lift or hydraulic steering wheels. (*any two of these*)
- b. (i) The lowest possible temperature at which molecules cease to move since substances do not have internal energy.
- (ii) $V_1 = 200\text{cm}^3, T_1 = 273\text{K}, V_2 = 300\text{cm}^3, T_2 = ?$

$$T_2 = \frac{V_2 \times T_1}{V_1} = \frac{300 \times 273}{200} = 409.5\text{K}$$
- c. (i) conducts electricity, are ductile, are shiny when freshly cut, are malleable, sonorous sound produced when dropped, react with water, react with oxygen, react with halogens, solid at room temperature, high melting and boiling point, insoluble in water and undergo corrosion. (*any three of these*)
- (ii) Potassium has more number of shells compared to sodium as such it can easily lose its outermost electron since the outermost electron experience less nuclear attraction or potassium has bigger atomic radius than sodium hence can easily lose its valence electron.
- d. (i) $R = 2, 8, 1$ or $R = 2:8:1$
 $Q = 2, 8, 7$ or $Q = 2:8:7$
- (ii) Period 3, Group 1
- (iii)
- $\left[R \right]^+$

$\left(\begin{array}{c} \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \\ \bullet \bullet \bullet \bullet \end{array} \right)^-$



- f. - Sulphates are used for making of:
- fertilizer
 - medicine
 - plaster of Paris
 - fungicides
 - pesticides
- (any two of these)

- c.
- $\text{HCO}_3^-/\text{CO}_3^{2-}$



- e. Reducing agent: Zinc (Zn)

Oxidising agent: Pb^{2+} or Lead ion.

3. a. (i) Examples of Scalars: mass, distance, speed, density, temperature, time, volume, area etc

(any two of these)

- (ii) It is represented by straight line with an arrow.

- b. (i) Rowing a boat pushes water backwards and the water reacts by pushing in the opposite direction or water exerts an equal but an opposite force on the boat.

- (ii) Newton's Third Law of motion.

- (iii) Weight, upthrust, water resistance, air resistance e.t.c. (any two of these)

4. a. (i) Polymers are long chain molecules or combination of monomers. Or polymers are compounds which are formed when monomers join together



(ii) Making of: plastic sheets, mesh, plastic carrying bags, plastic bottles, plastic plates/bottles
Polythene tubes. (any two of these)

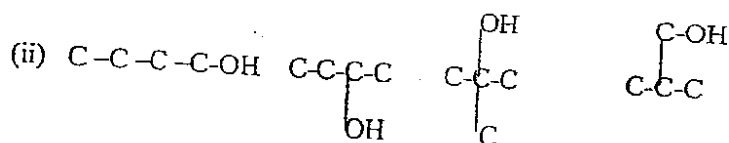
(iii) -Resistance to air. Do not react with air. Do not biodegrade. Do not corrode/rust
Do not conduct electricity. Have low density compared to water. Easily moulded.

(any two of these)

b. (i) Carboxylic acids have sour taste, have pH less than 7, affect colours of indicators, attack metals, soluble in water, react with alcohols, ionize in water. (any two of these)

(ii) Citrus fruits, milk, vinegar, tomatoes, insect bites, human sweat etc.

c. (i) Isomers are compounds with the same molecular formula but different structural formula.



(iii) $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$

d. (i) $\text{CH}_3\text{COOCH}_2\text{CH}_3$

(ii) Esterification

5. a. (i) protons and neutrons

(ii) They have unstable nucleus, emit radiations, they decay (transmutate), detected by magnetic field. (any two of these)

(iii) -Radiotherapy/treating of cancer cells

-Sterilisation of equipment

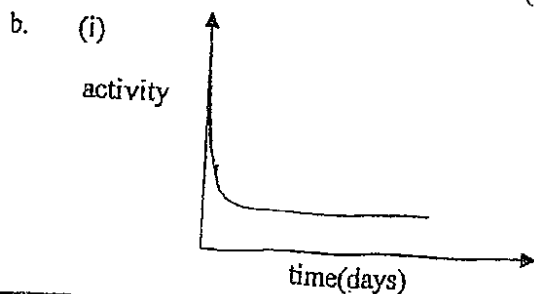
-Thickness gauge

-Food preservation

-Tracers in Agriculture/industries

-Carbon dating/Archeology.

(any two of these)



MWASE PRODUCTION (2011)

Page 14





- (ii) Time at: $12 - 4 = 8$ days
- c. An alpha particle.
6. a. (i) -Photocopier
 -Inkjet printer
 -Paint sprayer
 -Capacitor
 -Flue ash precipitation
 -Electrostatic precipitators. *(any two of these)*
- b. (i) It is known as a coil or solenoid.
 (ii) The iron fillings get attracted.
 (iii) When current flows through part X creates magnetic field which attract iron fillings.
 (iv) It increases magnetism.
- c. Electrical power is defined as the rate at which electrical energy is used per unit time.
- d. (i) It means that the power output of the bulb is 60W when connected to a 240V supply.
 (ii) Heat = power x time = $60\text{W} \times (8 \times 60)\text{s}$

$$= 28,800\text{J}$$
- e. $V_s = (N_s \times V_p) / N_p = \frac{50 \times 240}{1200} = 10\text{v}.$
- f. Alternating current in the primary coil induces a magnetic field. When the field cuts the secondary coil, it induces an alternating current in the secondary coil.
- g. (i) Real image is the one that can be seen on the screen while a virtual image is the one that cannot be seen on the screen.
 (ii) Real image is upside down (inverted) while virtual image is upright (erect).
 (iii) Virtual image is on the same side of the object while real image is on the other side of the lens.

$$(1) \quad \frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{30} + \frac{1}{v} = \frac{1}{10}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{30} = \frac{3-1}{10}$$



$$\frac{1}{v} = \frac{2}{30} = \frac{1}{v} = \frac{1}{15}$$

$$v = 15 \text{ cm}$$

$$(2) m = v/u$$

$$= \frac{15}{30} = 0.5$$

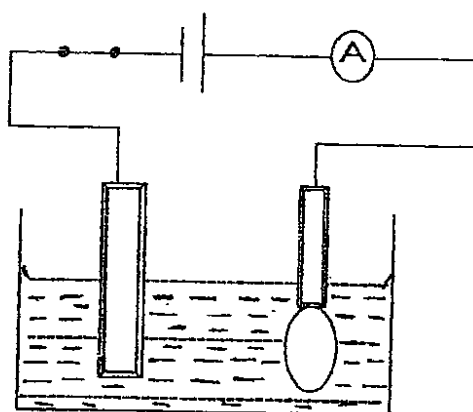
- h. (i) length of a pendulum, material (type of string), amplitude change.
 (ii) amplitude, frequency, period, equilibrium. (*any two of these*).

7. a. light from an object converges after passing through the convex lens and forms an image at a point of intersection of the rays.

b. The experiment is set as shown on the diagram below:

Materials: cells, ammeter, switch, spoon, copper chloride solution and a container

Procedure: set up the apparatus as shown in the fig below



-when the switch is closed, current starts flowing in the circuit. The cathode becomes negatively charged thereby attracting the positively charged copper ions from the solution. This results into gaining of electrons and coating the cathode (spoon) according to the equation: $\text{Cu}^{2+} + 2e \rightarrow \text{Cu}$

8. a. Constructive interference occurs when a crest/trough of one wave overlaps with a crest/trough of another wave hence making the amplitude to increase.
 b. clothes when heated during the day causes water molecules to gain kinetic energy thereby moving at higher speed and escaping at a higher rate from the clothes.

- c. propanoic acid ionises in water while propanol does not.
- d. double bond of ethene molecules breaks. The molecules formed then combine to form long chains
- e. a large metal axle is fitted in to a small hole on another metal by first dipping the larger metal (axle) into liquefied gas (e.g. liquid nitrogen) cooled at -196°C in order to shrink it. Then the axle is fitted into the hole and expands to produce a tight fit upon regaining its normal temperature.

2009 QUESTIONS

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.

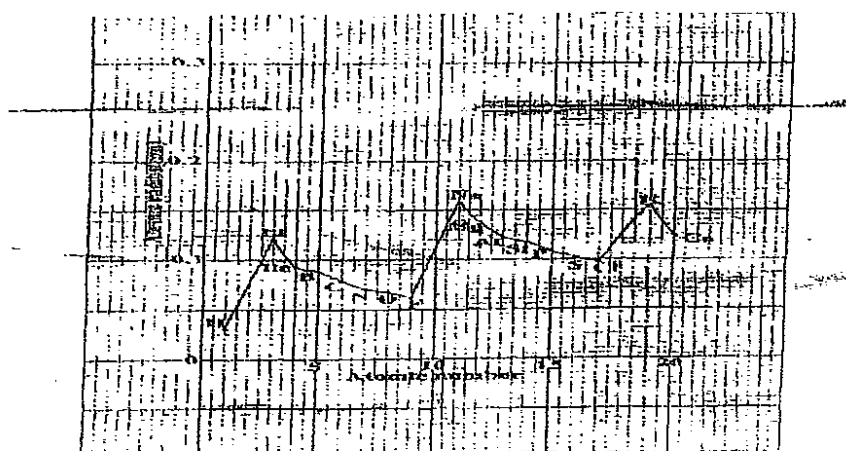


Figure 1

- (i) To which group of the periodic table 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 Cl.
- (v) Give two differences between the type of bonding in Lithium metal (Li) and Chlorine gas (Cl_2). (2marks)

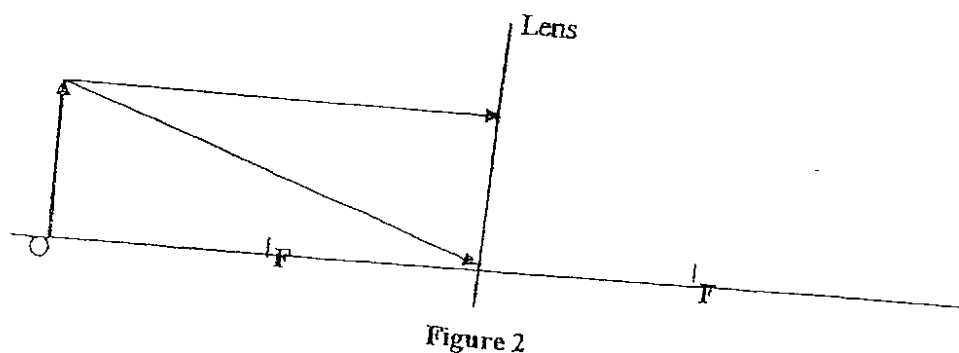
- c. (i) Mention any two uses of Sulphur. (2marks)
 (ii) Give any two physical properties of Sulphur. (2marks)
- d. Table 1 shows the number of valence electrons and valencies of some elements.

Table 1

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

- (i) How can element N attain stable electron configuration? (1 mark)
 (ii) Give a reason for the answer to 1.d(i) (1 mark)
 (iii) What is the formula of a compound that is formed between Li and O. (2marks)
 (iv) Give the charge on a Be ion. (1 mark)

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



- (i) Complete the ray diagram to show the position of the image. (3 marks)
 (ii) Calculate the magnification of the image. (3 marks)

(2marks)

(2marks)

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

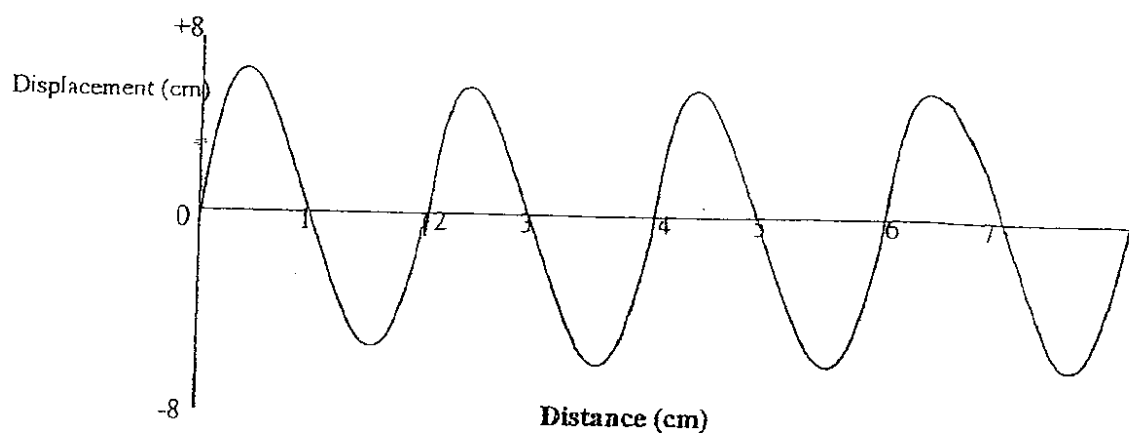


Figure 3

- (i) Name the type of a wave shown in Figure 3. (1 mark)
 - (ii) Give any two properties of a wave. (2marks)
 - (iii) What is the wavelength of the wave? (1 mark)
 - (iv) Calculate the speed of the wave. (2 marks)
- c. Figure 4 is a diagram of slide projector.

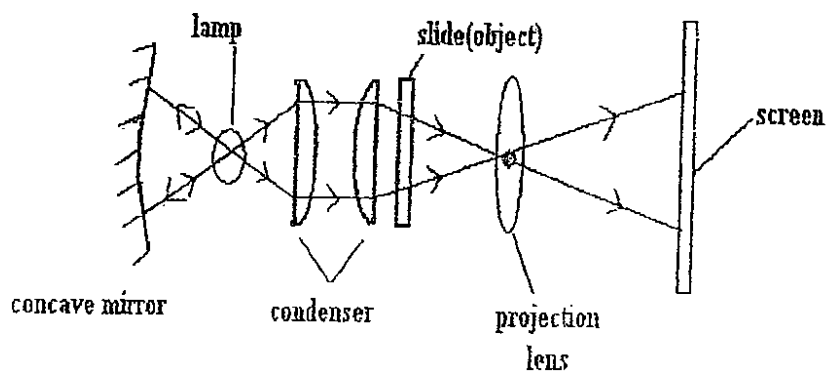


Figure 4

- (i) State the function of each of the following:
 - Concave mirror: (1mark)
 - Condenser lens: (1 mark)
 - (ii) Describe the nature of the image formed on the screen (3 marks)
3. a. Define "radioactivity" (2 marks)

- b. Name three types of radiation. (3 marks)
- c. Mention any two instruments that are used to detect radiation. (2 marks)
- d. (i) How do the chemical properties of the isotopes of uranium $^{238}_{92}\text{U}$ and $^{234}_{92}\text{U}$ compare? (2 marks)
- (ii) Give reason for the answer to 3.d. (i) (1 mark)
- e. Mention any one natural source of radiation. (1 mark)
- f. A radio active source has half life of 30 minutes. Calculate the fraction left after 2 hours.

4

- a. What do the following electrical symbols stand for?



(1 mark)



(1 mark)

- 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. (2 marks)

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

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

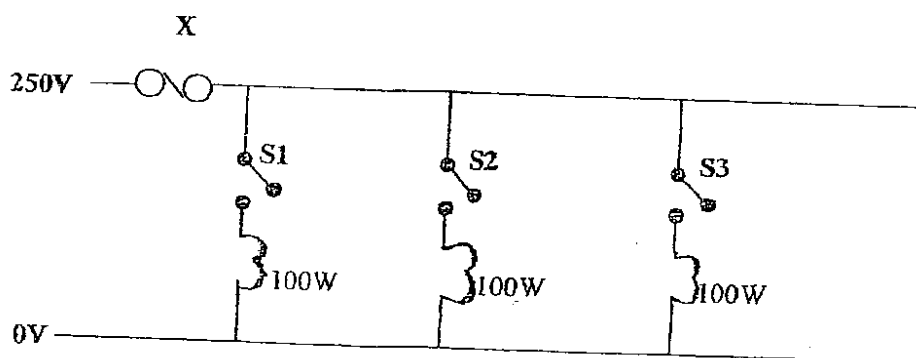


Figure 5

- (i) What type of circuit is shown in the diagram? (1 mark)
- (ii) Give two reasons why this type of circuit is preferred for wiring house. (2 marks)
- (iii) Explain the importance of including the part labeled X in the circuit in Figure 5.
- (iv) Give any one appliance where device X is used. (1 mark)

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

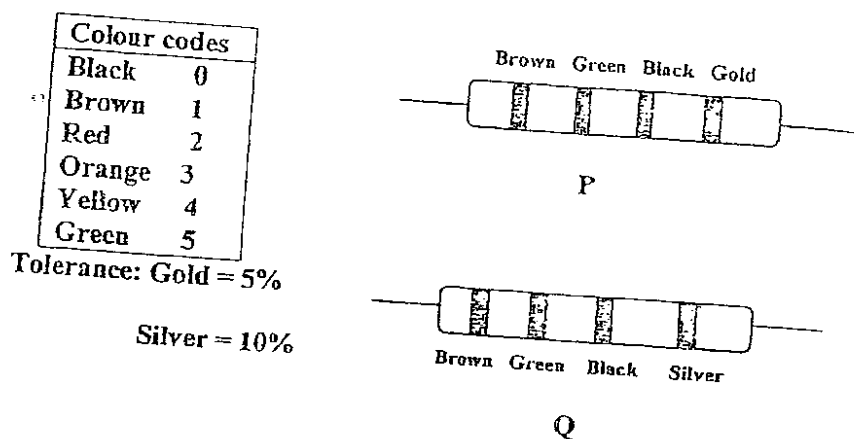


Figure 6

- (i) What is the resistance of the resistor P? (3marks)
- (ii) What is the advantage of using resistor P in a circuit than resistor Q (1 mark)
5. a. State any three uses of ethanoic acid (3 marks)
- b. Why is ethanoic acid regarded as a weak electrolyte? (1 mark)
- c. Write down the ionisation equation of ethanoic acid (CH_3COOH) in water (H_2O) (1 mark)
- d. Why does sodium metal react with ethanol in the same way as it does with water?
- e. Silver ions [$\text{Ag}^+(\text{aq})$] react with iron (Fe) according to the following equation:
- $$2\text{Ag}^+(\text{aq}) + \text{Fe}(\text{s}) \longrightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{Ag}(\text{s})$$
- (i) What is the meaning of (2+) on $\text{Fe}^{2+}(\text{aq})$? (1 mark)
- (ii) What is the oxidation number of silver before reaction? (1 mark)
- (iii) Which has been reduced? (1 mark)
- (iv) Give reason for the answer in 5e (iii) (1 mark)
- f. (i) Write down the general formula for carboxylic acids. (1 mark)
- (ii) What is the formula and name of the smallest carboxylic acid? (2 marks)
- (iii) How would the boiling point of butane compare with that of a carboxylic acid of similar size? (1 mark)
- (iv) Explain your answer to 5.f.(iii) (2 marks)

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

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

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

c. Two forces of magnitude 240 N and 420 N are being used to pull a boat at an angle of 60° to each other. Find the resultant force by using a scale diagram. (Use a scale of 1 cm to represent 100 N) (7 marks)

d. (i) Define 'gas pressure'. (1 mark)

(ii) Give any three uses of gas pressure. (3 marks)

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

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	1.5
Temperature ($^\circ\text{C}$)	0	50	100	150

(i) Plot a graph of pressure against temperature. (5 marks)

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

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

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

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

8. a. What is an 'electrolyte'? (2 marks)

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. (13 marks)

SOLUTIONS TO 2009 QUESTIONS

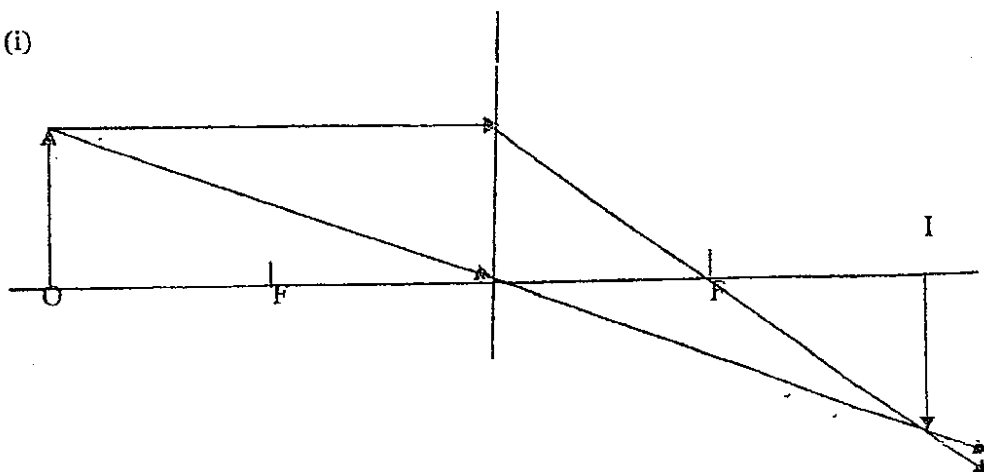
1. a. It is the arrangement of electrons in the shells of an atom.

b. (i) It belongs to group 6.

(ii) It has six electrons in the outermost shell.

- (iii) It is because F has two shells while Na has three shells.
- (iv) F is more reactive than Cl because the atomic radius of F is smaller than that of Cl. This then causes the outermost shell of F to experience more nuclear binding force attracting additional electron easily.
- (v) Lithium forms metallic bonds while chlorine forms covalent bonds and also Lithium forms stronger bonds than chlorine.
- c. (i) It is used in manufacturing of:
- sulphuric acid
 - plastics
 - fungicides
 - matches
 - drugs
 - sulphur concrete or added to cement
 - vulcanization of rubber
 - fertilizers (any two of these)
- (ii)
- solid at room temperature
 - non-metallic
 - does not conduct electricity
 - yellow color at room temperature
 - low melting point (any two of these)
- d. (i) by gaining three electrons
- (ii) It is easier for N to gain three electrons than losing five electrons
- (iii) Li_2O
- (iv) $2+$

2. a. (i)



(ii) Image height = 2 cm
 Object height = 2 cm

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

$$= \frac{2\text{cm}}{2\text{cm}}$$

$$= 1$$

- b. (i) It is a transverse wave
- (ii) These are:
- interference
 - reflection
 - refraction
 - diffraction (any two of these)
- (iii) 2m
- (iv) $\text{speed} = \lambda f = 2 \times 2$
 $= 4\text{m/s}$
- c. (i) concave mirror: to increase light intensity being directed to the condenser lens
 Condenser lens: to concentrate light on the slide
- (ii) Real, magnified, inverted.
3. a. A process whereby an unstable atomic nuclei disintegrate resulting into emission of beta, alpha, and gamma particles.
- b. These are: alpha, gamma and beta particles.
- c. These are:
- Geiger-Muller tube
 - cloud chamber
 - spark counter
 - ionization chamber
 - gold-leaf electroscope
 - photographic film
 - bubble chambers (any two of these)
- d. (i) They have similar chemical properties.
- (ii) Since the number of valence electrons of the isotopes are the same.

Chemical properties of elements depend on the valence electrons

- e. natural
- cosmic rays
 - gamma rays from the earth

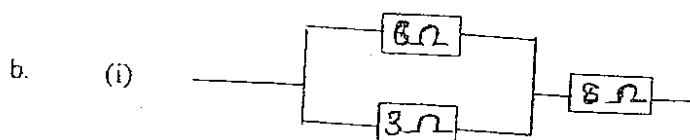
f. $1^{st} 30 \text{ min} = \frac{1}{2}$

$2^{nd} 30 \text{ min} = \frac{1}{2} \text{ of } \frac{1}{2} = \frac{1}{4}$

$3^{rd} 30 \text{ min} = \frac{1}{2} \text{ of } \frac{1}{4} = \frac{1}{8}$

$4^{th} 30 \text{ min} = \frac{1}{2} \text{ of } \frac{1}{8} = \frac{1}{16}$

4. a. (i) Capacitor
(ii) Rheostat/variable resistor



(i) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_T} = \frac{1}{6} + \frac{1}{3} = \frac{3}{6}$

$R_T = 2\Omega$

Total resistance = $8\Omega + 2\Omega$

$= 10\Omega$

- c. (i) Parallel circuit
- (ii) -Each component can be controlled independently.
-Adding more bulbs in the circuit does not affect brightness of the bulbs.
-If one bulb blows up, the others still function.
- (iii) When too much current flows in the circuit, device X melts thereby stopping the flow of current in the house circuit
- (iv) Includes pressing iron, three pin plug, electric kettle, fridge, cooker. (any one of these)

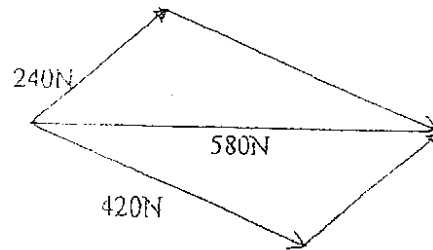


- d. (i) $15\Omega \pm 5\%$
 (ii) P has a greater accuracy

5. a. -solvent
 -consumed as vinegar
 -used in manufacturing of: aspirin, esters, synthetic fibre, varnish
 -cleaning agents (*any three of these*)
- b. it ionises partially in water.
- c. $\text{CH}_3\text{COOH}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} \rightleftharpoons \text{CH}_3\text{COO}^{-}(\text{aq}) + \text{H}_3\text{O}^{+}(\text{l})$
- d. Because ethanol molecules have the OH^{-} group which is also present in water molecule.
- e. (i) It means Fe has lost 2 electrons.
 (ii) Oxidation number of +I.
 (iii) silver ion (Ag^{+}).
 (v) Its oxidation number has decreased from +I to zero. Or it has gained an electron.
- f. (i) $\text{C}_n\text{H}_{2n+1}\text{COOH}$.
 (ii) HCOOH (methanoic acid).
 (iii) A Carboxylic acid has higher boiling point than butane.
 (iv) A Carboxylic acid has higher intermolecular forces due to presence of OH group (hydrogen bonding)
- g. -Recycling
 -Incinerating
 -land filling
 -Reusing
 -Degradation
6. a. A single vector whose effort is equal to the sum of two or more vectors.
 b. Speed is a scalar quantity because has magnitude only while velocity is a vector quantity because has both magnitude and direction.



c.



Using a scale diagram = 580N

d. (i) force exerted by a gas per unit area

(ii) -air ships

- syringes

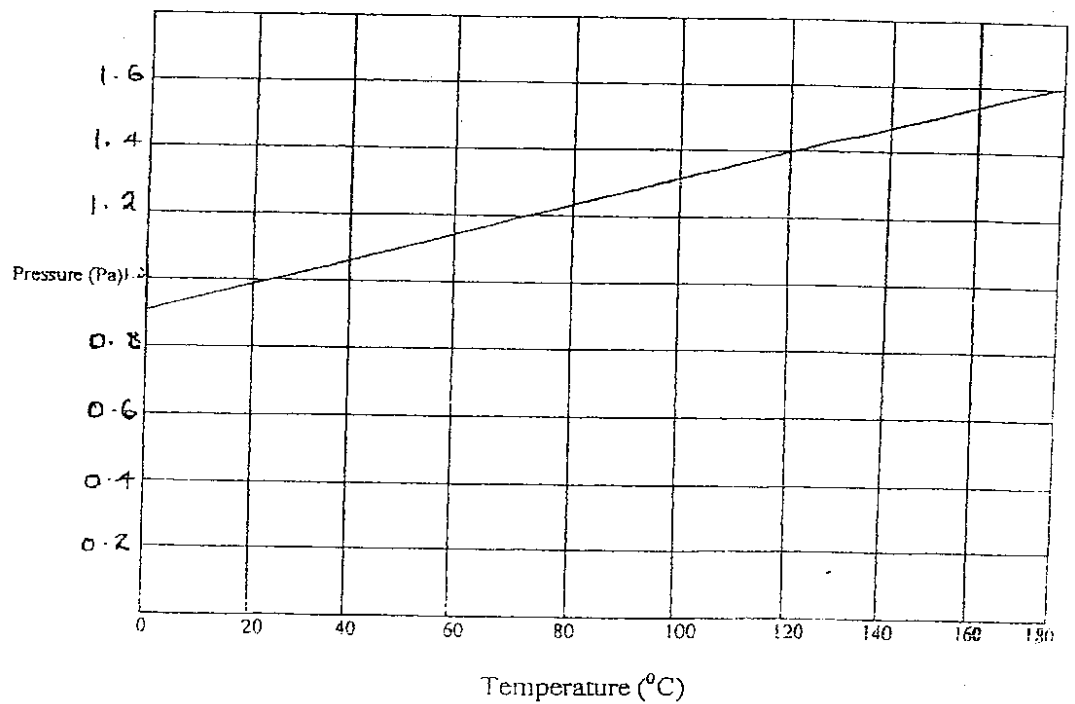
-bicycle tyres

(iii) When the temperature is increased it makes the molecules gain kinetic energy as a result they move faster and bombard the walls of the container more often and harder and this increases pressure.

e.

i.

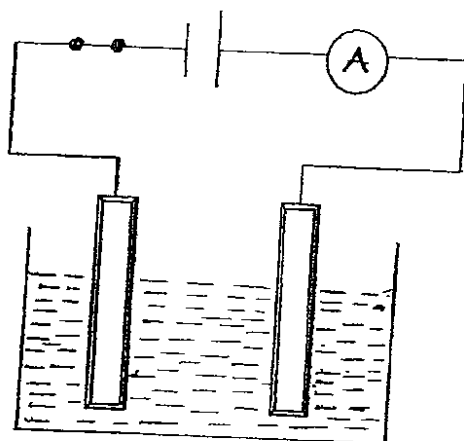
Graph of pressure against temperature



(ii) $1.38 \pm 0.01 \text{ Pa}$

7. a. -flexible therefore do not easily break
-stretch under tension because molecules are able to slide over each other
-soft hence melt at low temperature
- b. -The recycled materials serve as raw materials for making other products hence reduce expenses.
-Recycling organic compounds reduce pollution to the environment
- c. Thermoplastics have polymer chains which are linked or bonded to each other to give a cross-linked structure and so the chains are held firmly in place as such no softening takes place on further heating.

8. a. A substance which conducts electricity when in solution or molten form.
- b. Materials: cells, beaker, wires, ammeter, KNO_3 , KCl solutions, switch and electrodes
- Set up the apparatus as follows:



Pour potassium nitrate solution in the beaker. Switch on the circuit. Read and record the ammeter. Repeat the experiment using potassium chloride solution. Compare the two ammeter readings. The solution that gives a higher ammeter reading is a better conductor and hence a better electrolyte.

2008 QUESTIONS

1. a. Element X has atomic mass of 39 amu and atomic number of 19
- (i) How many protons are in the atom? (1mark)
- (ii) What would happen if element X was mixed with water? (1mark)

- (iii) Give a reason for your answer to 1.a. (ii). (2marks)
- b. Magnesium and Chlorine can be represented as $^{24}_{12}\text{Mg}$ and $^{35.5}_{17}\text{Cl}$ respectively
- (i) What are the valences of Magnesium and Chlorine?

Magnesium
Chlorine

(1mark)

(1mark)

- (ii) What is the molecular formula of the compound as a result of Magnesium reacting with Chlorine? (2marks)

- c. Draw an electronic dot and cross diagram of carbon dioxide (CO_2) given that carbon is in group 4 and oxygen in group 6 of the periodic table. (4marks)

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

- (ii) Give a reason for your answer to 1.c. (ii). (1mark)

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

Table 1

METAL	MELTING POINT($^{\circ}\text{C}$)
A	240
B	3370
C	1539
D	120

- (i) Which metal would be most suitable for making a filament of a bulb? (1mark)

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

- e. (i) Sulphuric acid (H_2SO_4) can be used as a dehydrating agent. Name the products in the dehydration of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$). (2marks)

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

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

- (iii) An object 10cm high is placed 25 cm from the centre of a convex lens of focal length of 10 cm. Draw a ray diagram to show the position of the image formed. (Scale: 1 cm to represent 5 cm). (6marks)

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

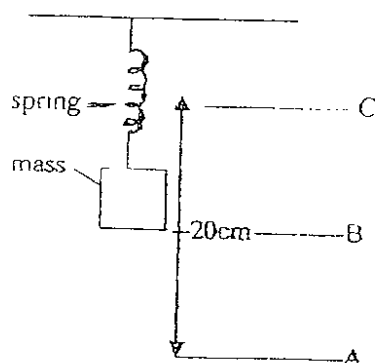


Figure 1

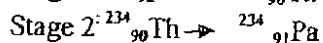
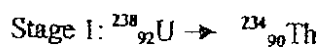
- Calculate the initial amplitude of the vibration. (2marks)
- At which point does the vibrating mass have the highest kinetic energy? (1mark)
- Describe how potential energy and kinetic energy change as the mass is vibrating from A to C. (4marks)
- Give two reasons why a mass would eventually stop vibrating. (2marks)

3. a. Define "nuclear fusion". (2marks)
- b. The equation below shows the fusion of a heavy hydrogen.



- Name the products (2marks)
- Identify the type of radioactive decay. (1mark)

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



- (i) Which particle are emitted at each stage?

Stage 1: _____ (1mark)

Stage 2: _____ (1mark)

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

- d. State any three safety precautions that must be followed when handling radioactive substances.
- e. When a source of radiation is placed in front of a Geiger-Muller counter, the initial count rate is 128. After 16 minutes the count rate is 8. Calculate the half life of the source. (6marks)
- f. 60 cm^3 of a solution whose concentration is 15 g/cm^3 were diluted with distilled water by raising its volume to 80 cm^3 . Calculate the concentration of the new solution. (3marks)
- g. Calculate the empirical formula of an organic compound containing 48.0g of carbon, 12.0g of hydrogen and 32.0g of oxygen. (RAM of C=12, H=1 and O=16). (7marks)
4. a. Figure 2 is a diagram of a transformer.

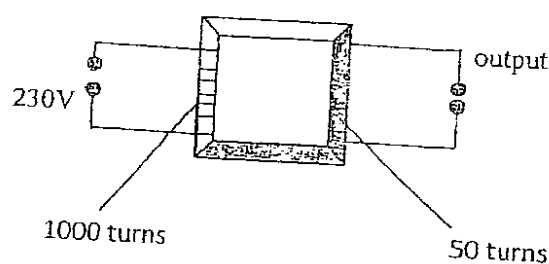


Figure 2

- Name the type of transformer shown in the diagram. (1mark)
 - Give a reason for the answer to 4.a(i). (1mark)
 - Calculate the output voltage of the transformer. (3marks)
- b.
- What are semiconductors? (1mark)
 - Explain how raising the temperature of semiconductors affects their electrical conductivity. (2marks)
- c. Figure 3 is a diagram of a transistor.

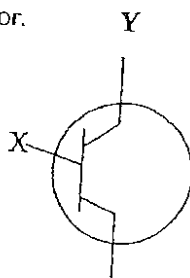


Figure 3

- Name the parts marked X and Y (1mark)
- Give any two uses of transistors. (1mark)

d.

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

(2marks)

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

(3marks)

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

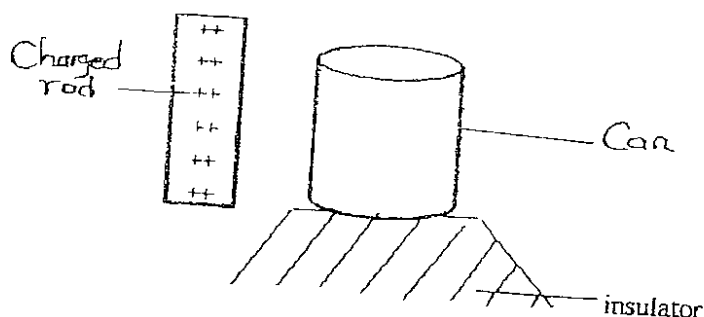


Figure 4

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

ii. Why was the can placed on an insulator?

(2marks)

a. Define "isomers".

(1mark)

b. Draw structural formulas for the 2 isomers of butane (C_4H_{10})

(2marks)

i. Name the isomers drawn in 5 b (i).

(2marks)

c. Figure 5 is a diagram of an experiment set up

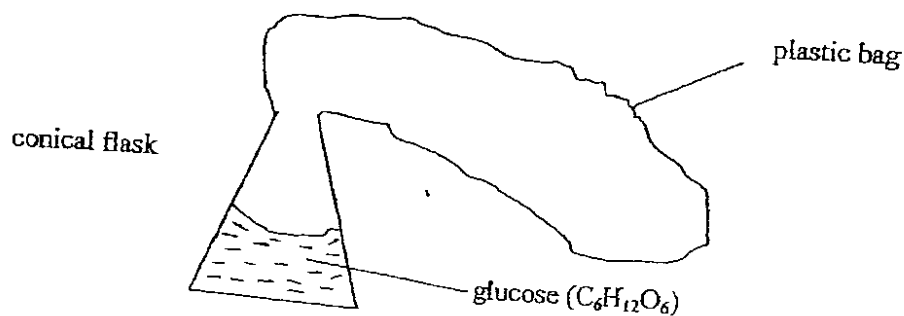


Figure 5

i. Name the process that would occur in the flask.

(1mark)

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

(3marks)

- d. State any two disadvantages of synthetic polymers. (2marks)
- e. Table 2 shows boiling points and solubility of some alkanols in water.

Table 2

Name	Boiling point ($^{\circ}\text{C}$)	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. (3marks)
- (ii) Explain why ethanol is more soluble in water than propanol. (3marks)
- f. (i) Complete the following equation to show the reaction between methane and chlorine.
- $$\text{CH}_4 + \text{Cl}_2 \rightarrow \text{---} + \text{---} \quad (2\text{marks})$$
- ii. Name this type of reaction. (1mark)
- iii. Give any one use of alkanes. (1mark)

6

- a. State any two factors that affect the terminal velocity of a free falling object in air.
- b. Figure 6 is a diagram showing an object falling at terminal velocity. F_1 and F_2 are forces acting on the object.



Figure 6

- i. Name the forces F_1 and F_2 . (2marks)
- ii. What would be the relationship between the magnitude of F_1 and F_2 at terminal velocity? (1mark)
- c. State Newton's second law of motion. (1mark)
- d. An object of mass 200kg accelerates uniformly from rest to a velocity of 20m/s in 4 seconds. Calculate:
- i. Acceleration of the object. (2marks)
- ii. Force required to produce the acceleration in 6. d. (i). (2marks)

7

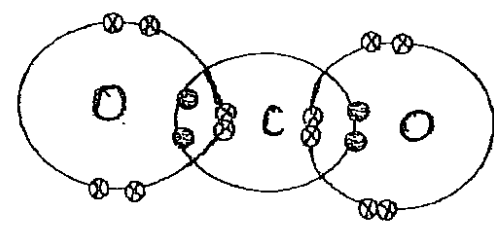
- a. Describe an experiment that can be done to distinguish octane from octene. (5marks)
- b. What is the difference between oxidation and reduction in terms of electron transfer? (1mark)
- c. Explain how each of the following prevents rusting of iron. (4marks)
 - i. Painting
 - ii. Galvanizing

8

- a. Explain why candle wax melts when it is heated. (3marks)
- b. With the aid of a well labeled diagram, describe how a manometer works to measure gas pressure. (12marks)

SOLUTIONS TO 2008 QUESTIONS

- I. a. (i) 19.
- (ii) Element X would react with water.
- (iii) Element X has one electron in its outermost shell, as such can easily lose it and react with water to give an alkaline solution and hydrogen gas.
- b. (i) Magnesium = 2, while Chlorine = 1.
- (ii) $MgCl_2$
- c. (i)

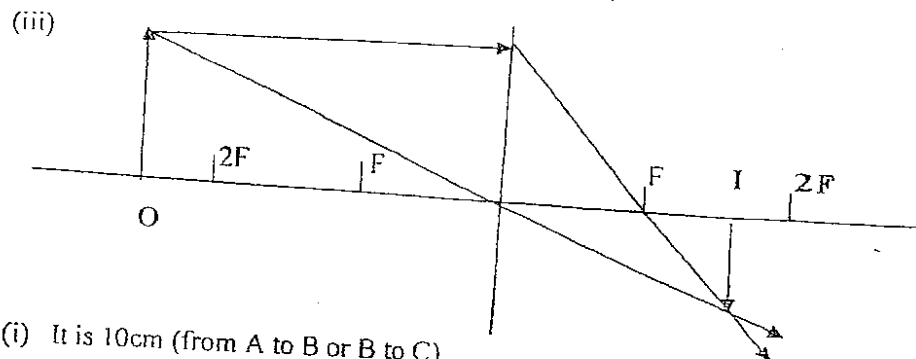

- (ii) Covalent bonding
- (iii) Electrons are shared and this involves nonmetallic elements.
- d. (i) B.
- (ii) To resist melting when red hot, the filament wire needs to have high melting point.
- e. (i) Carbon(C) and water (H_2O).
- (ii) It is used in: – manufacturing of fertilizer.
 - car batteries
 - as dehydrating agent

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- to manufacture metal salts (sulphates)
- artificial fibers
- steel
- detergents and soap (any two of these)

2. (i) It is the distance between the optical center of the convex lens and the focal point of the lens.
- (ii) -Using lens formula method.
-using distant object method.
-using plane mirror method. (any two of these)



- b. (i) It is 10cm (from A to B or B to C)
- (ii) At position B
- (iii) At position A lowest kinetic energy and maximum potential energy. Moving from A to B, potential energy decreases while kinetic energy increases. At position B, it has lowest potential energy and maximum kinetic energy. Moving from position B to C, potential energy increases while kinetic energy decreases, and at C, there is lowest kinetic energy and maximum potential energy.
- (iv) Because a certain amount of energy is converted to heat and sound energy. Also because of friction with air

3. a. is the process by which multiple nuclei join together to form a heavier nucleus.
- b. (i) Helium and neutron.
(ii) It is an alpha decay.
- c. (i) Stage 1: an alpha particle
Stage 2: beta particle.
(ii) energy

d. Taking the following measures:

- sources should only be handled by forceps provided and never touched by hand.
- Radiation should never be pointed towards a person.
- Food should not be taken where the sources are being used.
- Never smoke near a radioactive source.
- wear rubber gloves, and hands should be washed after the sources have been put away safely.
- Do not stay much long within the area where there are radioactive substances.

(any three of these)

e. Number of half lives = n , Initial count rate, $A_0 = 128$

Final count rate, $A_n = 8$

$$\frac{A_0}{A_n} = 2^n$$

$$\frac{128}{8} = 2^n$$

$$16 = 2^n$$

$$2^4 = 2^n$$

$$4 = n$$

Half life = $16/4 = 4$ minutes.

f. Calculation $C_1 = 15\text{g/cm}^3$

$$V_1 = 60\text{cm}^3,$$

$$V_2 = 80\text{cm}^3, C_2? C_1 \times V_1 = C_2 \times V_2$$

$$C_2 = (15\text{gcm}^{-3} \times 60\text{cm}^3) / 80\text{cm}^3$$

$$= 11.25\text{gcm}^{-3}$$

g. The empirical formula is: $\text{C}_2\text{H}_6\text{O}$ and is found by using the method shown below

<u>Element</u>	<u>mass</u>	<u>number of moles</u>	<u>simplest mole ratio</u>
C	48	$48\text{g}/12\text{gmol}^{-1} = 4\text{mol}$	$4\text{mol}/2\text{mol} = 2$
H	12	$12\text{g}/1\text{gmol}^{-1} = 12\text{mol}$	$12\text{mol}/2\text{mol} = 6$
O	32	$32\text{g}/16\text{gmol}^{-1} = 2\text{mol}$	$2\text{mol}/2\text{mol} = 1$

Ratio C: H: O = 2:6:1 which makes the empirical formula to be: $\text{C}_2\text{H}_6\text{O}$



-used as lubricating oils.

(any one of these)

6. a. shape of an object falling and mass of an object.
- b. (i) F_1 : upthrust
 F_2 : weight
- (ii) F_2 would be equal to F_1 at terminal velocity.
- c. It states that force acting on an object of constant mass is directly proportional to the product of its mass and the acceleration.
- d. (i) $U = 0\text{ms}^{-1}$, $V = 20\text{ms}^{-1}$, $t = 4\text{s}$,
$$a = \frac{V-U}{t} = \frac{(20-0)\text{ms}^{-2}}{4\text{s}} = 5\text{ms}^{-2}$$
- (ii) $F = ma = 200\text{kg} \times 5\text{ms}^{-2} = 1000\text{N}$

7. a. The following materials would be required: dropping bottles, bromine solution, testtubes,

Octane and Octene in separate beakers.

Procedure: - using 15 drops of bromine placed in two separate clean testtubes.

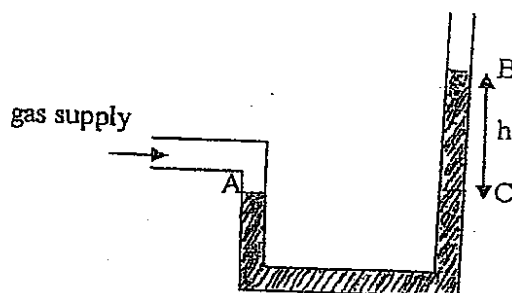
-to each testtube separately add 3 drops of test liquid (octane and Octene).

-observe the results in each testtube and record in the table.

If the liquid decolorizes the bromine solution from brown to colorless, then it contains a $\text{C}=\text{C}$ bond and it is an octene. But if the liquid under test does not change the color of bromine solution then it does not contain $\text{C}=\text{C}$ bond and it is an octane.

- b. Oxidation is loss of electrons while reduction is the gain of electrons.
- c. (i) Painting: This prevents direct contact of air and water with iron or steel.
- (ii) Galvanising: This involves dipping the Iron metal into molten zinc. When exposed to air and water, the thin layer of the more reactive zinc metal coating the iron object slowly corrodes and loses electrons to the iron, thereby protecting it. This process continues even when much of the layer of zinc has been scratched away, so the iron continues to be protected.
8. a. When heated the candle wax particles gain kinetic energy, hence they vibrate more and more. This increased vibration weakens the bonding (IMF) between the molecules. As such, the molecules move freely from the fixed position and they slide over each other.

- b. Using manometer to measure gas pressure

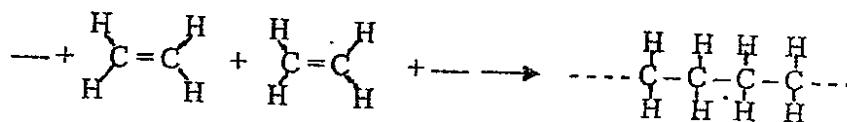


Each surface of the liquid is acted on equally by atmospheric pressure and the levels are the same. If one side of the tube is connected to the gas supply, the gas exerts a pressure on surface A and level B rises until the gas pressure is equal to the sum of atmospheric pressure and the pressure due to liquid column BC.

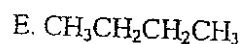
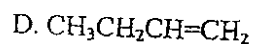
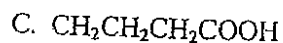
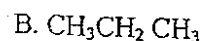
The pressure of the liquid column BC therefore equals the amount by which the gas pressure exceeds atmospheric pressure. This is equal to $10hd$ (in Pa) where h is the vertical height of BC (in m) and d is the density of the liquid (in kg/m^3).

2007 QUESTIONS

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



- (i) Name the polymerisation represented by the equation. (1 mark)
 - (ii) Describe how polymer is formed from ethene molecules. (3 marks)
 - (iii) Give two examples of artificial polymers. (2 marks)
- b. The following are formulac of some organic compounds:
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$



- (i) Identify one organic compound which is an alkanol. (1 mark)
- (ii) Which compounds belong to the same homologous series? (1 mark)
- (iii) Explain why a solution of compound C conducts electricity. (2marks)
- (iv) Draw a full structure of compound D. (1 mark)
- (v) Name the compound D. (1mark)
- c.
 - (i) Give three differences between thermosetting and thermoplastic polymers.
 - (ii) State two ways of disposing off plastics waste to avoid pollution. (2 marks)
 - (iii) Give three advantages of plastic materials over metallic materials. (3 marks)
2.
 - a. Give two factors that affect the frequency of a vibrating spring. (2marks)
 - b. Figure 1 is a diagram of a wave.

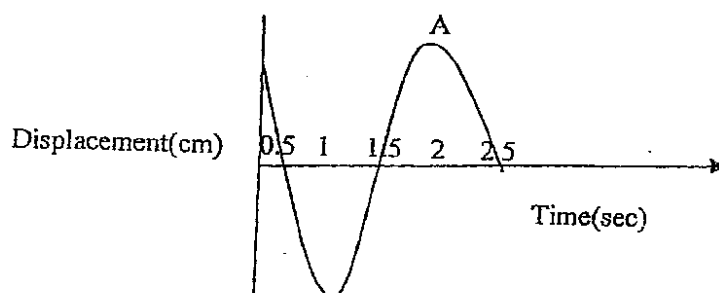


Figure 1

- (i) Name the part labelled A. (1mark)
- (ii) Calculate the frequency of the wave. (2marks)
- (iii) Calculate the velocity of the wave if its wave length is 50 m. (2marks)
- 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 is placed 15 cm away from a convex lens of focal length 10 cm.
- Using the lens formula, calculate the image distance. (4marks)
 - Calculate the magnification of the image. (2marks)
 - What is the nature of the image produced? (3marks)
3. a. Ammonia is an example of a strong base.
- What is a "strong base"? (1mark)
 - Write a chemical equation to show the ionisation of ammonia in water. (3marks)
 - Identify one conjugate acid- base pair from the equation in 3.a. (ii) (1mark)
- b. (i) Draw an energy level diagram for the following chemical reaction:
- $$\text{NaOH}_{(aq)} + \text{HCl}_{(aq)} \rightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)} \quad \Delta H = -57 \text{ kJ/mol}$$
- Is the reaction in 3.b.(i) endothermic or exothermic? (3marks)
 - Give a reason for the answer to 3.b.(ii) (1mark)
 - What is the meaning of (aq) and (l) in the equation? (2marks)
- c. A 300 mg tablet of a drug completely dissolved in 10 ml of water. The molecular formula of the drug is $\text{C}_9\text{H}_8\text{O}_4$
- Calculate the number of moles in the tablet. (RAM: C=12, H=1, and O=16) (4 marks)
 - Calculate the concentration of the solution in moles per litre. (4marks)
4. a. A current of 2A flows through an electric heater connected to a voltage supply of 240V. Calculate the:
- Resistance of the element. (4 marks)
 - Power dissipated by the heater. (2 marks)
 - Cost of running the heater for 3 hours if the cost of electrical energy is K5 per kWh. (4marks)
- b. (i) Give one advantage of alternate current over direct current. (1 mark)
- (ii) State any two causes of energy loss a transformer. (2 marks)
- (iii) How can each cause of energy loss mentioned in 4.b. (ii) be reduced? (2 marks)

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

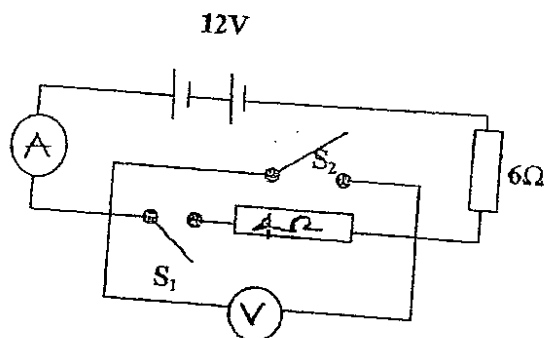


Figure 2

- (i) If S_1 is closed and S_2 is open, calculate the reading of the ammeter and voltmeter.
 Ammeter: (3 marks)
 Voltmeter (2 marks)
- (ii) What will be the effect on the voltmeter if both switches are closed? (1 mark)
- (iii) Give reason for the answer to 4.c. (ii) (1 mark)

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. (1 marks)
- (ii) Which two elements can form positive ions? (2 marks)
- (iii) Give a reason for the answer to 5.a.(ii) (2 marks)
- (iv) Give any three properties of element A (3 marks)

7. a. Draw full structures of ethanol (C_2H_5OH) and water (H_2O). (2 marks)
- b. Explain the difference in boiling points between ethanol and water. (5 marks)
- c. With the help of a labeled diagram, describe an experiment that can be done to separate a mixture of ethanol and water. (8 marks)
8. Describe the following radioactive processes: alpha decay, beta decay and gamma emission. In the description include atomic numbers, penetrating power, ionizing ability and behavior in magnetic and electric fields.
- Alpha decay: (5 marks)
- Beta decay: (6 marks)
- Gamma emission: (4 marks)

SOLUTIONS TO 2007 QUESTIONS

- I. a. (i) Addition polymerisation.
- (ii) This is formed when a number of ethene molecules break one of their double bonds and releasing free bonds which joins with each other to form long chain polymer (polythene).
- (iii) These includes:-polythene
- polyvinylchloride
 - polystyrene
 - perspex
 - nylon
 - polytetrafluoroethene
 - terylene
- (any two of these)
- b. (i) A
- (ii) E and B
- (iii) Because it can ionize in water hence ions are free to move.
- (iv) $C-C-C=C$
- (v) but-1-ene
- c. (i) Thermoplastics melt and flow when heated while thermosetting they do not

MWASE PRODUCTION (2011)

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melt (decompose).

Thermoplastics are flexible and stretches when bent while thermosetting are rigid

Thermoplastics can recycled while thermosetting cannot be recycled.

(ii) -recycling

-landfilling

-incineration (any two of these)

(iii) Plastics can be used as electrical or heat insulators than metals

Plastics do not corrode than metals

Plastic can easily be dyed while metals are not easily dyed.

Materials produced from plastics are lighter than those from metals which are heavier.
(any two of these)

2. a. These are : mass on end of the spring
material of the spring-force constant.

b. (i) crest

(ii) 0.5Hz

(iii) $V = f\lambda = \frac{0.5}{s} \times 50m = 25m/s$

c. (i) camera and an eye both use converging lenses.

both have light sensitive parts. An eye has a retina while a camera has film.

both inside surfaces are black

(ii) It allows light from an object to enter the camera.

d. (i) $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ Where $U=15cm$, $f = 10cm$, $V = ?$

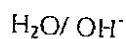
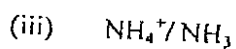
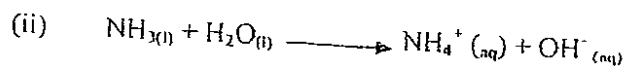
$$\frac{1}{10} - \frac{1}{15} = \frac{1}{v}$$

$$\frac{1}{v} = \frac{3-2}{30} = \frac{1}{30} \quad \text{Hence } V = 30cm$$

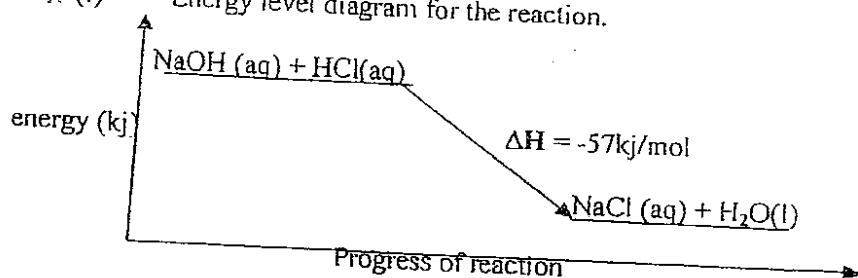
(ii) Magnification: $(M) = \frac{v}{u} = \frac{30cm}{15cm} = 2$

(iii) -real, magnified and inverted

3. a. (i) It is a substance that ionises in water to release OH^- ions



- b. (i) Energy level diagram for the reaction.



- (ii) exothermic reaction
 (iii) Because heat energy has been released and ΔH is negative
 (iv) (aq) means aqueous solution while (l) means liquid

c. (i) number of moles (n) = $\frac{\text{mass of a substance}}{\text{molar mass}} = \frac{\text{mass}}{M_r} = \frac{300\text{mg}}{180\text{g/mol}} = \frac{(300/1000)\text{g}}{180\text{g/mol}} = 0.00166\text{mol} = 0.0017\text{mol}$.

(ii) Concentration = $\frac{\text{number of moles}}{\text{volume of solution}} = \frac{n}{v} = \frac{0.00167\text{moles}}{0.01\text{l}} = 0.2\text{M}$

4. a. (i) $R = \frac{V}{I}$, where $V = 240\text{V}$, $I = 2\text{A}$

$R = \frac{240}{2} = 120\Omega$

(ii) $P = VI$ where $V = 240\text{V}$, $I = 2\text{A}$

$P = 240\text{V} \times 2\text{A} = 480\text{ Watts}$

(iii) time for running = 3hrs

cost of electrical energy: K5.00, Power in Kw = 0.48kW

total energy used = $0.48 \times 3 = 1.44\text{kwh}$

Total cost = $1.44\text{kwh} \times \text{K}5.00/\text{kwh} = \text{K}7.20$

- b. (i) Alternating current can be stepped up or down while direct current cannot be stepped up or down.

- (ii) -leakage of field lines.
-eddy current.
-resistance of the windings. (*any two of these*)
- (iii) - by winding the primary on top of the secondary and having a 'closed' iron core.
- Eddy currents are reduced by making the core from thin soft sheets which are insulated from each other so that their total resistance is high. A core made in this way is said to be **laminated (layered)**.
-the coils are made from thick wires and large transformers are oil-cooled to prevent overheating.

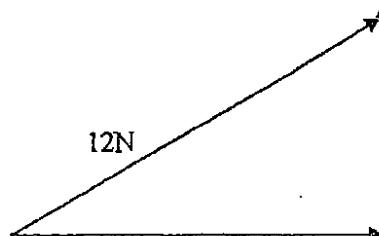
- c. (i) the ammeter reading will be 1.2A. this is found by:
total resistance in series = $4+6 = 10\Omega$
total voltage in series = 12v
 $I = \frac{V}{R} = \frac{12}{10} = 1.2A$
Voltmeter reading = $I \times R = 1.2A \times 4\Omega = 4.8V$
- (ii) The voltmeter reading will be lowest (zero).
 - (iii) It is a short circuit; hence no/little current is passing through 4Ω resistor.

5. a. (i) It is F
(ii) Elements C and D.
(iii) Both they can easily lose their two outermost electrons that require less energy than gaining six electrons to become stable.
(iv) -Has very low density.
-gas at room temperature.
-Low melting and boiling points.
-Cannot conduct electricity and heat.
-Chemically inert (*any three of these*)
- b. (i) From point A to B the car is moving with constant acceleration.
From B to C the car is moving with constant deceleration.
From C to D the car is at steady speed.
- (ii) Total distance = area under the graph = area of trapezium

$$= \left(\frac{U+V}{2}\right) \times t = \left(\frac{25+75}{2}\right) \times 40$$

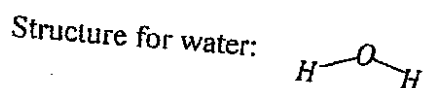
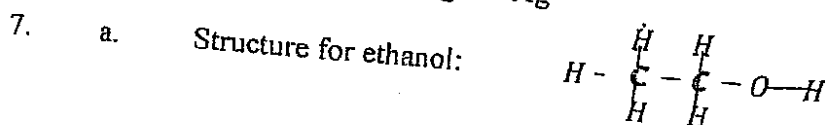
$$= 2000m$$

- c. (i) Completion of horizontal line which is perpendicular to vertical line

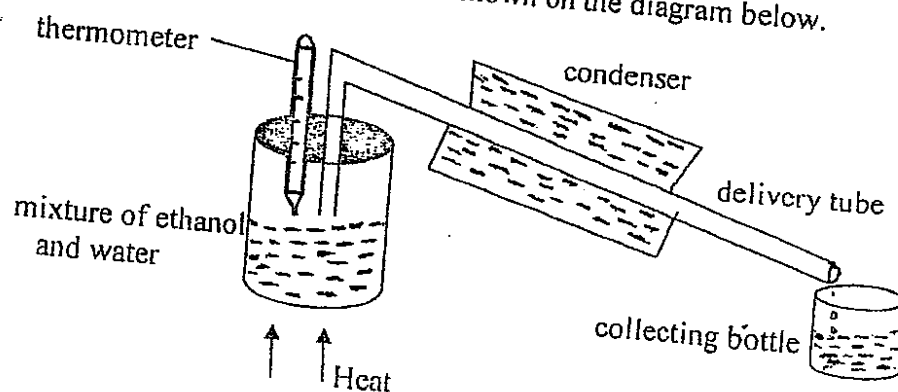


- (ii) horizontal component = 5.1cm, using scale: 1cm to 2N
 $= 5.1 \times 2 = 10.2N$

6. a. - pressure in a liquid increases with depth.
 - a liquid find its own level.
 - pressure at one level (depth) acts equally in all directions. (any two of these)
 - pressure depends on the density of the liquid.
 b. pressure of water at the bottom = dgh , where $h = 20\text{cm}/100 = 0.2\text{m}$
 $d = 1000\text{kg/m}^3$
 $g = 10\text{m/s}^2$
 $p = 0.2 \times 10 \times 1000 = 2000\text{Pa}$
 c. The devices include: - hydraulic brakes/hydraulic jack
 - hydraulic press
 - hydraulic fork lifts,
 - hydraulic steering wheels. (any two of these)
 d. (i) Absolute temperature is a temperature measured with respect to absolute zero on the Kelvin scale.
 (ii) Degrees Celsius = $K - 273.15 = 546 - 273 = 272.85^\circ\text{C}$
 e. (i) Magnesium (Mg)
 Aluminium (Al)
 (ii) they are higher in the reactivity series hence more reactive than zinc.
 f. (i) $\text{Mg}_{(s)} + 2\text{AgNO}_{3(aq)} \longrightarrow \text{Mg(NO}_3)_2 + 2\text{Ag}_{(s)}$
 (ii) Reducing agent: Mg
 Oxidizing agent: Ag^+



- b. The boiling point of water is higher than that of ethanol because of the ratio of OH group. The -OH group is responsible for hydrogen bonding in both, but it is greater in water than in ethanol. This hydrogen bonding makes IMF to increase.
- c. With a help of diagram to separate the mixture of ethanol and water.
 Materials: gauze wire, source of heat, tripod stand, thermometer, collecting bottles, flask, condenser.
 Procedure: set up the apparatus as shown on the diagram below.



Heat the mixture of water and ethanol. Using a thermometer note the temperature at which the mixture boils. At 78°C the ethanol will vaporize and be collected in the collecting bottle. What will be remaining in the boiling tube will be water.

8. An alpha particle is a helium nucleus represented by ${}^4_2\text{He}$ (α). It has atomic number of 2 and a charge of +2. This particle has a slight penetration power in substances such that it can only be stopped by a thick sheet of paper. With a charge of +2, it can ionise air particles, as such it has greater ionising power. Finally it is deflected in the magnetic field due to its charge.

Beta particle is represented by ${}^0_{-1}\text{e}$ (β). When released, these are of high energy electrons which are negatively charged and substance reduces its atomic number by one. They have greater penetration power to such extent that can be stopped by few millimeters thick of aluminium. They cause little ionisation of air as compared to the alpha particles. Since they are charged, they are deflected in both the magnetic field and electric field.

Gamma particle is represented by symbol γ . The gamma rays have no mass and carry no charge. As such, they are the most penetrating. They can penetrate as far as 30cm thick of lead. Since have no charge they cannot be deflected within magnetic and electric field. They cannot ionise air around it.

2006 QUESTIONS

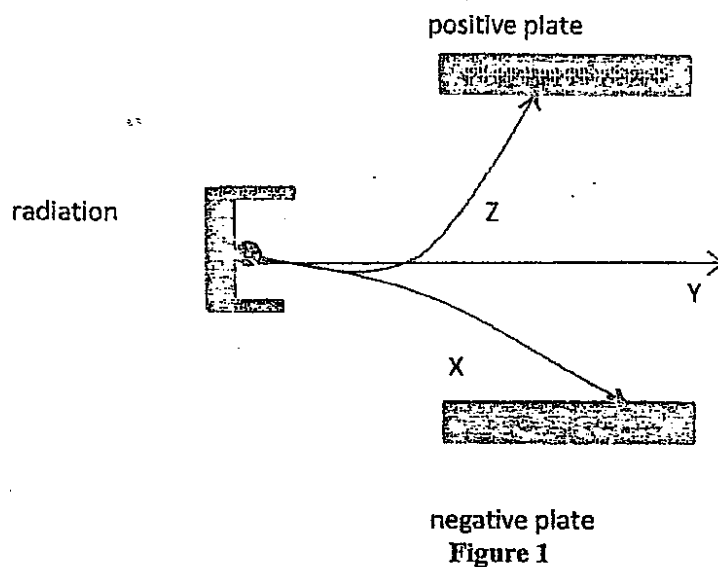
1. a. Given below are the general formulae some homologous series represented by letters P, Q, R and S.
- P: C_nH_{2n}
 Q: $\text{C}_n\text{H}_{2n+2}$
 R: $\text{C}_n\text{H}_{2n+1}\text{OH}$
 S: $\text{C}_n\text{H}_{2n+1}\text{COOH}$
- Name the homologous series represented by letters Q and S. (2marks)
 - Which general formulae represent hydrocarbons? (2marks)
 - Draw the structure of a compound with three carbon atoms in homologous series P. (2marks)
 - Name the compound drawn in 1.a. (iii). (1mark)
 - Explain how a compound of homologous series Q could be distinguished from a compound of homologous series R. (3marks)
- b.
 - Write down all structural isomers of pentane. (3marks)
 - Name the isomers in 1.b(i) (3marks)

- c. Ethene (C_2H_4) reacts with bromine (Br_2) in an addition reaction.
- Draw the structure of the product formed. (1mark)
 - Name the product formed in 1.c.(i). (1mark)
 - Why are addition reactions important in industries? Give two reasons.(2marks)
2. a. Halogens such as bromine (Br_2), Chlorine (Cl_2), and Iodine (I_2) can be prepared by reacting an alkali metal salt with concentrated sulphuric acid in the presence of a catalyst. Name any salt from which each of the following can be prepared.
- Br_2 (1mark)
 - Cl_2 (1mark)
 - I_2 (1mark)
- 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 $^{127}_{53}I$, $^{35.5}_{17}Cl$, $^{80}_{35}Br$ 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 sulphur is more stable than monoclinic sulphur. (4marks)
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.

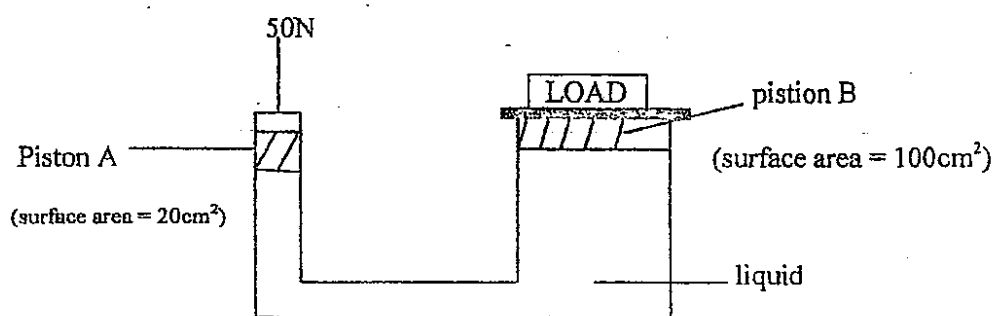
SAMPLE	EFFECT ON GOLD LEAF ELECTROSCOPE	EFFECT ON CARD BOARD OF SAMPLE
A	No effect	Sample passes through
B	Discharged	Sample blocked

- Identify particles emitted by samples A and B. (2marks)
- 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.



- (i) Name the particles taking paths X, Y and Z. (3marks)
 - (ii) Explain why particles Z will deflect towards the positive plate. (3marks)
- e. At atmospheric pressure a mercury barometer reads 0.76 m. if one atmosphere equals to 101000 Pa, calculate the density of mercury. (3marks)
- f. Figure 2 is a diagram showing a hydraulic machine being used to raise a load. A force of 50N is applied on piston A.



- (i) Calculate the pressure piston A on the liquid. (2marks)
- (ii) How much pressure does the liquid exert on piston B? (1 mark)

4. a. Figure 3 is a circuit diagram.

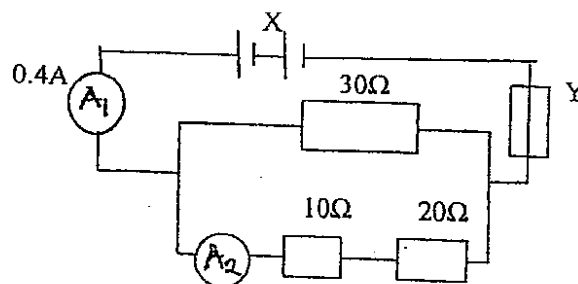


Figure 3

- (i) Name the components labeled X and Y. (2 marks)
 - (ii) Calculate the total resistance in the circuit. (5 marks)
 - (iii) Calculate the current in the 30Ω resistor. (2 marks)
 - (iv) Work out the voltage across the 10Ω resistor. (2 marks)
- b. (i) Define kilowatt-hour. (2 marks)
- (ii) The power rating of a television is 150 W. How much power in kilowatt-hours will it use if it is on for 10 hours? (3 marks)
- (iii) If the cost of power is k5.00 per kilowatt-hour, what will be the cost of the television in 4.d. (ii) for 10 hours per day for 2 days? (4 marks)
5. a. (i) Name the ion responsible for the acidic properties of a substance. (1 mark)
- (ii) Why is carbonic acid a weak acid while hydrochloric acid a strong acid? (2 marks)
- b. Calculate the volume of 0.1 M sodium hydroxide that is needed to neutralize 20cm^3 of 0.1 M hydrochloric acid. (3 marks)
- c. (i) What does the symbol $\rightleftharpoons$ mean in a chemical equation? (1 mark)
- (ii) Complete the following chemical equations:
1. $\text{HSO}_4^-(\text{aq}) + \text{_____} \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{_____}(\text{aq})$ (2 marks)
 2. $\text{H}_3\text{PO}_4(\text{aq}) + \text{NH}_3(\text{l}) \rightleftharpoons \text{_____} + \text{H}_2\text{PO}_4^-(\text{aq})$ (2 marks)

- d. The following is part of an activity series.

Sodium	↑ increasing reactivity
Lithium	
Magnesium	
Lead	
Hydrogen	
Copper	

- (i) State whether (Cu) will react with a solution of magnesium sulphate (MgSO_4). (1mark)
- (ii) Explain the answer to 5.d.(i). (2 marks)
- (iii) Which element is the most electropositive in the reactivity series?(1 mark)
- (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)
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)
- c. Figure 4 is a diagram showing waves on a rope xy.

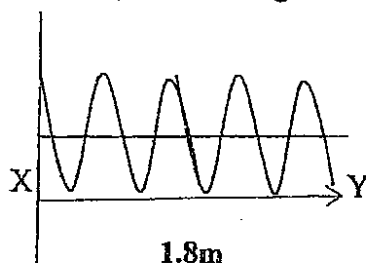


Figure 4

- (i) Calculate the wavelength. (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 waves approaching two slits S_1 and S_2 in an obstacle.

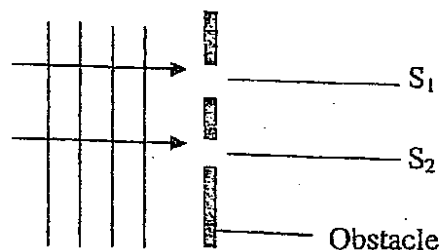
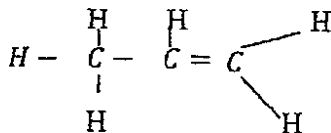


Figure 5

- (i) Complete the diagram to show waves emerging on the other side of the obstacle. (3marks)
 - (ii) State two properties of wave that are being demonstrated in the completed diagram. (2marks)
 - (iii) What would happen to the waves emerging on the other side of the obstacle if the width of S_1 and S_2 were increased? (1mark)
7. a. Describe how the thickness of a sheet of plastic could be controlled using radiation during manufacture. (5marks)
 - b. Explain, with the help of diagrams, the difference between constructive interference and destructive interference. (10marks)
 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)
 - b. Derive a formula to show that the pressure of a liquid depends on its density and depth. (7marks)

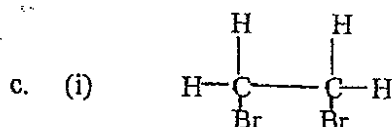
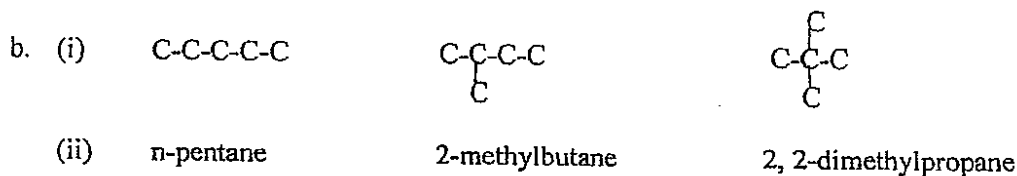
SOLUTIONS TO 2006 QUESTIONS

1. a. (i) Q = alkanes
S = carboxylic acids
- (ii) P and Q
- (iii)



- (iv) propene

- (v) Either by using solubility test. R with smaller number of carbon atoms dissolves in water while P does not dissolve. Or by using sodium metal which reacts with R while P does not react with sodium.

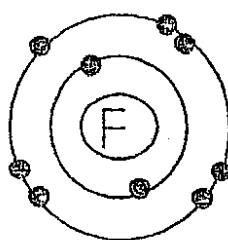


- (ii) 1, 2-dibromoethane.
 (iii) used in manufacturing of ethanol for industrial purposes.
 used in production of plastic pipes.
 also sometimes help in production of alkanes. *(any two of these)*

2. a. (i) These are : KBr or NaBr
 (ii) These are : LiCl or KCl
 (iii) These are: KI or LiI

- b. -These elements are coloured and darker going down the group
 -They exist as diatomic molecules, for example Cl_2 , Br_2 and I_2
 -They show a gradual change from a gas (Cl_2), through a liquid (Br_2), to a solid (I_2).
 -They form molecular compounds with other non metallic elements, for example HCl.
 -They react with hydrogen to produce hydrogen halides.
 -They react with metals to produce ionic metal halides.
 -Reactivity increases as we move up the group. *(any two of these)*

- c. Electronic shell for Flourine atom



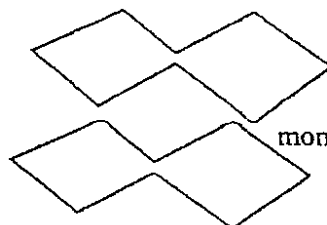
- d. The order is: I, Br and Cl
- e. Chlorine is the most reactive element of them all. This is because it has the smallest atomic radius which makes it easy for the incoming electron to be attracted due to greater attractive force between the nucleus and the outermost shell. While Iodine is the least reactive because of weaker attractive force between the nucleus and the outermost shell since the radius is bigger. This makes it difficult to attract an incoming electron. Finally Bromine lies between the two elements.

- f. -Sulphur reacts with oxygen to form sulphur oxide (SO_2)
 -Sulphur reacts with hydrogen to form hydrogen sulphide (H_2S)
 -It also reacts with metals to form metal sulphides eg $\text{Mg} + \text{S} \rightarrow \text{MgS}$
(any one of these)

g.



rhombic sulphur



monoclinic sulphur

using the diagrams shown above, rhombic sulphur has molecules that are closely packed as such they are more stable and difficult to separate while monoclinic sulphur molecules are spacially packed making it easy to separate, hence very unstable.

3. a. It is the splitting of a heavy nucleus into lighter nuclei and in process releasing energy.
 b. These are: protons and neutrons.
 c. (i) A: gamma rays
 B: alpha particles
 (ii) Because it is more massive and big.
 d. (i) X= alpha particle
 Y= gamma rays
 Z= beta particles
 (ii) Since it is negatively charged, unlike charges attract and it will be attracted towards the positive plate

- e. density of mercury, $d = p/hg$

where $p = 10100\text{Pa}$, $g = 10\text{ms}^{-2}$ and $h = 0.76\text{m}$

$$d = \frac{101000\text{Pa}}{0.76\text{m} \times 10\text{ms}^{-2}} = 13289.5\text{kgm}^{-3}$$

- f. (i) Force (F) = 50N, Area (A) = 20cm²

$$p = \frac{\text{force}}{\text{Area}} = \frac{50\text{N}}{20\text{cm}^2} = 2.5\text{N/cm}^2$$

- (ii) 2.5N/cm² (pressure on piston A = pressure on piston B because pressure is transmitted through the liquid).

4. a. (i) X = battery, Y = fuse
 (ii) Calculating the total resistance: $(10 + 20) \Omega = 30 \Omega$ (in series)

$$R_T = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{30} + \frac{1}{30} \text{ (in parallel)}$$

$$R_T = \frac{2}{30} = \frac{1}{15}$$

$$R_T = 15 \Omega$$
 (iii) Current in the 30Ω resistor = $0.4A/2$ (two equal resistors in parallel have same values)

$$= 0.2A$$
 (iv) Voltage across 10Ω resistor = $V = IR$

$$= 0.2A \times 10 \Omega$$

$$= 2.0V$$
- b. (i) Is the amount of electrical energy used by a 1 kilowatt appliance in 1 hour.
 (ii) Power = $150W/1000 = 0.15KW$, time = 10hrs

$$\text{Total energy used} = Pt = 0.15KW \times 10 \text{ hrs} = 1.5KWhrs$$
 (iii) Total time = $2 \times 10hrs = 20hrs$, Power = $0.15KW$

$$\text{Total energy used} = Pt = 0.15KW \times 20hrs = 3.0kwh$$

$$\text{Cost of energy} = 3.0kwh \times K5.00 = K15.00$$
5. a. (i) hydrogen ion.
 (ii) It releases few hydrogen ions when dissolved in water as compared to hydrochloric acids.
- b. $C_1V_1 = C_2V_2$

$$V_2 = (C_1V_1)/C_2 = (20cm^3 \times 0.1M)/0.1M = 20cm^3$$
- c. (i) means reversible reaction.
 (ii) 1. $HSO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_4^{2-}(aq)$
 2. $H_3PO_4(aq) + NH_3(l) \rightleftharpoons NH_4^+(aq) + H_2PO_4^-(aq)$
- d. (i) Copper will not react with magnesium sulphate solution.
 (ii) Copper is below magnesium in the reactivity series, hence less reactive.
 (iii) Sodium (Na)



- b. Deriving a formula to show that liquid pressure depends on density and depth.
 $d = \frac{m}{v}$, where d = density, m = mass and v = volume, therefore
 $m = dv$
 $F = mg$, where F = force, g = acceleration due to gravity
 Substituting $F = dvg$
 But $v = hA$, where h = height and A = area
 Substituting $F = dhAg$
 But pressure $P = \frac{F}{A} = \frac{dhAg}{A}$
 Therefore $P = dhg$. hence pressure depends on depth and density of the liquid.

2005 QUESTIONS

1. a. (i) Define the term diffusion. (2marks)
 (ii) In which state of matter does diffusion occur more quickly? (1mark)
 (iii) Give a reason for your answer to 1 a(ii) (2marks)
- b. Figure 1 is a diagram of a sealed glass tube containing two balls of cotton wool, one soaked in concentrated hydrochloric acid solution and the other in concentrated ammonia solution. Gases from the solution diffuse along the tube and a white cloud form where they meet.

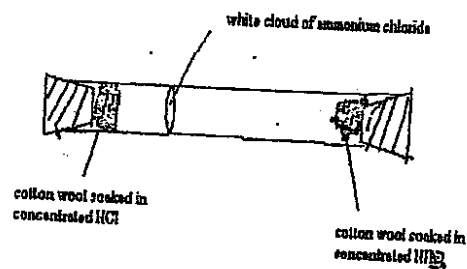


Figure 1

- (i) Which of the two gases is lighter? (1mark)
 (ii) Give a reason for your answer to b(i) (2marks)
 (iii) When the experiment is done on a sunny day, it takes a shorter time for the white cloud to form. Give a reason. (2marks)

- c. The volume of air in a container is 6 m^3 and has a pressure of 4 atmospheres (atm) when the temperature is 27°C . Calculate its pressure when the volume is reduced to 3 m^3 and its temperature raised to 177°C (4marks)
- d. Figure 2 is a diagram of a compass needle placed under a connecting wire.

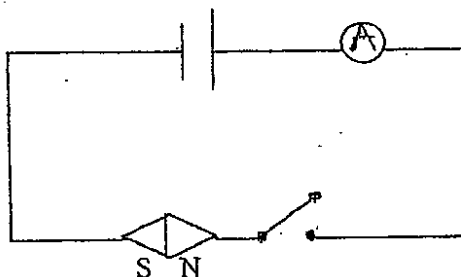


Figure 2

- (i) Draw arrows on the diagram to show, when the switch is closed, the direction of movement of:
- (1) The compass needle. (2marks)
 - (2) The current.
- (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 (1mark)
- e. Mention two devices which use electromagnets. (2marks)

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 $^{28}_{14}\text{X}$;
- (i) To which group of the periodic table does element X belong? Give a reason. (2marks)
 - (ii) Identify element X in the periodic table. (1mark)
- c.
- (i) Write the chemical formula of the compound formed between Al and O. (1mark)
 - (ii) What type of bonding exists between Al and O atoms in the compound formed in c (i)? Give a reason. (2marks)
- d. Define the term allotropes. (1mark)
- e. State two allotropes of sulphur. (2marks)

- f. Give the halogen used for:
- (i) Sterilizing drinking water. (1mark)
 - (ii) Photography (1mark)

Table 2

ELEMENT	ATOMIC NUMBER	MELTING POINT (°C)	BOILING POINTS (°C)
Chlorine	17	-101	-35
Bromine	35	-7	59
Iodine	53	114	184

- g.
- (i) Explain the increase of melting and boiling points from chlorine to iodine. (3marks)
 - (ii) What would happen if a solution of iodine was mixed with an aqueous solution of potassium bromide? Give a reason. (3marks)

3.

- a. Define acid according to Lowry- Bronsted theory. (1mark)
- b. In a titration, 20cm³ of hydrogen chloride solution reacted completely with 25cm³ of 0.2M sodium hydroxide 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. (2marks)
 - (iv) Calculate the concentration of the acid. (4marks)

4.

- a. Forces of 40N and 50N are acting at right angles. Draw a scale to find the resultant force. (use a scale of 1 cm to represent 10N). (5marks)
- b. Figure 3 is a diagram showing of a set up used in an experiment that was carried out to investigate how a feather and a metal would fall in a vacuum.

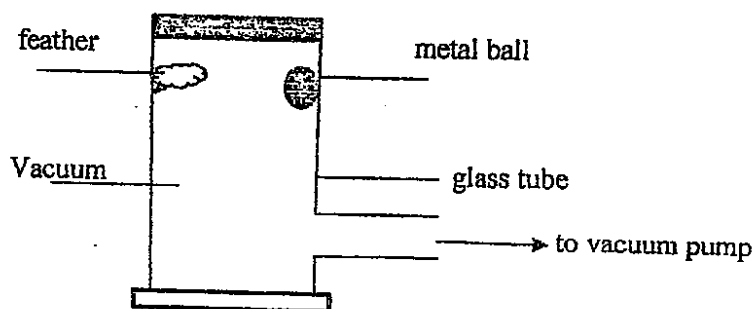


Figure 3

- (i) Name the resultant force acting on the ball. (1mark)
- (ii) State the direction of the resultant force in d (i). (2marks)

- (iii) If the feather and the metal ball were allowed to fall at the same time, draw in the diagram to show the positions of both the feather and the metal ball before they reach the bottom of the tube. (1mark)
- (iv) Explain your answer to 4b (iii) above. (2marks)
- 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)
- d. Figure 4 is a diagram showing the nuclei of two atoms.
- e.

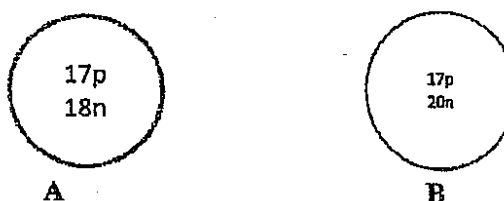


Figure 4

- (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 would each belong? (1mrk)
- (iv) Explain the answer to d(iii) (1mark)
5. a. Figure 5 is a diagram showing how ethanol and ethanoic acid are produced.

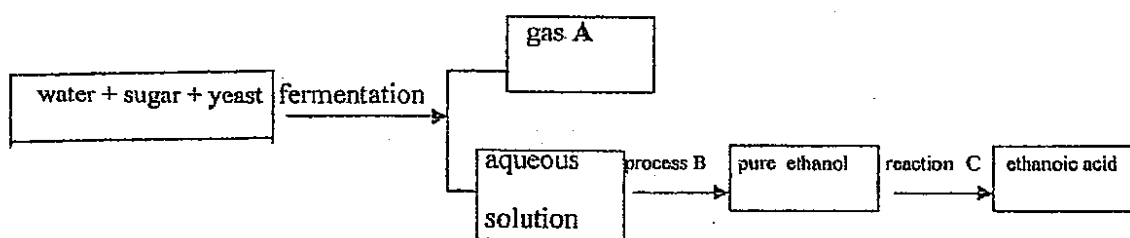
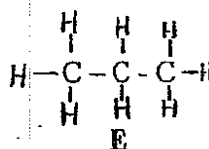
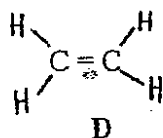
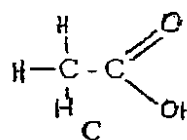
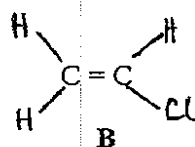
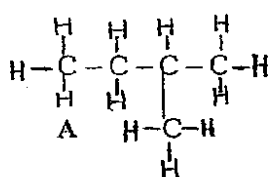


Figure 5

- (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 5a (ii) (1mark)

b. The following are structures of some organic compounds.



- (i) Name compound A
- (ii) Which compound is soluble in water? Give a reason
- (iii) Write letters representing three compounds that would not react with potassium, a group 1 metal element
- (iv) Which one of the compounds A and E would have a lower boiling point? Give a reason.
- (v) Compound B is a monomer. Write an equation to show its polymerization.
- (vi) Give the name of the kind of polymerization in 5 b(v).
- (vii) Give one use of the substance formed in the polymerization of compound B
- (viii) What is the state of D at room temperature?
- (ix) Describe a test that could be done to distinguish the compounds D and E
- (x) Write the other isomers of substance A

c. Give two advantages of thermoplastics

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

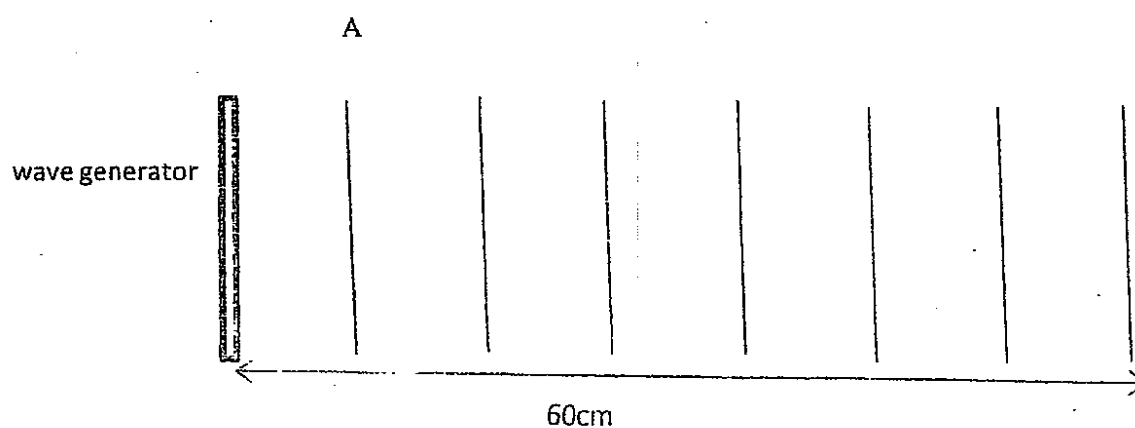


Figure 6

- a. What kinds of waves are represented by the crests? (1mark)
- 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 wavelength if the waves moved from deep water to shallow water? (1mark)
- f. Explain answer to 6(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)

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 electro plating of the nail in (a). Support the explanation with relevant chemical equations. (11marks)

8.

- a. 6 KW of power is fed to a transmission cable of resistance 3 ohm. Calculate the power wasted in the cable if power is transmitted at 300V. (4marks)
- b. Describe an experiment that could be done to find out if electrical resistance of a wire varies directly proportional to its length. (11marks)

SOLUTIONS TO 2005 QUESTIONS

1.
 - a.
 - (i) movement of particles from a region of high concentration to the region of low concentration.
 - (ii) gaseous state diffuses faster.
 - (iv) due to larger spaces and weak IMF between gas particles, this makes it easier to diffuse faster.
 - b.
 - (i) ammonia gas.
 - (ii) it has moved longer distance in the tube than hydrochloric acid particles, hence ammonia is lighter than hydrochloric acid.



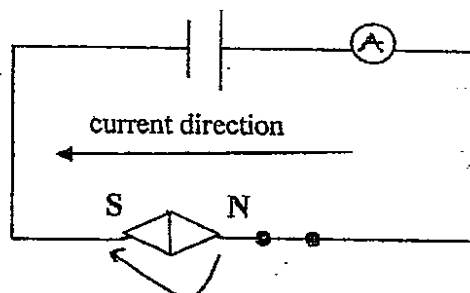
- (iii) During sunny day, the temperature becomes high and this makes the particles to gain kinetic energy hence move faster making the reaction (cloud formation) between the reactants to speed up.

c. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$, where $P_1 = 4 \text{ atm}$, $V_1 = 6 \text{ m}^3$, $T_1 = 27 + 273.15 = 300.15 \text{ K}$, $V_2 = 3 \text{ m}^3$,
 $T_2 = 177 + 273.15 = 450.15 \text{ K}$, $P_2 = ?$

$$P_2 = \frac{P_1 V_1 T_2}{T_1 V_2} = \frac{4 \text{ atm} \times 6 \text{ m}^3 \times 450.15 \text{ K}}{300.15 \text{ K} \times 3 \text{ m}^3}$$

$$P_2 = 12 \text{ atm}$$

d. (i)

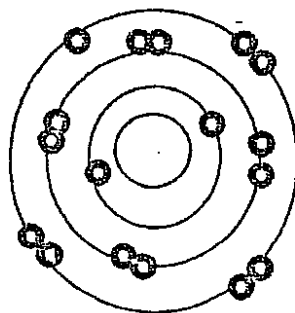


(ii) 1. the direction of the compass needle will also reverse.

2. no effect

- e. The devices includes: electric bell, relay switch, flood alarms, carbon microphone, circuit breakers and telephone ear piece. *(any two of these)*

2. a. atomic structure of Cl



b. (i) It belongs to group 4, because has 4 electrons in the outermost shell.

(ii) It is Si

c. (i) Al_2O_3

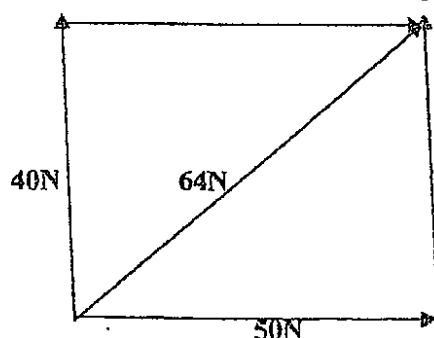
(ii) It is an ionic (electrovalent) bond because it involves a metallic element and non-metallic element.

- d. Allotropes are different structural forms of the same element having the same physical state.
- e. These are: **rhombic** and **monoclinic** sulphur.
- f. (i) sterilizing drinking water – **Chlorine**
 (ii) Photography – **Iodine**
- g. (i) When moving down the group, atomic size increases similarly the atomic charges increases. An increase in charges increases the intermolecular forces such that it becomes difficult to separate, making the melting and boiling point to increase.
 (ii) No reaction would take place, because bromine is more reactive than Iodine, so bromine cannot be displaced from its solution.

3. a. An acid is a proton donor.
- b. (i) phenolphthalein solution is used as an indicator for an end point of the reaction.
 (ii) Sodium hydroxide. Its concentration is known (0.2M).
 (iii) $\text{NaOH}_{(aq)} + \text{HCl}_{(aq)} \longrightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)}$
 (v) $\frac{C_1 V_1}{n_1} = \frac{C_2 V_2}{n_2}$, where C_1 = concentration of an acid, V_1 = volume of an acid, n_1 = number of moles of an acid given by coefficient, C_2 = concentration of a base, V_2 = volume of a base.

$$C_1 = \frac{1 \times 0.2M \times 25\text{cm}^3}{1 \times 20\text{cm}^3} = 0.25M$$

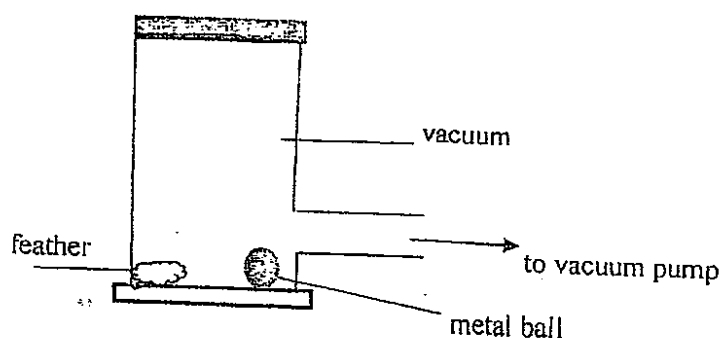
4. a. Scale: 1cm to 10N



The resultant force = 6.4cm x 10N = 64N

- b. (i) Weight
 (ii) It is downwards

(iii)



(vi) Because the acceleration due to gravity is the same and there is no any resistance force acting on both objects.

- c. (i) Original mass, $A_0 = 20g$
Number of half lives $= (12/3) = 4$
Final mass after decay $= A_n = ?$

$$\frac{A_0}{A_n} = 2^4$$

$$A_n = \frac{20}{16} = 1.25g$$

(ii) Radioisotopes of short half lives are preferred as tracers so as not to cause hazards if it collects somewhere.

(iii) It is used to produce heat for the production of electricity. Nuclear power stations use uranium in fission reactions as a fuel to produce energy. Steam is generated by the heat released during the fission process.

d. (i) This is because they are atoms of the same element, as such have the same number of electrons (7) in their outermost shell which in this case determines their reactivity.

(ii) Isotopes

(iii) period 3

(iv) Because they have three shells.

5. a. (i) 1. CO_2

2. distillation process.

3. it is oxidation process.

(ii) potassium permanganate.

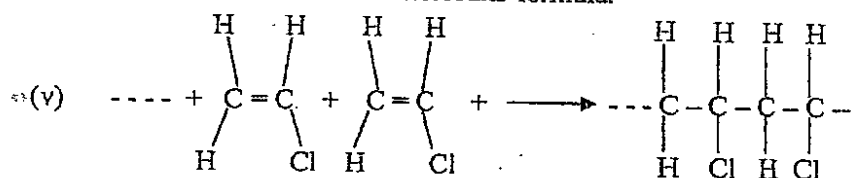
(iii) as an oxidizing agent.

b. (i) It is 2-methylbutane

(ii) C; because it is a polar molecule. (Presence of -OH group).

(iii) A, D and E

(iv) E, because it has smaller molecular formula.



(vi) Addition polymerisation

(vii) Making of PVC pipes

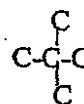
(viii) Gas

(ix) Using bromine test. Add some few drops of bromine solution to both E and D. D will change the colour of bromine while E will not change.

(x) Isomers of A



n-butane



2, 2-dimethylpropane

c. -Thermoplastics are easily moulded or formed into useful articles.

-they are flexible

-thermoplastics can be coloured.

(any two of these)

6. a. it is a transverse wave

b. distance = 60 = $\lambda = \frac{60\text{cm}}{5} = 12\text{cm}$

c. frequency = number of cycles/unit time = $\frac{4\text{cycles}}{1\text{s}} = 4\text{Hz}$

d. velocity = $f\lambda = 4\text{Hz} \times 0.12\text{m} = 0.48\text{m/s}$

e. The wavelength decreases when moving from deep to shallow water.

f. Water waves travel more slowly if they enter shallower water. When the waves enter the shallower water there is no change in their frequency (as this depends only on the frequency of the source/vibrator). The reduction in speed does however cause a reduction in wavelength.

g. Constructive interference occurs when crests of two waves meet each other to form a bigger crest or when similar troughs meet to form bigger trough.

h. - longitudinal waves produces rarefactions and compressions while transverse waves produce trough and crests.

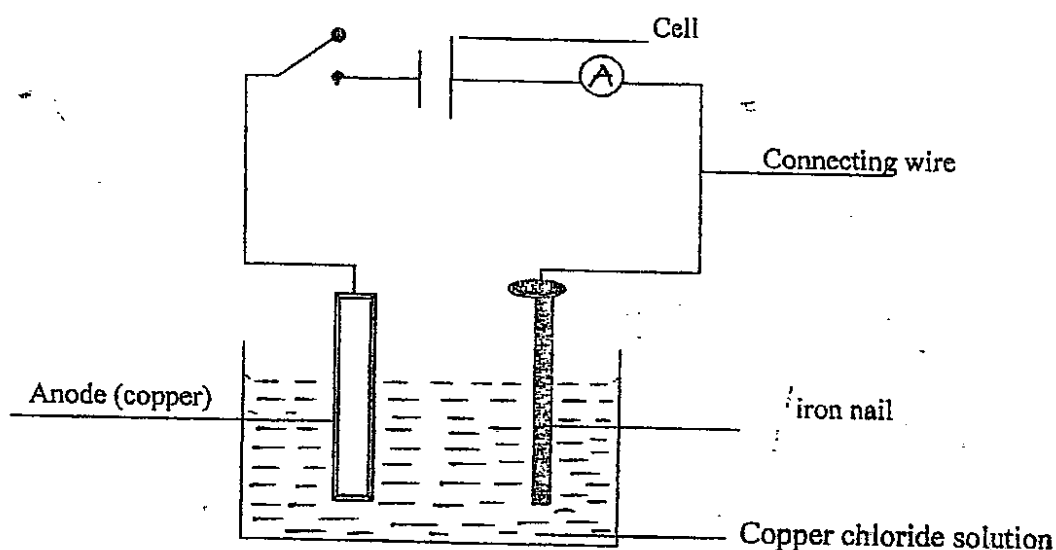
-In transverse, the disturbances causing the wave moves perpendicular to the direction of the wave while in longitudinal waves, the disturbances causing the wave move parallel to the direction of the wave.

-transverse wave can be transmitted though the vacuum while longitudinal wave that cannot be transmitted through the vacuum. *(any one of these)*

i. -- It is a transverse wave.

7.

a.



b. The following materials will be necessary for electroplating of an iron nail: cells, cell holders, beakers, nail, switch, connecting wires, anode made of copper metal and copper chloride solution.

Set up the apparatus as shown on the diagram above.

The metal to be coated is made to be the cathode .e.g. nail and the metal to be used in coating is copper (anode). The electrolyte used is copper chloride.

When the switch is closed, current starts flowing in the circuit .The cathode becomes negatively charged thereby attracting the positively charged copper ions from the solution. This results into gaining of electrons and coating the cathode (nail) according to the equation: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$.

At the anode, the chloride ions in solution lose electrons to the anode and are oxidize according to the equation shown.

$2\text{Cl}^-_{(\text{aq})} \longrightarrow \text{Cl}_2 + 2\text{e}^-$. This will result in chlorine gas coming out of the solution.

8. a. Power wasted in the cable, $P = I^2 R$

current passing through the cable, $I = P/V$

$$I = \frac{P}{V} = \frac{6000W}{300V} = 20A$$

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

$$= 400 \times 3$$

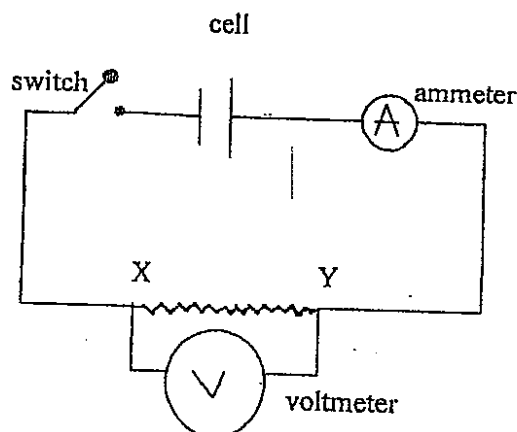
$$\text{Power wasted in the cable} = 1200W$$

- b. Effects of length on resistance.

The following materials would be required to carry out an experiment.

nichrome wire of different length (100,80,60,40,20)cm,ammeter,voltmeter,connecting wires cells, cell holders ,1 meter ruler.

Set up a circuit as shown in the fig below.



Measure the 100cm nichrome wire and connect at the gap XY. Close the switch and note the ammeter and voltmeter readings. Record the results in the table.

Repeat the same procedure but now using different length (80cm, 60cm, 40cm and 20cm) and record the results.

Then calculate the resistance by using the formula, $R = \frac{\text{Voltage}}{\text{Current}}$. Note the relationship between the resistance and the length of the conductor.

If the resistance changes when the length changes, then it means the length has an effect on the resistance.

