Name _____ Index No. _____

2601/102
2602/102
2603/102
PHYSICAL SCIENCE, MECHANICAL SCIENCE AND ELECTRICAL ENGINEERING PRINCIPLES
June/July 2014
Time: 3 hours

Candidate's Signature _____

Date _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING
(POWER OPTION)
(TELECOMMUNICATION OPTION)
(INSTRUMENTATION OPTION)
MODULE I

PHYSICAL SCIENCE, MECHANICAL SCIENCE
AND ELECTRICAL ENGINEERING PRINCIPLES

3 hours

FRUCTIONS TO CANDIDATES

e your name and index number in the spaces provided above.
and write the date of the examination in the spaces provided above.
should have mathematical tables/scientific calculator for this examination.
$U^0 = 2\pi \times 10^{-7}$ H/m and $\varepsilon^0 = 8.85 \times 10^{-12}$ F/m
paper consists of EIGHT questions in THREE sections; A, B and C.
wer TWO questions from Section A and ONE question from Section B and TWO questions from ion C in the spaces provided in this question paper.
uestions carry equal marks.
imum marks for each part of a question are as shown.
NOT remove any pages from this booklet.
Candidates should answer the questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	8	TOTAL SCORE
Candidate's Score									

This paper consists of 20 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Turn over

24

SECTION A: PHYSICAL SCIENCE

*Answer **TWO** questions from this Section.*

1. An aqueous solution of zinc sulphate is electrolysed using platinum electrodes as shown in the setup of Figure 1.

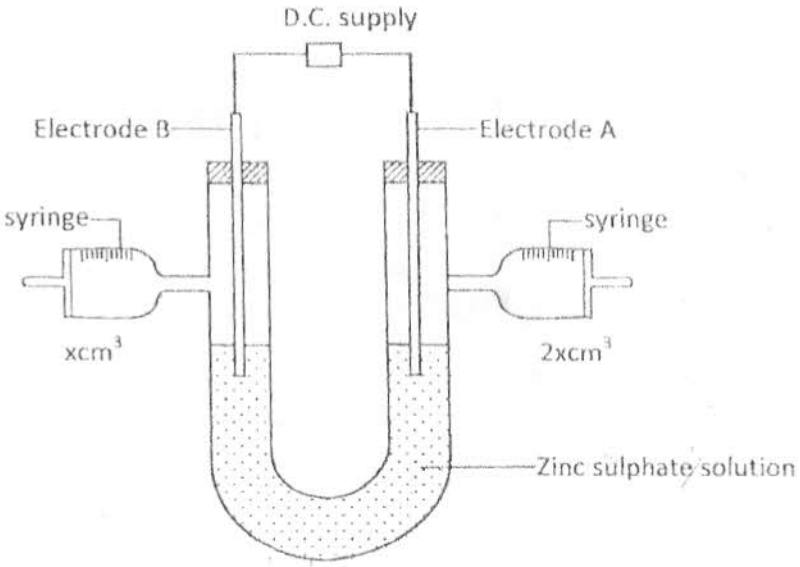

Fig. 1

(a) (i) write an ionic equation for the reaction taking place at electrode A;

(ii) identify electrode B;

(iii) explain the observations at the electrode B if a copper plate was used instead of platinum electrode;

(iv) draw one set of apparatus that would be used instead of the graduated syringe. (6 marks)

(b) 0.22 g of metal P are deposited by electrolysis when a current of 0.06 amperes flows for 99 minutes (P = 184, F = 96,500 C). Determine:

(i) the number of moles of electrons passed;

(ii) the number of moles of metal P deposited. (6 marks)

(c) Figure 2 below shows the arrangements of apparatus that could be used to prepare ethene gas:

(i) name the reagent A end state its two functions in this reaction;

(ii) explain why sand granules are put in the reaction flask;

(iii) name the alkali used in flask K and state its function;

(iv) explain why it is preferable to use a sand bath instead of heating the flask directly. (8 marks)

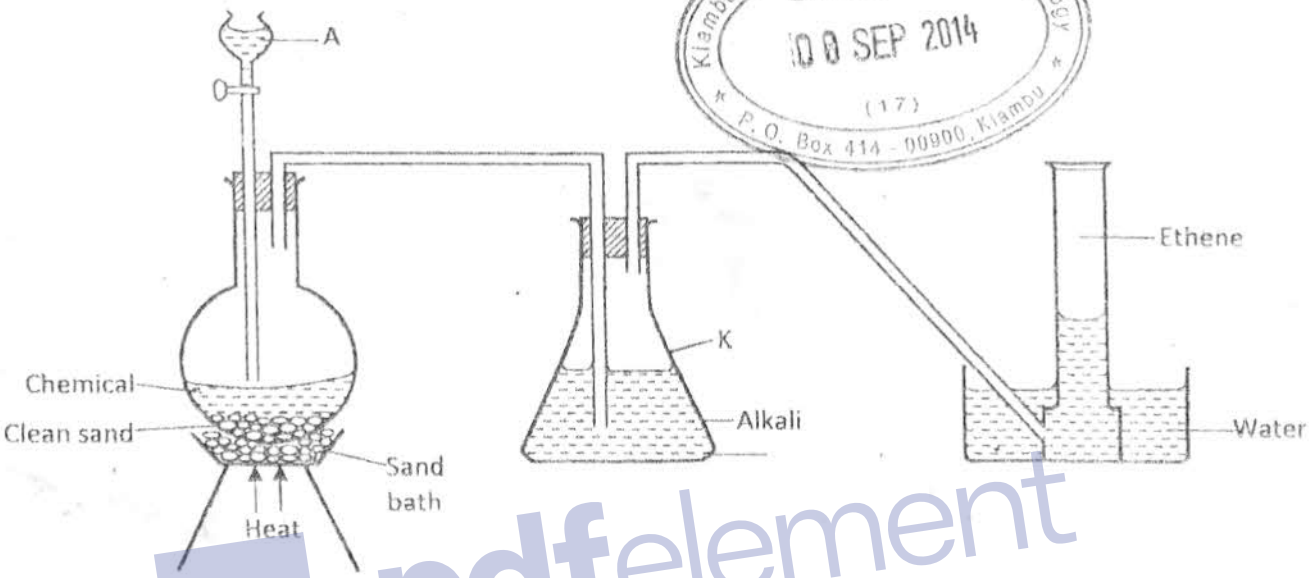

Fig. 2

2. (a) Sketch a graph of displacement (y-axis) against time of a wave of amplitude 1.0 cm and frequency 4.0 Hz over a time interval of 1.0 s. (4 marks)

(b) Describe with the aid of a diagram how you would produce stationary waves on a string. (5 marks)

(c) Figure 3 shows a series of wave fronts, one wavelength apart, approaching a narrow slit in a ripple tank.

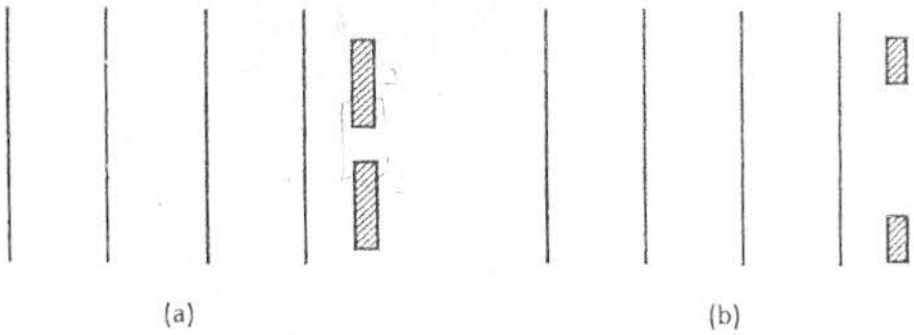

Fig. 3

(i) explain what is meant by a wave front;

(ii) add three more wave fronts to each diagram (a) and (b) shown in figure 3 to show what happens as the wave fronts pass through the slits. (5 marks)

(d) Explain **three** factors that affect the speed of sound in gases. (6 marks)

3. (a) (i) Define the tern 'background radiation';

(ii) State **two** possible sources of background radiation. (4 marks)

(b) Table 1 gives the Geiger-Muller counter readings recorded in an experiment with a radioactive source at one hour intervals. (The background radiation at the place is 40 counts/minute).

Table 1

Time/hour	0	1	2	3	4	5	6
Count rate/counts per minute	1040	831	649	516	411	330	266

(i) Plot a graph of the corrected count-rate against time;

(ii) Determine the half-life of the radioactive source from your graph. (6 marks)

(c) A typical nuclear fission reaction is given below.

$$^{235}_{92}U + {}^{1}_{x}A \longrightarrow {}^{148}_{57}La + {}^{y}_{35}Br + 3({}^{1}_{0}n)$$

(i) Determine the values of x and y;

(ii) Name the particle A. (3 marks)

(c) Figure 2 below shows the arrangements of apparatus that could be used to prepare ethene gas:

(i) name the reagent A end state its two functions in this reaction;

(ii) explain why sand granules are put in the reaction flask;

(iii) name the alkali used in flask K and state its function;

(iv) explain why it is preferable to use a sand bath instead of heating the flask directly. (8 marks)

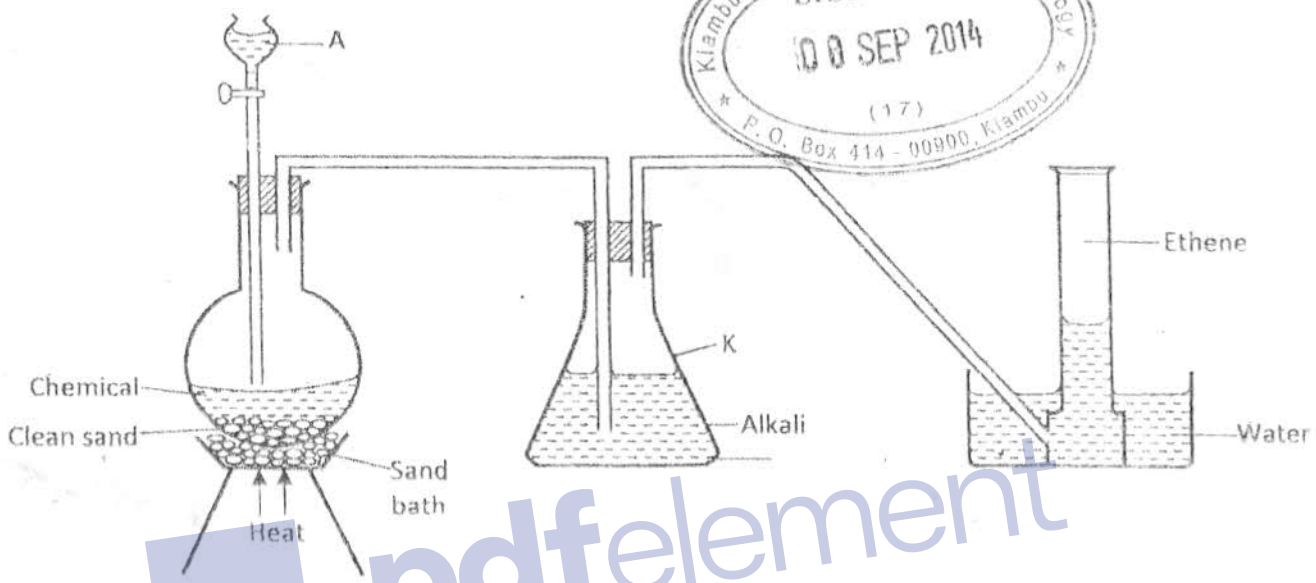

Fig. 2

2. (a) Sketch a graph of displacement (y-axis) against time of a wave of amplitude 1.0 cm and frequency 4.0 Hz over a time interval of 1.0 s. (4 marks)

(b) Describe with the aid of a diagram how you would produce stationary waves on a string. (5 marks)

(d) (i) Define Simple Harmonic Motion;

(ii) Identify the general conditions of Simple Harmonic Motion;

(iii) State the meaning of the following terms as applied to Simple Harmonic Motion:

I amplitude;
II periodic time;
III frequency. (7 marks)

SECTION B: MECHANICAL SCIENCE

*Answer **ONE** question from this Section.*

4. (a) Define the following:

(i) potential energy;

(ii) kinetic energy;

(iii) the law of conservation of energy. (6 marks)

(b) A pile of mass $\frac{3}{4}$ tonne can just support a stationary mass of 40 tonne without subsidence. The mass is removed and the pile is driven to a greater depth by blows of a 2 tonne hammer dropping on the top of the pile from a height of 1.22 mm. The hammer does not rebound from the top of the file. Calculate the:

(i) penetration per blow, assuming that the ground resistance is constant;

(ii) energy lost per blow, and;

(iii) efficiency of the operation. (14 marks)

5. (a) Three forces of 2P, 3P and 4P act along the three sides of an equilateral triangle of side 100 mm taken in order. Find the magnitude and position of the resultant force. (10 marks)

(b) A 4 mg body, A, travelling at 18 m/s runs into the back of another 6 mg body, B, travelling at 7 m/s in the same direction. Calculate the:

(i) momentum of each vehicle before impact;

(ii) final velocity of the bodies after impact assuming the bodies remain locked together. (10 marks)

SECTION C: ELECTRICAL ENGINEERING PRINCIPLES

*Answer **TWO** question from this Section.*

6. (a) (i) Define a magnet.

(ii) State **three** properties of magnetic lines of force. (4 marks)

(b) State **three** differences between electric and magnetic fields. (6 marks)

(c) Sketch the magnetic field pattern associated with a solenoid connected to a battery and wound on an iron bar. Show the direction of the field. (5 marks)

(d) Draw a dry lechlanche cell and label the essential parts. (5 marks)

7. (a) Explain three sources of error that may occur with an electrical measurement instrument. (9 marks)

(b) Figure 4 shows two resistors, A and B, having resistances 10 Ω and 15 Ω respectively, connected in parallel across a battery of four cells in series. Each cell has an e.m.f. of 2V and an internal resistance of 0.2 Ω. Calculate the:

(i) p.d. between battery terminals P,Q;

(ii) current through each resistor, and;

(iii) total power dissipated in the resistors. (11 marks)

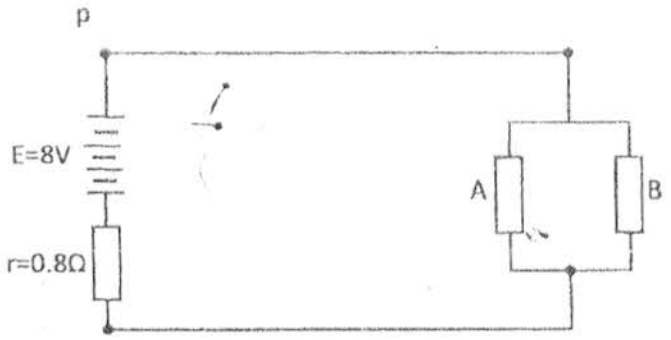

Fig. 4

8. (a) (i) State Kirchoff's current law.

(ii) Determine I_1, I_2, I_4 and I_5 in Figure 5 below.

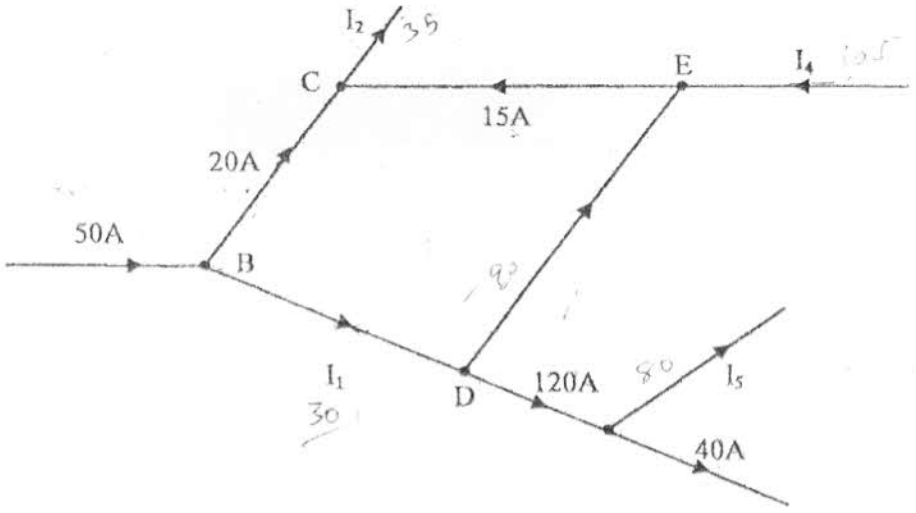

Fig. 5

(iii) Determine the value of e.m.f in figure 6 below. (7 marks)

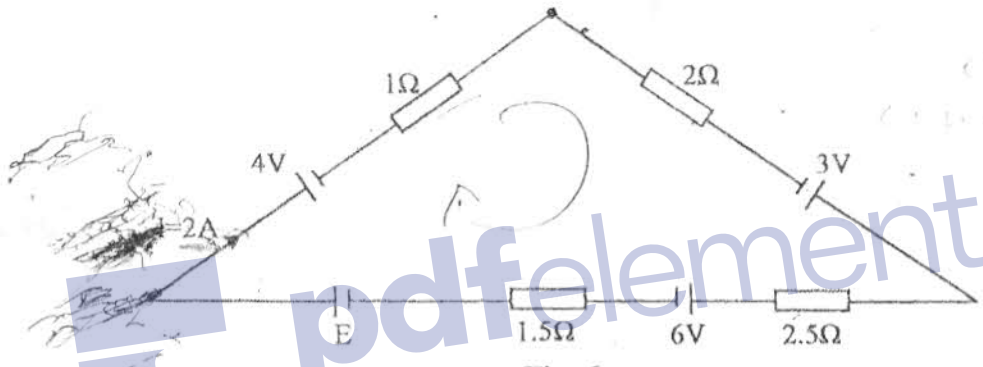

Fig. 6

(b) Explain **four** differences between conductors and dielectrics. (8 marks)

(c) A capacitor of capacitance C is fully charged by a 200 V d.c supply. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat 2.5×10^3 J/kg/K and of mass 0.1 kg. If the temperature of the block rises by 0.4 K, determine the value of C. (5 marks)