Name_____   Index No._____

1601/102
1602/102
**APPLIED SCIENCE, PRINCIPLES I
AND ELECTRONICS**
Oct./Nov. 2014
Time: 3 hours

Candidate's Signature _____

Date _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

**CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONICS ENGINEERING
(POWER OPTION)
(TELECOMMUNICATION OPTION)**

APPLIED SCIENCE, PRINCIPLES I AND ELECTRONICS

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have a scientific calculator and drawing instruments for this examination.
*This paper consists of **EIGHT** questions in **THREE** sections; **A**, **B** and **C**.*
*Answer **ONE** question from Section **A** and **TWO** questions each from Section **B** and **TWO** questions
from Section **C** in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
*Do **NOT** remove any pages from this booklet.*
Candidates should answer the questions in English.

Take: $\varepsilon_0 = 8.85 \times 10^{-12}$
$\mu_0 = 4\pi \times 10^{-7}$

For Examiner's Use Only

Section	Maximum Score	Candidate's Score
A		
B		
C		
Total Score	**100**	

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

SECTION A: APPLIED SCIENCE

Answer ONE questions from this Section.

1.   (a)   Define the following terms:

      (i)   work;

      (ii)   power.   (2 marks)

   (b)   Table 1 shows records of speeds against time taken by a vehicle. Draw a
      velocity time graph and determine the total distance covered.   (12 marks)

Table 1

Velocity (m/s)	0	15	30	45	60	75	75	75	75	75	60	40	20	0
Time (s)	0	5	10	15	20	25	30	40	50	60	70	80	90	100

   (c)   State the properties of fluid pressure.   (3 marks)

   (d)   A steel block of mass 90 kg is placed on a table. If the area of contact is 1500 mm^2,
      determine the:

      (i)   downward force;

      (ii)   average pressure.
      (assume acceleration due to gravity as 9.81 N/kg).   (3 marks)

2.   (a)   State **two** properties of the image in:

      (i)   a plane mirror;

      (ii)   pinhole camera.   (4 marks)

   (b)   A coin is placed at the bottom of a glass jar, when paraffin is poured to a depth of
      36 cm, the coin is apparently displaced 10.6 cm from the bottom. Determine the
      refractive index of paraffin.   (2 marks)

   (c)   (i)   State **two** characteristics of covalent compounds.   (2 marks)

      (ii)   Draw the pH scale and on it indicate the acidity, neutral and alkalinity levels.
                                                                                                          (3 marks)

   (d)   (i)   A cooking pan was placed on a gas cooker. State the processes of heat transfer
      involved when heating oil in the cooking pan.   (3 marks)

      (ii)   A 2 kW immersion heater heats water for 10 minutes from 20 ^{0}C to 100 ^{0}C.
      Determine the mass of water if the specific heat capacity of water is
      4200 J/kg K.   (6 marks)

SECTION B: MECHANICAL SCIENCE
Answer ONE question from this Section.

3. (a) State the effects of electric current. (3 marks)

   (b) A copper conductor 400 metres long carries a current of 600 A. If the voltage drop across it is 9.6 V, determine its cross-sectional area.
   (Take the resistivity of copper as 0.019 $\mu\,\Omega$m. (5 marks)

   (c) Figure 1 shows an electric circuit. Determine the:

   (i) total resistance;
   (ii) current flowing in each branch;
   (iii) voltage drop across the 350 Ω resistor;
   (iv) power dissipated by the 200Ω resistor;
   (v) energy consumed by 150 Ω resistor in 25 minutes in watt minutes.
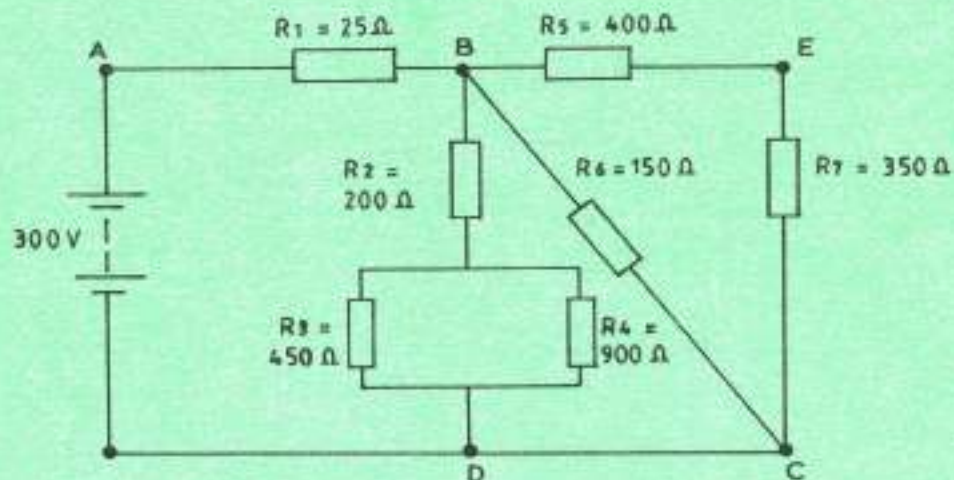
   (12 marks)

Fig. 1

4. (a) Define the following terms as used in electrostatics:

   (i) dielectric;
   (ii) relative permittivity. (4 marks)

   (b) Outline the factors that affect the capacitance of a capacitor. (4 marks)

   (c) A capacitor consisting of two parallel metal plates each of 40 cm² are spaced 0.16 mm apart. The dielectric has a relative permittivity of 6. If the voltage across the capacitors plates is 200 V, determine the;

   (i) electric field intensity;
   (ii) electric field density;
   (iii) energy stored by the capacitor. (9 marks)

(d) Derive the formulae for determining the total capacitance of two capacitors connected in parallel. (3 marks)

5. (a) Define the following terms:

   (i) inductance;
   (ii) reluctance. (4 marks)

   (b) A coil of 400 turns is wound uniformly on a ring of non-magnetic material. The ring has a mean circumference of 50 cm and a uniform cross-sectional area of 2.5 cm². If the current in the coil is 5 A, determine the:

   (i) magnetic field strength;
   (ii) magnetic flux density;
   (iii) total magnetic flux in the ring. (8 marks)

   (c) A 400 kVA transformer has a full load copper loss of 3 kW and an iron loss of 2 kW. Determine the:

   (i) output kVA at which the efficiency of the transformer is maximum.

   (ii) maximum efficiency if the load power factor is 0.8. (8 marks)

SECTION C: ELECTRONICS

Answer TWO question from this Section.

6. (a) List **four** properties that make germanium and silicon the most commonly used semiconductors. (4 marks)

   (b) With the aid of diagrams explain the formation of N and P types semiconductors. (10 marks)

   (c) Draw a labelled diagram showing the constructional features of a light emitting diode. (4 marks)

   (d) State any **two** applications of triacs. (2 marks)

7. (a) State any **three** methods of biasing transistors. (3 marks)

(b) Draw a labelled:

(i) circuit diagram of a half wave diode rectifier;
(ii) input and output voltage waveforms for b (i). (7 marks)

(c) (i) state the two conditions necessary for oscillations to occur in oscillators.
(ii) with aid of a diagram describe the operation of a tuned LC oscillator.
(10 marks)

8. (a) Convert $64.AB_{16}$ into:

(i) binary;
(ii) decimal. (5 marks)

(b) Figure 2 shows a logic gate circuit. Determine:

(i) Its Boolean expression;
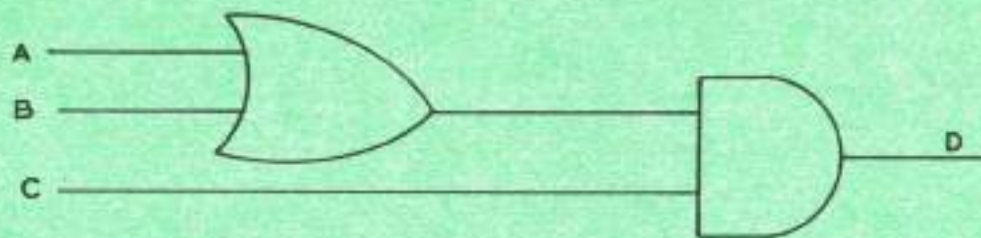(ii) Output D when, A = 0, B = 1 and C = 1. (5 marks)

Fig. 2

(c) (i) Define the term 'flip flop'.

(ii) With aid of a labelled diagram show the internal logic connections of a
JK - flip flop. (5 marks)

(d) (i) Differentiate between passive and active transducers.

(ii) A parallel plate capacitive transducer uses plates of area 500 mm² which are
separated by a distance of 0.2 mm. The dielectric is air having a permittivity
of 8.85×10^{-12} F/M. Calculate the change in capacitance if a linear displacement
reduces the distance between the plates of 0.18 mm.

(5 marks)