

1503/102
APPLIED SCIENCE AND
ELECTRICAL PRINCIPLES
June/July 2016
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
CRAFT CERTIFICATE IN MOTOR VEHICLE ENGINEERING
MODULE I

APPLIED SCIENCE AND ELECTRICAL PRINCIPLES

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination.

- *Non programmable scientific calculator*
- *Drawing instruments*
- *Answer booklet*

The paper consists of TWO sections; A and B. Answer TWO questions from Section A, TWO questions from Section B and ONE question from either Section A or B.

All questions carry equal marks.

Maximum marks for each part of the question are indicated.

Do not remove any pages from this booklet.

Candidates should answer all questions in English.

Take: $\epsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$ and $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$ and $g = 9.81 \text{ m/s}^2$

This paper consists of 4 printed pages.

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

SECTION A: APPLIED SCIENCE

Answer at least **TWO** questions from this section.

1. (a) State **four** properties of acids. (4 marks)
- (b) Explain **three** differences between covalent compounds and ionic compounds. (6 marks)
- (c) (i) Define the term hybridization. (2 marks)
- (ii) Distinguish between physical properties and chemical properties of matter. (8 marks)
2. (a) Differentiate between Electromagnetic spectrum and electromagnetic wave. (2 marks)
- (b) (i) State **four** properties of electromagnetic waves. (4 marks)
- (ii) State **three** types of electromagnetic radiation. (3 marks)
- (c) With the aid of diagrams, describe the principle of operation of a cathode ray oscilloscope (C.R.O) (11 marks)
3. (a) (i) With the aid of a diagram, differentiate between gauge pressure and absolute pressure. (5 marks)
- (ii) Draw and explain the principle of operation of a Bourdon-tube pressure gauge. (7 marks)
- (b) Define the following terms:
(i) density;
(ii) relative density. (2 marks)
- (c) A rectangular watertight box measuring 0.56 m long, 0.42 m wide and 0.21m deep weighs 223 N. If it floats on its side vertically in water of density 1030 kg/m^3 , determine the depth of the box submerged; (6 marks)
4. (a) Define the following terms
(i) energy;
(ii) work. (4 marks)
- (b) A motor vehicle of mass 800 kg is climbing a road inclined at 10° to the horizontal. If the vehicle moves a distance 50 m up the incline, determine the increase in potential energy. (7 marks)
- (c) A machine raises a load 160 kg through a distance of 1.6 m. The effort applied to the machine is 200 N and moves a distance of 16 m. Determine the:
(i) mechanical advantage;
(ii) velocity ratio;
(iii) efficiency. (9 marks)

SECTION B: ELECTRICAL PRINCIPLES

Answer at least **TWO** questions from this section.

5. (a) A flux of 10 mWb links with a 900 turns coil when a current of 3 A passes through the coil. Determine the:
- (i) inductance of the coil;
 - (ii) energy stored in the coil. (4 marks)
- (b) Two capacitors of capacitances 2 μF and 3 μF are connected in parallel and a 15 μF capacitor connected in series with the parallel combination across a 240 v d.c. supply. Draw the circuit and then determine:
- (i) equivalent circuit capacitance;
 - (ii) voltage across each capacitor;
 - (iii) total charge in the circuit;
 - (iv) total energy stored in the circuit. (16 marks)
6. (a) Define the following terms:
- (i) reluctance;
 - (ii) permeability. (2 marks)
- (b) State Faraday's laws of electromagnetic induction. (4 marks)
- (c) (i) State **two** types of losses that occur in transformers.
(ii) Describe how the losses in c(i) can be minimized. (6 marks)
- (d) A 100 kVA, 4000 V/200V, 50Hz single-phase transformer has 100 secondary turns. Determine the:
- (i) primary and secondary currents;
 - (ii) number of primary turns;
 - (iii) maximum value of the flux. (8 marks)
7. (a) Explain each of the following extrinsic semiconductors materials:
- (i) n - type
 - (ii) p - type (4 marks)
- (b) With the aid of a labelled diagram, describe the characteristics of a semiconductor diode. (8 marks)

(c) Figure 1 shows a common emitter configuration circuit. If $\beta = 50$ and $V_{BE} = 0.7$ V, determine:

- (i) I_E
- (ii) V_C
- (iii) V_E
- (iv) V_{CE}

(8 marks)

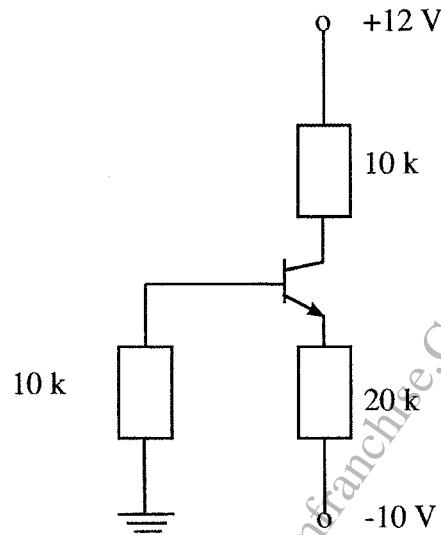


Fig 1.

8. (a) Distinguish between Zener breakdown and avalanche breakdown. (4 marks)
- (b) State **three** conditions necessary for proper working of a Zener diode. (3 marks)
- (c) With the aid of a labelled diagram, describe the B-H loop of a ferromagnetic material. (10 marks)
- (d) State the **three** factors that affect the capacitance of a capacitor. (3 marks)

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