1503/102
APPLIED SCIENCE AND
ELECTRICAL PRINCIPLES
Oct./Nov. 2019
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:
Answer booklet;
Non-programmable scientific calculator;
Drawing instruments.
*This paper consists of **EIGHT** questions in **TWO** sections; A and B.*
*Answer **FIVE** questions in the answer booklet provided by choosing at least **TWO** questions from each section.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.
Take $\mu_o = 4\pi \times 10^{-7} H/m$
$\varepsilon_o = 8.85\, No^{-12}\, F/m$
$g = 9.81\, m/s^2$
Speed of light, $C = 3.0 \times 10^8\, m/s$

This paper consists of 8 printed pages.

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

(c) Show the image formed when an object is placed:

(i) between F and 2 F of a concave lens;

(ii) at 2 F of a convex lens.

(6 marks)

(d) (i) Describe reverberation as used with respect to sound.

(ii) State the Laws of reflection of sound waves.

(6 marks)

3. (a) (i) State the perfect gas equation.

(ii) A gas occupies 1.12 mm^3 at a temperature of 127°C and pressure of 800 mm of mercury. Determine its volume at standard temperature and pressure. (Pressure of mercury = 760 mm/g).

(4 marks)

(b) (i) Distinguish between condensation and freezing point.

(ii) 2 g of mercury has a specific heat capacity of 0.12 $Jg^{-1}C^{-1}$. The temperature is to be raised from 10°C to 30°C. Determine the amount of heat energy required.

(6 marks)

(c) Figure 1 shows a diagram of a refrigerator. Explain its operation. (6 marks)

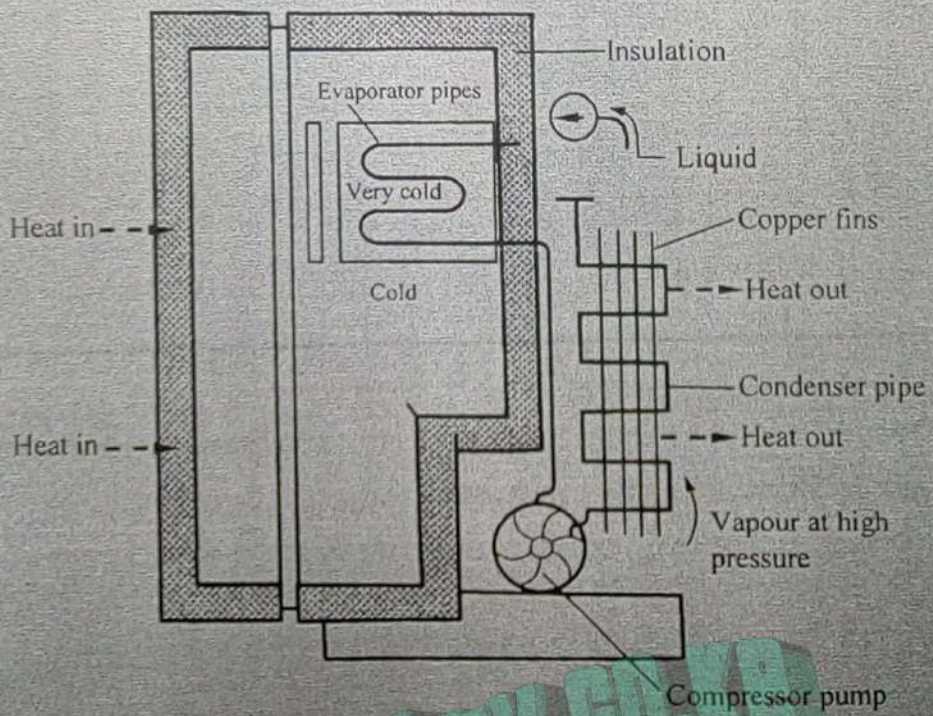

Fig. 1

(d) Differentiate between:

(i) latent heat of fusion and latent heat of vaporization:

(ii) specific heat capacity and heat capacity.

(4 marks)

4. (a) Define each of the following with respect to simple machines:

(i) mechanical advantage;

(ii) efficiency.

(2 marks)

(b) A lever has a load arm of 2 m and the effort arm of 6 m. It is able to lift a load of 60 N. Determine the:

(i) mechanical advantage;

(ii) effort.

(4 marks)

(c) (i) Distinguish between energy and power citing the S.I units in each case:

(ii) Table 1 shows types of machines. Complete the table by matching them to their corresponding order.

(10 marks)

Table 1

S/No.	Machines	Order		
		1st	2nd	3rd
1.	Forceps			
2.	Wheel barrow			
3.	Seesaw			
4.	Fishing rod			
5.	Nutcracker			
6.	Pliers			

(d) A force acting on a 20 kg mass changes its velocity from 5ms $^{-1}$ to 2 ms $^{-1}$. Determine the resultant work done by the force.

(4 marks)

SECTION B: ELECTRICAL PRINCIPLES

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

5. (a) (i) State Faraday's laws of electrolysis.

(ii) With the aid of a labelled diagram describe the construction of a Leclanche Cell.

(8 marks)

(b) Figure 2 shows a parallel-series capacitive circuit.

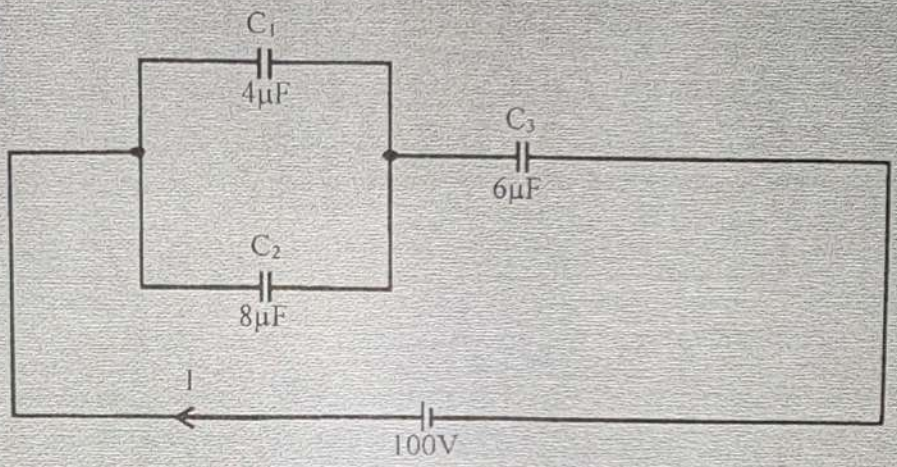

Fig. 2

Determine the:

(i) total capacitance for the whole system;

(ii) total charge;

(iii) potential difference across the $6\,\mu F$ capacitor.

(8 marks)

(c) Draw a B-H hysteresis curve showing:

(i) remanent flux;

(ii) coercive force.

(4 marks)

6. (a) State **two** factors that determine the resistance of a conductor in an electrical network. (2 marks)

(b) With the aid of a schematic circuit diagram explain the operation of separately excited D.C generator. (6 marks)

(c) (i) Distinguish between a Bipolar Junction Transistor (BJT) and a Field Effect Transistor (FET).

(ii) Figure 3 shows an LCD. Describe its operation. (6 marks)

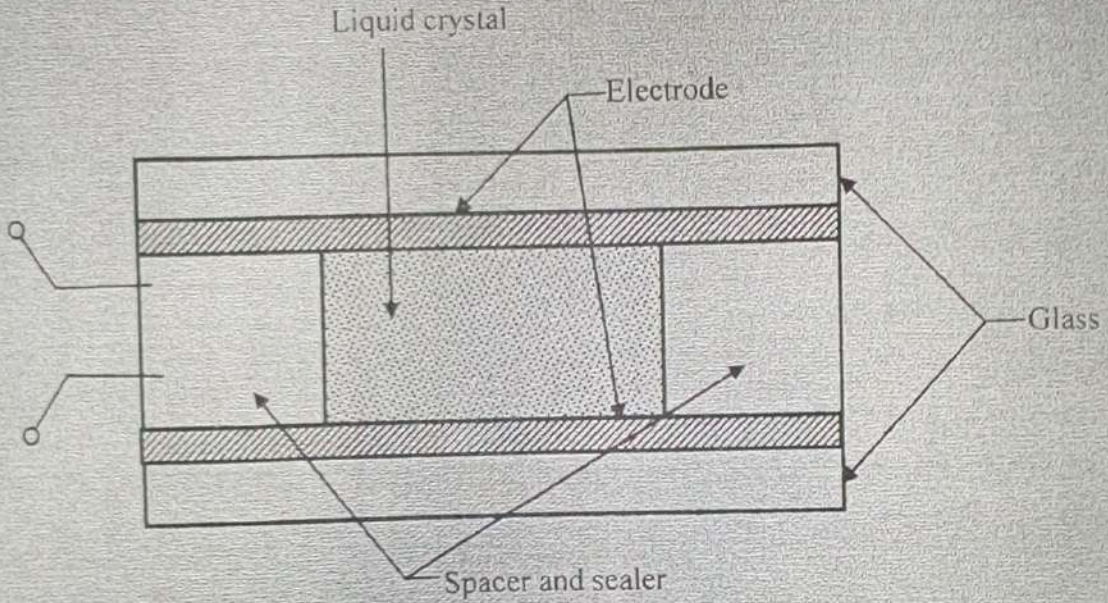

Fig. 3

(d) The current in an a.c circuit at any time (t) seconds is given by $i = 120\sin(100\pi t + 0.36)$ Amperes. Determine the:

(i) periodic time (T);

(ii) frequency;

(iii) phase angle in degrees. (6 marks)

7. (a) (i) State **three** factors which determine the magnitude of induced current in a closed coil.

(ii) Figure 4 shows a magnet. Draw the magnetic field lines.

Fig. 4

(6 marks)

(b) A single phase 500V/100V, 50 Hz transformer develops a maximum core flux density of 1.5 T and has an effective core cross-sectional area of 50 cm^2. Determine the:

(i) maximum flux (ϕ_m);

(ii) number of primary turns;

(iii) number of secondary turns.

(6 marks)

(c) With the aid of a block schematic diagram, describe the construction of a Silicon Controlled Rectifier (SCR). (8 marks)

8. (a) State:

(i) Lenz'z laws:

(ii) Fleming's Right-hand rule.

(4 marks)

(b) With the aid of a characteristic curve describe the constant-current method of charging a battery. (6 marks)

(c) Draw the output signal waveforms for each of the following classes of amplifiers:

(i) class A;

(ii) class B.

(4 marks)

(d) Figure 5 shows a circuit diagram of non-inverting Op-amp. The common mode gain is 0.001. Determine the:

(i) closed loop gain;

(ii) common mode rejection ratio;

(iii) peak-to-peak output voltage.

(6 marks)

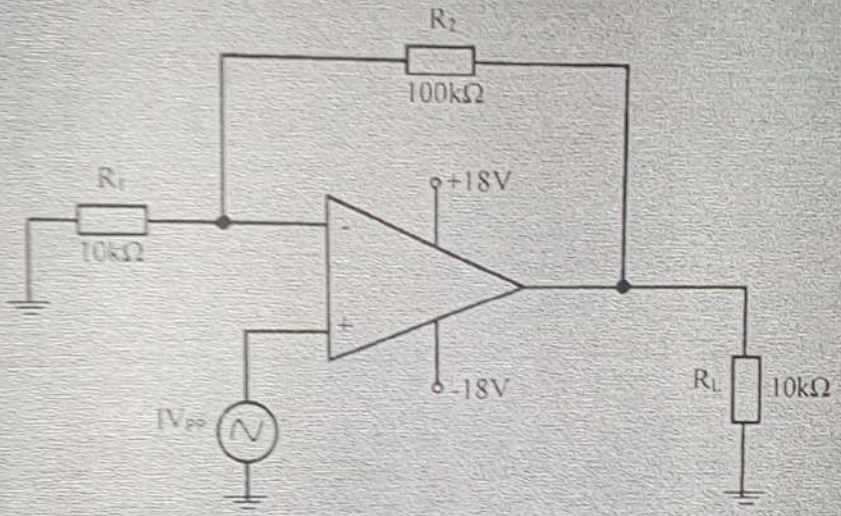

Fig. 5

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