

- (c) A cylinder of oxygen has a volume of 600 cm^3 and contains oxygen of 200 g by weight at a temperature of 25°C . If the characteristic gas constant of oxygen is 2080 J/kgK , determine the pressure of oxygen in the cylinder. (7 marks)

2. (a) Define the following terms:

(i) isotopes.

(ii) atomic number.

(iii) mass number. (3 marks)

(b) (i) Draw and explain the structure of an atom.

- (ii) An element X has two isotopes of mass numbers 235 and 238 and a relative abundance of 70% and 30% respectively. Determine the relative atomic mass of the element. (9 marks)

(c) (i) Differentiate between ionic and covalent bond.

(ii) State four properties of ionic compounds. (8 marks)

3. (a) (i) Define pressure.

(ii) With the aid of a diagram, differentiate between gauge pressure and absolute pressure.

(iii) Draw a Bourdon tube pressure gauge and explain its operation. (11 marks)

(b) (i) Differentiate relative density from density.

(ii) State the law of flotation. (4 marks)

(c) A hydrometer of mass 28 g floats with 3 cm of its stem out of water. The area of cross section of the stem is 0.75 cm^2 . Determine the:

(i) total volume of the hydrometer;

(ii) the length of stem above the surface when the hydrometer floats in a liquid of relative density of 1.4. (5 marks)

4. (a) Define:

(i) electromagnetic radiation.

(ii) electromagnetic spectrum. (4 marks)

1503/102
APPLIED SCIENCE
AND ELECTRICAL PRINCIPLES
Oct./Nov. 2016
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
CRAFT CERTIFICATE IN MOTOR VEHICLE ENGINEERING
MODULE 1

APPLIED SCIENCE AND ELECTRICAL PRINCIPLES

3 hours

INSTRUCTIONS TO CANDIDATES

The candidate should have the following for this examination:

Answer booklet

Non-programmable scientific calculator

This paper consists of TWO sections: A and B.

Answer FIVE questions by choosing at least TWO questions from each section.

All questions carry equal marks.

Maximum marks to each part of a question are indicated.

Write your answers in the answer booklet provided.

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

Candidates should answer the questions in English.

This paper consists of 5 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) Figure 2 shows an R-L series circuit. If the power absorbed in the circuit is 250 W, determine the:

(i) value of R and L.

(ii) power absorbed when the supply is 110 V 25 Hz.

(11 marks)

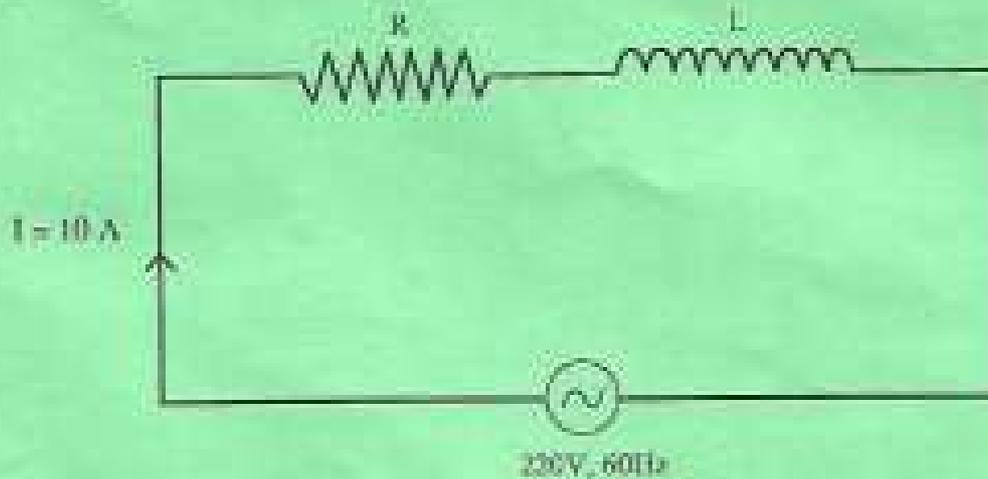


Fig. 2

7. (a) (i) State three differences between primary cells and secondary cells.

(ii) Outline three precautions that should be observed when working with batteries. (6 marks)

(b) (i) List two types of windings used in direct current machines and armature windings.

(ii) Describe the difference in construction between shunt-wound and series-wound d.c. generators with respect to field and armature windings. (6 marks)

(c) A capacitor whose plates are 20 cm by 3 cm separated by a 1.0 mm air gap is connected across a 12 V battery. Determine the charge on each plate. (8 marks)

8. (a) State Faraday's Law of electromagnetic induction. (4 marks)

(b) With the aid of a diagram, explain the operation of an autotransformer. (6 marks)

(c) With the aid of a labelled diagram and wave forms, describe the operation of a two-diode full wave rectification. (10 marks)

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SECTION A

Answer at least TWO questions in this section.

1. (a) (i) Define:

(I) mechanical advantage;

(II) velocity ratio;

(2 marks)

(ii) A load of 720 kg is lifted by a 3-pulley system as shown in Figure 1 below. When a force of 3.528 kN is applied, determine the:

(I) mechanical advantage;

(II) velocity ratio;

(III) efficiency.

(5 marks)

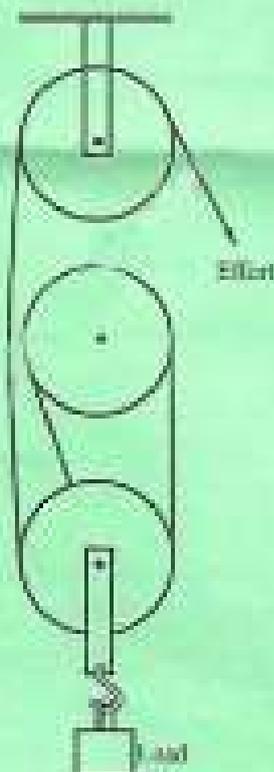


Fig. 1

(b) An electric motor provides power to a winding machine. The input power to the motor is 2.5 kW and the overall efficiency is 60%. Determine:

(i) power output

(ii) the velocity at which it can lift a 300 kg load vertically upwards.

(6 marks)

- (b) (i) State the properties of electromagnetic waves.
- (ii) State three types of electromagnetic radiation. (7 marks)
- (c) With the aid of a diagram, explain the principle of operation of a cathode ray oscilloscope. (9 marks)

SECTION B

Answer at least TWO questions in this section.

3. (a) Define the following electrical quantities stating the units in each case:
- (i) resistance. (4 marks)
- (ii) electromotive force. (4 marks)
- (b) State four factors that affect the resistance of a conductor. (4 marks)
- (c) An electric water heater has a rating of 1 kW, 230 V. The coil used as a heating element has a resistivity of 1.724×10^{-8} ohm-cm and is 10 m long. Determine the diameter of the coil wire. (8 marks)
- (d) Explain the functions of the following parts of a DC motor:
- (i) commutator; (4 marks)
- (ii) armature. (4 marks)
6. (a) Define the following terms for circuits:
- (i) period; (4 marks)
- (ii) power factor. (4 marks)
- (b) In an a.c. circuit, 10 A current flows when a voltage of 230 V is supplied. If the power of the circuit is 2 kW, determine:
- (i) power factor; (5 marks)
- (ii) phase angle. (5 marks)