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Date _17/03/2016_

APPLIED SCIENCE, ELECTRICAL PRINCIPLES
AND ELECTRONICS

March/April 2016

Time: 3 hours

MOMBASA TECHNICAL TRAINING INSTITUTE

CERTIFICATE IN ELECTRICAL AND ELECTRONICS ENGINEERING (POWER OPTION)

MODULE I

APPLIED SCIENCE, ELECTRICAL PRINCIPLES AND ELECTRONICS

CREE 16 J

INSTRUCTIONS

Write your name and index number in the spaces provided above.

Sign and write the date of the examination in the spaces provided above.

Hand in you examination booklet TOGETHER with this question paper (stapled).

You should have mathematical tables/scientific calculator for this examination.

This paper consists of SEVEN questions in TWO sections: A and B.

Answer ALL questions from Section A and ONE question from Section B.

All questions carry equal marks.

Maximum marks for each part of a question are as shown.

Do NOT unstaple any pages from this question paper.

Answer the questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	Total Score

This paper consists of 5 printed pages.

Check the question paper to ascertain that all the pages are printed as indicated and that questions are missing.

Answer ALL questions from this section
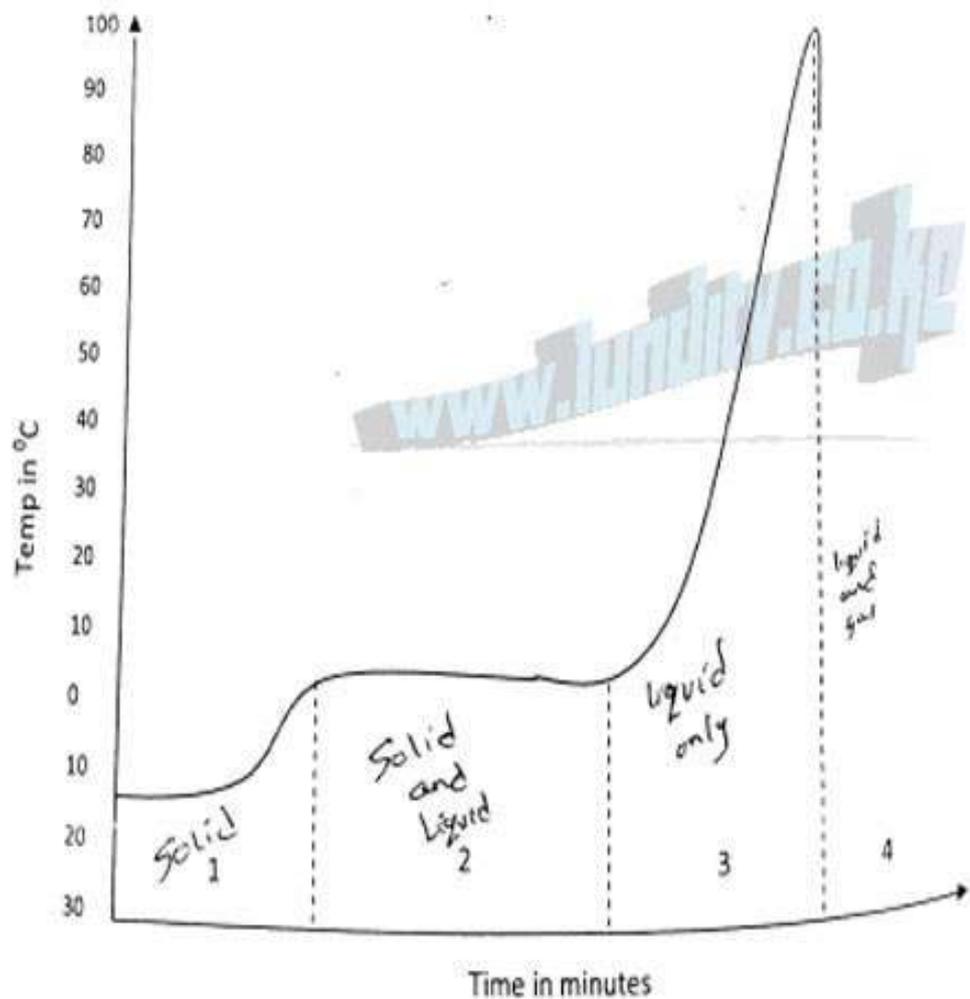
1. a) Define the following terms.

     i.   Matter

     ii.   Atom

     iii.   Element

  b) State any two properties of

     i.   Solids

     ii.   Liquids

     iii.   Gases

  c) With reference to the change of state graph shown below, name and explain what is represented by sections labeled 1,2,3 and 4

(6 m...

(6 m...

(8 ma...

HEATING AND COOLING CURVE OF WATER.

Temp in °C vs Time in minutes. Sections labeled: 1 - Solid; 2 - Solid and Liquid; 3 - Liquid only; 4 - Liquid and gas.

2. a) Explain bonding in some atoms. (2 marks)

   b) Explain each of the following types of bonds

      i. Ionic

      ii. Covalent

      iii. Hydrogen

      iv. Metallic (8 marks)

   c) Differentiate between period and group with reference to the periodic table of elements, giving two characteristics of each. (10 marks)

3. a) With respect to the seven SI base units, state any three quantities and their respective units. (3 marks)

   b) The rate of energy transfer in an electric circuit may be found from $P = I^2 R$. Derive two alternative equations for the same. (5 marks)

   c) A motor has a brake test performed on it using a rope wound around a flywheel with a constant force of 250 N applied to the rope. If the motor runs at 1800 rev/min and the diameter of the flywheel is 0.6 m, calculate the power developed. (6 marks)

   d) A colliery pump with an operating efficiency of 0.8 per unit is driven by a d.c. motor and has an output of 60 kW. Given that when operating with the above loading, the motor has an efficiency of 0.75 per unit, calculate;

      i. the input power, in kWh, to the pump

      ii. the input power, in kWh, to the motor

      iii. the annual cost of the energy consumed, with electricity at Ksh. 1 per unit, if the pump is in continuous use for 40 hours each week, 50 weeks each year. (7 marks)

4. a) Sketch the Standard Symbols for the following Electrical Components (2 marks)

      i. Fuse

      ii. Conductors crossing each other

   b) State three main effects of an electric current (3 marks)

      • Magnetic effect
      • Heat ...
      • Chemical ...

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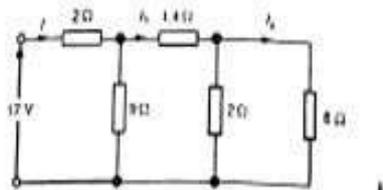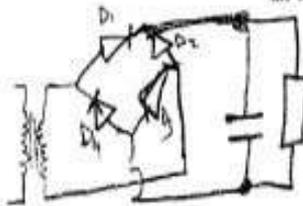c) For the arrangement shown in fig. 1, find the current I.

Fig 1

d) Two lathes connected in parallel take 12A from a 240 V supply. If a milling machine an electrical resistance of 13.3Ω is also connected in parallel, calculate;

(i) the resistance of the total parallel combination

(ii) the total current taken from the supply.

Section B

Answer ONE question from this section.

5. a) State the majority carriers in both p-type and n-type semiconductors.
(2 marks)

b) Explain the following terms as used in semiconductors:
(4 marks)

i. intrinsic conduction

ii. forward bias
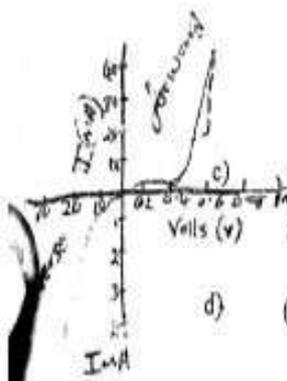
c) Sketch a typical forward and reverse characteristic for a pn junction diode and identify the reverse breakdown voltage.
(6 marks)

d) (i) Draw the circuit of a full-wave rectifier complete with smoothing circuit and a resistive load. Briefly explain the action of the circuit, and sketch the current waveform.

(ii) With the aid of a sketch, explain what would happen to the p.d. across the load resistor if one of the diodes became an open circuit.
(8 marks)

6. a) With reference to a p-n-p transistor, explain briefly the meaning of the term transistor action and why a bipolar junction transistor is so named.
(3 marks)

b) An n-p-n transistor has the following characteristics, which may be assumed to be linear between the values of collector voltage stated.

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Base Current	Collector Current (mA) for	
(μA)	collector voltages of:	
	1V	5V
30	1.4	1.6
50	3.0	3.5
70	4.6	5.2

The transistor is used as a common-emitter amplifier with load resistor $R_L = 1.2$ kΩ and a collector supply of 7V. The signal input resistance is 1 kΩ. Estimate the voltage gain Av, the current gain Ai and the power gain Ap when an input current of 20 μA peak varies sinusoidally about a mean bias of 50 μA. (12 marks)

c) A transistor has a common-base current gain (h_{fb}) of 0.98. Calculate the corresponding common-emitter current gain (h_{fe}). $h_{fe} = \frac{h_{fb}}{1-h_{fb}}$ $h_{fe} = \frac{0.98}{1-0.98} = 49$ units (5 marks)
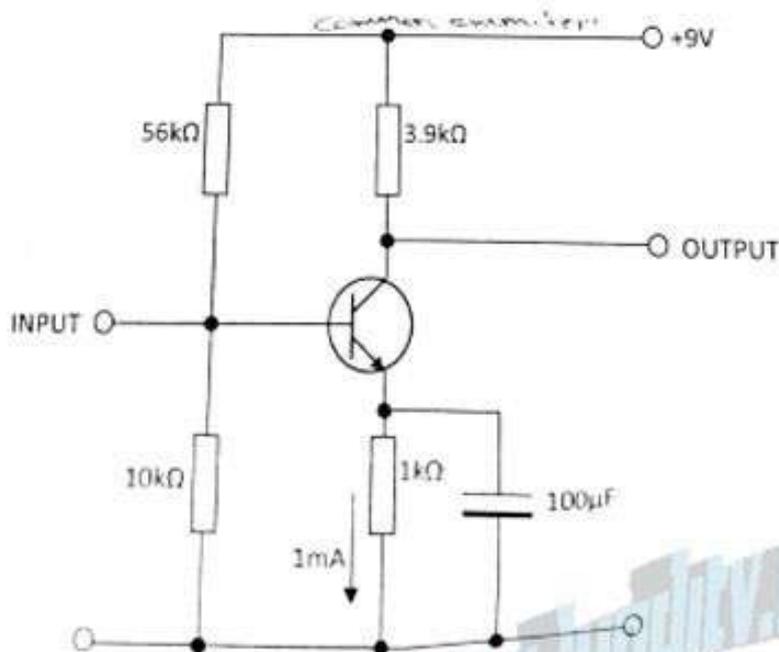
7. a) Draw the basic circuit of a transistor connected in common collector mode, showing the bias polarities. Explain why this mode is sometimes referred to as 'emitter follower' (6 marks)

b) For the circuit shown below, calculate

   i. the base-emitter bias voltage (V_{be}) (7 marks)

   ii. the collector-emitter voltage (V_{ce}) (7 marks)

(Ignore the effect of any base current flowing in the 56kΩ resistor)