



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SUPPLEMENTARY EXAMINATION FOR
DIPLOMA IN DEPARTMENT OF ELECTRICAL AND ELECTRONIC
ENGINEERING

SCU: 100 PHYSICS

DATE: 26/7/2019

TIME: 2:00 – 4:00 PM

INSTRUCTIONS:

Answer QUESTION ONE and any other TWO Questions.

SECTION A

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following words as used in blackbody radiation.
 - i. Absorptivity (1 Mark)
 - ii. Reflectivity (1 Mark)
 - iii. Transmittivity (1 Mark)
 - iv. Blackbody (1 Mark)
- b) What is heat transfer? (1Mark)
- c) Compute the thermal conductivity through a conductor when 30000w of heat flows through it having a length of 4m and area of 12m^2 given that the temperature gradient is 40K. (4 Marks)
- d) .
 - i. Derive the dimension of power (3 Marks)
 - ii. There are seven base units used in expressing the magnitudes of physical quantities of measurements. Define the seven fundamental units. (14 Marks)
- e) State the Newton's law of cooling. (1 Mark)
- f) Write three differences between heat and temperature (3 Marks)

QUESTION TWO (20 MARKS)

- a) What is an ideal gas? (1Mark)
- b) At 25°C, an airship has a volume of 300,000m³. How many kilograms of oxygen would fit in at 0.95 Atm by use of the relation $PV=mRT$ given that $R=0.0821 \frac{L.Atm}{Mol.K}$ (4 Marks)
- c) Calculate the volume occupied by one mole of a gas at 25°C and at 100Kp. (3Marks)
- d) How many moles of a gas are present in 2.50 litre container if the pressure is 1.50 Atm and the temperature is 25°C? (4 Marks)
- e) Define the Dalton's partial pressure law. (1 Mark)
- f) Show the correlation between Van der Waal's equation and ideal gas equation through derivations. (7 Marks)

QUESTION THREE (20 MARKS)

- a) Define the following words as used in thermodynamics;
- i. A thermodynamic system (1Mark)
 - ii. Microscopic thermodynamics (1 Mark)
 - iii. Macroscopic thermodynamics (1 Mark)
 - iv. An open system (2Marks)
 - v. A closed system (2 Marks)
 - vi. An isolated system (2Marks)
 - vii. Adiabatic processes (2 Marks)
 - viii. Isothermal changes (2 Marks)
- b) State the first law of thermodynamics (1 Mark)
- c) Prove that the relationship between heat capacity at constant pressure (C_P) and heat capacity at constant volume (C_V) is given by $C_P=C_V+R$ where R is the universal gas constant. (6 Marks)

QUESTION FOUR (20 MARKS)

- a) Explain five limitations of dimensional analysis of physical quantities. (10 Marks)
- b) Show that the following pairs of quantities have identical dimensions. (6Marks)
- i. Momentum and impulse.
 - ii. Torque and energy.
 - iii. Energy and work.
- c) What is meant by dimensional formula and equation? (2 Marks)
- d) State the principle of homogeneity of dimensions (2 Marks)

QUESTION FIVE (20 MARKS)

- a) What is meant by the term thermal conductivity? (2 Marks)
- b) After baking a cylindrical cake in an oven, the cake was set on a rack to cool. The cake had a height of 8cm and a diameter of 20cm. If the surface temperature of the cake was 90°C on all sides and the air in the room was at a temperature of 22°C , calculate the rate of heat loss from the cake to the air given that; the convection coefficients at the top and at the bottom surfaces were $15\text{W/m}^2\text{K}$ and $5\text{W/m}^2\text{K}$ respectively. The emissivity of the cake surface was approximated as $\epsilon=0.4$ on all sides. (Ignore heat losses resulting from conduction). (10 Marks)
- c) After sunset, radiant energy can be sensed by a person standing near a brick wall. Such walls frequently have temperatures around 44°C , and typical brick emissivity values are in the order of 0.92. What would be the radiant thermal flux per square foot from a brick wall at this temperature? (4 Marks)
- d) .
- i. What is thermal resistance, R ? (2 Marks)
- ii. A composite material is made up of three constituent materials of thermal resistances; $R_{\text{th } 1}$, $R_{\text{th } 2}$, and $R_{\text{th } 3}$ respectively. Write the expressions for the effective resistances for both series and parallel arrangement of the constituents. (4 Marks)