TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Mechanical Engineering (Y1S1)
APS 2150 : Physical Science for Engineers (Paper 2)
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Sep 2018

Instruction to Candidates:
You should have the following for this examination
- *Examination Pass & Student ID Card*
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

a) State the two laws of refraction. **(3 marks)**

b) Show that; **(6 marks)**

$$_a n_g = 1/_a n_g$$

c) State the conditions for total internal reflection. **(3 marks)**

d) With the aid of a ray diagram, explain the effect of refraction to a stick placed in water as observed by a person in the air medium. **(5 marks)**

e) A ray of light passing from air and incident to the mediums of glass and water at an incident angle of 60° is refracted by 20° and 15° in glass and water respectively. Calculate the refractive indices of; **(3 marks)**

   i.   Water

   ii.   Glass

Question TWO

a) Define the following terms: **(4 marks)**
   i.   Heat capacity
   ii.   Latent heat of fusion
   iii. Atomic mass unit
   iv.   Isotope

b) List 3 properties which make mercury a better thermometric liquid than alcohol.

(3 marks)

c) In chlorine 75.5% of the atoms have a mass number of 35, and the other 24.5% have a mass number of 37. Calculate the atomic weight of the element. **(4 marks)**

d) With the aid of a clear sketch, explain how an astronomical telescope works.

(5 marks)

e) Differentiate between the chemical properties and the physical properties of matter. In each case list two examples of the physical and chemical properties of matter.

(4 marks)

Question THREE

a) State, **(3 marks)**
   i.   The Archimedes principle
   ii.   The law of floatation

b) Define the following terms: **(3 marks)**
   i.   Density
   ii.   Relative density
   iii. Pressure

c) A rectangular solid glass of density 2.5 g/cm^3 has dimensions 10 cm x 40 cm x 30 cm. The block rests on a horizontal flat surface. Calculate; **(8 marks)**
   i)   The relative density of the glass
   ii)   The minimum pressure the glass can exert on the horizontal surface
   iii) The maximum pressure the glass can exert on the horizontal surface

d) Show that the pressure in a liquid is given by: **(2 marks)**
$$P = \rho g h$$
   Where: P is Pressure in the liquid, ρ is the density of the liquid and g is the gravitational force

e) A liquid has a density $\rho = 1.53 \times 10^3$ kg/m^3 and atmospheric pressure of 750 mmHg. For a point 3 m below the free space of the liquid, calculate; **(4 marks)**
   i.   Gauge pressure
   ii.   Absolute pressure

Question FOUR

a) State the following: **(4 marks)**

    i.   The Arrhenius Acid-Base Theory

    ii.   The Lewis Acid-Base Theory

b) Differentiate between a strong Acid and a weak acid **(2 marks)**

c) Define the following terms: **(4 marks)**

    i.   The mole

    ii.   Molar mass

d) An elemental analysis of a sample of an ionic compound showed 2.82 g of Na, 4.35 g of Cl and 7.83 g of O. What is the empirical formula and name of compound formed? Given that the Molar mass of Na = 22.9 g, Cl = 35.45 g, O = 7.83 g. **(5 marks)**

e) List 3 unique properties of carbon. **(3 marks)**

f) Differentiate between Oxidizing and reducing agents **(2 marks)**

Question FIVE

a) Define the following terms as used in the transfer of heat. **(3 marks)**

    i.   Conduction

    ii.   Radiation

    iii.   Convection

b) With the aid of a temperature – time cooling graph. Explain how a substance cools from the gaseous state to the solid state. **(5 marks)**

c) List three properties which makes mercury a better thermometric liquid than alcohol. **(3 marks)**

d) Complete the table below: **(4 marks)**

Element	K	O	Al	Fe
Protons	19		13	26
Neutrons		8		30
Mass Number	39	16	27	

e) Calculate the quantity of heat required to melt 4 kg of ice and raise the temperature to 50 °C. Take the specific latent heat of ice to be 3.4×10^5 J/kg·K. **(5 marks)**