THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)

DIPLOMA IN AUTOMOTIVE ENGINEERING

STAGE I SEMESTER II EXAMINATIONS

APRIL/MAY 2010 SERIES

PHYSICAL SCIENCE

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination:

- Two Answer Booklets
- Scientific Calculator

The paper consists of **THREE** Section **A, B** and **C.**
Question **ONE** is compulsory.
Answer **ONE** Question from Section **B** and **ONE** from Section **C**.
All questions marks.

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SECTION A - All Questions are Compulsory

Question ONE

(a). Calculate the oxidation numbers for the following:

Elements

(i). Sulfur in SO_3
(ii). Sulfur in H_2SO_4
(iii). Nitrogen in NH_3
(iv). Chromium K_2CrO_7

(4 Marks)

(b). Balance the following redox reaction equation using oxidation numbers.

$Zn + NO^-_3 \rightarrow Zn^{2+} + NH^+_4$ **(4 Marks)**

(c). Draw the following structures.

(i). Fcc (Face Centred Cubic)
(ii). HcP (Hexagonal (Close Packed)

(2 Marks)

(d). (i). A ray of light is incident in water at an angle of (I) 30º and (II). 70º on water glass plane surface. Calculate the angle of refraction in the glass in each case.

(ii). State the laws of refraction.

(iii). Calculate the critical angle for an air glass surface and draw a diagram illustrating the total internal reflection of a ray incident on the surface $(a^n g = 1.5)$.

(10 Marks)

SECTION B - Answer ONE Question

Question TWO

(a). Explain **FOUR** applications of radioactivity and radio isotope. **(8 Marks)**

(b). A radio isotope has a half life of 10 minutes. The GM tube counter records 20 counts per minutes without this radio isotope placed in front of its. With this radioisotope in front, it registers 400 counts per minutes. Calculate the count rate after 20 minutes. **(3 Marks)**

(c). Explain what you understand by "background radiation" stating two sources of this radiation. **(3 Marks)**

(d). In each case give TWO examples of elements exhibiting these type of structures:

(i). BCC (Body Centred Cubic)
(ii). FCC (Face Centred Cubic)
(iii). HCP (Hexagonal Close Packed Planar)

Question THREE

(a). Complete the following Equations.

(i). $Na_2CO_3.10H_2O_{(s)} \xrightarrow{Heat}$

(ii). $NaNO_{3(s)} \xrightarrow{Heat}$

(2 Marks)

(b). List **SIX** uses of salts.

(3 Marks)

(d). Write the net ionic equation for the following reactions:

(i). Calcium Chloride + Sodium Carbonate $\longrightarrow$

(ii). Silver Nitrate + Sodium Chloride $\longrightarrow$

(3 Marks)

(e). (i). A quantity of $1.00\times10^2\,ml$ of $0.500M$ Hcl is mixed with $1.00\times10^2\,ml$ of $0.500M$ NaOH in a constant pressure Calorimeter having a heat capacity of 335J/ºC. The initial Temperature of Hcl and NaOH solution is the same, 22.50ºC and the final temperature of the solution is 24.90ºC. Calculate the heat changes for the neutralization reaction. **(5 Marks)**

(ii). Define the following terms:

(i). Specific heat
(ii). Heat capacity
(iii). Calorimetry

(3 Marks)

(iii). Calculate the molar enthalpy of combustion of Methanol, CH_3OH from the following data:

Volume of water	=	500cm^3
Temperature change of water	=	7.0ºC
Mass of CH_3OH count	=	0.87g
Density of water 1g/cm^3		
Specific heat capacity of water	=	418J/Gk

(4 Marks)

SECTION C - Answer ONE Question

Question FOUR

(a). Using a diagram explain the essential features of the astronomical telescope. Define and deduce an expression for the magnifying power. **(7 Marks)**

(b). (i). Explain the differences between light and sound waves.

(ii). Describe a simple experiment you would perform to determine the velocity of sound using the echo method.

(iii). A person standing 99m from the fort of a tall cliff claps his hands and hears an echo 0.6 seconds later. Calculate the velocity of sound in air.

(13 Marks)

Question FIVE

(a). (i). Define the terms:

(I). Wavelength
(II). Amplitude
(III). Super position of waves

(ii). Show that the velocity of a particle of any instant in a ware is given by:

$$V = \frac{2\pi a}{T}\cos 2\pi\left(\frac{t}{T} - \frac{x}{y}\right)$$

(12 Marks)

(b). (i). Define diffraction.

(ii). Describe with aid of diagrams what happens when a plane waves are incident on the gap between two obstacles as in a ripple tank.

(8 Marks)