



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN CHEMICAL ENGINEERING

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
- Mathematical table

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 from each part of a question are as shown.

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

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SECTION A

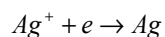
Question ONE

- (a). (i). State the laws of refraction.
- (ii). A ray of light is incident in water at an angle of; (I). 30° , (II). 70° on a water glass plane surface. Calculate the angle of refraction in the glass in each case. Take $n_g = 1.5$, $n_w = 1.33$
- (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 $n_g = 1.5$.
- (10 Marks)**
- (b). Define;
- (i). The standard heat of formation.
- (ii). The standard heat of combustion.
- (c). Given that the standard heats of combustion of butanol ($C_4H_{10}O$), carbon and hydrogen are -2671 , -393 and -286 KJ/mol respectively, calculate with the aid of an energy cycle diagram the heat of formation of butanol. **(10 Marks)**

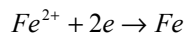
SECTION B - Answer ONE Question

Question TWO

- (a). Determine the oxidation number of chromium in the following species:
- (i). CrO_3 (ii). CrO_4^{2-} (iii). $Cr_2O_7^{2-}$ (iv). Cr_2O_3 (v). CrO^{2+}
- (5 Marks)**
- (b). State what has been reduced and what has been oxidized in the following equations:
- (i). $CuO + H_2 \rightarrow Cu + H_2O$
- (ii). $2FeCl_2 + Cl_2 \rightarrow FeCl_3$ **(4 Marks)**
- (c). Obtain separate half-equations and hence overall equation for the redox reaction between MnO_4^- and SO_4^{2-} . **(7 Marks)**
- (d). A galvanic cell consists of a silver electrode in 1.0M Ag^+ solution and an iron electrode in 1.0M Fe^{2+} solution. Calculate the emf of the cell and write the overall reaction given:



$$E^o = 0.80V$$



$$E^{\circ} = -0.44V$$

Question THREE

- (a). Draw a diagram showing how the apparatus for the determination of the standard electrode potential of $Fe^{3+}_{(aq)} / Fe^{2+}_{(aq)}$ would be assembled. **(4 Marks)**
- (b). Use chemical equations to illustrate how HSO_4^- can act as:
- Arrhenius and
 - Bronsted – Lowry acid
 - Bronsted – Lowry base
- (3 Marks)**
- (c). Identify the conjugate acid – base pairs in the following reactions:
- $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$
 - $2H_3O^+ + S^{2-} \rightarrow 2H_2O + H_2S$
- (4 Marks)**
- (d). Calculate the P^H of the following:
- 0.02M H_3PO_4
 - 0.02M $Ca(OH)_2$
- (4 Marks)**
- (e). Write the structural formula of all compounds having the formula C_6H_{14} and name them. **(5 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 foot 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 wave is given by:

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

(12 Marks)

(b). (i). Define diffraction.

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

(8 Marks)