TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL & AUTOMOTIVE ENGINEERING

SPH 2174: PHYSICS FOR ENGINEERS II

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FOUR** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

Question One (Compulsory)

[Multi-choice & True (T) on false (T) Questions]
Choose the most correct option(s) **(20 marks)**

a) A Photon is a particle that:
- **A.** has zero electric charge
- **B.** has zero electric field associated with it
- **C.** cannot travel in a vacuum
- **D.** has a velocity in a vacuum that varies with the photon frequency **(2 marks)**

b) Which type of mirror always makes an image smaller than the object:
- **A.** Planar

B. Concave
C. Convex **(2 marks)**

c) A tiny ball is suspended on a thread. Some tests show it gets attracted to a positively charged rod, and repelled by a negatively charged rod. What can be concluded about this ball:

A. It has a negative net charge
B. It has a zero net charge
C. It has a positive net charge
D. Its net charge changes when the rods are placed near it **(2 marks)**

d) What quantity is being used up when current flows through a resistor R?
A. Voltage across R
B. Current through R
C. Potential energy of charges **(2 marks)**

e) A region has a uniform magnetic field pointing horizontally to the right as shown in the figure. The magnetic force on a proton instantaneously moving into the page points:

B

A. Upwards
B. Downwards
C. To the left
D. To the right
E. Into the page
F. Out of the page

f) Choose T or F for the correct option:
(i) On a equipotential surface, the electric is a constant T F **(2 marks)**
(ii) The focal length of a plane mirror is infinite T F **(2 marks)**
(iii) A change in sound level by +3.0 decibels corresponds to a tripling of the sound intensity T F

(iv) A standard 100-watt incandescent light bulb uses 100 watts of power for any applied voltage T F **(2 marks)**
(v) The separation between adjacent maxima in a double-slit interference pattern using a monochromatic light is greatest for red light TF **(2 marks)**

g)

water

h) Peter can just see the drain at the bottom centre of a water-filled pool (n = 1.33) that is 3.5m wide by light emerging 20^o above the horizontal, as shown in the figure above. How deep is the pool? **(5 marks)**

i) Jane's eyes need reading glasses with power of +1.25 diopters to read a book held 25cm from the eye. The lens are held 2.5cm in front of the eye. Suppose the right and left eyes behave the same.

(i) What eye defect is Jane suffering from? **(1 mark)**

(ii) What corrective lens does Jane require? **(1 mark)**

(iii) What is Jane's near point if reading glasses are not being used? **(3 marks)**

Question Two

a) Draw electric field lines for a pair of equal and opposite charges separated by equal and opposite charges separated by some finite distance. **(2 marks)**

b) Lightening occurs when there is a flow of electric charge (principally electrons) between the ground and a thunder cloud. The maximum rate of charge flow in a lightning bolt is about 20000 C/s; this last for 100 μs or less.

(i) How much charge flows between the ground and the cloud in this time? **(2 marks)**

(ii) How many electrons flow during this time? **(2 marks)**

c) Two charges, $Q_1 = -30\mu C$ and $Q_2 = +30\mu C$ are arranged on the x-axis as shown below:

A

(i) Find the electric field that Q_1 produces at point B. Indicate its direction (using an arrow and label it $\vec{E}_1$) on the diagram. **(4 marks)**

(ii) Find the electric field that Q_2 produces at point B. Indicate its direction (using an arrow & label it $\vec{E}_2$) on the diagram. **(4 marks)**

(iii) Find the net electric field at point B (from your results in (i) and (ii) above). Give its magnitude and direction. **(3 marks)**

(iv) If a dust particle with charge $q = -1.0\mu C$ floats to point B, find the magnitude and direction of the electric force $\vec{F}$ that acts on it. **(3 marks)**

Question Three

a) Define the following terms as applied to a wave:

(i) Amplitude
(ii) Period
(iii) Phase angle
(iv) Frequency **(4 marks)**

b) Differentiate between transverse waves and longitudinal waves. Give an example in each case. **(4 marks)**

c) 4.0cm long nolin string has a mass per unit length of 0.15g/cm and a tension of 500N:

(i) What is the wave speed on this string? **(3 marks)**
(ii) What is the wavelength if the string is standing in a "three-loop standing" pattern? **(3 marks)**
(iii) For the three-loop standing wave pattern, what is the frequency **(2 marks)**

d) A mosquito that is 2.5m from your left ear is buzzing at a frequency of 230Hz. Your ear defects a sound level of 25dB from the mosquito. Find the sound intensity that the mosquito produces measured at your right ear. (Your answer should be in W/m^2) **(4 marks)**

Question Four

a) (i) State Kirchhoff's circuit rule for potential difference **(2 marks)**

(ii) Indicate the sign conventions used for voltages in using Kirchhoff's circuit rules. **(2 marks)**

b) Consider a simple circuit consisting of two resistors that are connected as shown below:

I_1

(i) Are the two resistors in series or parallel **(1 mark)**

(ii) If the current through R_1 is 0.6A, how large is the current through R_e? **(4 marks)**

(iii) Find the effective resistance which is equivalent to R_1 and R_2 in the circuit above. **(3 marks)**

c) The circuit above is now connected to a larger circuit as shown below (with the currents I_1 and I_2 as above). The sources have negligible internal resistance.

I_2

(i) Find the currents through R_3 and R_4 in the circuit above **(6 marks)**

(ii) Find the rate of energy consumption in R_3 **(3 marks)**