TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELETRICAL AND ELECTRONIC ENGINEERING

APS 2150 : PHYSIAL SCIENCE

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2019

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

__Instructions to Candidates__
You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of FIVE questions.
 Attempt Question any THREE **Questions.**
Do not write on the question paper.

QUESTION ONE (Compulsory)

a) Define the following terms

    i)   Binding energy

    ii)   Half – life

    iii)   Isotope

    iv)   Enthalpy   (4marks)

b) With the aid of a diagram, explain how X – rays are produced in a modern x – ray tube   (7marks)

c) State any THREE factors affecting electrolysis   (3marks)

d) A 1kW immersion heater is used to heat 5×10^{-3} m^3 of water (density = 100kg/m^3) containing 500g ice at 0°C. Calculate the time taken to boil away the mixture at 100°C given 30% of heat is lost to the surrounding. (Take c = 4200J/kg/K, L$_v$ = 33600 J/kg, L$_f$= 2260J/kg)   (6marks)

QUESTION TWO

a)

    i)   State the mathematical form of decay law

    ii)   Prove that half-life of a radioactive sample t$_{1/2}$ is given by:

$$t_{1/2} = \frac{In\ 2}{\lambda}$$

(6marks)

b) If the half-life of radioactive isotope Y is 20 minutes, determine the fraction of the

original mass of Y which would have decayed after 2 hours.   (4marks)

c) With the aid of a diagram, explain how a Geiger Muller tube operates as a radioactive detector.

(5marks)

d) An X- ray tube operates at 30 KV and the current through it is 2 mA. If the ratio e/M$_e$ =1.8 X 10^{-11} Ckg^{-1} .Where: e= Charge on an electron

                  M$_e$= Mass of an electron

   Determine:

    i)   The electric power input

    ii)   The number of electrons striking the target

    iii)   The speed of the electrons as they strike the target

    iv)   The lower wavelength of the X- ray emitted. (e = 1.6 x 10^{-19} c, h = 6.63 x 10^{-34})   (5marks)

QUESTION THREE

a)

    i)   Distinguish between the following terms:

I)   Transverse and longitudinal waves

II)   Amplitude and wavelength

ii)   A transverse wave of amplitude 2.5 cm and wavelength 3 cm travels 25.2 cm in 1.2 seconds. Determine the frequency of the wave.   (6marks)

b) Explain THREE factors affecting the velocity of sound in a gas   (6marks)

c) Sketch the diagram for electromagnetic spectrum and state an application for each section of band frequency   (5marks)

iii)   A band of radio waves has a range of wavelength 50 – 100 m. Determine the corresponding range of frequencies and the energy of the shortest wavelength.

(Plank's constant, $h = 6.63 \times 10^{-34}$)   (3marks)

QUESTION FOUR

a)

i)   Define simple harmonic motion. (S.H.M.)

ii)   State the relationship between displacement from a mean position and restoring force when a body executes S.H.M.   (3marks)

b) With the aid of a sketch, show that the periodic time for a simple oscillating pendulum is given by:

$$T = 2\pi \, [l/g]^{1/2}$$

Where: l is the length of the pendulum

g is the earth's gravitational field strength   (6marks)

c) A small bob of mass 20g oscillates as a simple pendulum with amplitude 5cm and period of 2 seconds. Determine:

I)   The velocity of the bob

II)   The tension in the supporting string when the velocity is maximum   (8marks)

d) Sketch, on the same axes, the displacement-time graph to illustrate the three types of damped vibrations

     (3marks)

QUESTION FIVE

a)

i)   State Boyle's law

ii)   Use Boyle's and Charles laws to show that for a perfect gas;

$$PV = RT$$

Where: P is the gas pressure,

V is volume of the gas,

T is the gas temperature and

R is the Gas mole constant   (5marks)

b) $125cm^3$ of a gas is collected at 15℃ and 755 mmHg. Calculate the volume of the gas at S.t.p

(760   Hg and 0℃)   (3marks)

c)

   i)   Define the term mole

   ii)   A compound P contains 73.5% carbon and 10.2% hydrogen. The rest is oxygen. Determine
             molar mass of P. (C = 12, H = 1, O = 16)   (5marks)

d) Graphite and diamond are two allotropes of carbon. In terms of structure and bonding, explain why
    graphite is a good conductor of electricity while diamond is not   (2marks).

e)

   i)   What is electrolysis?

   ii)   During purification of copper by electrolysis, 1.48 g of copper were deposited when current was
             passed through aqueous copper (II) sulphate for 2 ½ hours. Calculate the amount of current used.
             (Cu = 63.5, 1 Faraday = 96500℃).   (5marks)