TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

APS 2150: PHYSICAL 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 other THREE **Questions**
Do not write on the question paper.

QUESTION ONE

Define the following terms:

i) Binding energy
ii) Half – life
iii) Radioisotope (3marks)

a) With the aid of a diagram, explain how a Geiger Muller tube operates as a radioactive detector (7marks)

b) A parnt atom X of mass number 238, atomic number 92 undergoes two alpha decays followed by a beta decay to form an atom Y.
   i) Write a balanced equation for this process.
   ii) Determine the atomic number and mass number of Y.

iii) If the half-life of Y is 20 minutes, determine the fraction of the original mass of Y which would have decayed after 2 hours. (5marks)

c) The activity of a sample of radioactive element against time is recorded in table 1 below.

Table 1

Activity (count per minute)	800	500	350	200	80	25
Time (minutes)	0	1.0	1.8	3.0	5.0	7.5

Plot the graph of activity against time. Hence determine the half – life of the element. (5marks)

QUESTION TWO

a) Distinguish between the following terms giving an example of each:

i) Transverse wave

ii) Longitudinal waves. (4marks)

b)

i) Sate any TWO conditions necessary for stationary waves to be formed

ii) With the aid of diagrams, illustrate three characteristics of stationary waves that distinguish them from progressive waves. (5marks)

c)

i) Define the term electromagnetic spectrum

ii) Name any TWO electromagnetic waves with wavelengths shorter than that of visible light

iii) State the use of each wave/radiation named in c (ii) above. (5marks)

d) Plane waves of wavelength 4cm travelling at $30cms^{-1}$ asses from medium A to medium B at an angle of 40^{O} to common boundary of the media. The velocity of medium B is $20cms^{-1}$. Determine

I) Frequency of the wave

II) The wavelength in medium B

III) The refractive index of medium B (6marks)

QUESTION THREE

a) Define:

i) Latent heat

ii) Specific heat capacity

iii) Absolute zero temperature (3marks)

b) Explain why water is preferred to oil as a coolant in motor vehicle radiators (2marks)

c) With the aid of a diagram, describe the electrical method to determine the specific heat capacity of a solid which is a good conductor of heat. (8marks)

d) A 2kW immersion heater is used to heat 500g of ice initially at $-10^{O}C$. Determine the time it would have to completely boil away the ice. Assume no losses in heat ($Cw = 4200Jkg^{-1}K^{-1}$, $Ci = 2100\ Jkg^{-1}K^{-1}$, $Lf = 3.4x10^{5}Jkg^{-1}$ $Lv = 2.3x10^{6}Jkg^{-1}$) (7marks)

QUESTION FOUR

a)

i) Define simple harmonic motion (S.H.M.) (1mark)

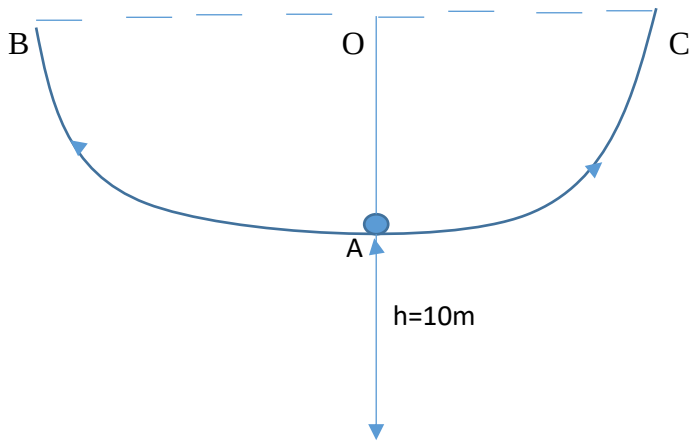
ii) On the same axes, sketch a graph of displacement against time to represent:

I) Free oscillation

II) Underdamped oscillation

III) Critically damped oscillation (3maks)

b) A bob of mass 0.5kg swings in a vertical plane between points B and C as shown in fig. 1



i) Sketch the diagram and show:
   I) Position of maximum kinetic energy
   II) Position of minimum potential energy
   III) The initial path of the bob if the string broke when it was in position A (3marks)

ii) If the string broke when the bob was at A, determine:
   I) How long it would reach the ground if the speed at A is 20m/s
   II) The horizontal distance covered (6marks)

c) A bob of mass 20g oscillates as a simple pendulum with amplitude 5cm and period 2 seconds. Determine:
   i) The maximum velocity of the bob
   ii) The tension in the supporting thread when the velocity of the bob is maximum (7marks)

QUESTION FIVE

a)
   i) Define the terms:
      I) Mole
      II) Electrolyte
   ii) Given Avogadro number L = $6x10^{23}$ atoms, calculate the number of atoms in 0.4g of oxygen. (4marks)

b) A substance contains 25.6% copper, 12.8% sulphur 26.5% oxygen and 36% water of crystallization. Determine its empirical formula. (Cu = 64, S = 32, O = 16) (4marks)

c)
   i) State Faraday's first law of 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)

d)
   i) Graphite and diamond are two allotropes of carbon. In terms of structure and bonding, explain why diamond is hard while graphite is soft.
   ii) State two uses of:
      I) Diamond
      II) Graphite (7marks)