DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

UNIVERSITY EXAMINATIONS 2020/2021 ACADEMIC YEAR

FOUTH YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF IN BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING AND BACHELOR OF EDUCATION TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

SPH 1222/SPH 2174/2171 PHYSIC II

DATE: 24/9/2021 TIME: 8.30AM-10.30AM

Constants

1. Charge of an electron $=1.602\times10^{-19}$ C
2. Speed of light $c= 3\times10^{8}$ m/s
3. Permittivity of free space $= 8.854\times10^{-12}$ F/m
4. Mass of proton = 1.007 3a.m.u
5. Mass of Newton = 1.0087 a.m.u
6. Mass of electron $=9.11\times10^{-31}$kg
7. Planks constant $h=6.63\times10^{-34}$ J.S
8. $r_0=1.2\times10^{-15}$ m
9. $R_H=1.097\times10^{7}$/m
10. 1 a.m.u $=1.66\times10^{-27}$ kg
11. 1 a.m.u = 931 MeV

INSTRUCTIONS

Answers question **one** and any other **two** questions.

QUESTION ONE (30 MARKS)

(a) Define the following terms

(i) Binding energy. **(1 mark)**

(ii) Potential. **(1 mark)**

(iii) Current density. **(1 mark)**

(b) State three applications of radioactive elements. **(3marks)**

(c) Differentiate between X-rays and gamma rays. **(3 marks)**

(d) A capacitor of 80 μF and another of 60μF capacitance is charged by connecting it across a 12 Vd.c supply .Calculate the energy stored in the capacitor and the charge on the capacitor.**(3 marks)**

(e) Show that the number of atoms N left after disintegration is always given by $N = N_O e^{-\lambda t}$ where all the symbols have their usual meaning. **(4marks)**

(f) Two charges are placed 140cm apart .If the charges are $-3.5x10^{-8}C$ *and* $4.5x10^{-8}$. Determine the potential (V) at the midpoint between them**.** **(3 marks)**

(g) A certain radioactive atom has a mass of 19.021a.m.u.Determine its binding energy if it has a mass number of twenty and atomic number of eleven. **(3 marks)**

(h) A coil of aluminum wire has a resistance of 80 Ω when its temperature is $20°C$ .Determine its resistance at $240°C$ if the temperature coefficient of resistance of aluminum at $20°C$ is $0.0039/°C$. **(3 marks)**

(i) An electron is transferred through a p.d fo 150,000 V .If all the energy is converted to electromagnetic radiation, determine the frequency of the electromagnetic wave produced. **(3marks)**

(j) Determine the standard value of the following carbon coded resistor

Blue – Yellow – Black – red. **(2marks)**

QUESTION TWO (20MARKS)

(a) State

(i) Lenz's Law. **(1mark)**

(ii) Right hand grip rule. **(1marks)**

(b) State two application of magnets. **(2 marks)**

(c) Determine the total flux emerging from a magnetic pole face having dimension of 20 mm by 25mm, if the flux density is 1.6T. **(3marks)**

(d) A flux of 3000Wb takes two minutes to pass through a coil. Find the rate at which the flux changes.**(3 marks)**

(e) An R-L d.c circuit consists a 60mH inductor ,a 50Ω resistor and a 60 V battery. The switch is closed at time is equal to zero seconds. Determine

(i) the time constant of the circuit **.(3marks)**

(ii) the current in the circuit at $t = 0.002$ seconds. **(4marks)**

(f) Calculate the force exerted on a charge of $2x10^{-18}C$ traveling at $3x10^{8}\frac{m}{s}$ at an angle of 80°to a field of density of 0.005T. **(3marks)**

QUESTION THREE (20MARKS)

(a) State Kirchhoff's loop law. **(1mark)**

(b) State and explain two factors that affect the resistance of a conductor. **(3 marks)**

(c) An electron is transferred through a p.d of 2 G V .If all the energy is converted to electromagnetic radiation, determine the wavelength of the electromagnetic wave produced. **(3marks)**

(d) An electron is transferred through a potentialof 160,000V in an X-ray tube,calculate the maximum speed the electron will attain as it strikes the anode. **(4 marks)**

(e) A person is provided with a battery of 12V, three resistors 12Ω,5Ω and 7Ω.If the person is to supply 6V to a radio .Draw and explain how the person will do it. **(4 marks)**

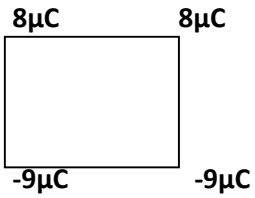
(f) Two resistors 60 Ωand 30 Ω are connected in parallel. This parallel is connected to Y Ω resistor. If they are connected to 20Vd.c and the power dissipated by the circuit is 60W , determine the value of Y**.(5 marks)**

QUESTION FOUR (20MARKS)

(a) State Coulomb`s law. **(1mark)**

(b) State three characteristics of electric field lines. **(3marks)**

(c) Two positive charges each of 8μC and two negative charges of - 9 μC are fixed at the corners of asquare of sides 100cm.Determine the electric field at the centre of the square**.** **(6marks).**



(d) An 100μF capacitor is charged to a potential of 1500V.The terminals of the charged capacitor is then disconnected and connected to 40μF capacitor, determine the change in energy in the two systems i.e original and final system**.** **(4 marks**)

(e) A capacitor of plate area 100mm^2 has a dielectric 2.5mm thick. If the dielectric constant is five and the capacitor is connected across 24 V .Determine

(i) The capacitance of the capacitor. **(3 marks)**

(ii) Electric field strength in the dielectric. **(3marks)**

QUESTION FIVE (20MARKS)

(a) State three applications of radio – activity **.** **(3 marks)**

(b) Write four characteristics of X-rays **.** **(2 marks)**

(c) Determine the potential difference through which an electron must be accelerated in order that the continuous x- rays produced shall have a wavelength of 6.2 picometres**.** **(4marks)**

(d) Calculate the longest wavelength of a Lyman series**.** **(4 marks)**

(e) For a liquid drop model shows that the density of the nucleus is $\rho = 2.3x10^{17}kg/m^3$**(4 marks)**

(f) The uranium isotope has a half life of 5.3 x 10^{10} years. Determine its decay constant**.(3marks)**