KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION SCIENCE

COURSE CODE: **CHEM 422**

COURSE TITLE: **RADIATION AND NUCLEAR CHEMISTRY**

STREAM: **Y4S2**

DAY: **TUESDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **16/03/2010**

INSTRUCTIONS:

Attempt **all** questions

Each Question = **17.5 marks**

Periodic Table provided,

Mass of particles: 1 proton = 1.0073 amu, 1 neutron = 1.0087 amu, 1 electron = 0.00054858 amu , 1 joule = 1 Kgm^2/s^2, 1 amu = 1.66056520 x 10^{-24} gms, Avogadro's No = 6.022 x 10^{23}

C = 3.0 x 10^8 m/s

PLEASE TURN OVER

1. (a) State the law of nuclear reaction and explain the difference between this law and the law of chemical reactions? **(5 mks)**

(b) Define binding energy and explain the relationship between binding energy and mass deficiency of a nucleus of an atom? **(5 mks)**

(c) The actual mass of Pd -108 atom is 107.90389 amu. Calculate (i) Mass deficiency in amu per atom (ii) Mass deficiency in grams per mole (iii) Binding energy in joules per mole of Pd. **(7 mks)**

2. (a) Define radioactivity and explain why radioactive isotopes undergo decay? **(2.5 mks)**

(b) Discuss briefly on (i) alpha decay, (ii) Beta decay (iii) Internal conversion decay. **(9 mks)**

(c) Write nuclear equation for each of the following bombardment processes: **(6 mks)**

(i) $^{113}_{48}Cd\ (n, \gamma)\ ^{114}_{48}Cd$ (ii) $^{6}_{2}Li\ (n, \alpha)\ ^{3}_{1}H$ (iii) $^{2}_{1}H\ (\gamma, p)$ X. Identify X

3. (a) (i) Define activity of a radiation **(1 mks)**

(ii) A radioactive nuclide often used in medical procedures Tc-99 undergo gamma decay with a half-life of 6 hours. The decay constant $\lambda = 0.115h^{-1}$. Calculate the amount of time it takes for the activity injected to a patient to reduce to 0.1% of the original amount. **(4 mks)**

(b) (i) Calculate the decay constant for a radioactive sample of Ar-37, if it takes 100 days for 86.3% of the sample to decay. **(4 mks)**

(ii) A detector used to count NSIT standard reference materials records a counting rate of 500 counts per second (cps). The certified value for standard is 1200 cps. Calculate the efficiency of the detector. **(2 mks)**

(c) (i) What is specific activity (SA) of a sample of a radionuclide? **(2 mks)**

(ii) A sample of 0.250 gm of a pure radioactive with mass number of 244 was observed to have absolute activity of 4.45 μCi. Calculate the half-life of the radionuclide. **(4.5 mks)**

4. (a) (i) Discuss by using example the difference between nuclear fusion and nuclear fission. **(2 mks)**

(ii) What is "Range of a radiation" (iii) Give four factors that affects the range of a radiation. **(4 mks)**

(b) (i) Describe the method of radiocarbon dating in determining the age of a material. **(3 mks)**

(ii) The C-14 activity of an artifact from the tomb of Hemaka (2930 BC) was 8.3 disintegration per min per gram of carbon. The half-life of C-14 is 5730 years and the current C-14 activity is 15.3 disintegration per min per gram of carbon. How old is the artifact? **(3.5 mks)**

(c) (i) Explain why it is easier for a nucleus to capture a neutron than a proton? **(1 mks)**

(ii) Name four devices used in detecting radiation. **(2 mks)**

(iii) Discuss the application of radionuclide in Agriculture sector. **(2 mks)**