KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION SCIENCE

COURSE CODE: PHYS 413

COURSE TITLE: NUCLEAR PHYSICS

STREAM: SESSION VII

DAY: FRIDAY

TIME: 9.00 – 11.00 A.M.

DATE: 27/11/2009

INSTRUCTIONS:

ANSWER QUESTION 1 **(COMPULSORY)** and any **OTHER TWO**

PLEASE TURN OVER

NOTE:

Take the following;

1. Atomic mass for:
   (i) = 97.9127
   (ii) = 134.9165
   (iii) = 1.008665
   (iv) = 235.0439234

2. 1 = 931.494 Me
   = 1.49×10^{-10}J
   = 1.66×10^{-27} Kg

QUESTION ONE

(a) Identify the missing nuclei in each of the following reactions.

(i) → + (1 mk)

(ii) → β+ (1 mk)

(iii) → + α (1 mk)

(iv) → β + (1 mk)

(v) 0 + ⁻ → (1 mk)

(b) Explain the following statements:

(i) Nuclear force is a STRONG, SHORT RANGE ATTRACTIVE and CHARGE INDEPENDENT. (7 mks)

(ii) In spite of its strength, the nuclear force is not able to hold together many protons. (2 mks)

(c) The count rate of radioactive nuclei is 8576 counts per minute. How long will it take for the count rate to drop to below 100 counts per minute? Take the half-life of nuclei to be 2.5 minutes. (6 mks)

(d) Radioactive isotopes used in medicine must have a short half-life. Why? (2 mks)

(e) Radium nucleus undergoes an alpha emission according to

$\rightarrow$ +

Show that the kinetic energy of alpha particle

$E_{kinetic} = 4.78$

M( ) = 226.025403 μ

M( ) = 222.017570 μ

M( ) = 4.002603 μ (8 mks)

(f) In an experiment to find the half life of some radioactive nuclei, the following count rates were obtained.

Time (Hrs)	0	1	2	3	4	5
Count Rate	78	49	31	20	12	8

(i) Plot the decay curve (4 mks)

(ii) From the curve, determine the half-life (3 mks)

(iii) How long will it take for 98% of the original nuclei to decay? (3 mks)

QUESTION TWO

The following is a fission reaction + $\rightarrow$ + (+ 3)

Calculate the mass of uranium which will produce the same energy as 1 ton of

Coal (= 3.3 × 10) (15 mks)

QUESTION THREE

At time = 0, radioactive sample contains 8.5g of pure $^{226}_{88}$.

This isotope has half life of 1.6 × 10 years.

Calculate;

a) The decay constant (7 mks)

b) The activity after the sample is 2.4 × 10 years old. (8 mks)

QUESTION FOUR

According to the liquid - drop model, the expression for the total binding energy is

$$= \quad - \quad - \quad \frac{(\quad)}{\quad} - \quad \frac{(\quad)}{\quad}$$

Where the constants $= 15.7$ $= 17.8$ $= 0.71$ $\forall$ and

$= 23.6$ refer to the four major effects influencing the binding energy.

(i) Discuss these four effects (8 mks)

(ii) Estimate the binding energy per nucleon for the nucleus of (5 mks)

(iii) What is the short coming of this model (2 mks)