RH = /100 CH1 = /100 CH2 = /100

PHYS 202 TEST #5 DR. HOLMES 4/29/19 NAME Key

Do all the problems. The worth of each problem is marked [ ] beside the problem. Show your work for partial credit. If you do not know the name of an element but only know its atomic number and mass number, then use X as the name of the element.

1) a) Is there a maximum or a minimum (other than zero) x-ray energy from an x-ray machine?

[1] **maximum** . b) What is this (maximum or minimum) energy of the photons from an x-ray machine using 8,500 volts?

[4] **8,500 eV = 1.36 x 10^{-15} J** . c) Is there a maximum or a minimum (other than zero) photon wavelength from an x-ray machine?

[1] **minimum** . d) What is this (maximum or minimum) wavelength of the photons from an x-ray machine using 8,500 volts?

[4] **1.46 x 10^{-10} m** . e) Is this wavelength much smaller than, about the same size as (within a factor of 100), or much larger than the size of an atom?

[1] **about the same** . f) If $_{27}$Co (Cobalt) is the target material and the above voltage is used, will characteristic radiation occur?

[1] **no** . g) If $_{47}$Ag (Silver) is the target material and the above voltage is used, will characteristic radiation occur?

[1] **no** .

2) a) Explain what happens in alpha decay: [3]

b) Explain what happens in β^- decay: [3]

c) Explain what happens in β^+ decay: [3]

d) Can α, β, or γ radiations make atoms radioactive?

[1] **no**

e) If yes, which of these can; if no, what can? [1] **neutrons**

3) Fill in the missing particle(s):

[1] $_{88}Rd^{226}$ goes to $_{86}X^{222}$ + alpha + energy

[3] $_{53}I^{122}$ goes to $_{52}X^{122}$ + $_{+1}\beta^{o}$ + $_{o}\nu^{o}$

[3] $_{53}I^{131}$ goes to $_{54}X^{131}$ + $_{-1}\beta^{o}$ + **anti-**$_{o}\nu^{o}$

[3] $_{27}Co^{58}$ goes to $_{26}X^{58}$ + $_{+1}\beta^{o}$ + $_{o}\nu^{o}$

(the one stable isotope of $_{53}I$ is 127; the one stable isotope of $_{27}Co$ is 59)

4) a) Given that the half life of $_{53}I^{122}$ is 3.5 minutes, what is the decay constant, λ, for this isotope?

[4] **3.30×10^{-3} / sec**. b) How many atoms of I^{122} are there in 1 gram?

[1] **4.92×10^{21}**.

c) What is the activity of 1 gram of I^{122} in dis/sec? In Curies ?

[3] **1.62×10^{19} Bq**. [1] **4.39×10^{8} Ci**.

d) What will be the activity of this one gram after 3 hours (in dis/sec) ?

[4] **5,350 Bq.**.

5) C^{14} has a half life of 5,730 years, and the ratio of C^{14} to C^{12} is 1.3×10^{-12}. a) What is the decay constant, λ, for C^{14} ?

[3] **3.84×10^{-12} / sec**. b) How many atoms of C^{14} are there in **4 grams** of carbon, assuming the ratio given above?

[1] **2.6×10^{11}**. c) What is the present activity of **4 grams** of carbon taken from a modern "bone" (this assumes the present ratio of C^{14} to C^{12}) ? Express your answer in two forms: in dis/sec: and in Curies:

[3] **1.0** [1] **2.70×10^{-11}**.

d) Assuming the ratio of C^{14} to C^{12} in the atmosphere has remained the same, what should the age of a bone be if 4 grams of carbon taken from the bone have an activity of 0.24 counts/sec ?

[5] **11,800 years**.

6) The half life of $_{53}I^{122}$ is 3.5 minutes and the half life of $_{53}I^{131}$ is 8 days.
a) If there is one gram of each, which (I^{122} or I^{131}) will have the higher activity initially?

[3] I^{122}. b) Which will have the higher activity after 1 month?

[3] I^{131}.

7) The radioactive isotope $_{88}Rd^{226}$ is found in nature (part of the uranium decay sequence).
a) Which stable isotope will it eventually decay into?

[3] $_{82}Pb^{206}$.

b) How many alphas will be emitted as it does decay to this stable isotope?

[3] 5.

c) How many betas will be emitted in this decay process?

[3] 4.

8) a) **Tell what each measures** (absorbed dose, exposure dose, activity)., and **define** the four measures of radioactivity

1) Curie: [2]

2) Roentgen: [2]

3) Rad: [2]

4) Rem: [2]

b) What is the average background radiation (in millirems/year) ?

[1] 200 - 300.

c) What acute dose of radiation will begin to cause some people to die of radiation sickness (in millirems) ?

[1] 200,000.

9) a) What is the linear hypothesis as applied to long-term dangers from radiation? [2]

b) What is the idea of hormesis as applied to long-term dangers from radiation? [2]

10) a) What is a chain reaction with respect to nuclear energy? [2]

b) Why is a moderator used in a nuclear reactor:

1. what does it do? [2]

2. why is it necessary? [2]

c) Name two materials that can be effectively used as a moderator in a nuclear reactor:

1. [1]

2. [1]

d) Can a nuclear reactor explode as a nuclear bomb?

[1] _____.

e) Explain your answer to part d above: [2]