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 7,500 volts?

[4] **7,500 eV = 1.2 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 7,500 volts?

[4] **1.66 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] **yes** .

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

b) Explain what happens in $\beta^-$ decay: [3]

c) Explain what happens in $\beta^+$ decay: [3]

d) Can $\alpha$, $\beta$, or $\gamma$ 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] $_{86}Rn^{222}$ goes to $_{84}X^{218}$ + alpha + energy

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

[3] $_{27}Co^{60}$ goes to $_{28}X^{60}$ + $_{-1}\beta^{o}$ + 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 $_{53}I^{131}$ is 8 days, what is the decay constant, $\lambda$, for this isotope?

[4] 1.00 x $10^{-6}$ / sec. b) How many atoms of $I^{131}$ are there in 1 gram?

[1] 4.58 x $10^{21}$.

c) What is the activity of 1 gram of $I^{131}$ in dis/sec? In Curies ?

[3] 4.59 x $10^{15}$ Bq. [1] 1.24 x $10^{5}$ Ci.

d) What will be the activity of this one gram after 1 year (in dis/sec) ?

[4] 85 Bq.

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

[3] 3.84 x $10^{-12}$ / sec. b) How many atoms of $C^{14}$ are there in **2 grams** of carbon, assuming the ratio given above?

[1] 1.3 x $10^{11}$. c) What is the present activity of **2 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] 0.50 [1] 1.35 x $10^{-11}$.

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 2 grams of carbon taken from the bone have an activity of 0.14 counts/sec ?

[5] 10,500 years.

6) The half life of $_{27}Co^{58}$ is 71 days and the half life of $_{27}Co^{60}$ is 5.27 years.
a) If there is one gram of each, which ($Co^{58}$ or $Co^{60}$) will have the higher activity initially?

[3] ___$Co^{58}$___. b) Which will have the higher activity after 5 years?

[3] ___$Co^{60}$___.

7) The radioactive isotope $_{86}Rn^{222}$ 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] ___4___.

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] ___no___.

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