私立臺北醫學院 89 學年度第 2 學期 期中 期末 考試 命(試)題紙

系級	科目	授課教師	考試日期	學號	姓名
公一	普通物理學	蔡文鋒	90年6月22日第1,2節		

※①請注意本試題共 2 張。如發現頁數不足及空白頁或缺印，應當場請求補齊，否則缺少部份概以零分計。
②每張試題卷務必填寫(學號)、(姓名)。

(1) Assume that a radioactive material has half life $T_h = 3.83$ days and initial radioactive nuclei N_0. According to the radioactive decay law, its radioactivity A at time t is related to its initial radioactivity $A_0 = 1.8$ mCi by the relationship $A = A_0\ e^{-\lambda t}$, where λ is its decay constant.

(a) **Calculate** the average life T_a of this radioactive material in unit of day.

(b) The actual radioactivity A of the radioactive material at its average life T_a is ___?___ mCi.

(c) The initial radioactive nuclides N_0 is also called ___?___ .

(d) Write down the relationship among N_0 , A_0 , and T_a : ___?___

(e) **Calculate** the number of N_0 = ___?___ mCi-hr = ___?___ nuclei . (1 Ci = 3.7×10^{10} dps)

(2) A 5 μCi source of Iodine-131 (^{131}I, 碘 , half-life = 8.0 days) is permanently implanted into a patient to check the activity of his thyroid. The biological half-life of ^{131}I in thyroid is 180 days.

(a) **Calculate** the effective half-life T_{eff} for this source in unit of day.

(b) If this source were left in place in the patient for three days, **calculate** the actual number of the emitted radiation absorbed by the patient in unit of μCi-day .

(3) **Calculate** the kinetic energy E_k of the α particle emitted in the following α -particle decay :

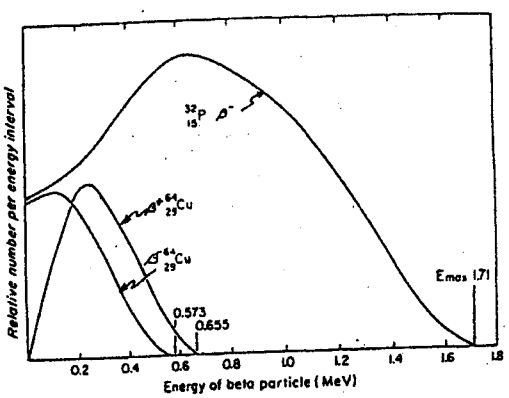
$^{226}_{88}Ra$ (radium 鐳) ⟶ $^{222}_{86}Rn$ (radon 氡) + α -particle + 0.18 Mev γ ray

Given : $^{226}_{88}Ra = 226.025406$ amu , $^{222}_{86}Rn = 222.017574$ amu , $^{4}_{2}He = 4.002603$ amu

(4) The figure shows the β^- - ray spectra for P-32 and β^+ - ray and β^- - ray spectra for Cu-64.

(a) Find the average kinetic energy of the β^- particles emitted from P-32 nuclei in unit of Mev.

(b) From the β^+ - ray and β^- - ray spectra for Cu-64, indicate which has the bigger average kinetic energy of the emitted β particles. Explain why.



(5) A sodium-22 nucleus ($^{22}_{11}Na$ 鈉) decays into a neon-22 nucleus ($^{22}_{10}Ne$ 氖) by undergoing a K-shell electron capture process.

(a) Write down the nuclear reaction for this K-capture process.

(b) Write down all the possible emitted particles or rays (photons) which may be detected as this K-capture occurs.

私立臺北醫學院 89 學年度第 2 學期 期中 期末 考試 命(試)題紙

系級	科目	授課教師	考試日期	學號	姓名
公一	普通物理學	蔡文鋒	90年 6月 22日第 1.2 節		

※①請注意本試題共 2 張。如發現頁數不足及空白頁或缺印，應當場請求補齊，否則缺少部份概以零分計。
②每張試題卷務必填寫(學號)、(姓名)。

(6) The figure as shown is the x-ray spectra by bombarding molybdenum (Mo 鉬 Z = 42) target . Each spectrum is labeled with the value of the accelerating voltage V in kilo-volt (kv).

(a) Explain how the continuous x rays spectra are generated.

(b)Explain how the K_α -Xray and the K_β - Xary are generated.

(c) Explain why the intensity of K_α -Xray is bigger than that of K_β - Xary .

(d) **Calculate** the minimum wavelength λ_{min} in unit of nm for the x-ray distribution with an accelerating voltage of 25 kv .

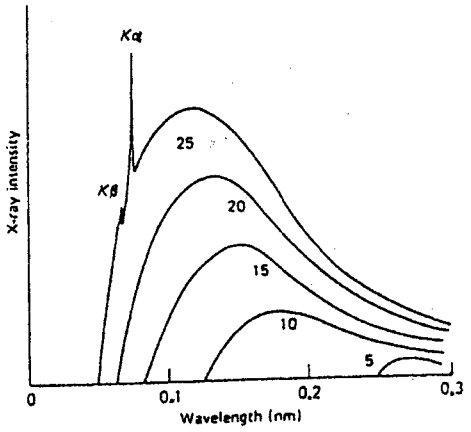
(e) For the x-ray tube having a current 20 mA and an accelerating voltage 20 kv , **calculate :**

(i) the input power P_{in} in watt to this x-ray tube,

(ii) the efficiency η of x-ray production,

(iii) the output power P_{out} in watt of the x-ray production, and

(iv) the rate of heat in watt produced in this x-ray tube.



(7)As the radiation in the form of x-rays or photons enters a biological system, describe how the absorbed radiation energy results in the biological damage.

(8) A beam of radiation containing 2000 photons is incident on a 10-cm slab of material. Assume that 500 transmitted photons are detected. (a) **Calculate** linear attenuation coefficient μ for this material.(b) **Calculate** the half value layer (HVL) for this material. (c) If the safety requires that only 10% of the radiation transmitted be allowed, **calculate** the maximum width of the material.

(9) An x-ray beam has exposure of 5 R. What does this exposure mean ?

(10) (a) The quality factor of the 200-kev x-rays is defined as ___?___ as they are absorbed to produce a given biological effect.

(b)The fast neutrons with energies above 0.1 Mev have a QF value 10 as they are received by the eyes for causing cataracts (白內障). This means that if the absorbed dose received from the fast neutrons for causing cataracts is 40 rads, the absorbed dose received from the 200-kev x-rays for causing cataracts is ___?___ rads.

(c) **Calculate** the dose equivalent received from the fast neutrons for causing cataracts in (b) above in unit of sievert (sv 西弗).

(11) A well-insulated tank of water exposed to radiation has its temperature increased by 10℃. **Calculate** the absorbed dose of radiation received by the water in unit of Gy (Gray).