

國立清華大學 101 學年度碩士班考試入學試題

系所班組別：核子工程與科學研究所甲組(工程組)

考試科目 (代碼)：核工原理(2702)

共 2 頁，第 1 頁

*請在【答案卷、卡】作答

1. Briefly explain the following terms: (20%, each 4%)
 - A. Boiling-Water Reactor (BWR) and Pressurized-Water Reactor (PWR)
 - B. Fissile, fissionable, and fertile
 - C. Enrichment
 - D. Burnup
 - E. Mean free path
2. Which one is correct? Carbon dating is possible because: (a) The specific activity of carbon-14 in living organisms has changed over time, and one can identify the era of time the organism lived based on its current specific activity. (b) Carbon-14 is in secular equilibrium with its daughter. (c) The specific activity of carbon-14 in living organisms is relatively constant through time, but decays after the death of the organism. (5%)

Assuming an archaeologist dug up an old wooden antique near forest, please provide a best guess of the age of the wooden antique given the following: the half-life of C-14 is 5715 years, specific activity for C-14 in a nearby living tree is 1.67×10^{-1} Bq/g, and specific activity for C-14 in the old wooden antique is 1.50×10^{-1} Bq/g. (10%)

(15%)

3. Consider a reactor operated at a thermal power of P megawatts, with a recoverable energy per fission of 200 MeV, (a) derive the following burnup rate defined as grams of ^{235}U per day fissioned, (10%)

$$\text{Burnup rate} = 1.05 \times P \text{ [g/day]}.$$

(b) The energy released by the fissioning of 1 g of ^{235}U is equivalent to the combustion of how many tons of coal with a heat content of 3×10^7 J/kg? (5%)

(15%)

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4. Explain the meaning of the following terms:

Fick's law; lethargy; neutron age; four factor formula . (15 %)

5. For a bare reactor, please write the two group diffusion equation. Neglect fast group absorption; assume fissions only induced in the thermal group and all fission neutrons are in the fast group. Also show that both group fluxes have the same spatial dependence. (20 %)

6. A slab reactor with thickness $2a$ and reflector with thickness d on each side. Write the neutron balance equation and boundary conditions based on one group diffusion theory. (15%)