國　立　清　華　大　學　命　題　紙

96 學年度 核子工程與科學 系（所） 甲 (工程) 組碩士班入學考試

科目 核工原理 科目代碼 3103 共 2 頁第 1 頁 *請在【答案卷卡】內作答

1. 是非題 (共 20 分，每小題答對者得 2 分，不答者不得分，答錯者倒扣 1 分)

   a) In the low energy region of most nuclei, inelastic scattering cross-section varies inversely as the neutron speed.

   b) The mean-life of a radioactive nuclide is longer than its half-life

   c) If the energies of the particles are of Maxwellian distribution, then the average energy is twice as large as the most probable energy.

   d) The water in a PWR is maintained at a high pressure of approximately 15 MPa. (1MPa = 145 psi)

   e) Charged particles are generally referred to as directly ionizing radiation.

   f) A reactor that sustains a steady-state chain reaction must be a "critical" reactor.

   g) The thermal utilization for a heterogeneous system is smaller than for the equivalent homogeneous mixture.

   h) The negative reactivity for both xenon-135 and samarium-149 show buildup after reactor shutdown.

   i) Sea water contains about 0.3 ppm of uranium.

   j) Resonance absorption increases with increasing temperature.

2. (7 分)

   A ^{25}Mg-nucleus is at the 1.61 MeV excited level. Assume it to be at rest, what kinetic energy is imparted to it by the emission of a γ-ray as it deexites to the ground state. (Data: 1 a.m.u. = 931.5 MeV)

3. (18 分)

   Briefly explain the following terms:

   a) nuclear Doppler effect

   b) self-shielding

   c) thermal disadvantage factor

   d) bremsstralung

   e) stopping power

   f) Bragg curve

4. (15 分)

a) What is the difference between (n,n) and (n,n')?

b) What is the difference between material buckling and geometric buckling?

c) What is the difference between thermal shield and biological shield?

5. (15 分)

Consider a bare, spherical, homogeneous reactor of radius R. Due to symmetry, the flux in this reactor is a function only of r (distance from the center), and the reactor equation is

$$\frac{1}{r^2}\frac{d}{dr}r^2\frac{d\phi}{dr}+B^2\phi=0$$

a) Determine the flux distribution in this critical reactor.

b) If $\sum_f$ = macroscopic fission cross-section,

E_R = recoverable energy per fission,

P =operating thermal power of the reactor;

determine the flux at the center of the reactor.

6. (15 分)

Consider a point source emitting S neutrons/sec in an infinite diffusion medium.

a) Find the flux distribution in the medium.

b) Find the probability density that a source neutron emitted will be absorbed in (r, r+dr) from the source.

c) Prove $L^2=1/6\overline{r^2}$ (L^2 is the diffusion area, $\overline{r^2}$ is mean square distance to absorption)

7. (10 分)

Consider the neutron cycle of a thermal nuclear reactor, use block diagram to explain the six-factor formula.