UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

ZCT 532/4 – Radiation Physics
[Ilmu Fizik Sinaran]

Duration: 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains **FIVE** printed pages before you begin the examination.
*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMA** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

Instruction: Answer all **FIVE (5)** questions. **For QUESTION TWO (2) answer either (2a) or (2b)** only. Students are allowed to answer all questions in Bahasa Malaysia or in English.

*[**Arahan**: Jawab semua **LIMA (5)** soalan. **Bagi SOALAN DUA (2) jawab samada (2a) atau (2b)** sahaja. Pelajar dibenarkan menjawab semua soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

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1. (a) Describe what is meant by the following terms, in one or two sentences :
[Perihalkan dengan menggunakan satu atau dua ayat, apakah yang dimaksudkan dengan istilah-istilah berikut:]

i) Isotone
[Isoton]

ii) Secondary radiation
[Sinaran sekunder]

iii) Spontaneous fission
[Pembelahan spontan]

iv) Antineutrino
[Antineutrino]

v) Saturation activity
[Keaktifan tepu]

vi) Cold neutron
[Neutron sejuk]

vii) Detector intrinsic efficiency
[Kecekapan intrinsik pengesan]

viii) Dead time of the detector system
[Masa mati suatu sistem pengesan]

b) Calculate the equivalent mass of:
[Hitungkan jisim setara bagi:]

i) Electron
[Elektron]

ii) Proton
[Proton]

c) Derive a simple formula to relate the tenth-value layer to the half-value layer.
[Terbitkan suatu formula ringkas bagi menghubungkaitkan lapisan nilai kesepuluh kepada lapisan nilai setengah.]

(46/100)

2. a) A pencil beam of γ-ray emitted from a Co-60 source (Average E=1.25MeV) incident on a Cu plate;
[Suatu alur pensel sinar-γ terpancar daripada suatu sumber Co-60 (Purata E=1.25 MeV) tertuju ke atas suatu plat Cu;]

i) What is the most probable interaction of γ-ray with Cu plate.
[Apakah interaksi sinar-γ yang paling mungkin dengan plat Cu.]

ii) Calculate the energy of the scattered γ-ray at an angle of 90°.
[Hitungkan tenaga sinar-γ terserak pada sudut 90°.]

iii) Calculate the energy of the scattered γ-ray at an angle of 180°.
[Hitungkan tenaga sinar-γ terserak pada sudut 180°.]

b) The α-Beryllium neutron sources are used in many applications;
[Sumber-sumber α-Beryllium neutron digunakan dalam kebanyakan aplikasi;]

i) Explain the method of neutron production in these sources.
[Terangkan kaedah penghasilan neutron di dalam sumber-sumber ini.]

ii) What are the factors affecting the neutron flux rate?
[Apakah faktor-faktor yang mempengaruhi kadar fluks neutron?]

(12/100)

3. a) Write the following reactions in an equation form:
[Tulis tindak balas berikut dalam bentuk suatu persamaan:]

i) $^{59}_{27}Co(n,\gamma)Co$.

ii) $^{203}_{81}Tl(p,3n)Pb$.

iii) $^{9}_{4}Be(p,d)Be$.

iv) $^{9}_{4}Be(d,n)Be$.

v) $^{39}_{19}K(\alpha,p)Ca$.

vi) Positron emission from $^{238}_{92}U$ atom after impinged on by a neutron producing Np.
[Pancaran positron daripada $^{238}_{92}U$ atom selepas terhentam oleh suatu neutron yang menghasilkan Np.]

vii) Internal conversion of $^{137m}_{56}Ba$ producing stable Ba.
[Penukaran dalaman $^{137m}_{56}Ba$ menghasilkan Ba stabil.]

viii) The D-T reaction.
[Tindak balas D-T.]

(32/100)

4. a) Discuss – with diagrams - the mechanism of γ-ray detection in a scintillation detector from the incidence of the quanta on the detector until a signal leave the photomultiplier tube.
[Berbantukan gambarajah, bincangkan mekanisme pengesanan sinar-γ dalam suatu pengesan sintilasi, bermula daripada tertujunya kuanta ke atas pengesan sehingga suatu isyarat meninggalkan tiub foto pendarab.]

b) Compare the advantages and disadvantages of a scintillation detector with that for a semiconductor detector.
[Bandingkan kelebihan dan kekurangan pengesan sintilasi dengan pengesan semikonduktor.]

(50/100)

5. A pure gold ^{197}Au sample was activated in a nuclear reactor for 6 hours producing ^{198}Au. The sample was counted after 20 hours using *NaI* scintillation detector which has an efficiency of $5x10^{-2}$. The sample counts 150 cps.
[Suatu sampel emas tulen ^{197}Au diaktifkan di dalam reaktor nuklear selama 6 jam menghasilkan ^{198}Au. Sampel itu dikira selepas 20 jam menggunakan pengesan sintilasi NaI yang mempunyai kecekapan $5x10^{-2}$. Kiraan sampel itu adalah 150 cps.]

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Given the following information:
[Diberikan maklumat berikut:]

Half-life of ^{198}Au = 2.69d, average cross-section for Au σ = 28b and Avogadro's number = 6.023×10^{23} atoms/g.
[Setengah hayat ^{198}Au = 2.69 hari, purata keratin rentas bagi Au σ = 28b dan nombor Avogadro = 6.023×10^{23} atoms/g.]

i) Calculate the activity of the gold sample at the end of the irradiation.
[Hitungkan keaktifan sampel emas pada penghujung penyinaran.]

ii) Calculate the saturation activity of the sample.
[Hitungkan keaktifan tepu sampel itu.]

iii) Calculate the neutron flux at the irradiation facility.
[Hitungkan fluks neutron di tempat kemudahan penyinaran.]

(60/100)

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