The Royal Australian and New Zealand College of Radiologists

FRANZCR Examination Part I

Radiation Oncology

Radiotherapeutic Physics

October 2007

Time Allowed: 3 Hours

INSTRUCTIONS

- There are a total of SIX questions.
- Write your answers in the book provided.
- All questions are of equal value. Sections within questions are not necessarily of equal value.
- All questions are to be attempted.
- You may use diagrams, tables or lists in your answers.
- Grid paper has been provided for optional use.
- Answers should be given from a radiotherapeutic physics viewpoint.
- Hand **all** papers to invigilator, no papers are allowed to be taken from the exam room. THIS INCLUDES EXAM PAPERS.

Question 1

A megavoltage linear accelerator is commonly used in external beam radiation therapy. Draw separate schematic diagrams for each of the following, with sufficient labelling and captions to explain:

a) how a linear accelerator produces a photon beam suitable for therapeutic use. (5 marks)

b) the changes required in the treatment head to produce an electron beam suitable for therapeutic use. (3 marks)

c) the location of the MLC in the treatment head, the structure of a multi-leaf collimator and how it generates different field shapes. (2 marks)

Question 2

A 24 week pregnant patient has been diagnosed with breast cancer and will commence radiation treatment to the breast next week. It is expected the foetus will remain outside of the primary beam during the treatment.

a) What would be the sources of the radiation dose to the foetus, if the patient is treated with a 6MV photon beam? (3 marks)

b) What steps should be taken to reduce the dose received by the foetus? (4 marks)

c) How could the radiation dose to the foetus be determined? (3 marks)

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Question 3

You are given 3 radiation measuring devices: a thimble ionization chamber, radiographic film and thermoluminescent dosimeter chips and you are asked to:

I. check the isodose distribution for an electron field on the linac. (5 marks)

II. determine the *in vivo* eye lens dose outside a photon field. (5 marks)

For each of these clinical scenarios listed above:

a) choose the most appropriate dosimeter.

b) give reasons for your choice.

c) describe how the selected dosimeter measures ionizing radiation.

d) explain why you decided that the other two devices would be inappropriate.

Question 4

I. Discuss the advantages and limitations of lead shielding when used for:

   a) protection of the teeth and gums from a 9 MeV electron beam treating the lower lip. (2 marks)

   b) protection of the lens from a 6 MeV electron beam treating the lower eye lid. (2 marks)

   c) defining the field size of an electron beam treating at 110cm SSD. (2 marks)

II. Electron beams have an inherent photon component, frequently termed photon contamination.

   a) What causes photon contamination? (2 marks)

   b) What is the maximum dose from photon contamination you would expect at a depth Rp? (2 marks)

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Question 5

a) Describe a method of measuring the source strength of an Ir-192 HDR brachytherapy source. (2 marks)

b) Compare the dose distributions from a point source of Ir-192 and an actual Ir-192 HDR brachytherapy source of the same activity. (2 marks)

Previously, iridium wires have been used for interstitial implants.

c) Describe how iridium wires may be positioned to treat a planar volume. (4 marks)

d) Describe how a single Ir-192 HDR seed source is used to produce a similar isodose distribution to that in part (c). (2 marks)

Question 6

Ia) Modern external beam radiation therapy machines have an isocentre. Describe how the isocentre is defined and how its location is quality assured. (2 marks)

Ib) Describe the problems associated with the fixed SSD technique that have motivated the adoption of isocentric treatment techniques. (3 marks)

IIa) Describe the use and components of "record and verify" systems. (2 marks)

IIb) Modern "record and verify" systems can automate all movements of the linac. Discuss how this functionality can alter levels of risk during radiation delivery. (3 marks)