THE ROYAL AUSTRALIAN AND NEW ZEALAND COLLEGE OF RADIOLOGISTS

EXAMINATION FOR DIPLOMA, PART I

RADIATION ONCOLOGY
RADIOTHERAPEUTIC PHYSICS
TIME ALLOWED: 3 HOURS

ALL QUESTIONS ARE TO BE ATTEMPTED. All questions are of equal value.
Clearly labeled diagrams should be drawn wherever relevant.

PART A

1. Discuss the physical principles, design details and operational features of a modern therapy simulator. Discuss the relative roles of this equipment versus the use of CT in treatment planning.

2. There are well in excess of a thousand known radionuclides yet only a few are clinically useful in radiotherapy. Why is this so? Describe the physical parameters of the radionuclides commonly used in radiotherapy.

PART B

3. Discuss the physical aspects of irradiating chest wall recurrences using electrons in previously irradiated tissues following mastectomy. Include reference in your answer to the dose received by skin, bone and lung; and the effect of obliquity and changing SSD.

4. a) Define percentage depth dose.
b) Approximately what percentage depth dose would you expect at 10 cm depth on the central axis of a 10 cm x 10 cm, 6 MV photon beam incident vertically at 100 cm SSD on a water phantom.
c) How would this percentage depth dose be affected if:
[i] the field size was increased to 20 cm x 20 cm?
[ii] the SSD was increased to 150 cm, the filled size at the water phantom surface being reset to 10 cm x 10 cm?
Explain briefly the reason for the effect on percentage depth dose in each case.
d) Sketch an isodose chart for the beam referred to in [b], and mention its clinically important features.
e) When such a beam is used for treatment, the dose distribution in the patient may vary from that in the phantom. Describe and explain briefly the variations which may occur, and give an estimate of their magnitude.

5. a) Discuss the advantages and disadvantages of caesium-137 and iridium-192 as radionuclides for brachytherapy.
b) For one of these radionuclides, outline one method by which it is deployed in the brachytherapy of cancer of the uterine cervix. Include a brief description of the source construction and the apparatus used.
c) Comment briefly on the salient features of the dose distribution produced.

6. Discuss what is meant by the terms stochastic and deterministic effects with regard to the impact of ionising radiation on human beings. Give two examples of each type of effect. Outline the human data sources that have been used by the ICRP to develop the current risks of radiation exposure.
What is the likely magnitude of the total detriment from radiation exposure at low doses and dose rates? What does this detriment include?
Define the set of dose limits that the ICRP have developed to protect both the worker and the population as a whole. How do these limits compare with the annual dose from natural background radiation?