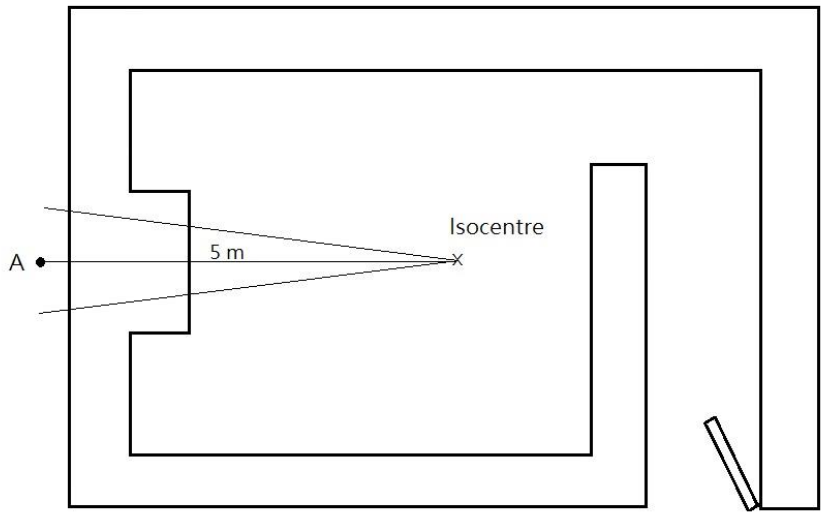
Sample Question for Health Physics (Total: 10 marks):



(a) The above diagram shows the structural layout of a treatment room installed with a 15 MV linear accelerator with maximum output dose rate of 400 MU/min. Please calculate the thickness of the concrete required in order to reduce the radiation dose rate at point A to the limit as stipulated in Regulation 17(1) of the Radiation (Control of Irradiating Apparatus) Regulations (Cap 303B).

You may take the tenth-value layers (TVLs) of concrete as TVL_1 = 45 cm and TVL_e = 43 cm. (5 marks)

Marking scheme:

(1) Using the correct equation (1.5 marks)

$$B = 10^{-1}10^{-(\frac{t-TVL_1}{TVL_e})}$$

(2) Correct dose rate limit as stipulated in Regulation 17(1) of Cap 303 B. (1 mark)

(3) Correct calculation of the required thickness of concrete (2.5 marks)

(b) (i) Please discuss the possible function of the maze (1 mark).

Marking scheme:

(1) attenuating primary radiation field by direct shielding (0.5 mark)
(2) reducing the energy and intensity of the radiation field through multiple scatterings (0.5 mark)

(ii) What are the dominant sources of radiation at the maze entrance? (2 marks)

Marking scheme:

(1) neutron capture gamma rays with specified gamma rays' energy (1 mark)
(2) photoneutrons with specified neutrons' energy (1 mark)

(iii) What materials are commonly used in a neutron door at the entrance and how should the materials be arranged for effective shielding of the radiation at the entrance? (2 marks)

Marking scheme:

(1) Lead and borated polyethylene (BPE) (5% by weight) (0.5 mark)
(2) Arrangement:

Lead + BPE + Lead (0.5 mark)

Explanation:

nonelastic scattering + neutron absorption + shielding for neutron capture gamma rays from BPE (1 mark)