

HLTH 204 Radiographic Physics and Protection

Assignment 1 – Radiation Physics

Due: 5pm Wednesday 3 September, 2008

Instructions: Answer the questions below in the spaces provided. Attach a completed cover sheet and turn in to the HLTH 204 assignment box in the ELS Centre (Room 101).

An x-ray exposure is taken for 0.15 s at 140 kV_p. During the exposure the step-up transformer supplying the high-voltage part of an x-ray tube draws a current of 150 A from the 240 V mains supply. Assume that the combined transformer and rectification circuit are 95% efficient and produce negligible ripple.

1. What is the mA of the exposure? [2 marks]

2. What is the resistance of the tube in the circuit? [2 marks]

3. How much energy is used by the tube during the exposure? [2 marks]

4. What is the kinetic energy of the electrons just before striking the anode? Express your answer both in keV and in joules. [3 marks]

5. What is the speed of an electron – as a fraction of the speed of light – just before striking the anode? (Hint: use $KE = \frac{1}{2}mv^2$, even though the relativistic formula might be more appropriate). [3 marks]

7. How many electrons strike the anode during the exposure? [3 marks]

8. What is the maximum energy of the x-ray photons that are produced at the anode? [2 marks]

9. Estimate the total energy of the x-rays produced during the exposure. [2 marks]

10. If the average energy of the x-ray photons is 10 keV, estimate the total number of x-ray photons produced during the exposure. [3 marks]

11. The tube rating chart is shown below. Is the exposure likely to damage the tube? Explain your reasoning. [3 marks]

