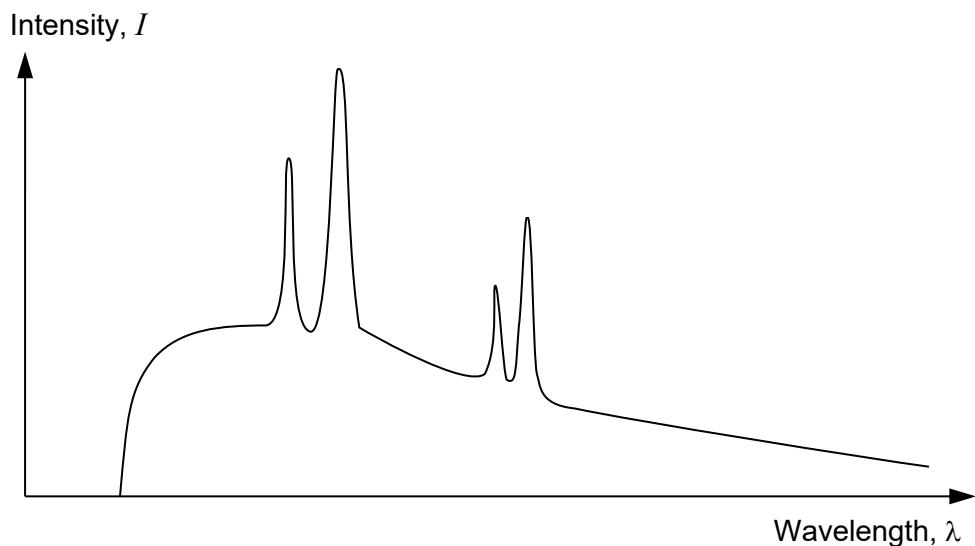


- 8 X-rays are produced when electrons are accelerated through a potential difference towards a metal target such as tungsten. Fig. 8.1 shows a typical X-ray intensity spectrum that can be produced from an X-ray tube.



**Fig. 8.1**

- (a) Using conservation of energy, explain why there is a minimum wavelength for the emitted X-rays as shown in Fig. 8.1.

.....  
.....  
.....

[1]

- (b) Explain the broad, almost continuous, spectrum shown in Fig. 8.1.

.....  
.....  
.....  
.....  
.....  
.....  
.....

[2]

- (c) In a chest X-ray, a photographic film receives photons which have travelled through flesh and bone from a source.

- (i) Estimate the area of a film which covers the chest of an adult.

$$\text{area} = \dots \text{ m}^2 \quad [1]$$

- (ii) Assume that on average, 10 x-ray photons fall on each grain of the photographic film and the grains are about  $1.0 \mu\text{m}$  apart as shown in Fig. 8.2.

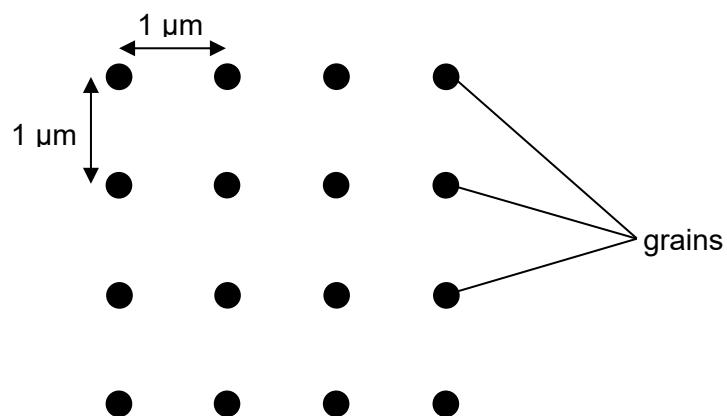


Fig. 8.2

Use your estimate in (c)(i) to determine the total x-ray energy falling on the film. Each x-ray photon has a quantum energy of  $10^{-15} \text{ J}$ .

$$\text{total energy} = \dots \text{ J} \quad [2]$$