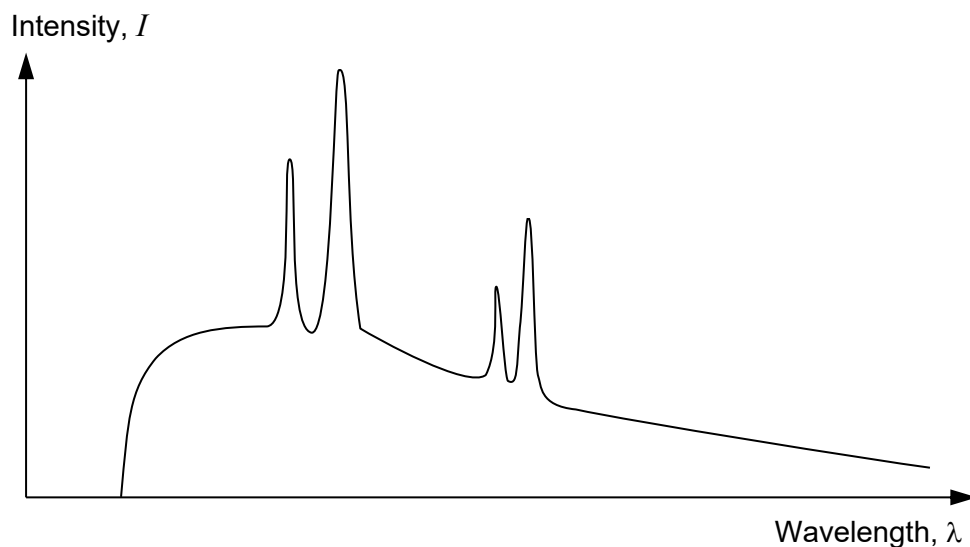


- 8 X-rays are produced when electrons are accelerated through a potential difference towards a metal target such as tungsten. Fig. 8.1 shows a typical X-ray intensity spectrum that can be produced from an X-ray tube.



**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.

area = ..... m<sup>2</sup> [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.

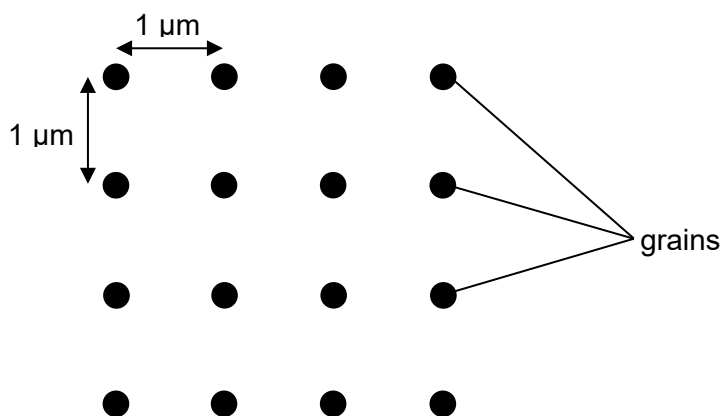


Fig. 8.2

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  $10^{-15}$  J.

total energy = ..... J [2]