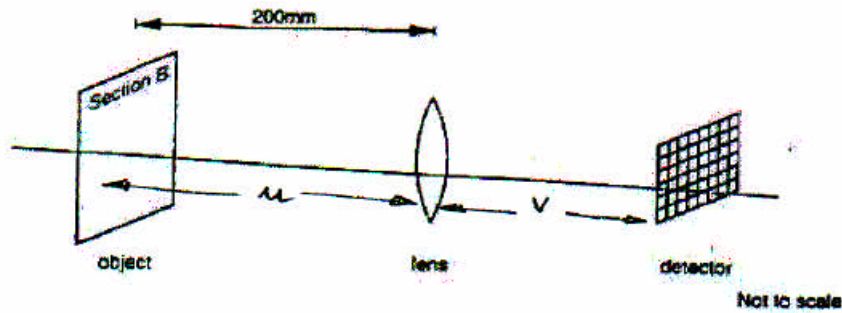


**Chapter 1**  
**Short answer questions - solutions**

1. This question is about a digital camera.



The lens of the camera is 200 mm away from the object. The lens has a focal length of 5.00 mm. It produces a sharp image on the detector.

- (a) Calculate the power of the 5.00 mm lens.

$$P = \frac{1}{f} = \frac{1}{5 \times 10^{-3}} = +200 \text{ D}$$

power = ..+ 200 D

- (b) Calculate the distance from the lens to the detector.

$$\frac{1}{f} = -\frac{1}{u} + \frac{1}{v}$$

$$\therefore 200 = \frac{-1}{-200 \times 10^{-3}} + \frac{1}{v}$$

$$\therefore v = 5.13 \times 10^{-3} \text{ m}$$

distance = ..5.13 mm

- (c) The detector has an array of  $10^6$  discrete light-sensitive elements in a square of side 2.5 mm.

- (i) Show that the width of each element is  $2.5 \mu\text{m}$ .

Width

$$= \frac{2.5 \times 10^{-3} \text{ mm}}{1 \times 10^3}$$

$$= 2.5 \times 10^{-6} \text{ mm}$$

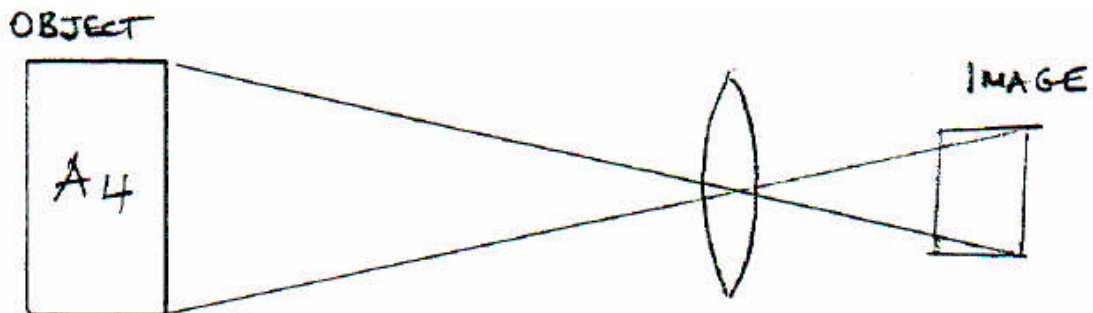
$$= 2.5 \mu\text{m}$$

- (ii) Calculate the distance this width corresponds to on the subject.

$$\frac{2.5 \times 10^{-6}}{\chi} = \frac{5}{200} \Rightarrow \chi = \frac{2.5 \times 10^{-6} \times 200}{5}$$

$$\text{Distance} = \dots 0.1 \text{ mm}$$

- (c) The object being imaged is this page. Comment on the quality of image that would be produced by this camera.



$$\text{Image size} = 10^3 \times 0.1 \text{ mm}$$

$$= 100 \text{ mm}$$

$$= 10 \text{ cm only}$$

So not the whole page will be visible