3 A student investigates the image produced by a lens.

Fig. 3.1 shows the set-up.

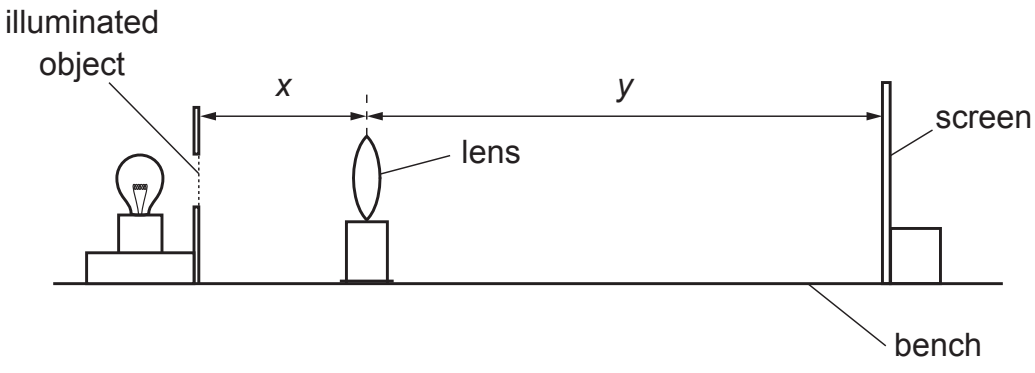

Fig. 3.1

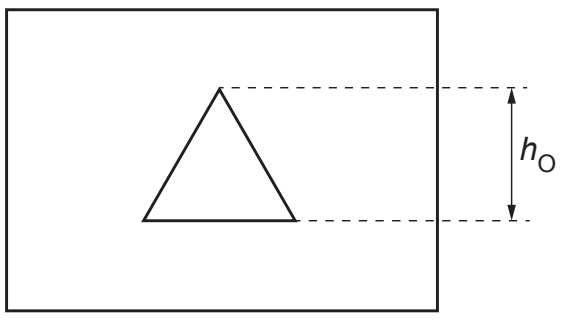

Fig. 3.2

(a) Fig. 3.2 shows the height h_O of the illuminated object.

On Fig. 3.2, measure h_O.

h_O = ... [2]

(b) Fig. 3.1 is drawn to scale. The actual distance u between the illuminated object and the lens is 20.0 cm.

(i) On Fig. 3.1, measure the distance x.

x = ... [1]

(ii) Calculate the scale ratio r using the equation

$$r = \frac{u}{x},$$

where u = 20.0 cm.

r = ... [1]

(c) The student moves the screen until a focused image is formed on the screen.

(i) On Fig. 3.1, measure the distance y.

y = ... cm [1]

(ii) Calculate the actual distance v between the lens and the screen using the equation $v = ry$. Use your value for r from **(b)(ii)**.

v = ... cm [1]

(d) Calculate the focal length f of the lens using the equation

$$f = \frac{uv}{(u + v)}.$$

Give your answer to a suitable number of significant figures for this type of experiment.

f = ... cm [2]

(e) In this type of experiment, it can be difficult to judge the screen position that produces the clearest image.

Suggest **two** precautions or techniques to overcome this difficulty.

1 .....

.....

2 .....

.....

[2]

(f) Fig. 3.2 shows the shape of the illuminated object. The image of the object is enlarged.

Draw a diagram to show the image that you would see on the screen.

[1]

[Total: 11]