Exercise walk-through

Images Formed by Lenses ▪ 13.4

eXercise

You must be able to

- use ray diagrams to locate images from **converging 会聚** and **diverging lenses 发散透镜**
- apply the **thin-lens equation 薄透镜公式** $\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}$ and the magnification relation
- describe the images formed and give an everyday application

Method — The thin-lens equation

$\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}$. A converging lens has $f > 0$; a diverging lens has $f < 0$.

Method — Magnification

$m = -\frac{s_i}{s_o}$ — negative means an inverted image.

Method — Applications

Cameras, the eye, and magnifying glasses all use converging lenses.

Practice 2.1 ▪ 2 marks

An object is 30 cm from a converging lens of focal length 10 cm. Find the image distance.

Solution 2.1

Method: The thin-lens equation

Worked steps

$$\frac{1}{s_i} = \frac{1}{10} - \frac{1}{30} = \frac{2}{30} \Rightarrow s_i = 15 \text{ cm} \quad \text{M1 A1}.$$

Practice 2.2 ▪ 1 mark

State whether a converging lens has a positive or negative focal length.

Solution 2.2

Method: The thin-lens equation

Worked steps

positive B1.

Practice 2.3 ▪ 1 mark

Give one everyday use of a converging lens.

Solution 2.3

Method: The thin-lens equation

Worked steps

a camera, the eye, or a magnifying glass (any one) B1.

Exam-style 3.1 ▪ 1 mark

The thin-lens equation is

A $\dfrac{1}{s_o} + \dfrac{1}{s_i} = \dfrac{1}{f}$

B $s_o + s_i = f$

C $f = s_o s_i$

D $m = s_o / s_i$

Solution 3.1

Method: The thin-lens equation

A $\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}$ ✓

B $s_o + s_i = f$

C $f = s_o s_i$

D $m = s_o / s_i$

Worked steps

A.

Exam-style 3.2 ▪ 1 mark

A converging lens used as a magnifier produces a

A real, inverted image

B virtual, upright image

C image at the focus

D no image

Solution 3.2

Method: The thin-lens equation

A real, inverted image

B virtual, upright image ✓

C image at the focus

D no image

Worked steps

B.

Exam-style 3.3 ▪ 3 marks

An object is placed 15 cm from a converging lens of focal length 10 cm.
(a) Find the image distance.
(b) State whether the image is real or virtual.

Solution 3.3

Method: The thin-lens equation

Worked steps

(a) $\frac{1}{s_i} = \frac{1}{10} - \frac{1}{15} = \frac{3-2}{30} = \frac{1}{30} \Rightarrow s_i = 30$ cm **M1** **M1** **A1**. (b) real $(s_i > 0)$ **B1**.