

13.4 Images Formed by Lenses

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS converging • thin-lens equation • diverging
 • diverging lenses

Objective

Build the skills to answer exam questions on **images formed by lenses**.

You must be able to:

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

1 Key knowledge and worked examples

Study these first. Each one shows the method for a question type used later.

■ 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 $f < 0$.

■ Magnification

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

■ Applications

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

2 Practice

2.1 An object is 30 cm from a converging lens of focal length 10 cm. Find the image distance. [2]

2.2 State whether a converging lens has a positive or negative focal length. [1]

2.3 Give one everyday use of a converging lens. [1]

3 Exam-style questions

3.1 The thin-lens equation is [1]

- ☐ **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 $m = s_o / s_i$

3.2 A converging lens used as a magnifier produces a [1]

- ☐ **A** real, inverted image
B virtual, upright image
C image at the focus
D no image

3.3 An object is placed 15 cm from a converging lens of focal length 10 cm.

(a) Find the image distance. [3]

(b) State whether the image is real or virtual. [1]

Solutions

Each answer shows the steps, then the **result**.

2.1

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

2.2

- positive

2.3

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

3.1 A

- $\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}$.

3.2 B

- virtual, upright image.

3.3

(a)

- $\frac{1}{s_i} = \frac{1}{10} - \frac{1}{15} = \frac{3-2}{30} = \frac{1}{30} \Rightarrow s_i = 30 \text{ cm}$

(b)

- real ($s_i > 0$)