# Lenses and magnification

Worked solutions

**GCSE science calculations**

This topic online

**1** A convex lens forms an image of a candle flame on a screen. The flame is 3.0 cm tall and the image is 12 cm tall.

Calculate the magnification. (2 marks)

Magnification = image height ÷ object height

magnification = 12 ÷ 3.0

**4 (no unit)**

**2** Priya looks at a stamp through a magnifying glass. A letter on the stamp is 0.8 cm tall. Through the magnifying glass the letter appears 2.0 cm tall.

Calculate the magnification of the magnifying glass. (2 marks)

Magnification = image height ÷ object height

magnification = 2.0 ÷ 0.8

**2.5 (no unit)**

**3** A camera lens forms an image of a person standing in a park. The person is 160 cm tall. The image on the camera sensor is 2.4 cm tall.

Calculate the magnification. (2 marks)

Magnification = image height ÷ object height

magnification = 2.4 ÷ 160

Less than 1 because the image is smaller than the object

**0.015 (no unit)**

**4** On a biology field trip, Tomasz looks at a ladybird through a hand lens. The ladybird is 6 mm long. The image he sees is 2.4 cm long.

Calculate the magnification of the hand lens. (3 marks)

Both heights must be in the same unit: 1 cm = 10 mm

image = 2.4 × 10 = 24 mm

Magnification = image height ÷ object height

magnification = 24 ÷ 6

**4 (no unit)**


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**5** An old slide projector in a village hall throws a picture onto a screen. The picture on the slide is 36 mm tall. The image on the screen is 1.8 m tall.

Calculate the magnification of the projector lens. (3 marks)

Both heights must be in the same unit: 1 m = 1000 mm

image = 1.8 × 1000 = 1800 mm

Magnification = image height ÷ object height

magnification = 1800 ÷ 36

**50 (no unit)**

**6** Grace uses a convex lens to make a magnified image of a small screw. She records these measurements.

| Measurement | Value |
|---|---|
| height of the screw | 4.0 mm |
| distance from the screw to the lens | 6.0 cm |
| distance from the lens to the image | 21 cm |
| height of the image | 1.4 cm |

Calculate the magnification. (3 marks)

Use the two heights, not the distances

Both heights must be in the same unit: 1 cm = 10 mm

image height = 1.4 × 10 = 14 mm

Magnification = image height ÷ object height

magnification = 14 ÷ 4.0

**3.5 (no unit)**

**7** A magnifying glass has a magnification of 6. Jamal uses it to read a number on a map that is 0.35 cm tall.

Calculate the height of the image of the number. (2 marks)

Magnification = image height ÷ object height

$$6 = \frac{\text{image height}}{0.35}$$

Multiply both sides by 0.35

image height = 6 × 0.35

**2.1 cm**


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**8** A jeweller looks at a gemstone through a lens with a magnification of 3.2. The image of the gemstone is 4.5 cm tall.

Calculate the real height of the gemstone.

Give your answer to 2 significant figures.

(3 marks)

Magnification = image height ÷ object height

$$3.2 = \frac{4.5}{\text{object height}}$$

Rearrange: object height = image height ÷ magnification

object height = 4.5 ÷ 3.2

object height = 1.40625 cm

**1.4 cm**

**9** A classroom projector has a magnification of 40. The picture inside the projector is 24 mm tall. The screen is 3.0 m from the projector.

Calculate the height of the image on the screen in metres.

(3 marks)

The 3.0 m distance to the screen is not needed

Magnification = image height ÷ object height

$$40 = \frac{\text{image height}}{24}$$

image height = 40 x 24 = 960 mm

Convert mm to m: 1 m = 1000 mm

image height = 960 ÷ 1000

**0.96 m**


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**10** Fatima tests two lenses, A and B.

- Lens A makes a 2.0 cm tall object look 5.0 cm tall.
- Lens B makes an 8 mm tall object look 2.6 cm tall.

a. Calculate the magnification of lens A.

b. Calculate the magnification of lens B.

c. Which lens gives the larger magnification? Show your working.

(4 marks)

Magnification = image height ÷ object height

a)

magnification = 5.0 ÷ 2.0

**2.5**

b)

Same unit: 1 cm = 10 mm

image = 2.6 × 10 = 26 mm

magnification = 26 ÷ 8

**3.25**

c)

3.25 > 2.5

**Lens B**


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**11** Daniel connects a mini projector to his phone to show a film in his garden. The picture on the projector's display is 6.5 cm tall. The projector has a magnification of 22. His screen is 1.5 m tall.

a. Calculate the height of the projected image in metres.

b. The image fits on the screen. Calculate the gap left between the height of the image and the height of the screen, in cm. Show your working.

(4 marks)

a)

Magnification = image height ÷ object height, so image height = magnification × object height

image height = 22 × 6.5

image height = 143 cm

Convert cm to m: 1 m = 100 cm

image height = 143 ÷ 100

**1.43 m**

b)

screen = 1.5 × 100 = 150 cm

gap = 150 - 143

**7 cm**


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**12** Zara photographs a block of flats that is 18 m tall. The image of the flats on the camera sensor is 9.0 mm tall.

a. Calculate the magnification of the camera lens. Give your answer in standard form.

b. Without moving the camera, Zara photographs a tree next to the flats. The image of the tree is 3.0 mm tall. Calculate the height of the tree in metres. Show your working.

(5 marks)

a)

Both heights must be in the same unit: 1 m = 1000 mm

image = 9.0 ÷ 1000 = 0.009 m

Magnification = image height ÷ object height

magnification = 0.009 ÷ 18

magnification = 0.0005

$5 \times 10^{-4}$

b)

image = 3.0 ÷ 1000 = 0.003 m

Rearrange: object height = image height ÷ magnification

height of tree = 0.003 ÷ 0.0005

6 m


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