

You hold a spherical salad bowl 70 cm in front of your face with the bottom of the bowl facing you. The salad bowl is made of polished metal with a 40 cm radius of curvature.

Review | Constants

▼ Part A

Where is the image of your 5.0-cm-tall nose located? Follow the sign rules. Enter the magnitude of the distance from the salad bowl.

Express your answer with the appropriate units.

$$s' = 16 \text{ cm}$$

[Submit](#)

[Previous Answers](#)

Correct

Correct answer is shown. Your answer 15.55 cm was either rounded differently or used a different number of significant figures than required for this part.

▼ Part B

What is the image's size?

Express your answer with the appropriate units.



▼ **Part C**

What is the image's orientation?

- erect
- inverted

**Submit**

**Request Answer**

▼ **Part D**

What is the image's nature?

- virtual
- real

**Exercise 34.23**

2 of 21

A small tropical fish is at the center of a water-filled spherical fish bowl 28.0 cm in diameter.

**Review | Constants****Part A**

Find the apparent position of the fish to an observer outside the bowl. The effect of the thin walls of the bowl may be ignored.

Express your answer in centimeters.

  
 $s' =$   cm**Submit**[Request Answer](#)**Part B**

Find the magnification of the fish to an observer outside the bowl.

  
 $m =$

▼ **Part C**

A friend advised the owner of the bowl to keep it out of direct sunlight to avoid blinding the fish, which might swim into the focal point of the parallel rays from the sun. Is the focal point actually within the bowl?

- yes
- no

**Submit**

[Request Answer](#)

**Exercise 34.28**

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To determine the focal length  $f$  of a converging thin lens, you place a 4.00-mm-tall object a distance  $s$  to the left of the lens and measure the height  $h'$  of the real image that is formed to the right of the lens. You repeat this process for several values of  $s$  that produce a real image. After graphing your results as  $1/h'$  versus  $s$ , both in cm, you find that they lie close to a straight line that has slope  $0.208 \text{ cm}^{-2}$ .

[Review | Constants](#)**Part A**

What is the focal length of the lens?

Express your answer with the appropriate units.

A rectangular input field for numerical answers. It contains a small icon of a ruler and a symbol for micrometers ( $\mu\text{\AA}$ ). To the right are icons for backspace, forward, refresh, keyboard, and help. Below the field is a horizontal bar divided into two sections: "Value" and "Units".

$f =$

**Submit**[Request Answer](#)

**Exercise 34.38**

◀ 4 of 21 ▶

A lensmaker wants to make a magnifying glass from glass with  $n = 1.55$  and with a focal length of 18.5 cm.

Review | Constants

**Part A**

If the two surfaces of the lens are to have equal radii, what should that radius be?

Express your answer with the appropriate units.

$R =$

**Submit**[Request Answer](#)

**Exercise 34.45 - Enhanced - with Solution**

Two thin lenses with a focal length of magnitude 21.0 cm, the first diverging and the second converging, are located 15.8 cm apart. An object 1.80 mm tall is placed 35.0 cm to the left of the first (diverging) lens.

For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of [An image of an image](#).

**Part A**

How far from this first lens is the final image formed?

**Express your answer in centimeters.**

□ ✓
AΣΦ
↶
↷
⟳
ⓧ
?
  

$$l = \text{_____}$$
 cm

**Submit**[Request Answer](#)**Part B**

Is the final image real or virtual?

Please Choose ↴

**Submit**[Request Answer](#)

▼ **Part C**

What is the height of the final image?

**Express your answer in millimeters.**

■  $\sqrt[n]{\square}$  AΣφ ↶ ↷ ⟳ ⌨️ ?

$|y'| =$   mm

**Submit**

[Request Answer](#)

▼ **Part D**

Is it erect or inverted?

Please Choose ↴

**Submit**

[Request Answer](#)

### Exercise 34.48

6 of 21

An object is to the left of a thin lens. The lens forms an image on a screen that is 2.60 m to the right of the object. The height of the image is 2.40 times the height of the object.

Review | Constants

#### ▼ Part A

Is the image upright or inverted?

- The image is inverted.
- The image is upright.

**Submit**

[Request Answer](#)

#### ▼ Part B

What is the focal length of the lens?

**Express your answer with the appropriate units.**



$f =$

**Submit**

[Request Answer](#)

▼ **Part C**

Is the lens converging or diverging?

- The lens is diverging.
- The lens is converging.

**Submit**

[Request Answer](#)

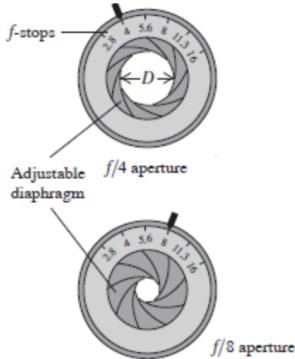
### Exercise 34.51

◀ 7 of 21 ▶

Consider the simple model of the zoom lens shown in the figure (Figure 1). The converging lens has focal length  $f_1 = 12\text{cm}$ , and the diverging lens has focal length  $f_2 = -12\text{cm}$ . The lenses are separated by 4 cm as shown in the figure below.

Figure

◀ 1 of 1 ▶



Review | Constants

#### ▼ Part A

For a distant object, where is the image of the converging lens?

Express your answer in centimeters to two significant figures.

□ □ AΣΦ ↶ ↷ ⟳ ⌨ ?

$s'_1 =$   cm

Submit [Request Answer](#)

#### ▼ Part B

The image of the converging lens serves as the object for the diverging lens. What is the object distance for the diverging lens?

Express your answer in centimeters to two significant figures.

□ □ AΣΦ ↶ ↷ ⟳ ⌨ ?

$s_2 =$   cm

▼ **Part C**

Where is the final image?

**Express your answer in centimeters to two significant figures.**

 AΣΦ    ?

$s'_2 =$  cm

**Submit**

[Request Answer](#)

▼ Part D

Now consider the model of the zoom lens shown in the lower figure, in which the lenses are separated by 8 cm. For a distant object, where is the image of the converging lens shown in lower figure, in which the lenses are separated by 8 cm?

**Express your answer in centimeters to two significant figures.**

■  $\sqrt[3]{\square}$  ΑΣΦ ↶ ↷ ⟳ ⌨ ?

$s'_1 =$

cm

**Submit**

[Request Answer](#)

▼ Part E

The image of the converging lens serves as the object for the diverging lens. What is the object distance for the diverging lens?

**Express your answer in centimeters to one significant figure.**

■  $\sqrt[3]{\square}$  ΑΣΦ ↶ ↷ ⟳ ⌨ ?

$s_2 =$

cm

▼ **Part F**

Where is the final image?

**Express your answer in centimeters to one significant figure.**



$s'_2 =$

cm

**Submit**

[Request Answer](#)

**Exercise 34.55**

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Ordinary glasses are worn in front of the eye and usually 2.00 cm in front of the eyeball. A certain person can see distant objects well, but his near point is 50.0 cm from his eyes instead of the usual 25.0 cm. Suppose that this person needs ordinary glasses.

**Review | Constants****Part A**

What focal length lenses are needed to correct his vision ?

Express your answer in centimeters.

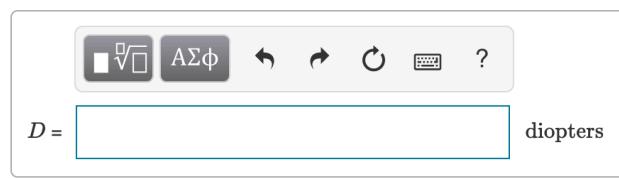


A digital calculator interface with a numeric keypad and various function keys. The display shows the letter 'f' followed by an equals sign and a blank input field. To the right of the input field is the unit 'cm'. Below the calculator are two buttons: 'Submit' in blue and 'Request Answer' in grey.

**Part B**

What is their power in diopters?

Express your answer in diopters.



A digital calculator interface with a numeric keypad and various function keys. The display shows the letter 'D' followed by an equals sign and a blank input field. To the right of the input field is the unit 'diopters'. Below the calculator are two buttons: 'Submit' in blue and 'Request Answer' in grey.

**Exercise 34.57**

◀ 9 of 21 ▶

A woman wears bifocal glasses with the lenses 2.0 cm in front of her eyes. The upper half of each lens has power  $-0.500$  diopter and corrects her far vision so that she can focus clearly on distant objects when looking through that half. The lower half of each lens has power  $+2.00$  diopters and corrects her near vision when she looks through that half.

**Review | Constants****Part A**

What are the far point and near point of her eyes? To determine the near point use a normal reading distance is about 25 cm.

**Express your answer in centimeters to three significant figures. Enter your answers numerically separated by a comma.**

$s_{FP}, s_{NP} =$  cm

**Submit****Request Answer****Part B**

While the woman is repairing a leaky pipe under her kitchen sink, she looks at close objects through the upper half of her bifocal lenses. What is the closest object that she can see clearly?

**Express your answer with the appropriate units.**

**Problem 34.67**

◀ 10 of 21 ▶

A concave mirror is to form an image of the filament of a headlight lamp on a screen 5.00 m from the mirror. The filament is 4.00 mm tall, and the image is to be 21.0 cm tall.

**Review | Constants****Part A**

How far in front of the vertex of the mirror should the filament be placed?

Express your answer in meters.

  
 $L =$   m  
**Submit**   [Request Answer](#)**Part B**

What should be the radius of curvature of the mirror?

Express your answer in meters.

  
 $R =$   m

**Problem 34.70**

11 of 21

A layer of benzene ( $n = 1.50$ ) that is 4.40 cm deep floats on water ( $n = 1.33$ ) that is 5.70 cm deep.

**Review | Constants****▼ Part A**

What is the apparent distance from the upper benzene surface to the bottom of the water when you view these layers at normal incidence?

Express your answer with the appropriate units.

  
 $|s'| =$   **Submit**[Request Answer](#)

**Problem 34.71**

◀ 12 of 21 ▶

A mirror on the passenger side of your car is convex and has a radius of curvature with magnitude 18.0 cm.

**Review | Constants****▼ Part A**

Another car is behind your car, 9.0 m from the mirror, and this car is viewed in the mirror by your passenger. If this car is 1.5 m tall, what is the height of the image?

Express your answer in meters.

  
 $y' =$   m**Submit**[Request Answer](#)

**Problem 34.73**

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A pinhole camera is just a rectangular box with a tiny hole in one face. The film is on the face opposite this hole, and that is where the image is formed. The camera forms an image *without* a lens. A certain pinhole camera is a box that is 24.0 cm square and 21.5 cm deep, with the hole in the middle of one of the 24.0 cm  $\times$  24.0 cm faces.

[Review | Constants](#)**Part A**

If this camera is used to photograph a fierce chicken that is 15.0 cm high and 2.00 m in front of the camera, how large is the image of this bird on the film?

Express your answer in centimeters.



$$|y'| = \text{[answer box]} \text{ cm}$$

**Submit**    [Request Answer](#)**Part B**

What is the magnification of this camera?



$$m = \text{[answer box]}$$

**Problem 34.77**

◀ 14 of 21 ▶

You want to use a lens with a focal length of 38.0 cm to produce a real image of an object, with the image twice as long as the object itself.

**Review | Constants****Part A**

What kind of lens do you need?

- diverging lens  
 converging lens

**Submit**[Previous Answers](#)**✓ Correct****Part B**

Where should the object be placed?

Express your answer with the appropriate units.



s =

### ▼ Part C

Suppose you want a virtual image of the same object, with the same magnification - what kind of lens do you need?

- converging lens
- diverging lens

**Submit**

[Request Answer](#)

### ▼ Part D

Where should the object be placed

**Express your answer with the appropriate units.**

s =

**Submit**

[Request Answer](#)

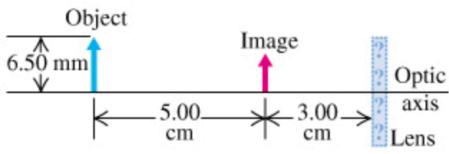
**Problem 34.80**

15 of 21

The figure (Figure 1) shows an object and its image formed by a thin lens.

**Figure**

1 of 1

**Part A**

What is the focal length of the lens?

Express your answer in centimeters.

AΣΦ?  
 $f =$   cm

**Submit**[Request Answer](#)**Part B**

What type of lens is it?

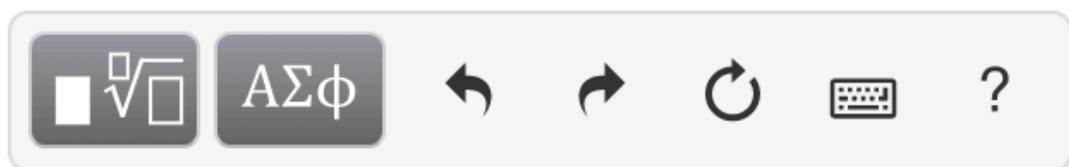
Please Choose

**Submit**[Request Answer](#)

▼ **Part C**

What is the height of the image?

**Express your answer in millimeters.**



$y' = \text{[answer box]} \text{ mm}$

**Submit**

[Request Answer](#)

▼ **Part D**

Is it real or virtual?

Please Choose ▾

**Submit**

[Request Answer](#)

**Problem 34.81**

◀ 16 of 21 ▶

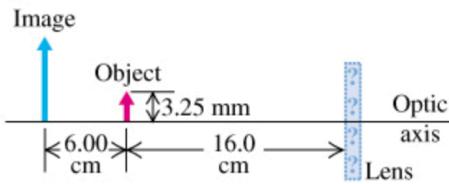
✓ Complete

■ Review | Constants

The figure (Figure 1) shows an object and its image formed by a thin lens.

**Figure**

◀ 1 of 1 ▶



## ▼ Part A

✓

What is the focal length of the lens?

Express your answer in centimeters.

$$f = 58.7 \text{ cm}$$

[Previous Answers](#)

## ▼ Part B

✓

What type of lens is it?

[Previous Answers](#)

▼ Part C ✓

What is the height of the image?

**Express your answer in milimeters.**

$$y' = 4.48 \text{ mm}$$

**Submit**

[Previous Answers](#)

✓ **Correct**

▼ Part D ✓

Is it real or virtual?

virtual

**Submit**

[Previous Answers](#)

✓ **Correct**

**Problem 34.86**

17 of 21

An object is placed 22.0 cm from a screen.

**Review | Constants****Part A**

At what two points between object and screen may a converging lens with a 3.00 cm focal length be placed to obtain an image on the screen?

Enter your answers numerically in centimeters separated by a comma.

$s_1, s_2 = 3.58, 18.4$  cm from the object.

[Previous Answers](#)

 **Correct**

**Part B**

What is the magnification of the image for each position of the lens?

Enter your answers numerically separated by a comma.



$m_1, m_2 =$

**Problem 34.87**

◀ 18 of 21 ▶

✓ Complete

A person with a near point of 85.0 cm, but excellent distant vision, normally wears corrective glasses. But he loses them while traveling. Fortunately, he has his old pair as a spare.

Review | Constants

## ▼ Part A ✓

If the lenses of the old pair have a power of +2.50 diopters , what is his near point (measured from his eye) when he is wearing the old glasses if they rest 2.00 cm in front of his eye?

Express your answer with the appropriate units.

$$d_{\text{near}} = 27.0 \text{ cm}$$

[Previous Answers](#)

✓ Correct

## ▼ Part B ✓

What would his near point be if his old glasses were contact lenses instead?

Express your answer with the appropriate units.

$$d_{\text{near}}' = 27.2 \text{ cm}$$

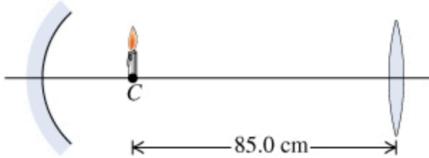
**Problem 34.89 - Enhanced - with Feedback**

◀ 19 of 21 ▶

As shown in (Figure 1) the candle is at the center of curvature of the concave mirror, whose focal length is 10.0 cm. The converging lens has a focal length of 32.0 cm and is 85.0 cm to the right of the candle. The candle is viewed looking through the lens from the right. The lens forms two images of the candle. The first is formed by light passing directly through the lens. The second image is formed from the light that goes from the candle to the mirror, is reflected, and then passes through the lens.

**Figure**

◀ 1 of 1 ▶

**Review | Constants****▼ Part A**

Where is the first image?

Express your answer with the appropriate units.

 $s'_1 =$   Value  Units**Submit** [Request Answer](#)**▼ Part B**

Is this image real or virtual?

- The image is real.
- The image is virtual.

**Submit** [Request Answer](#)

▼ **Part C**

Is this image erect or inverted with respect to the original object?

- The image is erect.
- The image is inverted.

**Submit**

[Request Answer](#)

▼ **Part D**

Where is the second image?

**Express your answer with the appropriate units.**



$s'_2 =$

*Value*

*Units*

**Submit**

[Request Answer](#)

▼ **Part E**

Is this image real or virtual?

- The image is real.
- The image is virtual.

**Submit**

[Request Answer](#)

▼ **Part F**

Is this image erect or inverted with respect to the original object?

- The image is erect.
- The image is inverted.

**Submit**

[Request Answer](#)

**Problem 34.94**

◀ 20 of 21 ▶

The smallest object we can resolve with our eye is limited by the size of the light receptor cells on the retina. In order to distinguish any detail in an object, its image cannot be any smaller than a single retinal cell. Although the size depends on the type of cell (rod or cone), a diameter of a few microns ( $\mu\text{m}$ ) is typical near the center of the eye. We shall model the eye as a sphere 2.50 cm in diameter with a single thin lens at the front and the retina at the rear, with light receptor cells 5.00  $\mu\text{m}$  in diameter.

**Review | Constants****Part A**

What is the smallest object you can resolve at a near point of 25.0 cm?

**Express your answer in microns.**



$$h_{\min} = \quad \mu\text{m}$$

**Submit****Request Answer****Part B**

What angle is subtended by this object at the eye? Express your answer in units of minutes ( $1^\circ = 60 \text{ min}$ ) (Note: There are other limitations, such as the bending of light as it passes through the pupil, but we shall ignore them here.)

**Express your answer in minutes.**



$$\alpha = \quad \text{minutes}$$

### Challenge Problem 34.107

◀ 21 of 21 ▶

People with normal vision cannot focus their eyes underwater if they aren't wearing a face mask or goggles and there is water in contact with their eyes. In a simplified model of the human eye, the aqueous and vitreous humors and the lens all have a refractive index of 1.40, and all the refraction occurs at the cornea, whose vertex is 2.60 cm from the retina.

■ Review | Constants

#### ▼ Part A

With the simplified model of the eye, what corrective lens (specified by focal length as measured in air) would be needed to enable a person underwater to focus an infinitely distant object? (Be careful—the focal length of a lens underwater is *not* the same as in air! Assume that the corrective lens has a refractive index of 1.62 and that the lens is used in eyeglasses, not goggles, so there is water on both sides of the lens. Assume that the eyeglasses are 1.91 cm in front of the eye.)

Express your answer with the appropriate units.

f =

Submit   Request Answer