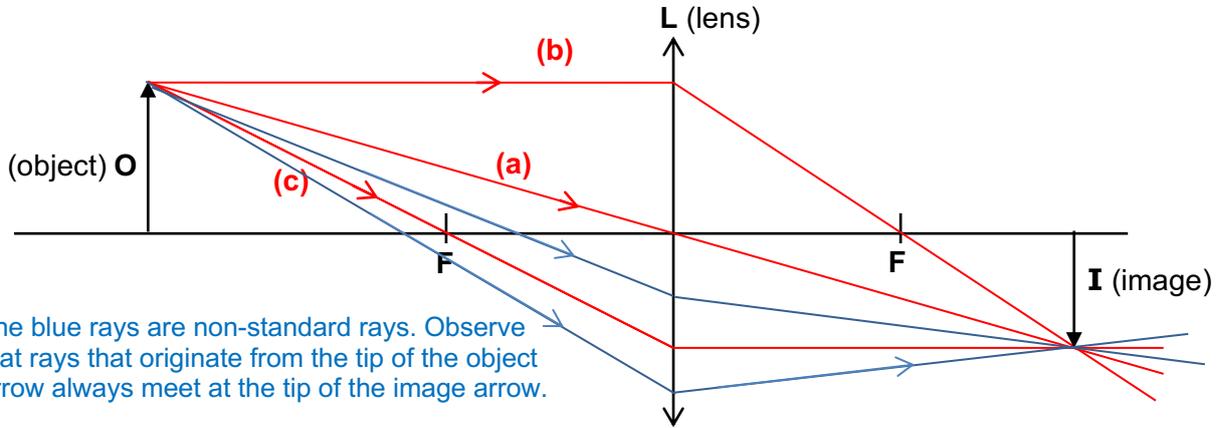


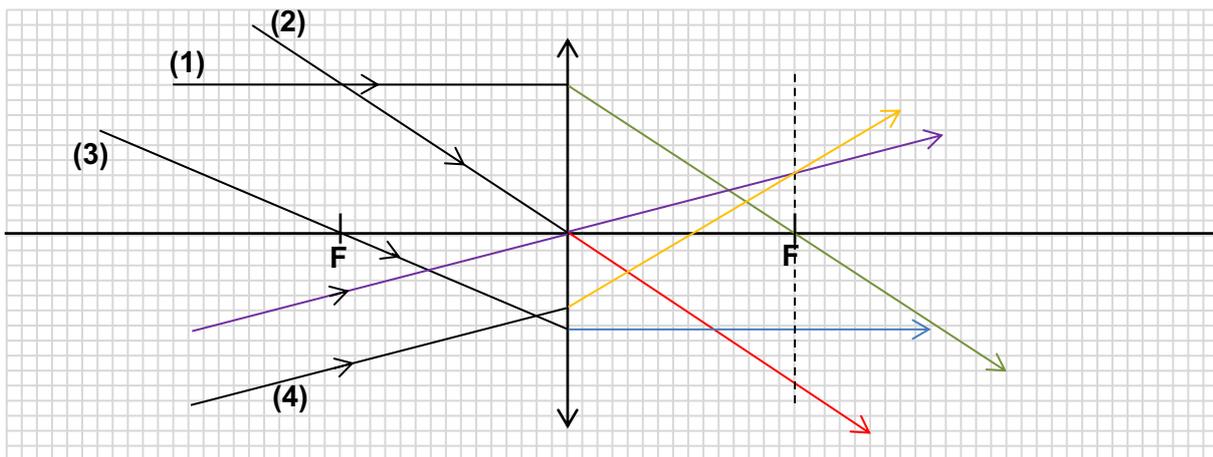


# 2023 Sec 3 Physics Notes Answers Chapter 4 Lenses

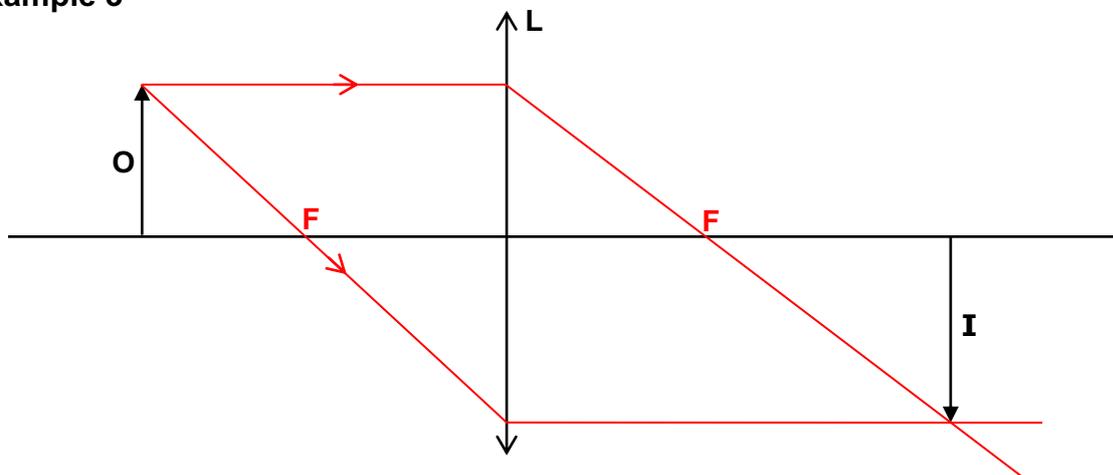
## Example 1



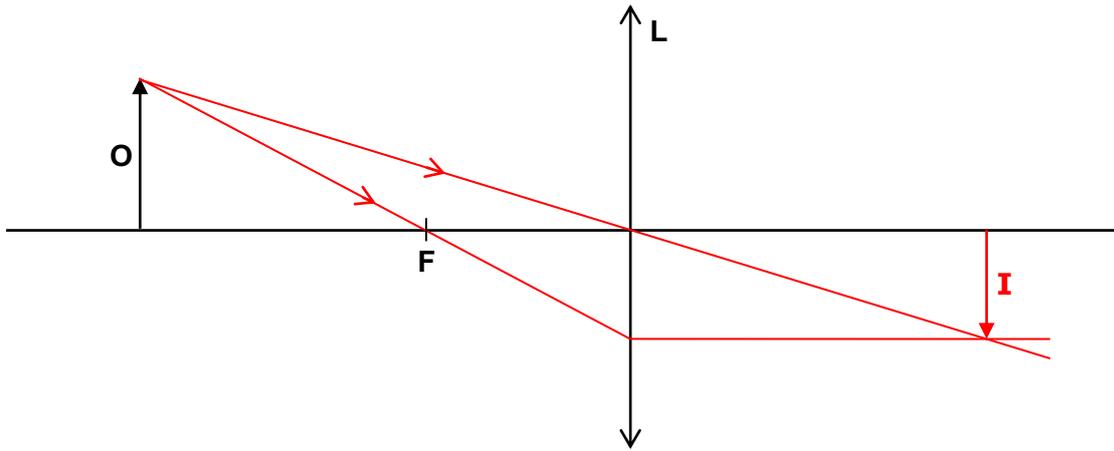
## Example 2



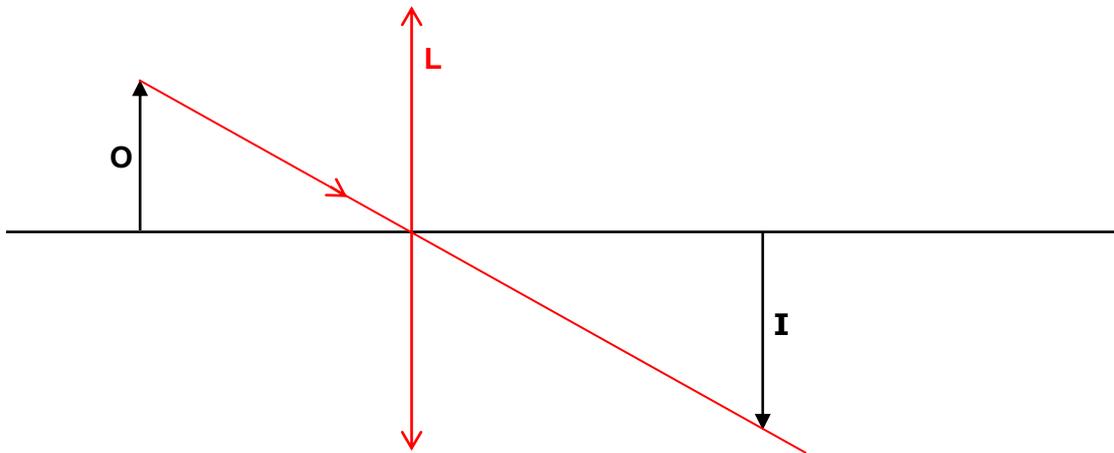
## Example 3



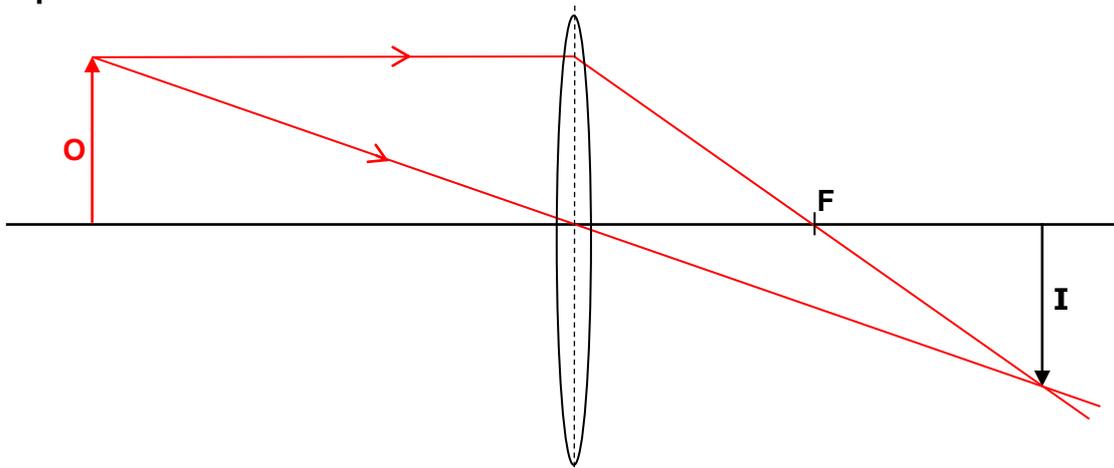
Example 4:



Example 5:



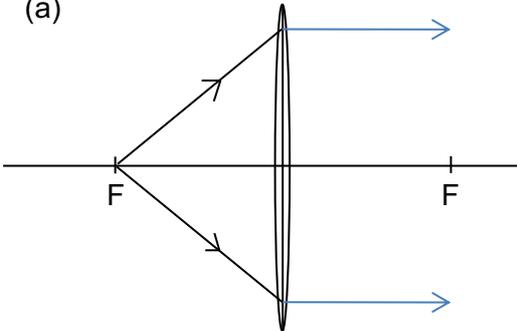
Example 6:



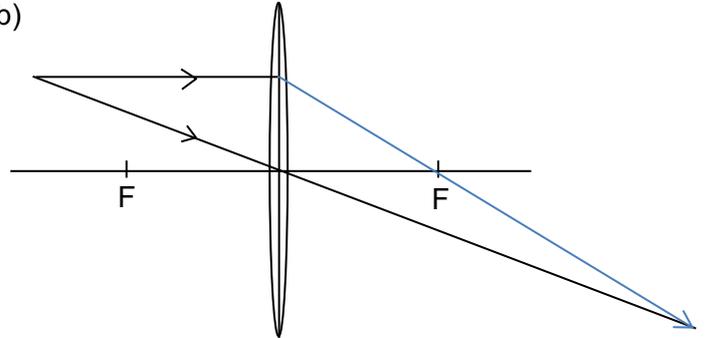
## Exercises

- 1 (a) It bends the light rays towards the principal axis.  
(b) It bends light rays away from the principal axis.  
(c) Light rays from the same point O on an object can converge and meet at a common point I (image). I lies on the principal axis provided O lies on the principal axis.

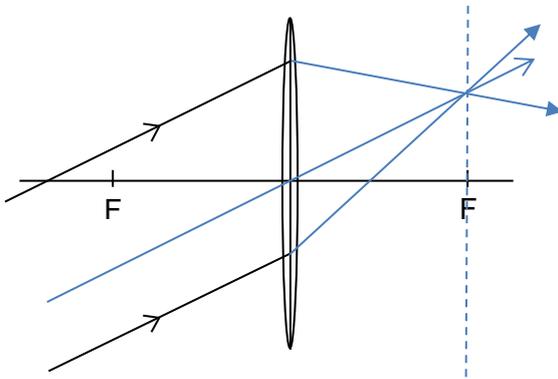
2 (a)



(b)



(c)

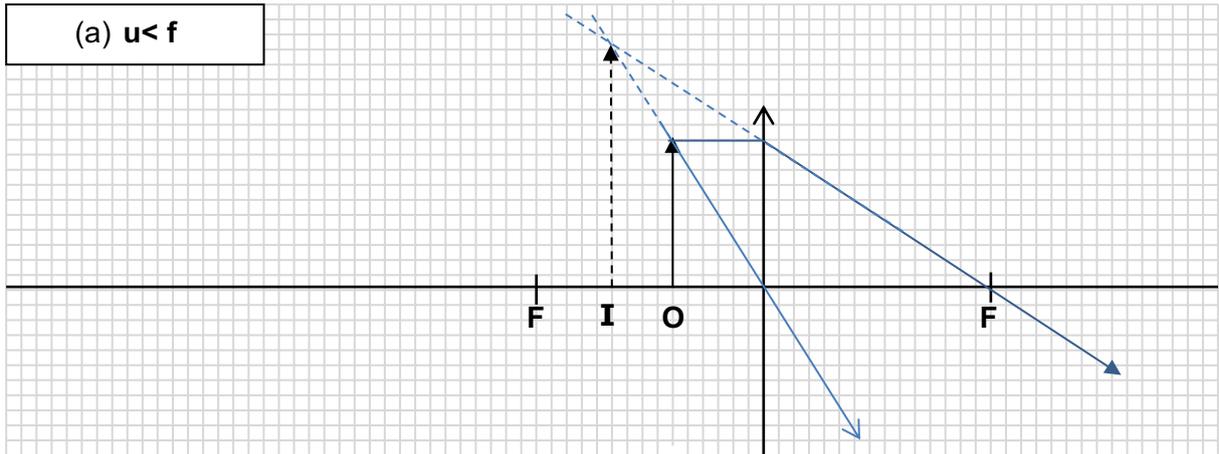


- 3 The entire image will still be visible but will be less bright.

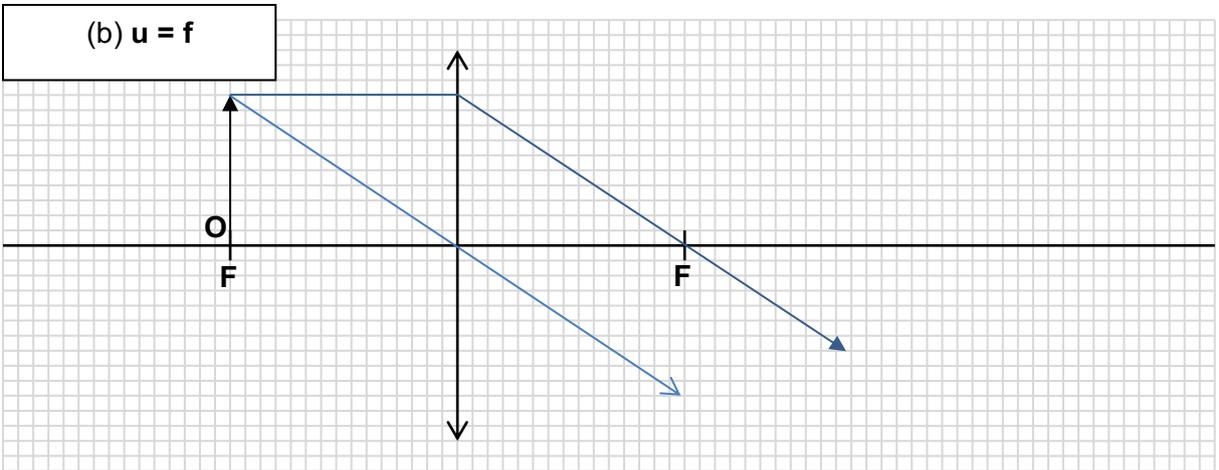
## 7 Description of image

when  $m$  is greater than 1, the image is magnified  
when  $m$  is less than 1, the image is diminished  
when  $m$  is equal to 1, the image is of the same size

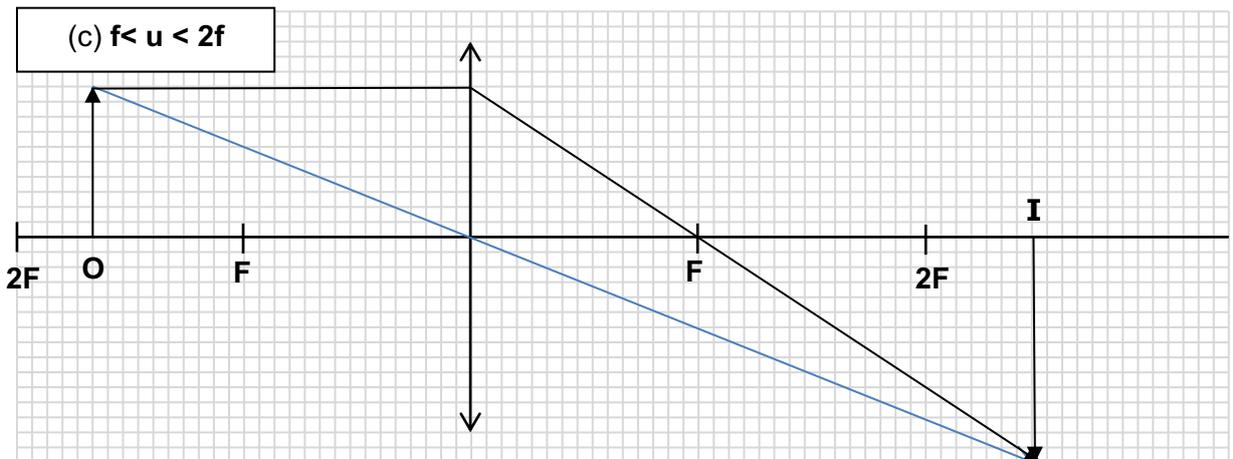
**Example 7**



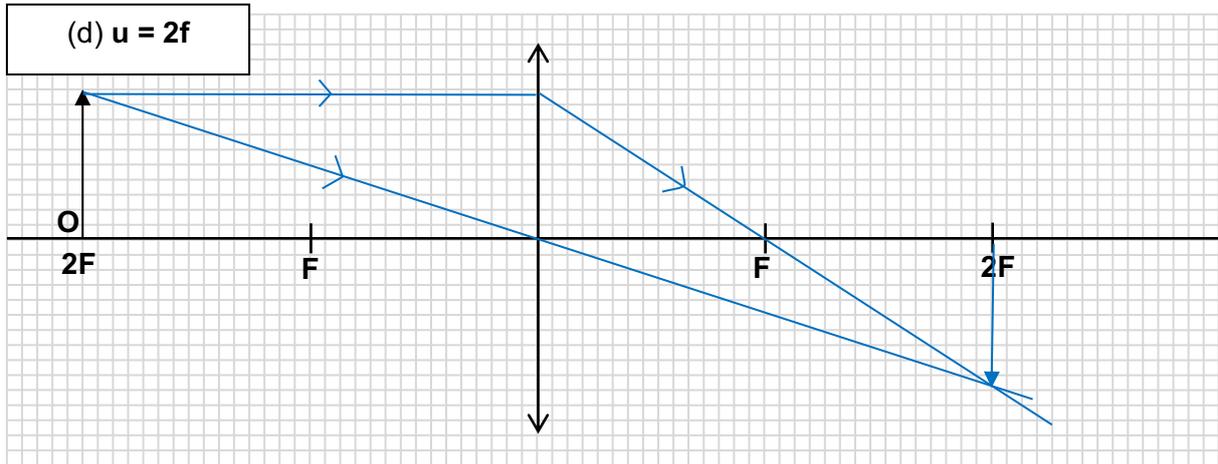
- (i) Description of the image formed: upright, magnified and virtual
- (ii)  $u = 6.0 \text{ cm}$        $v = 10.0 \text{ cm}$        $m = 1.67$



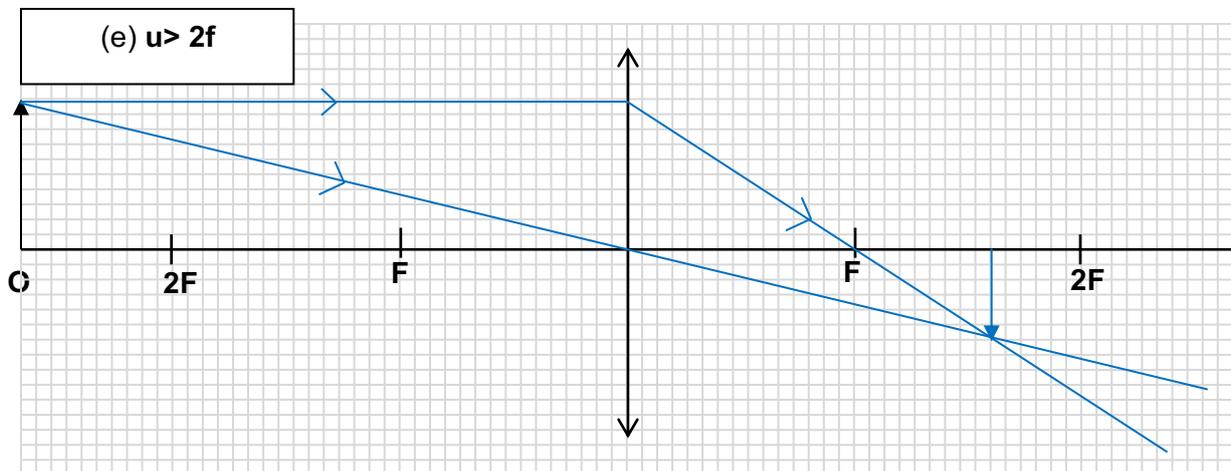
- (i) Description of the image formed: magnified, inverted and real
- (ii)  $u = 15.0 \text{ cm}$        $v = \infty$        $m = \infty$



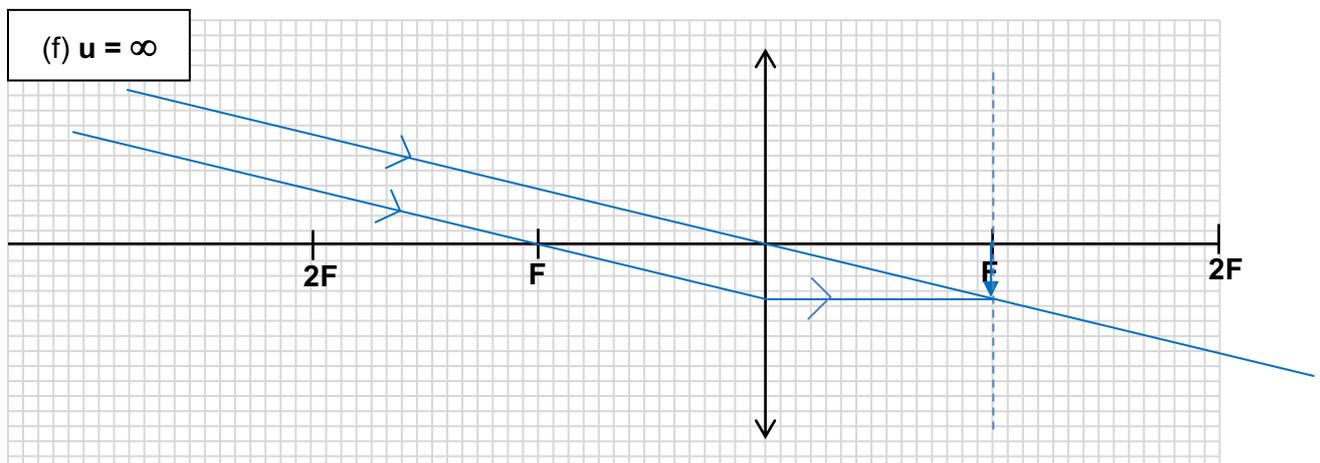
- (i) Description of the image formed: inverted, magnified and real.
- (ii)  $u = 25.0 \text{ cm}$        $v = 37.5 \text{ cm}$        $m = 1.50$



- (i) Description of the image formed: real, same sized, inverted  
 (ii)  $u = 30.0 \text{ cm}$        $v = 30.0 \text{ cm}$        $m = 1.00$



- (i) Description of the image formed: inverted, diminished, real  
 (ii)  $u = 40.0 \text{ cm}$ .       $v = 24.0 \text{ cm}$        $m = 0.600$

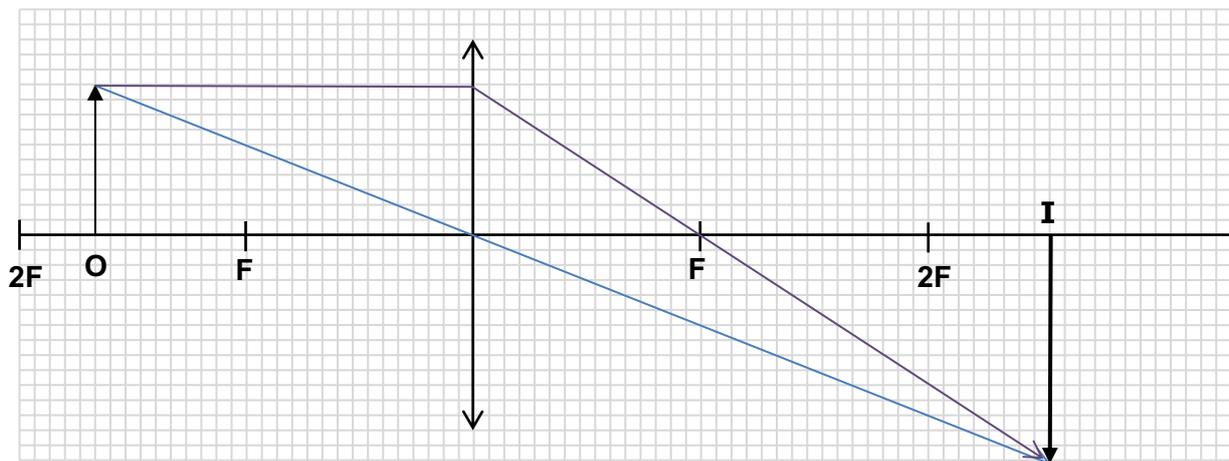


- (i) Description of the image formed: real, inverted, diminished  
 (ii)  $u = \infty$        $v = f = 15.0 \text{ cm}$        $m = \text{N.A.}$

**8 Uses of thin converging lenses** (refer textbook on p. 260-261)

Location of object	Ray diagrams	Characteristics of image	Location of image	Uses
$u = \infty$		<ul style="list-style-type: none"> <li>- Real</li> <li>- Inverted</li> <li>- Diminished</li> </ul>	$v = f$	Object lens of a telescope
$2f < u < \infty$		<ul style="list-style-type: none"> <li>- Real</li> <li>- Inverted</li> <li>- Diminished</li> </ul>	$f < v < 2f$	Camera Eye
$u = 2f$		<ul style="list-style-type: none"> <li>- Real</li> <li>- Inverted</li> <li>- Same size</li> </ul>	$v = 2f$	Photocopier making same-sized copy
$f < u < 2f$		<ul style="list-style-type: none"> <li>- Real</li> <li>- Inverted</li> <li>- Magnified</li> </ul>	$2f < v < \infty$	Projector Photograph enlarger
$u = f$		Depends on usage	$v = \infty$	Spotlight
$u < f$		<ul style="list-style-type: none"> <li>- Virtual</li> <li>- Upright</li> <li>- Magnified</li> </ul>	Same side as object	Magnifying glass

**Example 8**



(i) Description of the image formed: real, inverted and magnified.

$u = 25.0 \text{ cm.}$

$v = 37.5 \text{ cm}$

$m = 1.50$

### Example 9

$$\frac{1}{v} = 1/25.0 - 1/80.0$$

$$v = \underline{36.4 \text{ cm}}$$

$$h_i / h_o = v/u$$

$$h_i = 36.4/80.0 \times 8.0 = \underline{3.6 \text{ cm}}$$

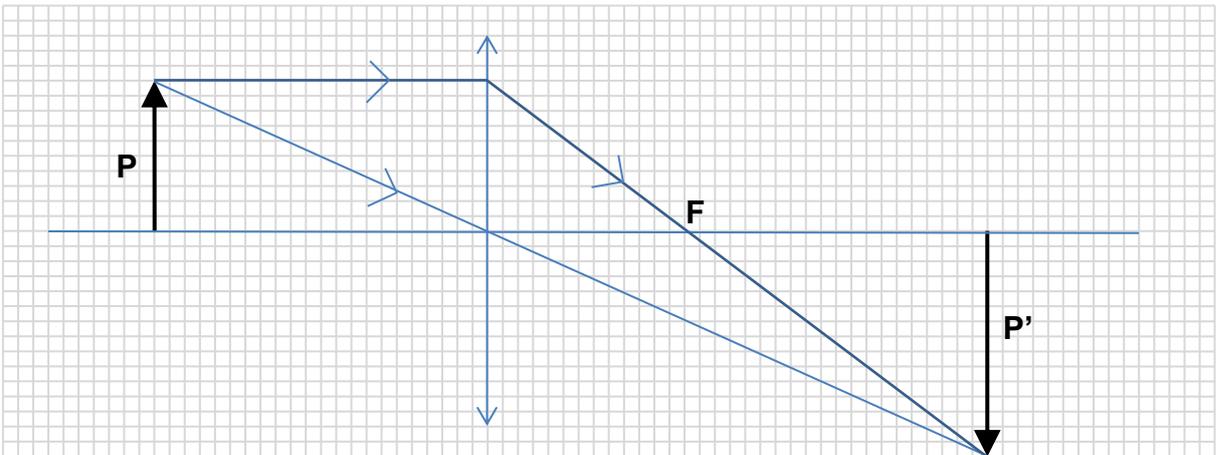
### Exercises

1  $1/v = 1/0.050 - 1$   
 $v = \underline{0.053 \text{ m}}$

$$h_i / h_o = v/u$$

$$h_i = 0.05263\text{m}/1.00 \times 0.25 = \underline{0.013 \text{ m}}$$

2



(a) Draw a ray from **P** to locate the position of the lens, and label the position **L**.

(b) Draw a second ray from **P** to determine the focal length of the lens.

$$\text{Focal length} = \underline{13.0 \text{ cm}} \text{ (assuming } 1.0 \text{ cm}:5.0 \text{ cm)}$$

(c) The object is then moved slightly further from the lens. State the change to the:

(i) Image position nearer to the optical centre

(ii) the image height shorter

3 A converging lens with a focal length of 20.0 cm is used to create an image of the sun on a paper screen.

How far from the lens must the paper be placed to produce a clear image? Explain with the aid of a sketch of a ray diagram.

The lens must be at a distance of  $f$  (20.0 cm). Rays of distant objects (considered to be parallel) will converge along the focal plane. Diagram is same as 2(d) above.

## Enrichment

1  $1/f = 1/50 + (-1/150)$   
 $f = 75 \text{ mm}$

2 (a)  
 $1/f = 1/u + 1/v$   
 $1/22.0 = 1/u + 1/(-50.0)$   
 $1/u = 1/22.0 + 1/50.0$   
 $u = 15.3 \text{ cm}$

(b)  
 $H_i / H_o = v/u$   
 $H_i = 50.0/15.27 \times 25.0 = 81.8 \text{ cm}$

3 If we take  $u$  as positive (which is always the case),  $v = -3u$   
 $1/150 = 1/u - 1/3u$   
 $u = 100 \text{ mm}$