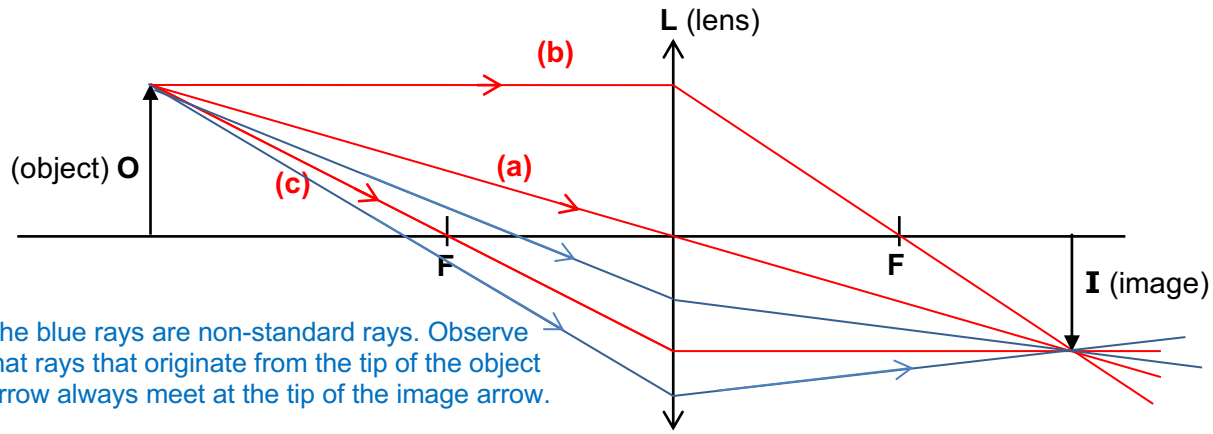
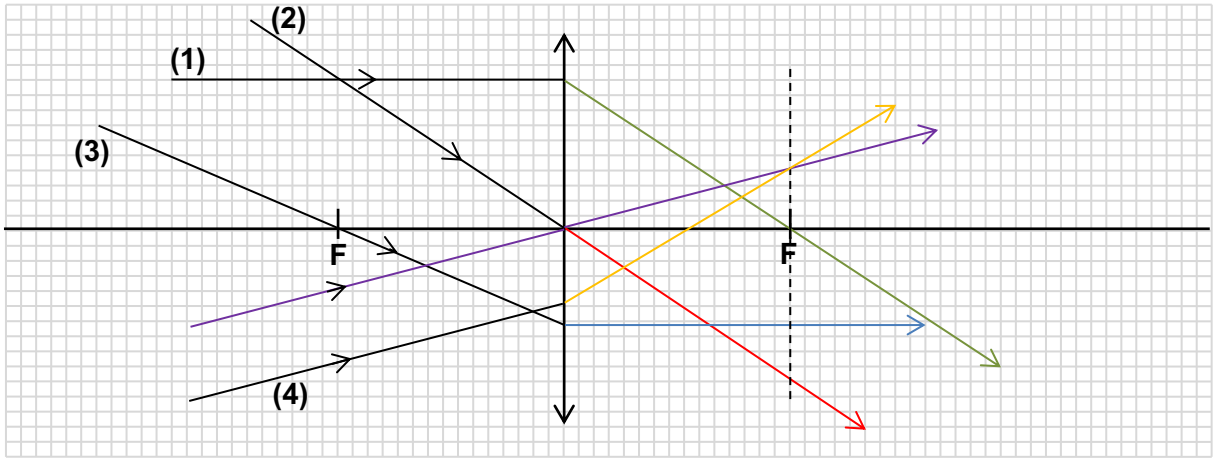
2021 Sec 3 Physics Notes Answers
Chapter 4 Lenses

Example 9.1

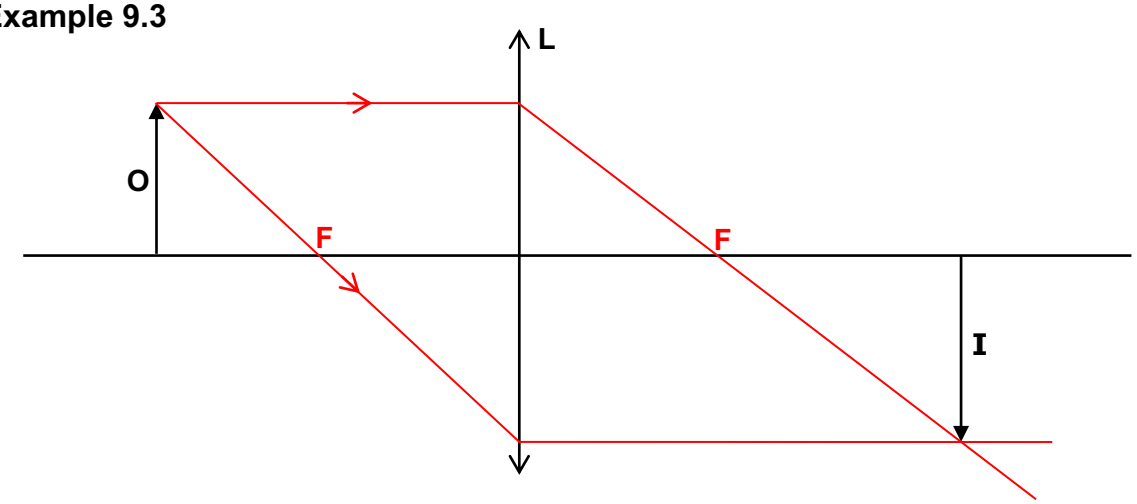


The blue rays are non-standard rays. Observe that rays that originate from the tip of the object arrow always meet at the tip of the image arrow.

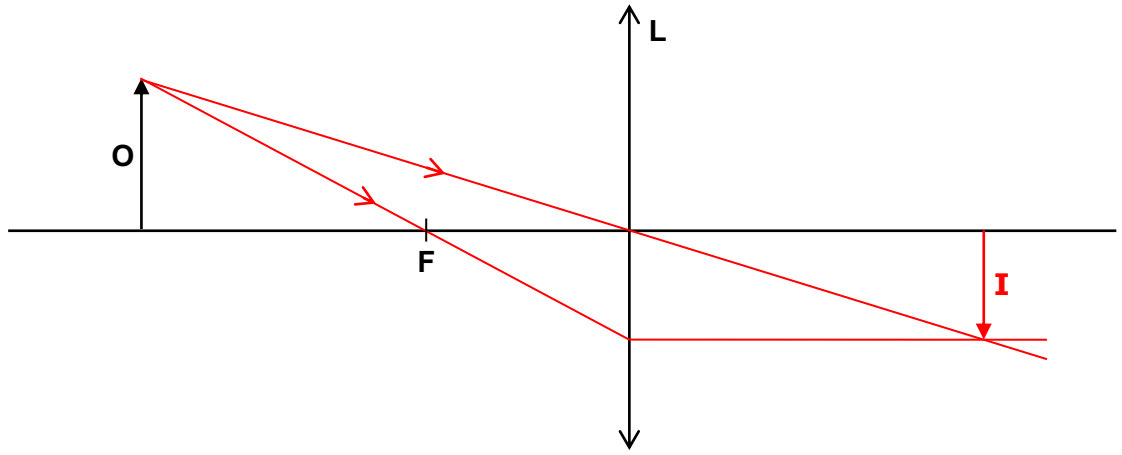
Example 9.2



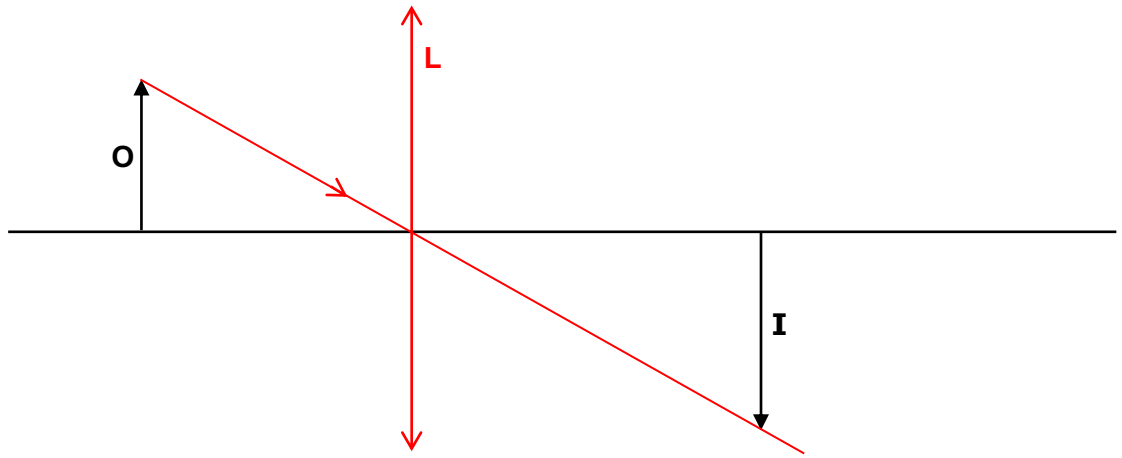
Example 9.3



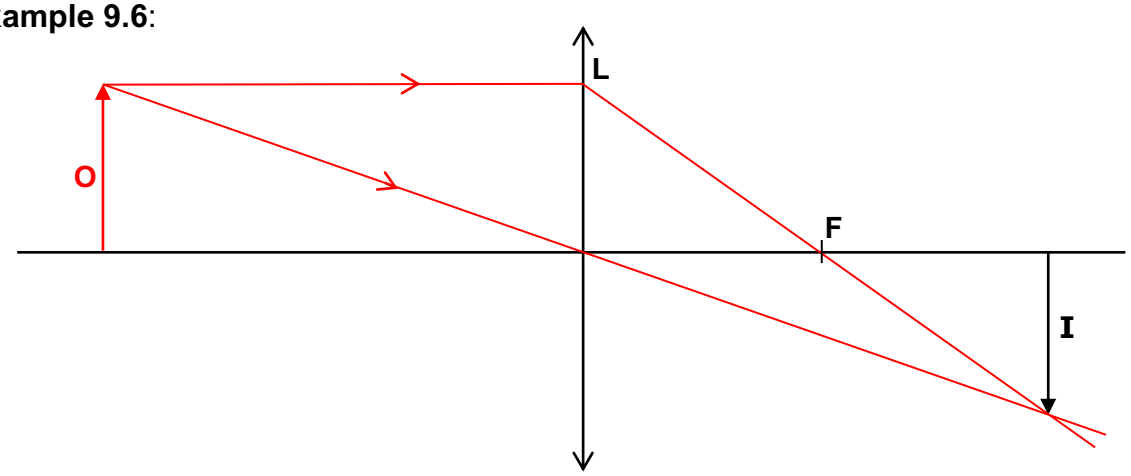
Example 9.4:



Example 9.5:



Example 9.6:



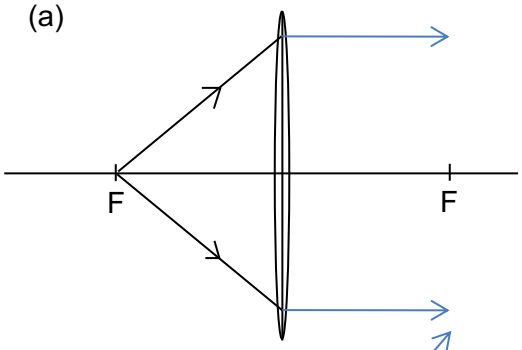
Exercises

1 (a) It bends the light rays towards the principal axis.

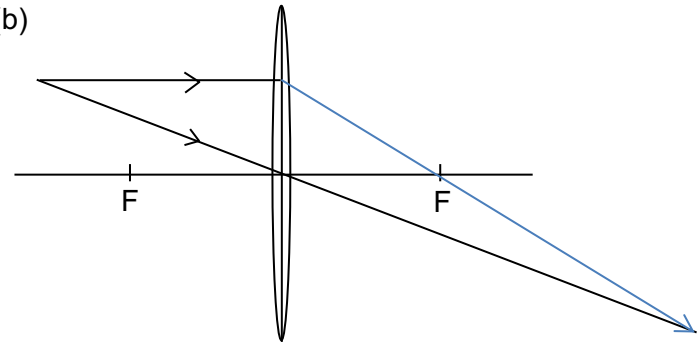
(b) It bends light rays away from the principal axis.

(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.

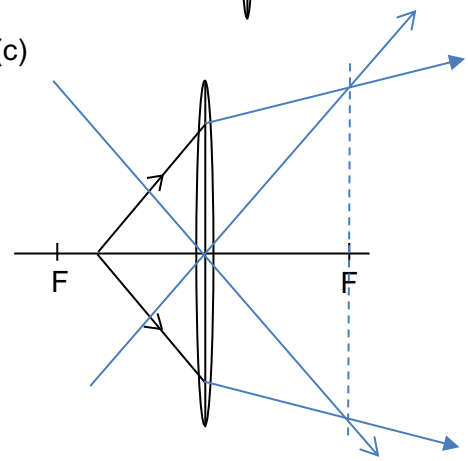
2 (a)



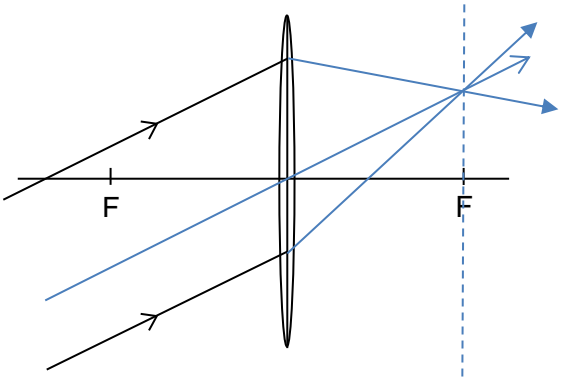
(b)



(c)



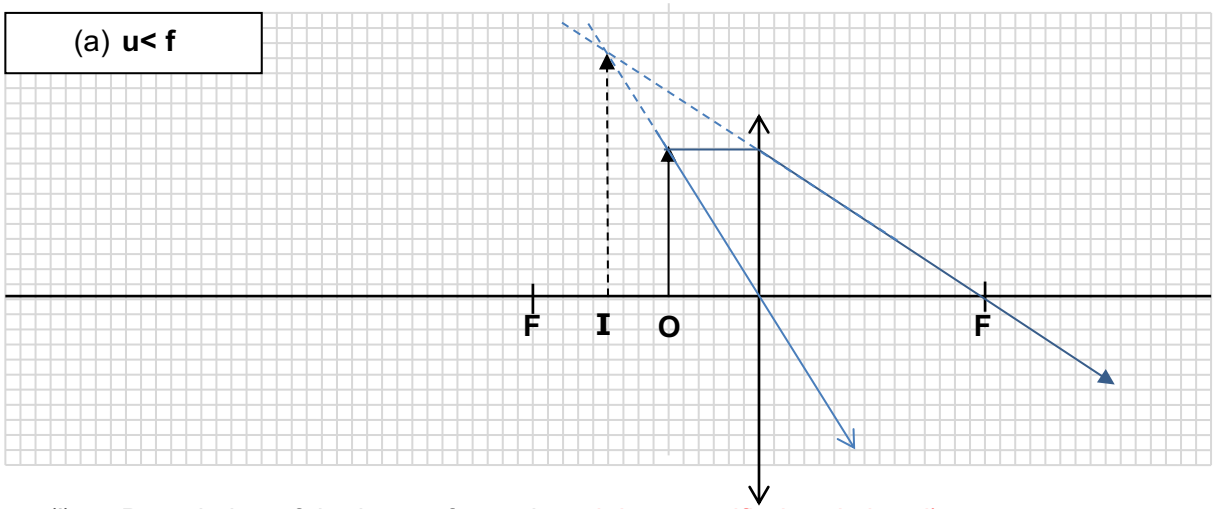
(d)



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

Example 9.7

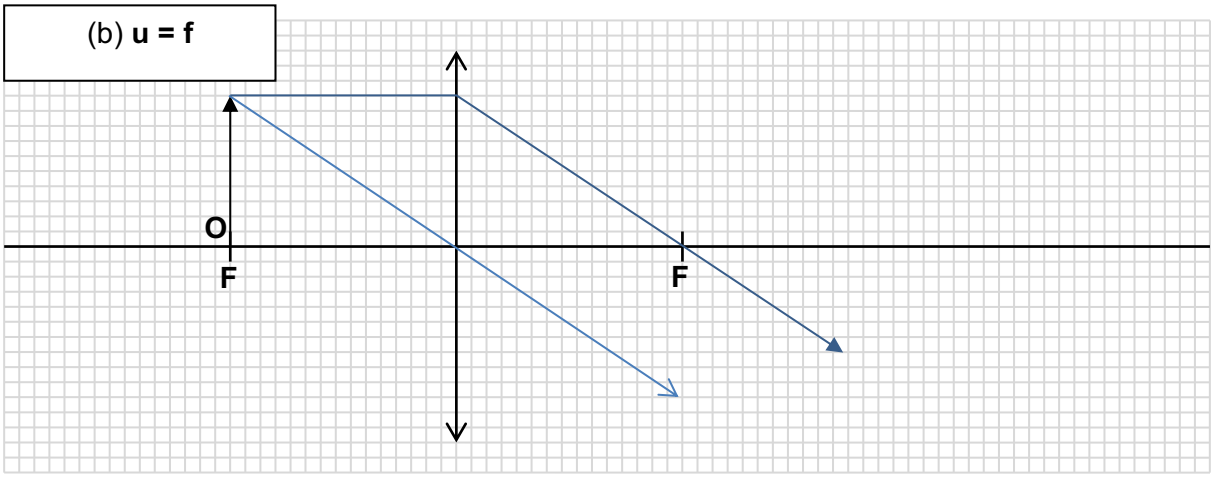
(a) **u< f**



(i) Description of the image formed: upright, magnified and virtual)

(ii) u = 6.0 cm v = 10.0 cm m = 1.67

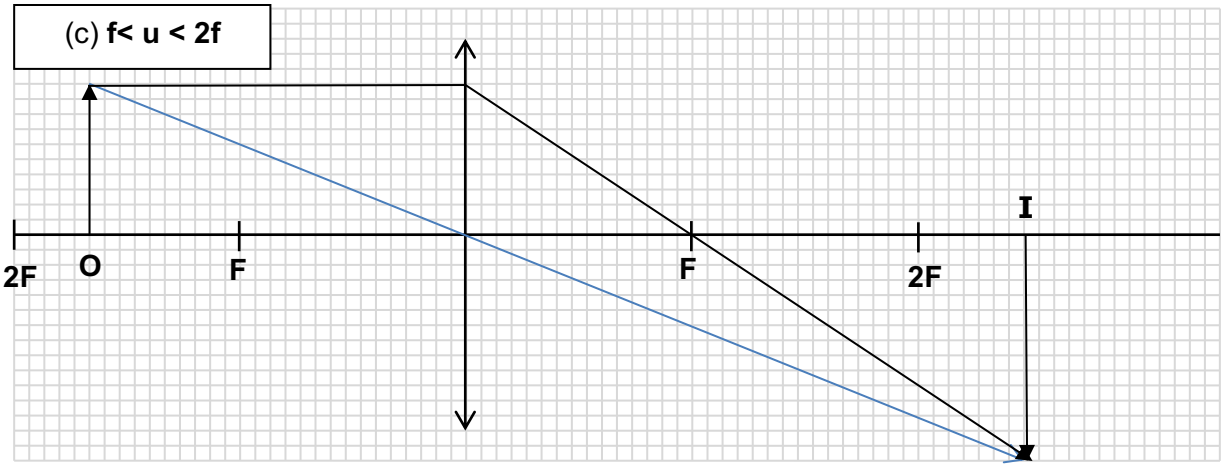
(b) **u = f**



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

(ii) u = 15.0 cm v = ∞ m = ∞

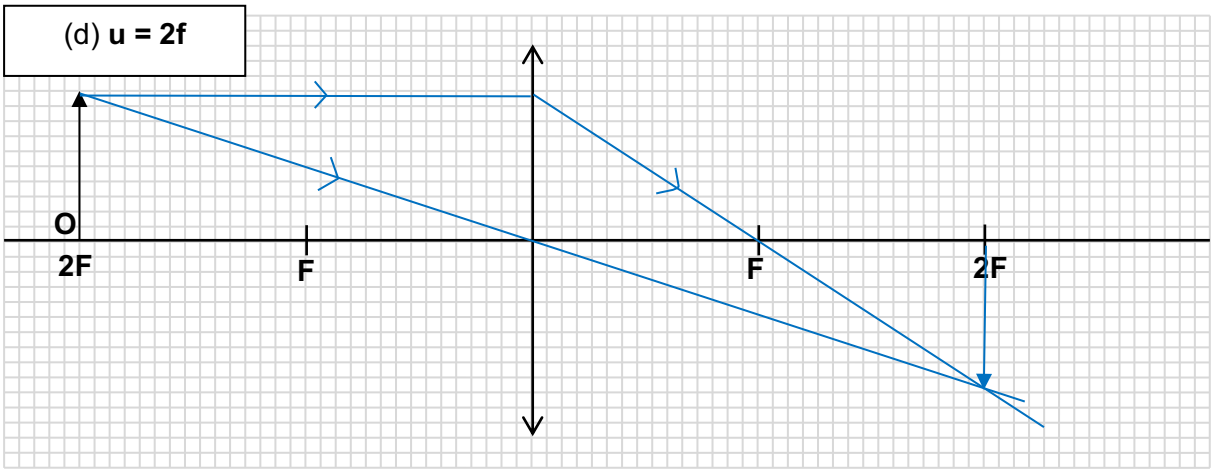
(c) **f< u < 2f**



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

(ii) u = 25.0 cm v = 37.5 cm m = .1.50

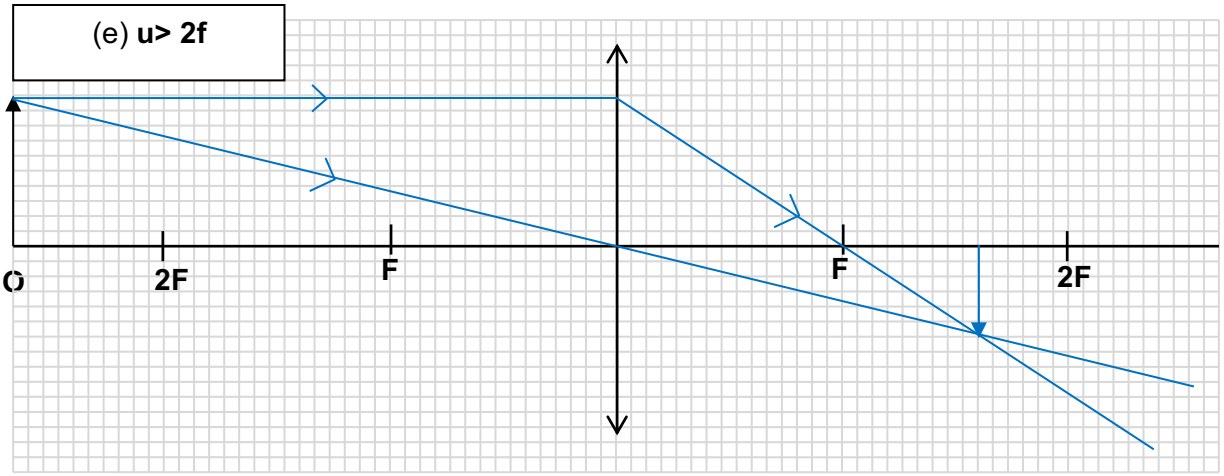
(d) **u = 2f**



(i) Description of the image formed: real, same sized, inverted

(ii) u = 30.0 cm v = 30.0 cm m = 1.00

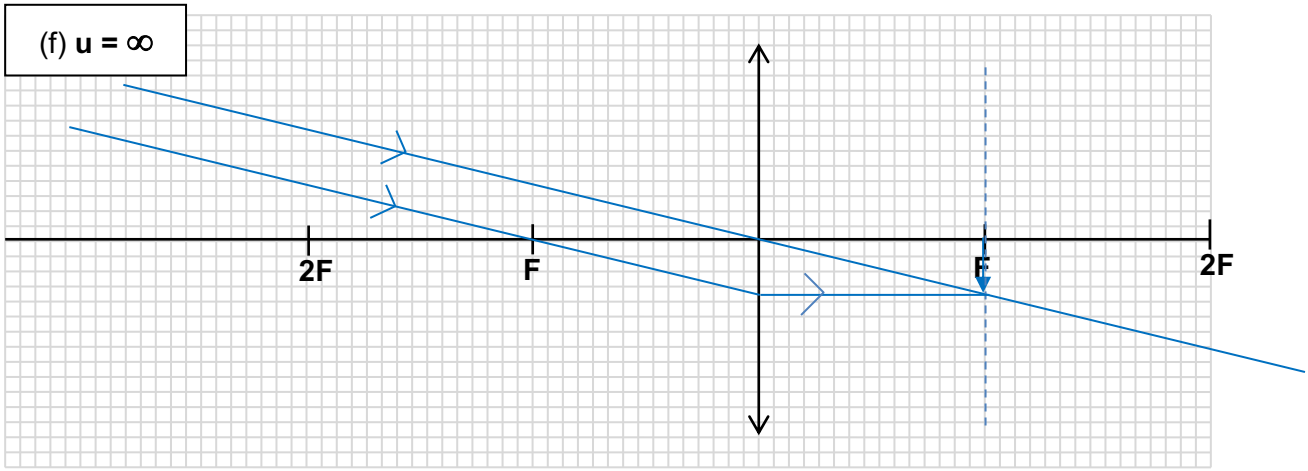
(e) **u> 2f**



(i) Description of the image formed: inverted, diminished, real

(ii) u = 40.0 cm. v = 24.0 cm m = 0.600

(f) **u = ∞**



(i) Description of the image formed: real, inverted, diminished

(ii) u = ∞ v = f = 15.0 cm m = N.A.

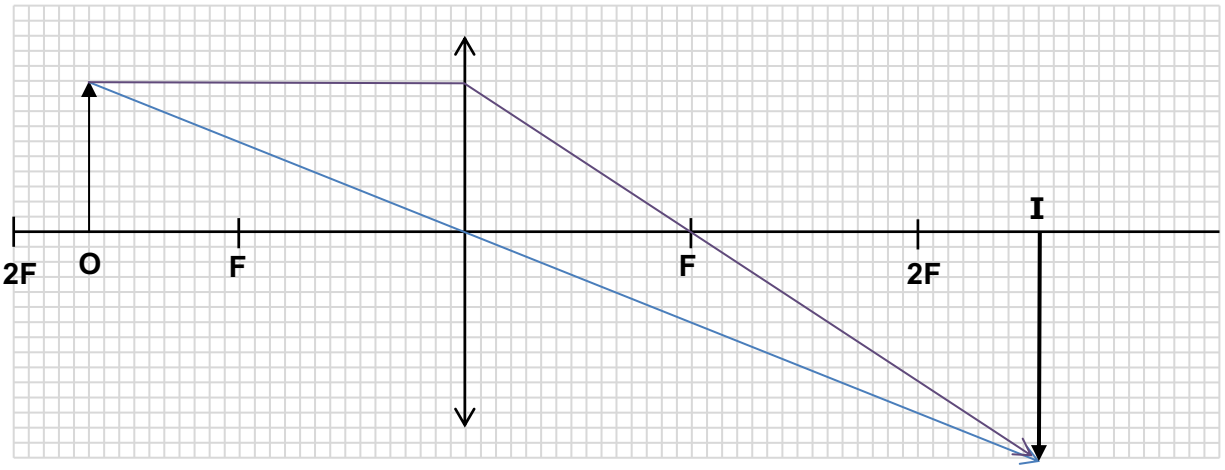
9.7 Description of image

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

9.8 Uses of thin converging lenses (refer textbook on p. 272)

Location of object	Ray diagrams	Characteristics of image	Location of image	Uses
u = ∞		- Real - Inverted - Diminished	v = f	Telescope
2f < u < ∞		- Real - Inverted - Diminished	f < v < 2f	Camera
u = 2f		- Real - Inverted - Same size	v = 2f	Photocopier
f < u < 2f		- Real - Inverted - Magnified	2f < v < ∞	Projector
u = f		Depends on usage	v = ∞	Spotlight
u < f		- Virtual - Upright - Magnified	Same side as object	Magnifying glass

Example 9.8



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

u = 25.0 cm. v = 37.5 cm m = 1.50

Example 9.9

$\frac{1}{v}$ = 1/25.0 – 1/80.0

v = 36.4 cm

h_i / h_o = v/u

h_i = 36.4/80.0 x 8.0 = 3.6 cm

Exercises

1 (a) the position of the object,

1/u = 1/22.0 + 1 /50.0

u = 15.3 cm

(b) the height of the image formed.

H_i / H_o = v/u

H_i = 50.0/15.27 x 25.0 = 81.8 cm

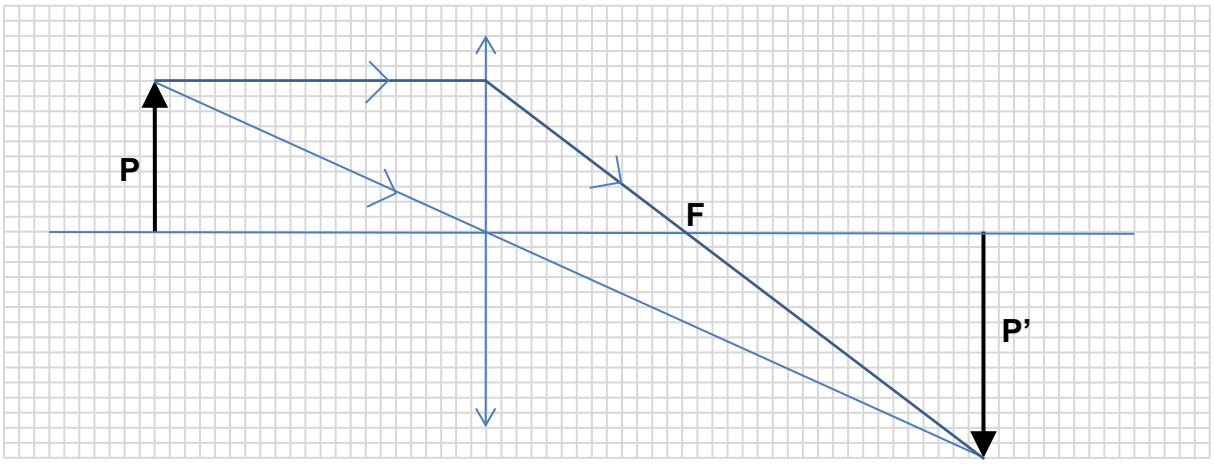
2 1/v = 1/0.050 – 1

v = 0.053 m

h_i / h_o = v/u

h_i = 0.05263m/1.00 x 0.25 = 0.013 m

3



(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.

Focal length = 13.0 cm (assuming 1.0 cm:5.0 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

4 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.