Unit 17 · Lenses

WORKSHEET

Full marks 37

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 37

1 Key words [4]

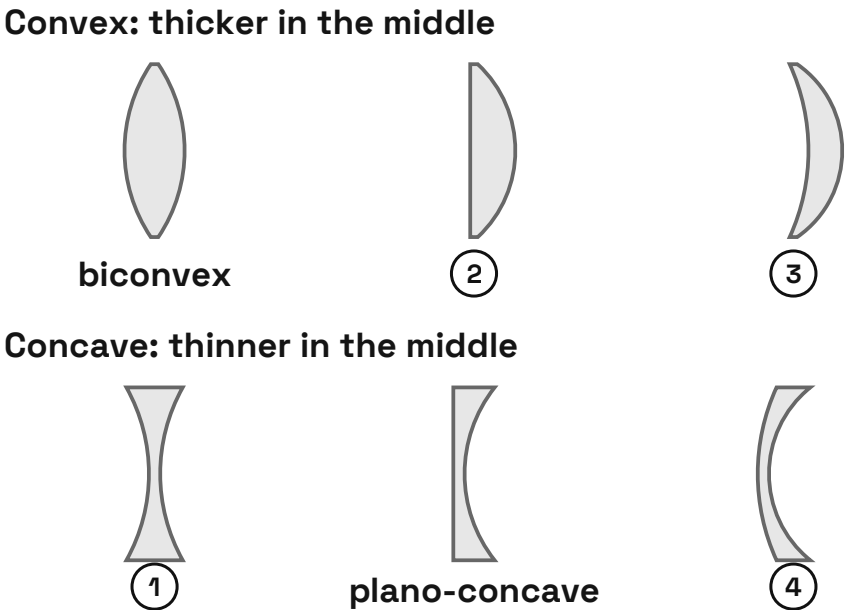
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

angular magnification	**convex**	**critical angle**	**diopters**	**focal plane**	**optical center**
power	**principal axis**	**refracting edge**	**visual angle**		

A lens that is thicker in the middle than at its edges is a _____ lens. A ray passing through the _____ of a thin lens goes on without being deviated. The straight line through the two centers of curvature is the _____. The plane through a principal focus, perpendicular to the axis, is the _____. The reciprocal of the focal length in meters is the _____ of the lens, measured in _____. The angle an object subtends at the eye is its _____, and the size of the image on the retina is proportional to it. The ratio of the visual angle of the image to that of the object is the _____.

2 Label the diagram [2]

The diagram shows the six shapes of lens, cut through the middle. Write the names that belong in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The power of a concave lens of focal length 50 cm is: [1]

a. +2 D **b.** −2 D
c. −0.02 D **d.** −50 D

ii. A lens forms an upright, diminished image of a real object, whatever the object's distance. The lens is: [1]

a. convex **b.** concave
c. plano-convex **d.** concavo-convex

iii. In the lens maker's formula, the flat face of a plano-convex lens adds to 1/f: [1]

a. 1/R of the curved face **b.** $\mu - 1$
c. nothing, since its radius is infinite **d.** an infinite amount

iv. The size of the image of an object on the retina is proportional to: [1]

a. the real size of the object only
b. the distance of the object only
c. the visual angle the object subtends at the eye
d. the power of the eye

v. A simple magnifier forms its image at the least distance of distinct vision, 25 cm. If its focal length is 10 cm, its magnifying power is: [1]

a. 2.5 **b.** 3.5
c. 10 **d.** 1.5

4 Very short answers [3]

Write very short answers to the following questions.

a. Define the optical center of a lens. [1]

b. Define one diopter. [1]

c. What is the power of a convex lens and a concave lens of equal focal length placed in contact? [1]

5 Short answers [6]

Write short answers to the following questions.

a. Distinguish between linear magnification and angular magnification. [2]

b. Why do opticians describe spectacle lenses by their power rather than by their focal length? [2]

c. Pasang holds a pair of reading glasses in sunlight over a sheet of paper and the paper starts to smoke. His friend's glasses for short sight, held the same way, do nothing. Explain. [2]

6 Long answer [4]

Write a long answer to the following question.

Two thin lenses of focal lengths f_1 and f_2 are placed in contact. Show that the focal length F of the pair is given by $1/F = 1/f_1 + 1/f_2$.

7 Numerical problems [10]

Solve the following problems. Show your working. Use the "real is positive" sign convention.

a. An object 4.0 cm tall stands 30 cm from a concave lens of focal length 15 cm. Find the position, size and nature of the image. **[3]**

Answer: _____

b. A biconvex lens has faces of radii of curvature 20 cm and 30 cm and is made of glass of refractive index 1.6. Find its focal length and its power. **[3]**

Answer: _____

c. An optician puts a lens of +3.0 D in contact with a lens of −1.25 D. **[4]**

i. Find the power and focal length of the pair, and say whether it converges or diverges.

ii. Through the pair, Sabina looks at a page 50 cm away. Where is the image of the page, and how many times larger is it?

Answer: _____

8 Think [3]

The bottom half of a convex lens is covered with black paper while it forms an image of a candle on a screen. Does half of the candle's image disappear? Explain.

9 Activity: The focal length of a lens (Activity 17.1) (not marked)

Use a magnifying glass or reading glasses. First catch the image of a distant window on a sheet of paper. Then put a paper screen about 1 m from a torch behind a paper arrow, and find the two positions of the lens between them that give a sharp image.

	u (cm)	v (cm)	f = uv ÷ (u + v) (cm)
Distant window	very far		
First position			
Second position			

What is the power of the lens in diopters? Compare it with the label on the glasses, if there is one.