Light — Reflection and Refraction

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. The radius of curvature of a concave mirror is 24 cm. Its focal length is:
(a) −24 cm **(b)** 12 cm **(c)** −13 cm **(d)** −12 cm

2. A concave lens has a focal length of −200 cm. Its power is:
(a) −0.5 D **(b)** 0.5 D **(c)** −0.01 D **(d)** −200 D

3. Light travels at 3×10^8 m/s in vacuum and 2.4×10^8 m/s in a medium. The refractive index of the medium is:
(a) 1.75 **(b)** 2.4 **(c)** 3 **(d)** 1.25

4. An object 2 cm tall forms a real, inverted image 10 cm tall. The magnification is:
(a) −5 **(b)** 5 **(c)** −0.2 **(d)** −10

5. The angle of incidence equals the angle of reflection. This is:
(a) a law of reflection **(b)** the lens formula
(c) the mirror formula **(d)** Snell's law

6. An object is placed 56 cm in front of a concave mirror of focal length 24 cm. The image forms at:
(a) −21 cm **(b)** −42 cm **(c)** 42 cm **(d)** −66 cm

7. An object is placed 42 cm from a convex lens of focal length 24 cm. The image forms at:
(a) 24 cm **(b)** −56 cm **(c)** 80 cm **(d)** 56 cm

8. Assertion (A): A convex lens of focal length 25 cm has a power of −4 D.
Reason (R): Power of a lens = 1 ÷ focal length in metres, and a convex lens has a positive focal length.
(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Section B — Short answer — 8 × 2 = 16 marks

9. An object is 60 cm in front of a concave mirror of focal length 10 cm. Find the position and nature of the image.

10. An object is 18 cm in front of a convex mirror of focal length 36 cm. Find the position and nature of the image.

11. An object is 42 cm from a convex lens of focal length 36 cm. Find the image distance and the magnification.

12. An object is 10 cm from a concave lens of focal length 40 cm. Find the position and nature of the image.

13. An object 6 cm tall is placed 10 cm from a convex lens of focal length 5 cm. Find the image distance and the height of the image.

14. Two thin lenses of power +10 D and −2.5 D are placed in contact. Find the combined power and focal length. (Give the answer to 2 decimal places where needed.)

15. The refractive index of medium A is 1.25 and of medium B is 2. Find the refractive index of B with respect to A. (Give the answer to 2 decimal places where needed.)

16. Where should an object be placed in front of a convex lens of focal length 9 cm to get a real image the same size as the object?

Section C — Word problems — 4 × 4 = 16 marks

17. An 8 cm tall candle stands 48 cm in front of a concave mirror of focal length 40 cm. Where should a screen be placed to get a sharp image? Describe the image and find its height.

18. A car's rear-view convex mirror has a focal length of 12 cm. A scooter is 36 cm behind it. Find the position of the image and its magnification.

19. A projector lens forms a sharp image on a screen 90 cm away from a slide placed 45 cm from it. Find the focal length of the lens and the magnification.

20. An optician prescribes a lens of power +2.5 D. Find its focal length, and say whether it is a converging or a diverging lens. (Give the answer to 2 decimal places where needed.)

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Answer key

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Q	Answer	Working
1	**(d) −12 cm**	f = R/2, negative for a concave mirror
2	**(a) −0.5 D**	P = 1 ÷ f (in m) = 100 ÷ −200
3	**(d) 1.25**	n = c ÷ v = 3 ÷ 2.4
4	**(a) −5**	m = image height ÷ object height = −10 ÷ 2; negative for a real, inverted image
5	**(a) a law of reflection**	—
6	**(b) −42 cm**	1/v = 1/f − 1/u = 1/(−24) − 1/(−56), so v = −42 cm
7	**(d) 56 cm**	1/v = 1/f + 1/u = 1/24 + 1/(−42), so v = 56 cm
8	**(d) A is false, but R is true.**	A is false: P = 100 ÷ 25 = +4 D, not −4 D. R is true.
9	**v = −12 cm (in front of the mirror); real, inverted and diminished**	1/v = 1/f − 1/u gives v = −12 cm; m = −v/u = −0.2
10	**v = 12 cm (behind the mirror); virtual, erect and diminished**	1/v = 1/f − 1/u gives v = +12 cm; m = 0.67
11	**v = 252 cm; m = −6**	1/v = 1/f + 1/u gives v = 252 cm; m = v/u = 252 ÷ (−42)
12	**v = −8 cm; virtual, erect and diminished**	1/v = 1/f + 1/u gives v = −8 cm (same side as the object); m = 0.8
13	**v = 10 cm; height −6 cm (inverted)**	v = 10 cm; m = v/u = −1; h′ = m × 6
14	**+7.5 D; 13.33 cm**	P = P_1 + P_2 = +7.5 D; f = 100 ÷ P cm
15	**1.6**	n_BA = n_B ÷ n_A = 2 ÷ 1.25
16	**18 cm from the lens (u = −18 cm)**	m = v/u = −1, so v = −u; 1/v − 1/u = 1/9 gives u = −18 cm, v = 18 cm
17	**240 cm in front of the mirror; real, inverted and magnified; height 40 cm**	v = −240 cm; m = −5; h′ = m × 8
18	**9 cm behind the mirror; m = 0.25 (virtual, erect, diminished)**	1/v = 1/f − 1/u = 1/12 − 1/(−36); m = −v/u
19	**30 cm; m = −2**	1/f = 1/v − 1/u = 1/90 − 1/(−45); m = v/u
20	**+40 cm; converging (convex)**	f = 100 ÷ P cm; positive power means a convex lens

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