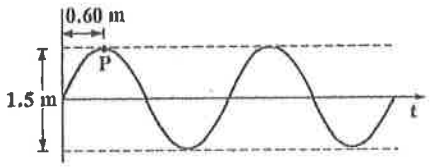
Waves & Optics Review

1. The diagram shows a wave traveling on a rope with a frequency of 4.0 Hz.



a) Determine the amplitude, wavelength and period of the wave.

b) Find the speed of the wave.

c) Find the total distance through which point P moves in 8.0 s.

2. Radio waves travel through air at a speed of 3.0×10^8 m/s. An AM radio station emits a radio signal with a frequency of 6.0×10^5 Hz.

a) Determine the period of the radio signal.

b) Determine the wavelength of the radio signal.

3. A water wave traveling at a speed of 0.16 m/s in shallow water enters deep water and travels at a speed of 0.24 m/s. The wavelength of the wave in shallow water is 0.014 m.

a) Find the wavelength of the wave in deep water.

b) Find the frequencies of the wave in shallow water and in deep water.

4. A water wave of an amplitude of 1.2 m interferes with a second water wave of an amplitude of 0.70 m traveling in the same direction.

a) State the condition under which the maximum resultant amplitude occurs, and find the maximum resultant amplitude.

b) State the condition under which the minimum resultant amplitude occurs, and find the minimum resultant amplitude.

5. A woman hears the rumble of a thunder 3.8 s after she sees the lightning flash. Find the distance to the lightning flash. The speed of sound is 343 m/s.

6. One light-year is the distance that light travels in one year. Alpha Sirius, one of the nearest stars from the earth, is located 8.7 light-years from the earth. Find the distance between the earth and Alpha Sirius in meters.

7. A beam of light of wavelength 4.4×10^{-7} m in air enters a crown-glass container filled with oil and then exits through the glass wall of the container. The index of refraction of the oil is 1.48.

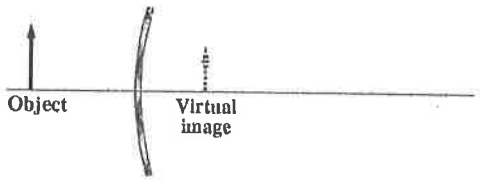
a) Find the wavelengths of the light in the oil and in the glass.

b) Find the frequencies of the light in the oil and in the glass.

8. In a certain time, light travels 2.8×10^5 m in a vacuum. During the same time, light travels 2.2×10^5 m in a substance. Find the index of refraction of the substance.

9. An object and its image formed by a spherical mirror appear in each diagram. Locate the focal point and center of curvature of each mirror.

a)



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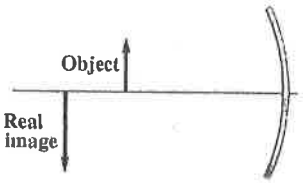
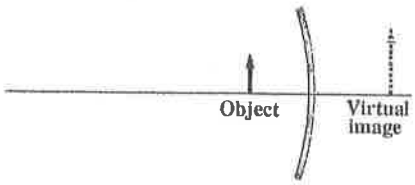


c)



10. A convex mirror is used to monitor the aisles in a store. The mirror has a radius of curvature of 4.0 m, and a 1.5-m-tall customer is standing 12 m in front of the mirror.

a) Locate the image of the customer.

b) How tall is the image?

c) Is the image real or virtual?

d) Is the image upright or inverted?

11. A man is using a mirror to shave his chin. When he stands 1.48 m in front of the mirror, the inverted image of his chin is produced 32 cm in front of the mirror.

a) Determine the radius of curvature of the mirror.

b) If he wants to form an upright image of his chin that is twice the actual size of his chin, how close to the mirror should he stand?

12. An object is placed 36 cm in front of a convex mirror, and the image is produced 18 cm behind the mirror. When a second object, which is 1.5 times as tall as the first object, is placed in front of the mirror, the image of the second object has the same height as the first image.

a) Find the focal length and radius of curvature of the mirror.

b) Locate the second object and its image.

13. An object is located in front of a concave mirror with a radius of curvature of 60 cm, and the distance between the object and its image is 80 cm.

a) If the object is placed beyond the center of curvature, find the object and image distances.

b) If the object is placed within the focal point of the mirror, find the object and image distances.

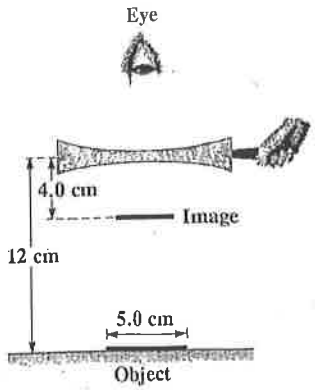
14. A convex lens has a focal length of 24 cm, and a coin is placed 16 cm from the lens.

a) Locate the image of the coin.

b) Find the magnification.

c) Is the image real or virtual? Explain your answer.

15. A student is holding a concave lens 12 cm above a 5.0-cm-long object, and the image is 4.0 cm beneath the lens.



a) Find the focal length of the lens.

b) Find the magnification. Is the image enlarged or reduced in size?

16. A convex lens has a focal length of 14 cm, and produces an image of an object. The image is 2.5 times larger than the object.

a) If the image is real and inverted, find the object distance and the image distance.

b) If the image is virtual and upright, find the object distance and the image distance.

17. A convex lens is used to project an image of an object onto a screen in a physics lab. An object is located 32 cm from the lens, and a sharp image appears on the screen. When a second object is placed 4.0 cm farther away from the lens, the screen must be moved 24 cm closer to the lens to produce a sharp image.

a) Find the focal length of the lens.

b) Find the image distance of each object.

c) Find the magnification for each case.

SOLUTIONS:

1. a) 0.75m, 2.4m, 0.25s
   b) 9.6m/s
   c) 96m
2. a) 1.7×10^{-6} s
   b) 5.0×10^{2} m
3. a) 0.021 m
   b) 11 Hz, 11 Hz
4. a) 1.9m
   b) 0.5m
5. 1300m
6. 8.2×10^{16} m
7. a) 3.0×10^{-7} m
   2.9×10^{-7} m
   b) 6.8×10^{14} Hz FOR BOTH
8. 1.27
9. See Worked Solutions
10. a) -1.7m
    b) 0.21
    c) VIRTUAL
    d) UPRIGHT
11. a) 52.6cm
    b) 13cm
12. a) -36cm, 72cm
    b) 72cm, -24cm
13. a) 120cm, 40cm
    b) 20cm, -60cm
14. a) -48cm b) 3.0
    c) VIRTUAL
15. a) -6.0cm b) 0.33
16. a) 19.6cm, 49cm
    b) 8.4cm, -21cm
17. a) 24cm
    b) 72cm
    c) -2.0