Exercise and activity answer key

1. The arrangement of colors with decreasing wavelength during dispersion of light by prism is

A. violet, green, yellow, red
B. red, orange, green, blue
C. red, violet, yellow, green
D. violet, red, yellow, green

Answer: B. these colors, in order of decreasing wavelength, are red, orange, yellow, green, blue, and violet. Violet light deviates the most, red light the least, and the remaining colors in the visible spectrum fall between these extremes.

2. The refractive index of water is 4/3. How fast does light travel in water?

A. 1.45 x 10^8 m/s
B. 1.80 x 10^8m/s
C. 2.25 x 10^8m/s
D. 2.75 x 10^8m/s

Answer: C. applying the equation of absolute index of refraction:

$$v=\frac{3x10^8 m/s}{4/3}=2.25x10^8 m/s$$

3. A lens has a lens power of 2D. When an object is placed on the principal axis of the lens at a distance of 30 cm from the optical center, find image nature and distance.

A. Real: 60 cm
C. Virtual: 75 cm
B. Real: 80 cm
D. Virtual: 100 cm

Answer: C. the lens power is the reciprocal of wavelength in meter.

$$f=\frac{1}{fp}=\frac{1}{21/m}=\frac{1}{2}m=50cm$$

The position of the image is: $di=\frac{fdo}{do-f}=\frac{50cmx30cm}{30cm-50cm}=-75cm$. Therefore, the nature of the image is virtual and its position is 75 cm.

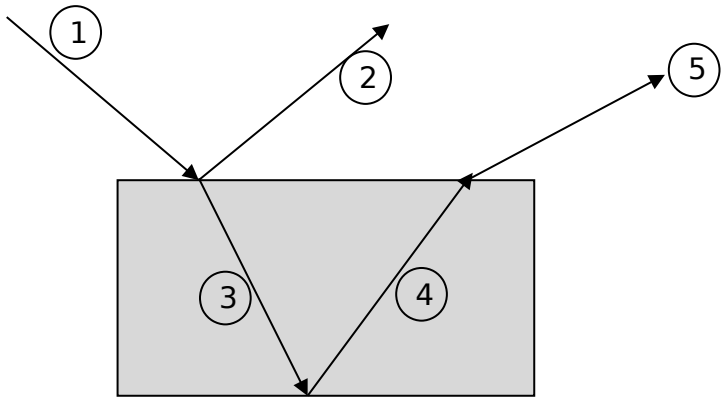
4. When white light is passing through a glass prism, which color has least speed after refraction?

A. violet
B. red
C. green
D. yellow

Answer: A. when light passes through a prism, you will notice that violet is refracted more than red. This occurs because the speed of violet light through

glass is less than the speed of red light through glass. Violet light has a higher frequency than red light, which causes it to interact differently with the atoms of the glass. This results in glass having a slightly higher index of refraction for violet light than it has for red light.

5. If beam 1 is the incoming beam shown in the figure, which of the other four lines are reflected beams and which are refracted beams?



A. 2 and 4 are reflected, 3 and 5 refracted
B. 2 and 3 are reflected, 4 and 5 refracted
C. 3 and 5 are reflected, 2 and 4 are refracted
D. 2 and 5 are reflected, 3 and 4 are refracted

Answer: A. when ray 1 is incident ray 2 is reflected, and ray 3 is refracted, ray 4 is reflected, and ray 5 is refracted. Therefore, ray 2 and ray 4 are reflected, and ray 3 and ray 5 are refracted.

6. When an object is 10 cm from a certain converging lens, the image is magnified by a factor of 1.5. What is the distance of the image?

A. 3.3 cm B. 6.6 cm C. 10 cm D. 15 cm

Answer: D. applying the equation of magnification:

$$m=\frac{\mathrm{di}}{\mathrm{do}} \Rightarrow \mathrm{di}=\mathrm{m\ x\ do}=1.5\ \mathrm{x}\ 10\ \mathrm{cm}=15\ \mathrm{cm}$$

7. Which of the following statements is **true**?

i. virtual images can be projected onto a screen
ii. real images can never be seen
iii. real images can only be created by converging lenses and concave mirrors in a single lens or single mirror system

A. iii only B. I and ii only
C. i and iii only D. i. ii, and iii

Answer: A. virtual images ae called ‘virtual’ because they are not really there, so they cannot be projected on to a screen. Real images can be seen if they are focused into the eye or projected onto a screen. Diverging lenses and convex mirrors, by themselves, can only create virtual images.

8. A real image can only be formed by one of the following?

A. plane mirror B. concave mirror
C. convex mirror D. concave lens

ANSWER: **B**. plane mirror, convex mirror, and concave lens are used to produce virtual image.

9. Among the following which one has high wavelength?

A. visible light B. infrared light
C. microwaves D. radio waves

Answer: D. the electromagnetic wave in increasing wavelength is, γ - Rays, X – rays, ultraviolet rays, visible light, infrared light, microwaves, radio waves.

10. Light passes from a material with index of refraction 1.3 into one with index of refraction 1.2. Compared to the incident ray, the refracted ray

A. bends toward the normal B. is undeflected
C. bends away from the normal. D. is reflected back

Answer: C. because the light is entering a material in which the index of refraction is lower, the speed of light is higher and the light bends away from the normal.

11. A material with a large number of narrow, regularly spaced slits, designed to produce a diffraction pattern is

A. prism B. slits C. Fresnel lens D. grating

Answer: D. a prism is a three dimensional triangle used to produce dispersion of light, sits are small openings used to form interference and diffraction pattern, and Fresnel lens is used to concentrate solar light for use in solar cookers, solar forges, and solar collectors to heat water for domestic use.

12. Optical fibers are functioning by the principle of

A. critical angle B. total internal reflection
C. Snell's law D. lenses

Answer: B. critical angle is formed when light is incident from more denser region and the refracted ray travels parallel t the surface of separation, Snell's law describes the ratio of the sine of the angle of incidence to the sine of angle of refraction is a constant, and lenses are transparent objects that functions refraction of light.

13. The image formed by a converging lens of focal length 5 cm is real and twice the size of the object. Where is the position of the object?

A. 7.5 cm B. 5 cm C. 10 cm D. 12 cm

Answer: A. the magnification of the image: $di/do = hi/ho \Rightarrow di = 2do$

The position of the object: $5\ cm = 2do \times do/2do + do$, after some rearrangement, $do = 7.5\ cm$.

14. Two boys wish to start a fire during the day. One boy is nearsighted and one is farsighted. Whose glasses should be used to focus the Sun's rays onto some leaf to start the fire?

A. either boy B. the nearsighted boy
C. the farsighted boy D. both together

Answer: C. the Sun's rays must converge onto the leaf. A farsighted boy wears converging lenses.

15. Which one of the following statement is **true** about astronomical telescope?

A. the final image formed is virtual

B. the total length of the telescope is the difference of the focal length of the objective and the eyepiece

C. the ratio of the focal length of the eyepiece to the focal length of the objective is angular magnification

D. the objective has large focal length and the eyepiece has small focal length

Answer: D. A. the final image formed is real, inverted,

B. the total length of the telescope is the sum of the focal length of the objective and the eyepiece

C. the ratio of the focal length of the objective to the focal length of the eyepiece is angular magnification.

16. Which one f the following statements about waves is **not correct**?

A. Gamma rays have relatively very high frequencies.
B. Radio waves travel with the speed of light.
C. Light is a transverse wave.
D. Microwaves are mechanical waves.

Answer: D. gamma rays, radio waves, visible light waves, ultraviolet waves, infrared light, x-rays, and micro waves are electromagnetic waves.

17. A certain electromagnetic wave has a frequency of 1.875×10^8 Hz. Find its wavelength. (Light speed: $c = 3 \times 10^8$ m/s)

A. 1.2 m B. 1.6 m C. 2.1 m D. 2.4 m

Answer: B. the wavelength of an electromagnetic wave is can be calculated in the form of: $\lambda = \frac{c}{f} = \frac{3x10^8 m/s}{1.875x10^8 Hz} = 1.6m$

18. The refractive indices of ice, glass, salt, and diamond are 1.31, 1.46, 1.54 and 2.42, respectively, for light with a wavelength of 590 nm. Total internal reflection occurs when light passes from _____ to _____ .

A. Salt to diamond B. Diamond to ice
C. ice to glass D. Ice to salt

Answer: B. total internal reflection takes place when light is traveling from denser to less denser medium. In our cases it can takes place when light is travelling:

From diamond to salt, diamond to glass, diamond to ice, salt to glass, salt to ice, and glass to ice. From our choice only B is takes place.

19. When an object is placed along the principal axis of a biconvex lens of focal length 60 cm, a magnified virtual image is formed at a distance of 120 cm from the lens. What is the distance of the object from the lens.

A. 20 cm B. 30 cm C. 40 cm D. 50 cm

Answer: C. applying the lens equation:

$$\mathrm{do} = \frac{\mathrm{di\ x\ f}}{\mathrm{di} - f} = \frac{-120\ \mathrm{cm\ x\ 60\ cm}}{-120\ \ \mathrm{cm} - 60\ \mathrm{cm}} = 40\ \mathrm{cm}$$

20. All of the following are examples of wave diffraction **except**

A. a light wave bends when passing from air to water
B. music audible around a corner from the source
C. the shadow cast by statue is blurred at the edges
D. ripples in water become semicircular after passing through a small space

Answer: A. it describes refraction, not diffraction. Roughly speaking, diffraction occurs when waves bend around a corner or around the edge of an obstacle.

21. One of the following is false about electromagnetic waves

A. it is a result of both electric and magnetic field traveling parallel to each other
B. it can travel through vacuum
C. they can form electromagnetic spectrum
D. they can travel in vacuum with a speed of light

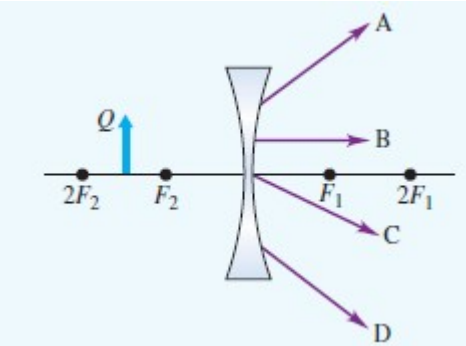
Answer: A.

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Answer: A.

23. In the Figure shown below, which of the rays (A–D) *did not* originate from point *Q* at the top of the object?



A. A and D B. B and C C. B and D . A and D

Answer: C. because the lens is a diverging lens, rays spread apart after passing through it. Ray C comes from point *Q* and passes in a straight line through the lens, crossing the optic axis at its center. When rays A and D are projected backward, they pass through the focal point F2, thus, before they passed through the lens, they were parallel to the axis of the lens. Ray A therefore came from *Q*; ray D did not. Ray B is parallel to the axis after refraction, so it was directed toward focal point F1, before being refracted. Thus, rays D and B do not come from *Q*.

24. Which of these statements **correctly** describe the images formed by an object placed before a single thin lens?

a. Real images are always enlarged.
b. Real images are always inverted.
c. Virtual images are always upright.
d. Convex lenses never produce virtual images.

A. a and c B._b and c C. b and d D. b, c, and d

Answer: B. when an object is situated in front of a lens real, inverted, and virtual, erect (upright) image is formed.