Properties of Light
Practice Items

1. Which of the following types of electromagnetic radiation has the longest wavelength?

    A. infrared radiation
    B. gamma rays
    C. microwaves
    D. X-rays

2. The quantum nature of light is most important to which of the following phenomena?

    I.   Polarization
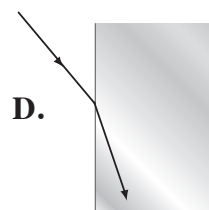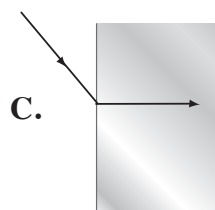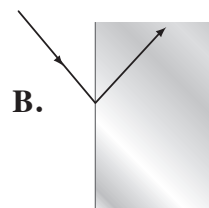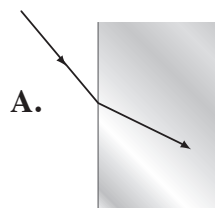   II.   Interference
    III. Photoelectric effect
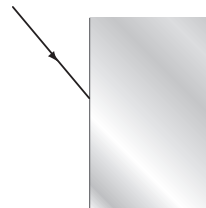
    A. only I
    B. only III
    C. I and II
    D. I, II, and III

3. Which of the following distinguishes electromagnetic waves from sound waves?
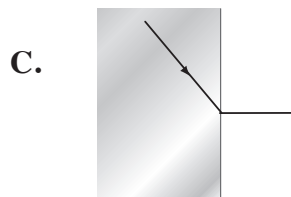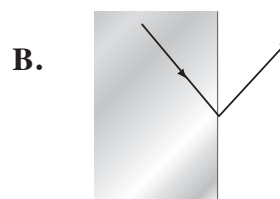
    I.   Electromagnetic waves can be polarized.
    II.   Electromagnetic waves are transverse.
    III. Electromagnetic waves carry energy.

    A. only I
    B. only II
    C. I and II
    D. I, II, and III

4. A light ray in air is incident on a glass block as shown at right. Which of the following diagrams represents the transmitted ray?

5. The incident angle for a light ray passing through the boundary from glass into air is less than the critical angle. Which of the following diagrams represents the transmitted ray?

6. A Crookes tube emits X-rays having a wavelength of 1.5Å in air. What is their frequency?

   A. 2.0×10^2 s^{-1}
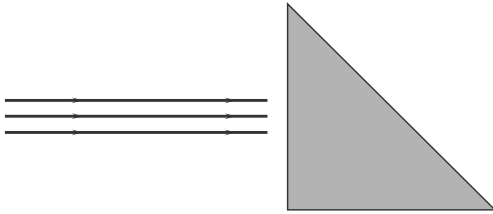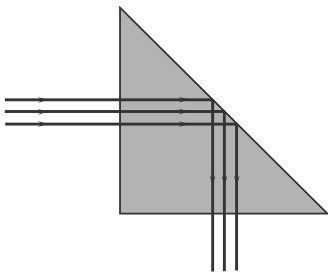   B. 4.5×10^8 s^{-1}
   C. 5.0×10^{17} s^{-1}
   D. 2.0×10^{18} s^{-1}

7. The wave number of a source of electromagnetic radiation is 1700 cm^{-1}. The type of electromagnetic radiation is

   A. infrared
   B. visible light
   C. ultraviolet light
   D. x-ray

8. The speed of light in glass (refractive index $n = 1.5$) is approximately

   A. 1.5×10^8 m/s
   B. 2.0×10^8 m/s
   C. 3.0×10^8 m/s
   D. 4.5×10^8 m/s

9. As visible light moves from air into water its wavelength

   A. shortens
   B. lengthens
   C. remains the same
   D. the answer depends on the angle of incidence

10. Which of the following best explains why gem cut diamonds sparkle?

   A. high refractive index
   B. high reflectance
   C. low emittance
   D. high transparency

11. When unpolarized light is incident on a transparent dielectric surface at Brewster's angle, the refracted light is

   A. polarized
   B. partially polarized
   C. unpolarized
   D. nonexistent

12. The transition energies associated with intramolecular vibration and rotation generally correspond to frequencies of

   A. microwave radiation
   B. infrared radiation
   C. ultraviolet light
   D. X-rays

13. Light traveling through air is incident at an angle of 90° on a crown glass surface. As the light is transmitted into the glass its

   A. frequency decreases
   B. direction changes
   C. wavelength decreases
   D. frequency increases

14. When plane polarized light is passed through a circularly birefringent, or in other words, optically active fluid, the light will exit

   A. still linearly polarized but with the axis of polarization rotated.
   B. with electric and magnetic fields rotating at the optical frequency.
   C. exhibiting elliptical polarization.
   D. split into two beams polarized in mutually orthogonal planes.

15. Suppose blue light were beamed perpendicular to the side of an isosceles right-triangular crown glass prism as shown below.
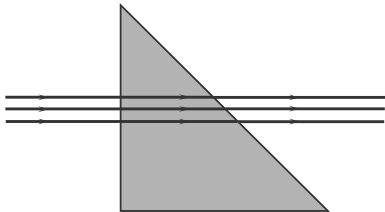
If the index of refraction of the prism is 1.52, which of the diagrams below correctly illustrates the result? (assume $n_{air} = 1$)
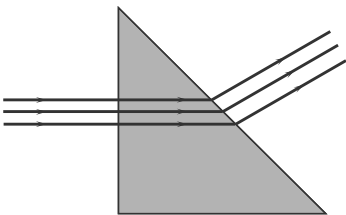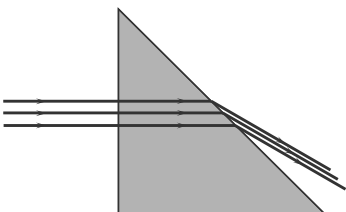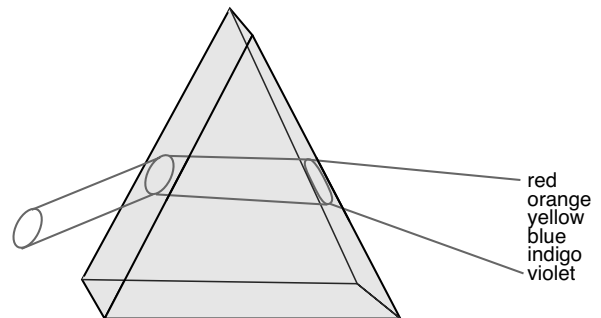
A.

B.

C.

D.

The following passage pertains to questions 16 - 19.

When light passes at an angle of incidence from one medium into another, refraction will occur because the speed of light is different within the two media. The ratio of the speed of light in a vacuum to the speed of light in a particular medium is called the index of refraction for that medium. The relationship between the angle of incidence, the angle of refraction, and the indices of refraction for the two media is given by Snell's law:

$$n_1 \sin \theta_i = n_2 \sin \theta_r$$

The index of refraction of a certain media is not constant for the entire electromagnetic spectrum, however, but depends somewhat upon the frequency. Most substances show increasing refractive index with increasing frequency of light. Such phenomena as dispersion of visible light into its spectral components by a prism, illustrated below, can be understood in terms of the variation of refractive index with frequency.

red
orange
yellow
blue
indigo
violet

16. A prism separates white light into separate colors because

   A. constructive interference occurs at different angles for different wavelengths.

   B. the different path lengths through the glass lead to destructive interference for certain wavelengths.

   C. white light is not coherent.

   D. different colors of light have different indices of refraction in glass.

17. The index of refraction of crown glass is 1.53 for violet light. What will the approximate angle of refraction in glass equal if the angle of incidence at the air-glass boundary is 45°?

A. 15°
B. 30°
C. 45°
D. 60°

18. According to the passage which of the following statements follows from the relationship between the index of refraction for glass and the properties of the incident light?

A. High frequency light is refracted with a smaller angle of refraction than low frequency light.
B. Orange light has longer wavelength than violet.
C. A low energy photon travels more slowly through glass than a high energy photon.
D. The refractive index is the ratio of the speed of light in vacuum and the phase speed of light in a material.

19. Orange light has a wavelength in air of 600 nm. What is its frequency?

A. 180 GHz
B. 500 GHz
C. 330 THz
D. 500 THz