1. The law of reflection states that
   A) incoming light is reflected back along its original path.
   B) the angle of incidence is equal to the angle of reflection.
   C) the angles of incidence and reflection always add up to 90°.
   D) for curved mirrors, the angle of reflection is twice the angle of incidence.

2. A person stands 2 m in front of a plane mirror. His reflection appears
   A) 1 m behind the mirror.  
   B) 1 m in front of the mirror.  
   C) 2 m behind the mirror.  
   D) 2 m in front of the mirror.

3. When you use a second mirror to look at the back of your head, you are seeing
   A) the real image of a real object.  
   B) the real image of a virtual object.  
   C) the virtual image of a real object.  
   D) the virtual image of a virtual object.

4. How big must a mirror be to be used as a full-length mirror?
   A) Any size will work. The farther away you get, the more of yourself you will see.
   B) The mirror must be at least as tall as you are, or you will never see your complete image.
   C) The mirror must be exactly half your height, at a distance exactly equal to your height. If you move any closer to the mirror, it needs to be bigger for you to see your complete image.
   D) The mirror must be at least half your height, and your distance from the mirror is not material.

5. Parallel rays of light strike a convex mirror. The reflected rays
   A) diverge away from each other. The real rays will never intersect.
   B) are parallel as well. They bounce back along their original path.
   C) are perpendicular. They make a 90° angle with the incoming rays.
   D) converge at the focal point in front of the mirror.
   E) are everywhere. Curved mirrors can only reflect diffusely, so the rays go in all directions randomly.

6. Explain the difference between a concave mirror and a convex mirror.
   A) Both can form either real or virtual images. Concave mirrors curve outward, convex curve inward.
   B) Concave mirrors form only virtual images. Convex form only real images. Both curve outward.
   C) Concave mirrors form only real images. Convex form only virtual images. Both curve inward.
   D) Convex mirrors curve outward and form only virtual images. Concave mirrors are curved inward.
   E) Convex mirrors cannot form either type of image. Concave can form either real or virtual images.

7. The principle of least time states that
   A) the shortest path between two points is always the fastest path.
   B) a beam of light will always follow the fastest path from one point to another.
   C) a beam of light will always travel along the shortest path from one point to another.

8. When light passes from one medium to another,
   A) it continues to travel at 300,000 km/s regardless of the type of medium.
   B) it always slows down, and it refracts regardless of the angle of incidence.
   C) it bends only when it strikes the boundary between the media at a 90° angle.
   D) it may slow down or speed up, depending on the medium. The amount of refraction depends on the angle at which the light strikes the boundary.

9. As a light wave passes from glass to air,
   A) it slows down and bends away from the normal.
   B) it speeds up and bends away from the normal.
   C) it speeds up and bends toward the normal.
   D) it slows down and bends toward the normal.

10. You are watching your favorite goldfish in his tank. Because of the refraction of light,
    A) he appears smaller and deeper than he actually is.
    B) he appears larger and shallower than he actually is.
    C) he appears smaller and shallower than he actually is.
    D) his appearance is no different than if he was out of the water.
11. You are playing with your laser-sighted crossbow, out in the boat in the middle of the lake. You look down, and there beneath the surface is a fish. If you aim the laser sight right at the fish,
   A) the bolt from the bow will strike the fish at exactly the same spot as the laser light.
   B) the bolt will pass above and behind the real fish.
   C) the bolt will pass below and before the real fish.
   D) Put the crossbow down. You could put somebody's eye out with that!

12. You are driving I-40 across New Mexico. It's gorgeous! Suddenly your sister wakes up and yells, "Watch out! The road is wet! Don't skid!" What do you do?
   A) Remind her of that time when you were little and she thought that if you ate Pop Rocks while drinking a Coke your head would explode. Then make fun of her hair from sleeping in the car.
   B) Slow down and pull over. The road really is wet, and since you're in New Mexico on a sunny day, it's probably a trap. When you spin out on the wet road the aliens come and abduct you.
   C) The road probably is wet, but there are no aliens. The water condenses on the highway because it is warmer than the surrounding desert. Just drive carefully, but you don't need to panic.
   D) Nothing. Well, keep right on singing really loud along with the radio, but you don't need to worry about the road. It's a mirage caused by the refraction of light through the air.
   E) Keep singing, but know that the mirage is not a result of refraction at all. It is a dispersion effect, as red light and blue light are reflected differently off the surface of the highway.

13. The index of refraction for glass is 1.5 and the index for water is 1.3. Compare the speed of light through each of these media.
   A) The higher the index of refraction, the faster the speed of light through the medium.
   B) The higher the index of refraction, the slower the speed of light through the medium.

14. White light shines through a prism.
   A) White light emerges, unbent.
   B) The colors are separated according to their wavelengths.
   C) Red light, having the longest wavelength, gets bent the most.
   D) The prism scatters the blue light, and only red light emerges.

15. When you see a rainbow in the sky,
   A) sometimes the red band is on top, sometimes the blue band is. It's random.
   B) everyone in town sees exactly the same rainbow as you do.
   C) if you hold your head just right, you can see an entire circle, not just the arc.
   D) it's because raindrops are dispersing the white light, bending the blue light more than the red.

16. A converging lens
   A) can only form virtual images.
   B) can form either real or virtual images.
   C) causes parallel light rays to be bent away from the positive focal point.
   D) is most useful for the correction of nearsightedness.

17. When a converging lens is used as a magnifying glass, the object is
   A) placed at a distance greater than the focal length in front of the lens.
   B) placed at a distance exactly equal to the focal length of the lens.
   C) is placed at a distance less than the focal length in front of the lens.
   D) distance does not matter, as long as the image distance is greater than the focal length.

18. A diverging lens
   A) can only form real images.
   B) can form either real or virtual images.
   C) causes parallel light rays to be bent away from the negative focal point.
   D) is most useful for the correction of farsightedness.

19. An object is placed at the focal point of a diverging lens, d_o = f. What kind of image will be formed?
   A) None; the rays of light will all be parallel on both sides of the lens. No real or virtual image forms.
   B) A real image. Real rays of light will intersect on the side of the lens opposite the object.
   C) The real image is formed when real rays intersect on the same side of the lens as the object.
   D) Virtual. Real rays diverge. Virtual rays intersect on the opposite side of the lens as the object.
   E) A virtual image forms, but the virtual rays intersect on the same side of the lens as the object.
20. A real image
   A) appears where real light rays intersect.  C) cannot be inverted, it is always upright.
   B) is always inverted and magnified.         D) cannot be seen, so does not really exist.

21. A virtual image
   A) appears where real light rays intersect.  C) cannot be inverted, it is always upright.
   B) is always inverted and magnified.         D) cannot be seen, so does not really exist.

22. Spherical aberration
   A) is the tendency of lenses to make objects appear to be out of focus.
   B) is the result of using colored glass to make a lens.
   C) occurs when light passing through the edges of a lens is focused differently than light passing through the center of the lens.
   D) results because different colors of light have different speeds through the lens, so they will be bent by the lens slightly differently. Blue light will have a slightly shorter focus than red light.

23. Chromatic aberration
   A) is the tendency of lenses to make objects appear to be out of focus.
   B) is the result of using colored glass to make a lens.
   C) occurs when light passing through the edges of a lens is focused differently than light passing through the center of the lens.
   D) results because different colors of light have different speeds through the lens, so they will be bent by the lens slightly differently. Blue light will have a slightly shorter focus than red light.