Name: _____   Date: _____

___ **1.** As used in the laws of reflection and refraction, the "normal" direction is:
   A) any convenient direction
   B) tangent to the interface
   C) along the incident ray
   D) perpendicular to the electric field vector of the light
   E) perpendicular to the interface

___ **2.** If $n_{water} = 1.50$ and $n_{glass} = 1.33$, then total internal reflection at an interface between this glass and water:
   A) occurs whenever the light goes from glass to water
   B) occurs whenever the light goes from water to glass
   C) may occur when the light goes from glass to water
   D) may occur when the light goes from water to glass
   E) can never occur at this interface

___ **3.** Let f_o and f_e be the focal lengths of the objective and eyepiece of a compound microscope. In ordinary use, the object:
   A) is less than f_o from the objective lens
   B) is more that f_o from the objective
   C) produces an intermediate image that is slightly more than f_e from the eyepiece
   D) produces an intermediate image that is $2 f_e$ away from the eyepiece
   E) produces an intermediate image that is less than f_o from the objective lens

___ **4.** Real images formed by a spherical mirror are always:
   A) on the side of the mirror opposite the source
   B) on the same side of the mirror as the source but closer to the mirror than the source
   C) on the same side of the mirror as the source but closer to the mirror than the focal point
   D) on the same side of the mirror as the source but further from the mirror than the focal point
   E) none of the above

___ **5.** A ray of light passes obliquely through a plate of glass having parallel faces. The emerging ray:
  A) is totally internally reflected
  B) is bent more toward the normal than the incident ray
  C) is bent further away from the normal than the incident ray
  D) is parallel to the incident ray but displaced sideways
  E) lies on the same straight line as the incident ray

___ **6.** A student sets the cross-hairs of an eyepiece in line with an image that he is measuring. He then notes that when he moves his head slightly to the right, the image moves slightly to the left (with respect to the cross-hairs). Therefore the image is:
  A) infinitely far away
  B) farther away from him that the cross-hairs
  C) nearer to him than the cross-hairs
  D) in the focal plane of the eyepiece
  E) in the plane of the cross-hairs

___ **7.** A man stands with his nose 8 cm from a concave shaving mirror of radius 32 cm The distance from the mirror to the image of his nose is:
  A) 8 cm   **B)** 12 cm   **C)** 16 cm   **D)** 24 cm   **E)** 32 cm

___ **8.** Consider the following four statements concerning a compound microscope:
  1. Each lens produces an image that is virtual and inverted.
  2. The objective lens has a very short focal length.
  3. The eyepiece is used as a simple magnifying glass.
  4. The objective lens is convex and the eyepiece is concave.
  Which two of the four statements are correct?
  A) 1, 2   **B)** 1, 3   **C)** 1, 4   **D)** 2, 3   **E)** 2, 4

___ **9.** The index of refraction of a substance is:
  A) the speed of light in the substance
  B) the angle of refraction
  C) the angle of incidence
  D) the speed of light in vacuum divided by the speed of light in the substance
  E) measured in radians

___ **10.** Which of the following five glass lenses is a diverging lens?

A   B   C   D   E

A) A   **B)** B   **C)** C   **D)** D   **E)** E
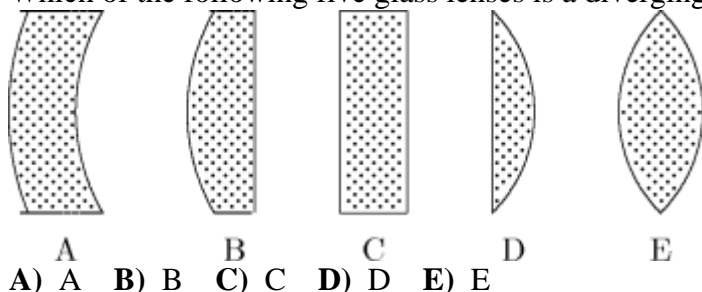
___ **11.** A magnifying glass has a focal length of 15 cm. If the near point of the eye is 25 cm from the eye the angular magnification of the glass is about:
A) 0.067   **B)** 0.33   **C)** 0.67   **D)** 1.7   **E)** 15

___ **12.** Where must an object be placed in front of a converging lens in order to obtain a virtual image?
A) At the focal point
B) At twice the focal length
C) Greater than the focal length
D) Between the focal point and the lens
E) Between the focal length and twice the focal length

___ **13.** A pole stands in a river, half in and half out of the water. Another pole of the same length stands vertically on the shore at a place where the ground is level. The shadow cast by the pole in the river on the river bottom is:
A) slightly longer than the shadow of the pole on land
B) much longer than the shadow of the pole on land
C) shorter than the shadow of the pole on land
D) shorter than the shadow of the pole on land if the Sun is high and longer if the sun is low
E) the same length as the shadow of the pole on land

___ **14.** A convex spherical refracting surface separates a medium with index of refraction 2 from air. The image of an object outside the surface is real:
A) always   **D)** only if it is far from the surface
B) never   **E)** only if the radius of curvature is
                                                      small
C) only if it is close to the surface

___ **15.** The relation $n_1 \sin \theta_1 = n_2 \sin \theta_2$, which applies as a ray of light strikes an interface between two media, is known as:

A) Gauss' law   **D)** Cole's law
B) Snell's law   **E)** law of sines
**C)** Faraday's law

___ **16.** When you stand in front of a plane mirror, your image is:
A) real, erect, and smaller than you
B) real, erect, and the same size as you
C) virtual, erect, and smaller than you
D) virtual, erect, and the same size as you
E) real, inverted, and the same size as you

___ **17.** In a two lens microscope, the intermediate image is:
A) virtual, erect, and magnified   **D)** virtual, inverted, and reduced
B) real, erect, and magnified   **E)** virtual, inverted, and magnified
C) real, inverted, and magnified

___ **18.** The index of refraction for diamond is 2.5. Which of the following is correct for the situation shown?
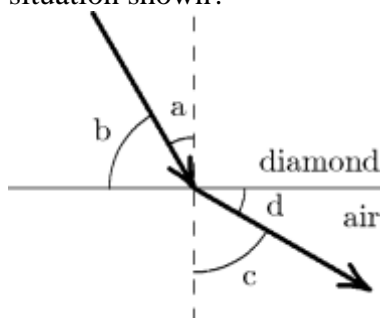
A) $(\sin a)/(\sin b) = 2.5$ **D)** $(\sin c)/(\sin a) = 2.5$
B) $(\sin b)/(\sin d) = 2.5$ **E)** $a/c = 2.5$
C) $(\cos a)/(\cos c) = 2.5$

___ **19.** A concave spherical surface with radius r separates a medium with index of refraction 2 from air. As an object is moved toward the surface from far away along the central axis, its image:
A) changes from virtual to real when it is $r/2$ from the surface
B) changes from virtual to real when it is $2r$ from the surface
C) changes from real to virtual when it is $r/2$ from the surface
D) changes from real to virtual when it is $2r$ from the surface
E) remains virtual

___ **20.** An object is in front of a converging lens, at a distance less than the focal length from the lens. Its image is:

A) virtual and larger than the object **D)** real and larger than the object
B) real and smaller than the object **E)** virtual and the same size as the object
C) virtual and smaller than the object

Answer Key

1. E
   Origin: Chapter 35- Images, 3
2. D
   Origin: Chapter 35- Images, 22
3. B
   Origin: Chapter 35- Images, 86
4. E
   Origin: Chapter 35- Images, 41
5. D
   Origin: Chapter 35- Images, 12
6. C
   Origin: Chapter 35- Images, 94
7. C
   Origin: Chapter 35- Images, 51
8. D
   Origin: Chapter 35- Images, 87
9. D
   Origin: Chapter 35- Images, 5
10. A
    Origin: Chapter 35- Images, 79
11. D
    Origin: Chapter 35- Images, 91
12. D
    Origin: Chapter 35- Images, 67
13. C
    Origin: Chapter 35- Images, 16
14. D
    Origin: Chapter 35- Images, 63
15. B
    Origin: Chapter 35- Images, 2
16. D
    Origin: Chapter 35- Images, 28
17. C
    Origin: Chapter 35- Images, 95
18. D
    Origin: Chapter 35- Images, 10
19. E
    Origin: Chapter 35- Images, 65
20. A
    Origin: Chapter 35- Images, 77