1. For a plane mirror, compared to the object distance, the image distance is always
   A) less          B) greater          
   C) the same

2. Which graph best represents the relationship between image distance \( (d_i) \) and object distance \( (d_o) \) for a plane mirror?
   A) \( d_i \) \( d_o \)          B) \( d_i \) \( d_o \)          
   C) \( d_i \) \( d_o \)          D) \( d_i \) \( d_o \)

3. Base your answer to the following question on the diagram below which shows four rays of light from object \( AB \) incident upon a spherical mirror whose focal length is 0.04 meter. Point \( F \) is the principal focus of the mirror, point \( C \) is the center of curvature, and point \( O \) is located on the principal axis.

   A) decreases          B) increases          
   C) remains the same

4. Base your answer to the following question on the diagram below which shows the principal axis of a concave spherical mirror. The focal point is \( F \), and \( C \) is the center of curvature of the mirror. The focal length of the mirror is 0.10 meter.

   If an object is placed at point \( D \), its image will be located at a position between points
   A) \( O \) and \( F \)          B) \( O \) and \( B \)          
   C) \( C \) and \( D \)          D) \( F \) and \( C \)

5. Which phenomenon may cause a concave mirror to form fuzzy, out-of-focus images?
   A) spherical aberration          B) chromatic aberration          
   C) dispersion          D) refraction

6. Base your answer to the following question on the information and diagram below.

   An object is located at the center of curvature \( C \) of a concave spherical mirror with principal focus \( F \). The focal length of the mirror is 0.10 meter.

   At what distance from the mirror is the image located?
   A) 0.10 m          B) 0.20 m          
   C) 0.30 m          D) 0.40 m

7. The tip of a person's nose is 12 centimeters from a concave (converging) spherical mirror that has a radius of curvature of 16 centimeters. What is the distance from the mirror to the image of the tip of the person's nose?
   A) 8.0 cm          B) 12 cm          
   C) 16 cm          D) 24 cm
8. Base your answer to the following question on the information below.

A concave mirror with a focal length of 20. centimeters is used to examine a 0.50-centimeter-wide freckle on a person's face. The person's face is located 10. centimeters from the mirror.

What is the width of the image of the freckle?
A) 1.0 cm  B) 2.0 cm  C) 0.50 cm  D) 1.5 cm

9. In the diagram below, how far from the mirror is the light bulb (object) most likely located?

A) closer than the focal length of the mirror  B) at the principal focus of the mirror  C) at twice the focal length of the mirror  D) farther than twice the focal length of the mirror

10. The diagram below shows a light ray parallel to the principal axis of a spherical convex (diverging) mirror. Point $F$ is the virtual focal point of the mirror and $C$ is the center of curvature.

After the light ray is reflected, it will pass through point
A) $A$  B) $C$  C) $D$  D) $F$

11. In the diagram below, a lamp 0.4 meter tall is placed 0.6 meter in front of a convex mirror.

Which diagram best represents an image of the lamp that could be formed by this mirror?
A)  B)  C)  D)

12. An image is projected on a screen with the use a converging lens. Which pair of terms best describes the image?
A) real and erect  B) real and inverted  C) virtual and erect  D) virtual and inverted
13. Base your answer to the following question on the information and diagram below. A convex lens having optical center $O$ and principal focus $F$ is used to produce an image of a candle. Ray $RF$ is shown.

When ray $RF$ reaches the lens, the ray will
A) reflect back through point $R$
B) polarize and travel perpendicular to the principal axis
C) refract and pass through point $2F$
D) refract and emerge parallel to the principal axis

14. An object is placed at point $A$ before a converging lens as shown in the diagram below.

As the object moves from point $A$ toward point $B$, the size of the image formed
A) decreases
B) increases
C) remains the same

15. As the object is moved closer to the focal point from position $X$, the image will
A) decrease in size and move farther from the lens
B) decrease in size and move closer to the lens
C) increase in size and move farther from the lens
D) increase in size and move closer to the lens

16. The formation of the image is best explained in terms of
A) reflection
B) diffraction
C) polarization
D) refraction

17. Four identically shaped converging lenses are made of crown glass, flint glass, Lucite, and fused quartz. Which lens would have the shortest focal length?
A) crown glass
B) flint glass
C) Lucite
D) quartz

18. Base your answer to the following question on the diagram below which represents an object placed 0.20 meter from a converging lens with a focal length of 0.15 meter.

Which monochromatic light, when used to illuminate the object, would produce the smallest image distance?
A) red
B) yellow
C) green
D) blue
19. Base your answer to the following question on the information and diagram below.

A converging lens has a focal length of 0.080 meter. A light ray travels from the object to the lens parallel to the principal axis.

How far from the lens is the image formed?
A) 0.020 m  
B) 0.18 m  
C) **0.40 m**  
D) 0.80 m

20. An object 0.080 meter high is placed 0.20 meter from a converging (convex) lens. If the distance of the image from the lens is 0.40 meter, the height of the image is
A) 0.010 m  
B) 0.040 m  
C) 0.080 m  
D) **0.16 m**

21. In the diagram below, parallel light rays in air diverge as a result of interacting with an optical device.

The device could be a
A) convex glass lens  
B) rectangular glass block  
C) plane mirror  
D) **concave glass lens**

22. An object is located 0.40 meter in front of a diverging lens having focal length of -0.20 meter. Compared to the object, the image by the lens is
A) smaller, inverted, and real  
B) larger, inverted, and real  
C) **smaller, erect, and virtual**  
D) larger erect, and virtual

23. The diagram at the right represents light rays approaching a diverging lens parallel to the principal axis. Which diagram below best represents the light rays after they have passed through the diverging lens?

A)  
B)  
C)  
D)  

24. A light ray is incident upon a diverging lens as shown in the diagram to the right.

Which diagram below best represents the path of the ray after it enters the lens?
A)  
B)  
C)  
D)  

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19. A converging lens has a focal length of 0.080 meter. A light ray travels from the object to the lens parallel to the principal axis.

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24. A light ray is incident upon a diverging lens as shown in the diagram to the right.

Which diagram below best represents the path of the ray after it enters the lens?
1. C
2. D
3. A
4. D
5. A
6. B
7. D
8. A
9. C
10. C
11. A
12. B
13. D
14. A
15. C
16. D
17. B
18. D
19. C
20. D
21. D
22. C
23. B
24. C