Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. A person uses a convex lens that has a focal length of 12.5 cm to inspect a gem. The lens forms an upright image. Is the image real or virtual?
   a. real  
   b. virtual  
   c. neither, no image is formed  
   d. not enough information

2. You focus on an object that is very far away. Then, the object moves closer to you. The focal length of your eye lens has...
   a. decreased  
   b. increased  
   c. stayed the same

3. What happens to the image size in a flat mirror when you move away from the mirror?
   a. it gets bigger  
   b. it gets smaller  
   c. it remains the same size  
   d. it depends on the size of the mirror

4. If you want to set fire to a pile of leaves with a lens, which of these is the best one to use?
   a. convex lens  
   b. concave lens  
   c. neither of these  
   d. both of these will work
5. The following figure shows the positions of a mirror, the object, and the image. What type of mirror would produce the image as shown?

- convex mirror
- concave mirror
- flat mirror
- Either concave or convex

6. Lenses experience which of these aberrations:
   I. Spherical Aberration
   II. Chromatic Aberration

   - I
   - II
   - I & II
   - neither of these

7. A diffraction grating has 3000 lines per centimeter. What is the slit spacing, “d,” for this grating?

   - 3.1x10^{-3} m
   - 1.2x10^{-4} m
   - 3000 m
   - 3.3x10^{-6} m
8. The following figure shows a Michelson interferometer. If the source of light is a laser of wavelength $\lambda$, what is the smallest distance the translating mirror must move ($\Delta x$) in order to see a shift on the detector of 1 fringe (ie. where there was once a dark fringe, there would now be a bright fringe)?

![Michelson Interferometer Diagram](image)

- a. $1\lambda$
- b. $\frac{1}{4}\lambda$
- c. $\frac{1}{2}\lambda$
- d. $\frac{1}{2}\lambda$

9. The following figure shows the interference pattern produced by a diffraction grating. What is the pathlength difference of the two waves that are incident to create the dark fringe indicated by the arrow?

![Diffraction Grating Diagram](image)

- a. $\frac{1}{4}\lambda$
- b. $\frac{1}{2}\lambda$
- c. $1\lambda$
- d. $1 \frac{1}{2}\lambda$
10. In a single slit diffraction pattern, what would you do to make the central bright spot narrower?
   a. move the screen further away  
   b. increase the wavelength  
   c. decrease the slit width  
   d. increase the slit width

11. These 2 waves are:
   a. in phase  
   b. 90° out of phase  
   c. 360° out of phase  
   d. 180° out of phase

12. What caused the diffraction pattern in this picture?
   a. light incident on a circular object (such as a penny)  
   b. a laserbeam incident on a single slit  
   c. light from a light bulb incident on a double slit  
   d. none of these
13. Place these stages in the proper order for the formation of a star:

1. Star
2. Protostar+disk
3. Star-forming cloud
4. Star-forming core

a. 3, 2, 4, 1  
   c. 3, 4, 2, 1
b. 4, 3, 2, 1  
   d. 2, 3, 4, 1

14. Why is star-formation activity more readily apparent in infrared observations than in visible images?

a. infrared light can pass through dust unattenuated  
   c. star-forming regions emit radiation mostly in the infrared part of the spectrum
b. visible light is obscured by the dust in star-forming regions  
   d. all of these

15. This plot has reddening and distance for a group of stars. Which of these statements best describes the location of the stars in the box on the plot?

a. in another galaxy  
   c. behind a star-forming core
b. beside a star-forming core  
   d. in front of a star-forming core
Problem

16. (15 pts) Two lenses are configured as in this figure; their focal lengths are as shown. If the object is a distance \( p = 20 \) cm to the left of lens 1, what is the final position and magnification of the image from lens 2?

Image position: ________________________

Total magnification_____________________

Object

\[ f_1 \ (10.0 \text{ cm}) \]

\[ f_2 \ (20.0 \text{ cm}) \]

50.0 cm
17. (15 pts) An object, 3 cm high, is 20 cm in front of a mirror. The image is upright and 1.5 cm high.

What type of mirror is this? ___________________

What is the magnification? _________________

Where is the image located? _________________

What is the focal length of the mirror? __________
18. (15 pts) Red light at 650 nm is diffracted by a grating with 5000 lines per cm. On a screen 5 meters away, what is the distance between the central fringe and the 2nd bright fringe?

Sketch the diffraction pattern that is visible on the screen. Show (& calculate) the appropriate number of orders.
19. (10 pts) A Michelson interferometer uses light of wavelength 500 nm. As you move the translating mirror in this figure, 300 bright fringes pass a fixed point on the detector. How far did the mirror move?
20. (15 pts) A double slit apparatus has a slit separation of 0.2 mm. Light of wavelength 630 nm is incident on the slit. The diffraction pattern is on a screen 2 m away. What is the width of the central bright fringe?
Exam 3--PHYS 202--S10
Answer Section

MULTIPLE CHOICE

1. ANS: B  PTS: 1
2. ANS: A  PTS: 1
3. ANS: C  PTS: 1
4. ANS: A  PTS: 1
5. ANS: B  PTS: 1
6. ANS: C  PTS: 1
7. ANS: D  PTS: 1
8. ANS: B  PTS: 1
9. ANS: B  PTS: 1
10. ANS: D PTS: 1
11. ANS: B PTS: 1
12. ANS: A PTS: 1
13. ANS: C PTS: 1
14. ANS: D PTS: 1
15. ANS: C PTS: 1

PROBLEM

16. ANS:
   
   PTS: 1
17. ANS:
   
   PTS: 1
18. ANS:
   
   PTS: 1
19. ANS:
   
   PTS: 1
20. ANS:
   
   PTS: 1