Fundamentals in Optics
Final Exam Practice

Chapter1: Introduction to Geometric Optics
Wave motion, Transverse & Longitudinal Waves, Rectilinear Propagation

1. What is the velocity of light in air (or a vacuum):

2. What is the index of a lens material that reduces the velocity of light to 2.0×10^8 m/s:
   A. 1.00
   B. 1.25
   C. 1.50
   D. 1.75

3. What happens to the frequency of light as it passes through a medium with an index greater than the index of air:
   A. It increases
   B. It decreases
   C. It remains unchanged

4. When light is represented using a sine function, the wavelength is the:
   A. Number of cycles per unit of time
   B. The distance from the center line to the peak of the curve
   C. The distance between peaks
   D. All of the above

5. The electric and magnetic components of an EM wave are perpendicular to each other:
   A. True
   B. False

6. The image formed by a pinhole camera is one half the size of a 20cm object. If the distance from the pinhole to the screen is 10cm, how far from the pinhole is the object:

7. What is the diameter of the shadow formed on a wall 2m from a point source of light if a 20cm opaque disk is placed 1m in front of the light source:

Chapter 2: Laws of reflection and refraction

8. What is the relationship between velocity and wavelength of light traveling through air:
   A. Velocity increases as wavelength decreases
   B. Velocity decreases as wavelength decreases
   C. Wavelength remains the same in all media while velocity changes
   D. Velocity remains the same in all media while wavelength changes

9. What percent of light incident normal to a plane surface of a medium with an index of refraction equal to 1.33 is reflected from the surface:

10. Light incident at 30 degrees on a plane surface of lens material emerges at an angle of 19.5 degrees. What is the index of the material:
    A. 1.40
    B. 1.50
    C. 1.60
    D. 1.70

11. What is the incident angle on a plane surface of a medium (n = 1.70) if the light emerges at an angle of 20 degrees:

12. Index of Refraction quantifies the change is velocity of light in a medium relative to the velocity in air:
    A. True
    B. False

13. Light is incident 45 degrees on a plane glass surface (n = 1.53). What is the angle of reflection for the light?
    A. 22.5 degrees
    B. 30 degrees
    C. 45 degrees
    D. 90 degrees

14. When light is incident at an acute angle relative to normal on a plane interface that separates two media where the second medium has a lower index of refraction, the emergent light is refracted toward the normal (smaller angle):
    A. True
    B. False

Chapter 3: Prisms

15. When viewing a distant object through a base down prism the object will appear to move up:
    A. True
    B. False

16. Which wavelength will experience the greatest refraction when white light is dispersed by a prism:
    A. Red
    B. Yellow
    C. Green
    D. Violet

17. Prism deviation decreases as index of the prism increases:
    A. True
    B. False

18. What is the deviation for prism with an apical angle of 35 degrees and an index of refraction 1.50 for a ray incident normal to the first surface:

19. What is the limiting angle (incident angle at the first surface) for a prism that has an apical angle of 60 degrees and an index of refraction of 1.50:

20. What is the angle of emergence of a prism with an apical angle of 40 degrees made of plastic with an index of 1.580 if the angle of incidence is 50 degrees:

21. What is the refracting power of a prism that creates an apparent movement of 6cm up for an object that is 2m away:
    A. 1.0 prism diopters
    B. 1.5 prism diopters
    C. 2.0 prism diopters
    D. 3.0 prism diopters

22. Your strabismic patient has a constant left exotropia (left eye turns out). They also have significant amblyopia (reduced vision) in the left eye. They are more interested in a cosmetic improvement than a functional solution. Which prismatic treatment will make the eyes appear mor aligned through their spectacle lenses:
    A. Base Up prism in the right lens
    B. Base Out prism in the left lens
    C. Base Down prism in the left lens
    D. None of these will provide cosmetic improvement

Chapter 4: Vergence, Object & Image Relationships

23. An object 10cm behind a -5.00D surface is a real object:
    A. True
    B. False

24. Which is NOT a characteristic of a real image:
    A. It forms to the right of a refracting surface
    B. It can be associated with a real object
    C. It is formed by diverging rays
    D. It can be inverted

25. Virtual Objects are always associated with converging incident vergence:
    A. True
    B. False

26. The incident vergence on a refracting surface that separates air from glass (n = 1.53) is negative and of a greater magnitude than the +5.00 surface. Which is a TRUE statement:
    A. The object is real, and located between F and infinity
    B. The object is real, and located at F
    C. The object is real and located between F and the refracting surface
    D. The object is virtual

Chapter 5: Single Refracting Surfaces

27. What is the emergent vergence from a +2.00D convex SRS that separates air from plastic (n = 1.50) when an object is located 10cm in front of the surface:
    A. +8.00D
    B. +12.00D
    C. -8.00D
    D. -12.00D

28. Which accurately describes the relationship between radius of curvature, sagittal depth, and surface power:
    A. The greater the radius, the greater the sagittal depth and the greater the power
    B. The greater the radius, the smaller the sagittal depth and the greater the power
    C. The greater the radius, the greater the sagittal depth and the lower the power
    D. The greater the radius, the smaller the sagittal depth and the lower the power

29. A convex SRS separating water (n = 1.33) from a media of index 1.25 creates a negative surface:
    A. True
    B. False

Chapter 6: Thin Lenses

30. What is the power of a thin lens that has an index of 1.50, a front surface radius of +20cm, and a back surface radius of +10.cm:

31. What is the lens form when both lens surfaces have positive radii of curvature:
    A. Biconvex
    B. Biconcave
    C. Meniscus

32. Which of the following will create a negative powered spectacle lens when made from an ophthalmic plastic with an index of 1.586:
    A. Center of Curvature for F1 is 10cm behind the lens, r_2 = +0.25m
    B. Center of Curvatures for F1 and F2 are +0.20m and +0.10m
    C. F1 has radius of +20cm and F2 has radius of -20cm.
    D. All of these are minus lenses

33. What is the lateral magnification of an image produced by a thin lens (n = 1.50) when F1 = +4.00D and F2 = -3.00D for an object 2m in front of the lens:

34. Where is the image formed by a +5.00D thin lens when the object is at infinity:

35. Your patient's corrective lens power is +4.50D. Where is the far point of the eye:

Answers:

1. 3.0×10^8 m/s
2. C: 1.50 (divide the speed of light in air by the speed of light in the medium)
3. C: frequency remains constant
4. C
5. True
6. 20cm (use similar triangles)
7. 40cm (use similar triangles)
8. B: since frequency is constant, velocity decreases when wavelength decreases
9. 2.0% (use Fresnel's Law of reflection: $((n'-n)/(n'+n))^2 \times 100$)
10. B: use Snell's Law: $n\sin\Theta = n'\sin\Theta'$
11. 35.6 degrees (use Snell's Law)
12. True
13. C (law of reflection)
14. False, the angle of emergence will be greater
15. True, objects appear to move toward the apex of the prism
16. D (Violet) shorter wavelength have greater refraction
17. False (increasing index increases deviation)
18. Total Deviation = 24.4 degrees
19. Limiting Angle = 28 degrees
20. Angle of Emergence = 17.5 degrees
21. D (use Prentice's rule)
22. B (make the image of the eye move inward)
23. B (objects in image space are always virtual)
24. C. (only a virtual image can be formed by diverging rays)
25. True (converging incident vergence places the object in image space)
26. C (RO with plus surface results in VI if object between F and surface)
27. C (L' = L + F), L' should be negative as image is virtual when object is between F and surface
28. D
29. A
30. -5.00D (F1 = +2.50D and F2 = -5.00D)
31. Meniscus (both are curved in the same direction)
32. B
33. -1.0x
34. 20cm behind the lens
35. 22.2cm behind the eye (1/RE)