Physics 104   Exam 3 April 24, 2003

Name_____ ID #_____

Section #_____ TA Name_____

Fill in your name, student ID # (not your social security #), and section # (under ABC of special codes) on the Scantron sheet. Fill in the letters given for the first 5 questions on the Scantron sheet. These letters determine which version of the test you took, and it is very important to get this right. Make sure your exam has questions 6—25.

1. A

2. E

3. D

4. A

5. C

6. Which of the following best describes the image of a convex mirror when the object's distance from the mirror is less than the absolute value of the focal point distance?

   a. virtual, upright and magnification less than one
   b. virtual, upright and magnification greater than one
   c. real, inverted and magnification less than one
   d. real, inverted and magnification greater than one
   e. virtual, inverted, and magnification greater than one

7. You stand two feet away from a plane mirror. How far is it from you to your image?

   a. 4.0 ft
   b. 2.0 ft
   c. 3.0 ft
   d. 5.0 ft
   e. 1.0 ft

8. The real image of an object is located 45.0 cm away from a concave mirror, which has a focal length of 10.0 cm. How far is the object from the mirror?

   a. 40.0 cm
   b. 35.0 cm
   c. 22.5 cm
   d. 12.9 cm
   e. 4.5 cm

9. An object is placed at a distance of 50 cm from a thin lens along the axis. If a real image forms at a distance of 40 cm from the lens, on the opposite side from the object, what is the focal length of the lens?

   a. 22 cm
   b. 45 cm
   c. 90 cm
   d. 200 cm
   e. 150 cm

10. A projector lens is needed to form an image on a screen 10 times the size of its corresponding object. The screen is located 8.0 m from the lens. What is the required focal length of the lens?

   a. 0.32 m
   b. 0.54 m
   c. 1.25 m
   d. 0.80 m
   e. 0.73 m

11. If a wave from one slit of a Young's double-slit set-up arrives at a point on the screen one wavelength behind the wave from the other slit, what is observed at that point?

   a. dark fringe
   b. multi-colored fringe
   c. gray, not dark nor bright
   d. bright fringe

12. A Young's double slit has a slit separation of 2.50×10^{-5} m on which light of a single wavelength is directed. The resultant bright fringes on a screen 1.00 m from the double slit are separated by 2.30×10^{-2} m. What is the wavelength of this beam? (1 nm = 10^{-9} m)

    a. 373 nm
    b. 454 nm
    c. 667 nm
    d. 725 nm
    e. 575 nm

13. A beam of polarized light of intensity I_0 passes through a sheet of ideal polarizing material. The polarization axis of the beam and the transmission axis of the sheet differ by 30 . What is the intensity of the emerging light?

    a. 0.87 I_0
    b. 0.50 I_0
    c. 0.75 I_0
    d. 0.25 I_0
    e. 0.33 I_0

14. Waves from a radio station with a wavelength of 600 m arrive at a home receiver a distance 50 km away from the transmitter by two paths. One is a direct-line path and the second by reflection from a mountain directly behind the receiver. What is the minimum distance between the mountain and receiver such that destructive interference occurs at the location of the listener? Assume no phase change on reflection.

    a. 300 m
    b. 450 m
    c. 600 m
    d. 75 m
    e. 150 m

15. A soap bubble (n = 1.35) is floating in air. If the thickness of the bubble wall is 300 nm, which of the following wavelengths of visible light is strongly reflected?

    a. 620 nm (red)
    b. 540 nm (green)
    c. 580 nm (yellow)
    d. 500 nm (blue)
    e. 850 nm (infrared)

16. A simple magnifier makes an image appear at the near point distance from the eye of the viewer (25 cm). What is the magnifying power of the magnifier if it is constructed of a lens of focal length of 4.0 cm?

    a. 1.2
    b. 5.0
    c. 7.3
    d. 50
    e. 6.2

17. You are designing eyeglasses for someone whose near point is 60 cm. What focal length lens should you prescribe so that an object can be clearly seen when placed at 25 cm in front of the eye?

    a. –15 cm
    b. 18 cm
    c. 60 cm
    d. 43 cm
    e. 25 cm

18. If different transmission filters are used with an astronomical telescope, which of the following would give the best angular resolution?

    a. red
    b. blue
    c. green
    d. All yield the same resolution.
    e. infrared

19. A 1.5 m tall woman stands 5.0 m in front of a camera with a 4.0 cm focal length lens. What is the size of the image formed on film?

    a. 2.4 cm
    b. 1.9 cm
    c. 0.60 cm
    d. 1.2 cm
    e. 1.0 cm

20. You are building a compound microscope with an objective lens of focal length 0.70 cm and an eyepiece lens of focal length 5.0 cm. You mount the lenses 18 cm apart. What is the maximum magnification of your microscope?

    a. 130
    b. 3.1
    c. 7.3
    d. 67
    e. 175

21. Einstein's theory of relativity is based in part on which one of the following postulates?

    a. the existence of an absolute frame of reference
    b. space and time are absolutes
    c. energy is conserved only in elastic collisions
    d. speed of light in a vacuum is same for all observers regardless of source velocity
    e. conservation of momentum

22. An astronaut at rest has a heart rate of 65 beats/min. What will her heart rate be as measured by an earth observer when the astronaut's spaceship goes by the earth at a speed of 0.60 c?

    a. 52 beats/min
    b. 39 beats/min
    c. 108 beats/min
    d. 81 beats/min
    e. 103 beats/min

23. The observed relativistic length of a super rocket moving by the observer at 0.70 c will be what factor times that of the measured rocket length if it were at rest?

    a. 0.45
    b. 0.82
    c. 0.71
    d. 1.4
    e. 0.55

24. How fast would a rocket have to move past a ground observer if the latter were to observe a 4.0% length shrinkage in the rocket length? ($c = 3.00 \times 10^8$ m/s)

    a. 0.12×10^8 m/s
    b. 0.28×10^8 m/s
    c. 0.84×10^8 m/s
    d. 1.2×10^8 m/s
    e. 1.4×10^8 m/s

25. An unknown particle in an accelerator moving at a speed of 2.00×10^8 m/s has a measured total energy of 1.80×10^{-9} J. What is its mass? ($c = 3.00 \times 10^8$ m/s)

    a. 0.650×10^{-26} kg
    b. 0.810×10^{-26} kg
    c. 1.01×10^{-26} kg
    d. 1.49×10^{-26} kg
    e. 2.00×10^{-26} kg