Exam 3--PHYS 102--Spring 2016

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

1. An 3 C charge is traveling at 10 m/s in a magnetic field that is orthogonal to the velocity and has a magnitude of 4 T. What is the magnitude of the force on the electron?
   a. 1.2 N
   b. 120 N
   c. 70 N
   d. 7.5 N

2. Which of these statements about the magnetic force on a charged particle travelling through a magnetic field is true:
   I. The magnetic force is a centripetal force.
   II. The magnetic force is always perpendicular to the velocity.
   III. The magnetic force always causes circular motion.
   a. I & II
   b. II only
   c. I & III
   d. II & III
   e. all of these are true

3. At some moment, an electron moves with a velocity of 1 m/s in the same direction as a 1-T magnetic field. The force acting on the electron is
   a. 0 N.
   b. 1.0 N.
   c. $1.0 \times 10^{-9}$ N.
   d. $1.6 \times 10^{-19}$ N.

4. An electron moves through a region of crossed electric and magnetic fields. The electric field $E = 2000$ V/m and is directed straight down. The magnetic field $B = 0.80$ T and is directed to the left. For what velocity $v$ of the electron into the paper will the electric force exactly cancel the magnetic force?

   a. 2500 m/s
   b. 4000 m/s
   c. 8000 m/s
   d. 5000 m/s

5. Consider a long, straight, thin wire carrying a steady 0.5 A current. The value of the magnetic field 5 cm from the wire is

   a. $2.0 \times 10^{-6}$ T.
   b. $8.6 \times 10^{-6}$ T.
   c. $6.5 \times 10^{-6}$ T.
   d. $4.5 \times 10^{-6}$ T.

6. Which of these statements is true?
   a. opposite poles of a magnet attract
   b. magnetic monopoles do not exist
   c. all permanent magnets are ferromagnetic
   d. all of these are true
7. The Earth’s magnetic field plays a role in which of these atmospheric phenomena:
   a. atmospheric refraction
   b. mirages
   c. aurora borealis
   d. high-energy particle showers

8. A current goes through this solenoid. What is the direction of the magnetic field inside of the solenoid?
   a. to the left
   b. to the right
   c. up
   d. down
   e. into the page

9. A positive particle approaches a current-carrying wire as shown here. What is the direction of the current that causes the particle to travel the path as shown?
   a. left
   b. right
   c. there is no current
   d. the current could be going either direction

10. A current travels through a wire as shown. What is the direction of the force on the wire?
    a. up
    b. to the right
    c. down
    d. to the left
    e. into the page

11. What is the initial direction of this positively charged particle when it enters the magnetic field as shown?
    a. up
    b. left
    c. into the page
    d. out of the page
    e. right

12. Organize these types of radiation in order of highest to lowest frequency:
    X-Ray
    Infrared
    Ultraviolet
    Radio
    a. X-ray, ultraviolet, infrared, radio
    b. radio, infrared, ultraviolet, X-ray
    c. ultraviolet, radio, infrared, x-ray
    d. infrared, radio, ultraviolet, x-ray
13. Which of the following statements is true?

I. Newton believed light was a wave because of refraction
II. Einstein showed light was a particle because of interference
III. Huygens believed light was a wave because of refraction
IV. Young showed light was a wave through the double-slit experiment

a. I & IV  
b. III  
c. II & III  
d. III & IV

14. These two mirrors sit at an angle of 100° to one another. A ray of light is incident at 40° on the first mirror. What is the angle of reflection ($\theta_r$), with respect to a perpendicular line to the second mirror, as shown?

a. 60°  
b. 50°  
c. 20°  
d. 40°  
e. 70°

15. A ray of light in air strikes a thick sheet of some transparent material ($n = 3.0$) at an angle of 30° with the normal. Find the angle of the refracted ray within the glass with respect to the normal.

a. no refraction occurs  
b. 10°  
c. 20°  
d. 32°

16. Light travels through 3 media as shown here. In which medium is light travelling the fastest?

a. Medium 1  
b. Medium 2  
c. Medium 3  
d. the same for all 3 media

17. If a material has an index of refraction of 1.33, the speed of light through it is

a. $2.26 \times 10^8$ m/s.  
b. $3.99 \times 10^8$ m/s.  
c. $3.00 \times 10^8$ m/s.  
d. $5.30 \times 10^8$ m/s.  
e. $1.70 \times 10^8$ m/s.
18. A ray of light travels from water to air. What is the appropriate angle of incidence where total internal reflection will occur? (The index of refraction for water is 1.3.)

a. 50º  
b. 1.3º  
c. 39º  
d. 45º  
e. Total internal reflection will not occur

19. This is a figure of a fiber optics cable. A light ray coming into the acceptance zone will experience total internal reflection within the core. What must be true about the indices of refraction for the cladding \((n_{\text{clad}})\) and core \((n_{\text{core}})\).

a. \(n_{\text{clad}} > n_{\text{core}}\)  
b. \(n_{\text{clad}} = n_{\text{core}}\)  
c. \(n_{\text{clad}} < n_{\text{core}}\)  
d. it depends on the entry angle of light ray

20. If atmospheric refraction did not occur, how would the apparent time of sunset be changed?
   a. Sunset would occur later.  
b. Sunset would occur at the same time.  
c. Sunset would occur earlier.

21. Mirages are a result of _____.
   a. reflection  
b. refraction  
c. diffraction  
d. dispersion

22. An image formed by a mirror is found to have a negative image distance. If the image is smaller than the object, then, which of these also describes the image?

a. upright  
b. inverted  
c. real  
d. backwards

23. You stand two feet away from a plane mirror. How far is it \textit{from you} to your image?

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

24. A mirror produces an upright image. The object is 8 cm high and to the left of the mirror; the image is 16 cm high. The center of curvature of the mirror is 8 cm. Where is the image located?

   a. 4 cm to the right of the mirror  
b. 2 cm to the right of the mirror  
c. 4 cm to the left of the mirror  
d. 6 cm to the right of the mirror  
e. there is no image
25. A **concave mirror** can produce:
   I. a virtual image
   II. a real image
   III. a magnified image
   IV. an upright image
   a. I
   b. II
   c. I & IV
   d. I, II, and III
   e. all of these

26. A concave mirror has a focal length of 10 cm. An object is 10 cm from the mirror. Where is the image located?
   a. 5 cm
   b. 10 cm
   c. there is no image
   d. 20 cm

27. Consider the rays drawn for this mirror. Which ray(s) is/are drawn incorrectly?
   a. Ray 1
   b. Ray 2
   c. Ray 3
   d. Rays 1 & 3
   e. All are drawn incorrectly
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Answer Section

MULTIPLE CHOICE

1. ANS: B  PTS: 1  REF: S16
2. ANS: E  PTS: 1  REF: S16
3. ANS: A  PTS: 1  REF: S16
4. ANS: A  PTS: 1  REF: S16
5. ANS: A  PTS: 1  REF: S16
6. ANS: D  PTS: 1  REF: S16
7. ANS: C  PTS: 1  REF: S16
8. ANS: A  PTS: 1  REF: S16
9. ANS: A  PTS: 1  REF: S16
10. ANS: E  PTS: 1  REF: S16
11. ANS: C  PTS: 1  REF: S16
12. ANS: A  PTS: 1  REF: S16
13. ANS: D  PTS: 1  REF: S16
14. ANS: A  PTS: 1  REF: S16
15. ANS: B  PTS: 1  REF: S16
16. ANS: B  PTS: 1  REF: S16
17. ANS: A  PTS: 1  REF: S16
18. ANS: A  PTS: 1  REF: S16
19. ANS: C  PTS: 1  REF: S16
20. ANS: C  PTS: 1  DIF: 1  TOP: 23.5 Atmospheric Refraction
21. ANS: B  PTS: 1
22. ANS: A  PTS: 1
23. ANS: A  PTS: 1  DIF: 1  TOP: 23.1 Flat Mirrors
24. ANS: A  PTS: 1  REF: S16
25. ANS: E  PTS: 1  REF: S16
26. ANS: C  PTS: 1  REF: S16
27. ANS: C  PTS: 1  REF: S16