Exam 3--PHYS 102--S15

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

1. Consider this circuit. Which of these equations is correct?
   a. \( I_1 + 4 + 2I_1 - 2 = 0 \)
   b. \( 2 - 2I_1 + 8 = 0 \)
   c. \( I_1 + I_2 = I_3 \)
   d. \( 2 - 2I_1 - 4 + 2I_2 = 0 \)

2. For the circuit above, what is the direction and magnitude of \( I_2 \)?
   a. 3 A, up
   b. 5 A, down
   c. 2 A, up
   d. 1 A, up

3. This multiloop circuit has 6 distinct currents. Which of these equations is correct?
   a. \( I_1 + I_3 = I_4 \)
   b. \( I_1 - I_2 = I_3 \)
   c. \( I_2 + I_6 = I_5 \)
   d. \( I_1 + I_6 = I_4 \)

4. Which of these plots shows the current vs time for a charging capacitor?
   a. A
   b. B
   c. C
   d. D
5. Consider a series RC circuit for which $R = 1.0 \, \text{M}\Omega$, $C = 5.0 \, \mu\text{F}$, and $\epsilon = 30.0 \, \text{V}$. Initially the capacitor has no charge. When connected to the battery and resistor, what is the charge on the capacitor after 10.0 seconds?

a. 150 $\mu\text{C}$  
b. 130 $\mu\text{C}$  
c. 20 $\mu\text{C}$  
d. 10 $\mu\text{C}$  
e. 170 $\mu\text{C}$

6. Consider the RC circuit in the previous question. How long will it take for the capacitor to fully charge?

a. 50 s  
b. 150 s  
c. 5 s  
d. 1500 s

7. This is a true statement: “a monopole does not exist.” Which of these is the best reason for why this is true?

a. moving electrons cause magnetic fields  
b. permanent magnets are magnetic because their magnetic domains all line up  
c. a current in a wire can generate a magnetic field  
d. ferromagnetic materials are able to be magnetized

8. This figure shows a wire between the poles of a magnet. At the location of the wire, what is the direction of the magnetic field?

a. to the left  
b. out of the page  
c. up  
d. to the right  
e. down

9. Consider the figure in the previous question. If a current in the wire is travelling out of the page, what is the direction of the force on the wire?

a. to the left  
b. down  
c. up  
d. out of the page  
e. to the right

10. A current goes around this page in a clockwise direction. At the center of the page, the magnetic field is directed

a. away from you  
b. towards you  
c. to the left  
d. to the right

11. The point A is equidistance between these two, long parallel wires. What is the direction of the magnetic field at point A due to the two wires?

a. To the left  
b. Into the page  
c. Out of the page  
d. To the right  
e. There is no magnetic field at A

12. An $2 \, \text{C}$ charge is traveling at 12 m/s in a magnetic field that is orthogonal to the velocity and has a magnitude of 3 T. What is the magnitude of the force on the electron?

a. 8 N  
b. 18 N  
c. 72 N  
d. 0.5 T
13. A positive particle approaches a current-carrying wire as shown here. What direction will the particle go?

\[ \text{\textbullet} \quad \text{\textbullet} \quad \text{\textbullet} \quad \text{\textbullet} \]

a. left  
b. right  
c. out of the page  
d. into the page  
e. it will go back the way it came (up)

14. This loop of wire, which sits in a B-field directed to the right, has a current in the direction shown by the arrows. The loop has a What is the direction the loop will turn?

\[ \text{\textbullet} \quad \text{\textbullet} \quad \text{\textbullet} \quad \text{\textbullet} \]

a. clockwise  
b. counterclockwise

15. 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. I & III  
c. II only  
d. II & III  
e. all of these are true

16. A current of 30 A is in a circular loop with a radius of 0.1 meters. The loop has 10,000 turns of wire. What is the magnetic field at the center of the loop?

\[ \text{\textbullet} \quad \text{\textbullet} \quad \text{\textbullet} \quad \text{\textbullet} \]

a. 12 T  
b. 2 T  
c. 3000 T  
d. 24 T

17. A positive particle moves into the B-field of a mass spectrometer; the particle is moving at a speed of 4 m/s. The magnetic field has a magnitude of 8.0 T, and the radius of the particle’s path is 0.5 m. Following is a table with the masses and charges of some imaginary particles. Which is this particular particle?

<table>
<thead>
<tr>
<th>Particle</th>
<th>Mass (kg)</th>
<th>Charge (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litrium</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mammium</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Sirmium</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Tilanium</td>
<td>16</td>
<td>1</td>
</tr>
</tbody>
</table>

a. Litrium  
b. Mammium  
c. Sirmium  
d. Tilanium

18. Organize these types of radiation in order of shortest wavelength to longest wavelength:
Gamma  
Infrared  
Radio  
Visible

a. visible, infrared, radio, gamma  
b. radio, infrared, visible, gamma  
c. gamma, infrared, visible, radio  
d. gamma, visible, infrared, radio
19. Which of the following statements is true?

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

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

20. The following figure shows a fiber optic cable. In order for total internal reflection to occur, which of these statements about the indices of refraction must be true?

![Fiber optic cable diagram]

a. $n_1 > n_2$  
b. $n_1 = n_2$  
c. $n_1 < n_2$  
d. Total internal reflection will occur for all of these scenarios.

21. The index of refraction of benzene is 1.80 and, for air, it is 1.0. The critical angle for total internal reflection, at a benzene-air interface, is about:

a. 34°  
b. 22°  
c. 18°  
d. 56°  
e. 47°

22. A ray of light in air strikes a thick sheet of glass ($n = 1.5$) at an angle of 25° with the normal. Find the angle of the refracted ray within the glass with respect to the normal.

a. 16°  
b. 46°  
c. 56°  
d. 25°

23. When light passes from air to glass, it bends:

a. away from the normal and speeds up  
b. toward the normal and slows down  
c. toward the normal without changing speed  
d. away from the normal and slows down  
e. toward the normal and speeds up

24. Light travels through 3 media as shown here. Where does the light travel at the fastest speed?

![Light travel diagram]

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

25. Consider this arrangement of mirrors. What is the angle of reflection off of mirror #2?

![Mirror arrangement diagram]

a. 30°  
b. 40°  
c. 60°  
d. 90°  
e. 120°
Exam 3–PHYS 102–S15
Answer Section

MULTIPLE CHOICE

<table>
<thead>
<tr>
<th></th>
<th>ANS:</th>
<th>PTS:</th>
<th>REF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>D</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>2.</td>
<td>C</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>3.</td>
<td>C</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>5.</td>
<td>B</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>6.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>7.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>8.</td>
<td>D</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>9.</td>
<td>C</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>10.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>11.</td>
<td>E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>C</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>13.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>14.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>15.</td>
<td>E</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>18.</td>
<td>D</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>19.</td>
<td>C</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>20.</td>
<td>A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>22.</td>
<td>A</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>23.</td>
<td>B</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>24.</td>
<td>C</td>
<td>1</td>
<td>S15</td>
</tr>
<tr>
<td>25.</td>
<td>C</td>
<td>1</td>
<td>S15</td>
</tr>
</tbody>
</table>

TOP: 22.3 The Law of Refraction