University of Puerto Rico
Mayagüez Campus
Departament of Physics

Final Exam – Fisi 3162/3172

Name: _____ Thursday, May 8, 2008

Section: _____ Prof. _____

Read the instructions carefully. Select the best answer. You are required to answer only 20 of the 25 questions. You have to select and identify the 20 questions to be corrected by circulating the question's number. If you choose not to indicate which questions are the chosen ones, the first 20 questions will be the ones selected. Al answers most be justified, either by some analytical procedure or by some physics principle. If there is no justification for the answer then it will be considered a wrong answer. In other words 'to guess' the answer is not valid. The points assigned per question will be: 5 % to a correct answer with a correct justification, 2.5 % to an incorrect answer with a correct justification, and 0% to a correct or incorrect answer with either no justification or an incorrect one.

1. Two point-charges Q_1= +9 μc and Q_2 = - 4 μc are located at x=0 (Q_1) and x=10 cm (Q_2) along the x-axis as shown in figure 1. Find the x coordinate at which a third charge Q_3 placed at that point experiences a net force equal to zero (0) is (in cm):

   a) -6
   b) 6
   c) 20
   d) 30
   e) Another: Which?

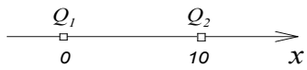

Figure 1

2. A particle with a mass of 15 g with charge q = +2.0 μc is floating above a horizontal, very large and uniformly charged non-conducting plane as shown in figure 2. The charge density on the plane (in $\mu C/m^2$) is:

   a) -0.65
   b) 0.65
   c) -1.3
   d) 1.3
   e) Another: Which?

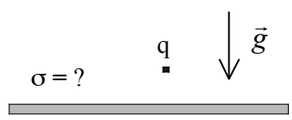

Figure 2

3. A particle (m = 8.0 g, q = - 6.0 μC) which is located at point A has a speed of 0.80 m/s. It moves to point B where the electric potential is 200 V greater than at point A. The particle's kinetic energy in mJ when it reaches B is: (Assume that only electric forces act on the particle.)

   a) 1.20

   b) 1.36

   c) 2.56

   d) 3.76

   e) Another: Which?

4. A hollow conducting sphere has a net charge of +3.0 nC. A point charge of +2.0 nC is placed inside the sphere. The distribution of charges in the inner and outer surfaces of the sphere are respectively (in nC):

   a) 0 and 3

   b) -2 and +1

   c) -2 and +5

   d) +2 and +1

   e) Another: Which?

5. A hollow conducting sphere is charged to a potential V. The potential at its center is:

   a) -V

   b) 0

   c) V

   d) 2V

   e) πV

6. There is a capacitor with a capacitance C connected to a battery with voltage V. The battery is changed to a battery with voltage 4V and so the voltage of the capacitor is increased four times. The capacitance in the new configuration is:

   a) C/4
   b) C/2
   c) C
   d) 2C
   e) 4C

7. In the circuit shown in figure 3 $C_1 = 2$ nF, $C_2 = 5$ nF, $C_3 = 4$ nF y $C_4 = 6$ nF. If the charge in the capacitor C_1 is 10 nC ($Q_1 = 10$ nC) then the voltage between points a and b is:

   a) 4 V
   b) 8 V
   c) 10 V
   d) 16 V
   e) Another: Which?

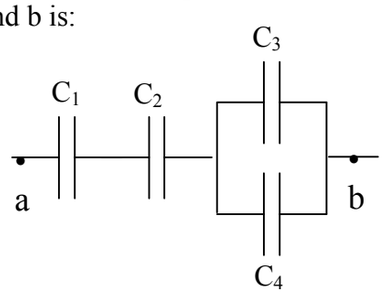

Figure 3

8. There are two wires with the same length but different diameters. The diameter of the first is *d* and that of the second is four times that of the first (4*d*). If both wires are of the same material and the resistance of the first is R, that of the second is:

   a) 16 R
   b) 4 R
   c) R
   d) R/4
   e) R/16

9. Consider the circuit diagram in figure 4. The equation which is not correct for the circuit of the ones listed below is:

   a) $\varepsilon_1 - I_1 R_1 - I_2 R_2 = \varepsilon_2$
   b) $\varepsilon_3 + I_3 R_3 - I_2 R_2 = \varepsilon_2$
   c) $\varepsilon_1 - I_1 R_1 + I_3 R_3 = \varepsilon_3$
   d) $I_1 - I_2 = I_3$
   e) $-I_1 + I_2 = -I_3$

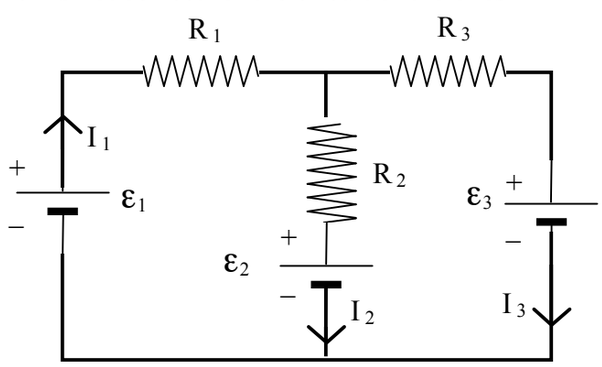

Figure 4

10. Which of the following statements for the circuit shown in figure 5 is correct?

a) If S is in position ‘a’ for a very long time the current in R_1 approaches zero (0).

b) If S is in position ‘a’ for a very long time the charge in C se approaches $\mathcal{E}$C .

c) If S is in position ‘a’ for a very long time the current in R_1 approaches $\mathcal{E}/R_1$.

d) Immediately after closing switch S toward position ‘a’ the current in R_1 approaches $\mathcal{E}/(R_1 + R_2)$

e) Immediately alter closing switch S toward position ‘a’ the current in R_2 approaches zero (0).

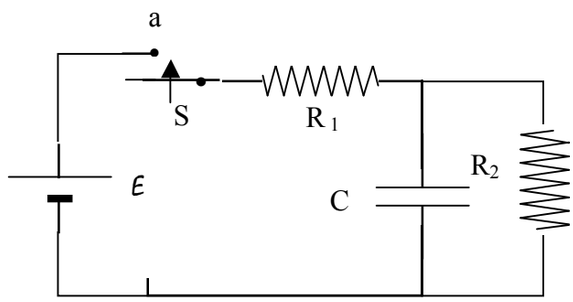

Figure 5

11. Figure 6 shows an electron moving in a region in space where there is a magnetic field. The force $\vec{F}$ on the electron is shown; however the direction of the magnetic field is not. The magnetic field vector points:

a) toward the right

b) upward

c) downward

d) toward the page

e) out of the page

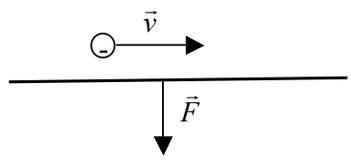

Figure 6

12. Two parallel wires, separated by 0.04 m, have currents of 2 A and 4 A, respectively, in the same direction. The force per unit length in N/m that each wire exerts on the other is:

a) 1×10^{-3}, repulsion

b) 1×10^{-3}, attraction

c) 4×10^{-5}, repulsion

d) 4×10^{-5}, attraction

e) Another: Which?

13. The magnitude of the magnetic field at *P*, in the center of the semi-circular wire (see figure 7) which has a current $i = 7.0$ A and a radius $R = 3.5$ cm, is given in (T) by:

a) 3.5×10^{-5}

b) $7.0\pi\times10^{-5}$

c) $2.0\pi\times10^{-5}$

d) $4.0\pi\times10^{-4}$

e) Another: Which?

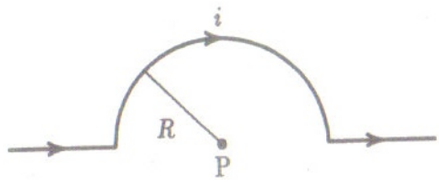

Figura 7

14. Two straight wires go through the window in a room (see figure 8). One has a current of 3.0 A (I_1) entering the room, and the other has a current of de 5.0 A (I_2) leaving the room. The magnitude in T · m of the line integral $\oint \vec{B}\cdot d\vec{l}$ for a closed path around the frame of the window is:

a) 2.5×10^{-6}

b) 3.8×10^{-6}

c) 6.3×10^{-6}

d) 1.0×10^{-6}

e) Another: Which?

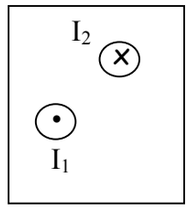

Figure 8

15. A circular wire is placed with one half inside and the other half outside a square region with a uniform magnetic field $\vec{B}$ toward the plane of the page as shown in figure 9. In order to induce a clockwise current in the wire one has to

a) move the wire in the direction of $+x$

b) move the wire in the direction of $+y$

c) move the wire in the direction of $-y$

d) move the wire in the direction of $-x$

e) increase the magnitude of $\vec{B}$

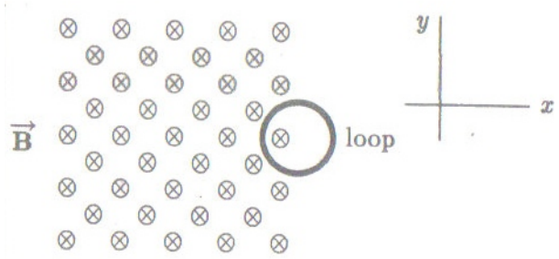

Figure 9

16. If the electric field of an electromagnetic wave is along the ; figure 10) and its magnitude is given by $E_m \sin(kx - \omega t)$, in SI units, then the magnetic field is along the 'z' axis and its magnitude is given by:

a) $(E_m/c)\cos(kx - \omega t)$

b) $-(E_m/c)\cos(kx - \omega t)$

c) $-(E_m/c)\sin(kx - \omega t)$

d) $E_m \cos(kx - \omega t)$

e) $(E_m/c)\sin(kx - \omega t)$

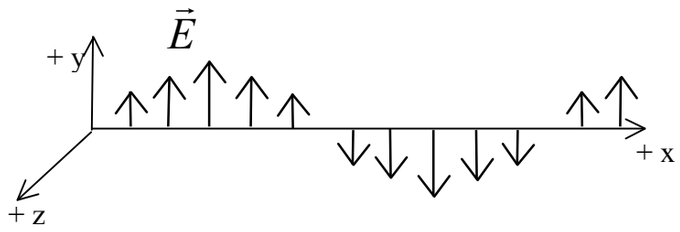

Figure 10

17. A light bulb burns at a distance d in front of the center of a 40-cm wide flat mirror that is hung vertically on a wall (see figure 11). A person walks in front of the mirror along a line that is parallel to the mirror and twice as far (2d) from it as the bulb. The greatest distance D he can walk in front of the mirror and still see the image of the bulb is:

a) 20

b) 40

c) 60

d) 80

e) 120

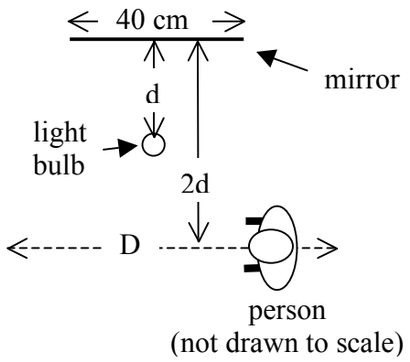

Figure 11

18. A man stands with his nose 8 cm from a concave shaving mirror with a radius of curvature of 32 cm. The distance from the mirror to the image of his nose is:

    a) 8
    b) 12
    c) 16
    d) 24
    e) 32

19. When a light wave travels from one medium to another,

    a) the frequency f does not change
    b) the wavelength λ does not change
    c) both f and λ do not change
    d) both f and λ change

20. A magnifying glass has a focal length of 15 cm. If the near point of the eye is at 25 cm the angular magnification of the glass when it is placed in front of the eye is:

    a) 0.067
    b) 0.33
    c) 0.5
    d) 0.67
    e) 1.7

21. A double slit with a separation between slits of 0.100 mm is 1.20 m from a screen. Monochromatic light with wavelength λ = 500 nm is incident on the slits from a distant source. The separation between two consecutive interference maxima in the screen will be in mm:

    a) 0.75
    b) 1.5
    c) 3.0
    d) 6.0
    e) Another: Which?

22. Monochromatic light with a wavelength of 750 nm passes through a single slit 2.5×10^{-4} m wide. The central maximum in a screen 2.0 m away is ____ cm wide.

a) 0.30

b) 0.60

c) 1.2

d) 2.4

e) Another: Which?

23. A non polarized beam of light with intensity I_0 enters a polarizer which has its transmission axis oriented vertically (see figure 12). The beam of light then enters a second polarizer whose transmission axis makes an angle θ with respect to that of the first polarizer. The intensity of the beam after leaving the second polarizer is 3/8 I_0. The angle θ between both axes is:

a) 25.5^o

f) 30.0^o

g) 52.2^o

h) 60.0^o

i) Another: Which?

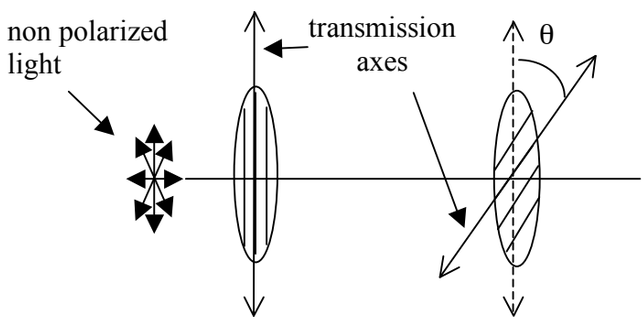

Figure 12

24. The longest wavelength a photon may have to be able to eject an electron from a sodium surface whose work function is 2.3 eV is _____ nm.

a) 450

b) 540

c) 650

d) 1080

e) Another: Which?

25. The wavelength in nm of an electron whose kinetic energy is 125 eV is:

a) 0.11
b) 0.22
c) 0.44
d) 1.1
e) Another: Which?