University of Alberta
Department of Physics

Phys 230 A02 Final Exam
Monday, December 11, 2006
14:00 – 16:00

ETLE1-017
Dr. J.Jung

No notes or textbooks allowed
Formula sheet and a calculator are allowed
This exam has 15 questions; the value of each is indicated in the table below. Budget your time accordingly.
Show all your work in a neat and logical manner in the space provided
Messy work will not be marked

Do not separate the pages of the exam

Student Name:

Student ID:

Question	Value	Mark
1	1	
2	1	
3	1	
4	1	
5	4	
6	1	
7	1	
8	1	
9	1	
10	1	
11	1	
12	1	
13	10	
14	10	
15	10	
Total	45	

1. Two conductors are joined by a long copper wire. Thus
    a. Each conductor carries the same charge.
    b. Each conductor must be at the same potential.
    c. The electric field at the surface of each conductor is the same.
    d. No free charges can be present on each conductor.
    e. The potential on the wire is the average of the potential of each conductor.

2. For an electron moving in a direction opposite to the uniform electric field:
    a. Its potential energy increases and its potential decreases.
    b. Its potential energy decreases and its potential increases.
    c. Its potential energy increases and its potential increases.
    d. Its potential energy decreases and its potential decreases.

3. The minimum capacitance that can be make using five 10-nF capacitors is:
    a. 50 nF
    b. 10 nF
    c. 0.2 nF
    d. 2 nF

4. A parallel plate capacitor is connected to a battery and becomes fully charged. The capacitor is then disconnected, and the separation between the plates increases. The energy stored in the capacitor has:
    a. Increased.
    b. Decreased.
    c. Not changed.
    d. Becomes zero.

5. The plates of a parallel plate capacitor are connected to a battery and is left to charge. A slab of dielectric material is then inserted between the plates while the battery is still connected. Indicate how would each of the following quantities change when the dielectric is inserted:

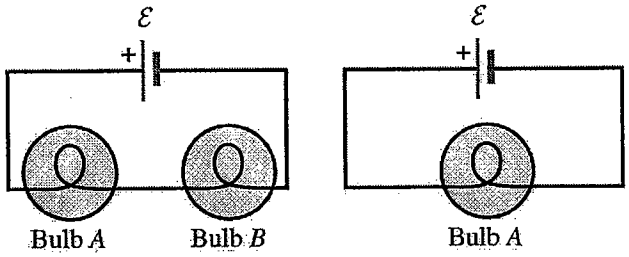
	Increase	Decrease	Stay the same
Capacitance			
Charge			
Potential			
Stored energy			

6. A current density J is flowing in a resistor of resistivity ρ. The quantity $J^2\rho$ represents:
    a. The electric field in the resistor.
    b. The total power dissipated in the resistor.
    c. The rate at which heat is generated per unit volume of the resistor.

d. The electrical energy stored in the resistor.
e. The potential drop across the resistor.

7. Electrons in an electric circuit pass through a source of emf. The wire has the same diameter on each side of the source of emf. Compared to the drift speed of the electrons before entering the source of emf, the drift speed of the electrons after leaving the source of emf is:
   a. Faster
   b. Slower
   c. The same
   d. Not enough information given to decide

8. In the circuit shown in (a), the two bulbs *A* and *B* are identical. Bulb *B* is removed and the circuit is completed as shown in (b). Compared to the brightness of bulb *A* in (a), bulb *A* in (b) is:
   a. Brighter
   b. Less bright
   c. Just as bright
   d. Any of the above, depending on the rated wattage of the bulb.



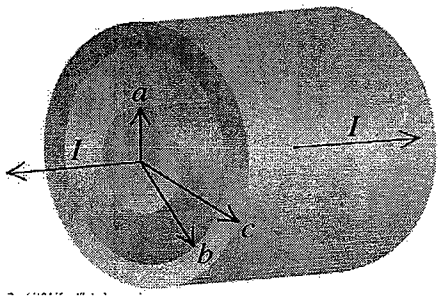
9. A cylindrical copper rod has resistance R. It is reshaped to twice its original length with no change of volume. Its new resistance is:
   a. R
   b. 2R
   c. 4R
   d. 8R
   e. R/2

10. A charged particle moves across a constant magnetic field. The magnetic force on this particle:
   a. Changes the direction of the particle's velocity.
   b. Increases the particle's speed.
   c. Is in the direction of the particle's motion.
   d. Both (a) and (b) are correct.

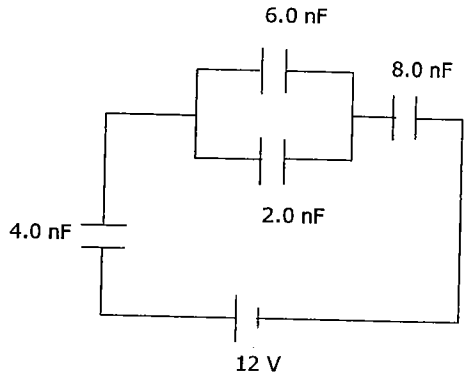
11. A circular loop of wire of cross-sectional area $0.12m^2$ consists of 200 turns, each carrying 0.50 A. It is placed in a magnetic field of 0.050 T oriented at 30° to the plane of the loop. The torque acting on the loop (in N.m) is:
    a. 0.25
    b. 0.52
    c. 2.5
    d. 5.2

12. A coaxial cable consists of a solid conducting rod with radius a on the axis of a conducting cylinder with inner radius b and outer radius c (see figure below). The space between these conductors is insulating. The central conducting rod and the outer conducting cylinder carry equal currents I in opposite directions. The currents are distributed uniformly over the cross sections of each conductor.
    The magnitude of the magnetic fields at a point inside the central conductor at $r < a$, and at a point outside the outer cylinder at $r > c$, are:

    a. $\mu_o I/2\pi r$ and $\mu_o I/2r$
    b. $\mu_o I/\pi a^2$ and zero
    c. $\mu_o Ir/2\pi a^2$ and zero
    d. $\mu_o Ir/\pi a^2$ and $\mu_o I/2\pi r$



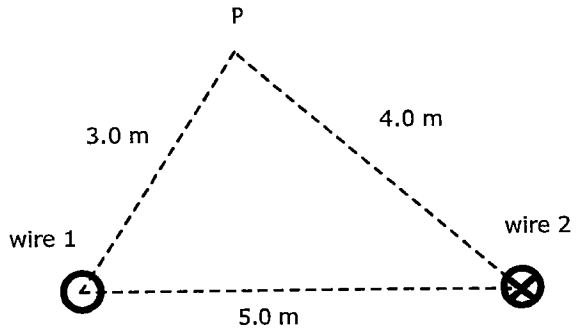
13. In the circuit shown below:
    a. Find the equivalent capacitance.
    b. Find the potential across the 4.0 nF capacitor.
    c. Find the charge on the 6.0 nF capacitor.



14. Two very long straight parallel wires run perpendicular to the page and are separated by a distance of 5.0 m as shown in the figure. Wire 1 to the left carries a current of 50.0 A out of the page, while wire 2 to the right carries a current of 75.0 A into the page.

    a. Find the magnetic field, magnitude and direction, at point P.
    b. An electron moving horizontally with a speed of $3x10^5$ m/s passes through point P from left to right. At this particular instant, calculate the force on the electron, its magnitude and direction.
    c. If the directions of both currents are the same (into page), find a distance from wire 1 along the 5.0 m line joining the two wires, at which the total field is zero.

    ($\mu_o = 4\pi \times 10^{-7}$ Tm/A)



15. The region between two concentric conducting spheres with inner and outer radii a and b is filled with a conducting material having resistivity ρ (see figures below)

    a. Calculate the resistance of the material between the spheres.
    b. Calculate the dependence of the current density on the distance r (a<r<b) from the center of the spheres if the potential difference between the spheres is known.