PHY 106 *Final Exam* August 4, 2005 90 minutes La Salle University Dr. R. DiDio

ALL WORK MUST BE DONE IN BLUE BOOK!

- 1. [12 pts] A mass undergoes Simple Harmonic Motion described by
 - $x(t) = 5\sin(\pi t + \pi/3)$ cm, where t is in seconds
 - a) Calculate the period and frequency of the motion
 - b) Determine the maximum velocity and acceleration of the mass
 - c) At what time is the kinetic energy equal to the potential energy? (Note: the first time after t=0)
- 2. [4 pts] A pendulum on the surface of the Earth has a period of one second. What would be its period if the pendulum were 10,000 km above the surface of the earth where the acceleration due to gravity is on 15.2% of its value at sea level?
- 3. [4 pts] A pressure wave in air is described by $p(x,t) = 0.75\cos(\pi x/2 170t)$ pascals, where x is in meters and t is in seconds. Calculate the wavelength, frequency, and velocity of the wave.
- 4. [6 pts] An observer moves at 80 m/s towards a source emitting a sound of 990 Hz
 - a) Find the wavelength of the sound waves between the source and listener
 - b) What is the frequency heard by the observer?
- 5. [6 pts] The lowest A on a piano has frequency of 27.5 Hz.
 - a) If the tension in the 2.0-meter string is 308 N, what is the mass of the wire?
 - b) What tension will double the frequency?
- 6. [12 pts] The charges of a dipole each have a magnitude of 3.97 x 10⁻¹⁰ C, and they are separated by 0.0112 m.
 - a) What is the magnitude of the electric field halfway between the charges? In what direction does it point?
 - b) Calculate the force on each charge due to the other charge. In what directions are these forces?
- 7. [12 pts] Three capacitors are placed in series (with capacitances of $3\mu F$, $6\mu F$, and $9\mu F$), and a potential difference of 120 V is applied across them.
 - a) Calculate the total charge that leaves the battery
 - b) Calculate the total energy stored in each capacitor
 - c) Re-do part (a), only with all capacitor connected in parallel.
- 8. [8 pts] A particle of charge 2.0 mC moves under the influence of a constant electric field. It has a kinetic energy of 5.0 J at point A. It then passes through point B, which has an electric potential of +1.5 kV with respect to point A
 - a) Determine the kinetic energy at B
 - b) If E is 7500 N/C, how far apart are points A and B?

9. [6 pts] Four resistors (values R, 2R, 3R, and 4R) are placed in parallel, and a power supply with potential ΔV_0 is placed across them. Calculate the total current leaving the power supply and the power output of the supply in terms of ΔV_0 and R

10. [10 pts] Two long wires parallel to the x-axis each carry 20 amps of current.µµ



11. [4 pts] An electron moves with a velocity of 0.55c in the xy plane at an angle of 30° to the x-axis. A magnetic field of 0.85T is in the negative-y direction. Determine the magnetic force on the electron (Magnitude and direction)

$$f' = f\left(\frac{v \pm v_0}{v \pm v_s}\right) \qquad B = \frac{\mu_0 I}{2\pi R}$$
$$e = 1.602 \times 10^{-19} \text{ C}$$
$$v_{\text{sound}} = 343 \text{ m/s}$$
$$c = 3 \times 10^8 \text{ m/s}$$

$$\mu_0 = 4\pi \ge 10^{-7}$$
 $\epsilon_0 = 8.854 \ge 10^{-12}$