PHY 121  
Fall 2003  
Exam #1

Name:________________________    ID Number:_________________________

Signature:_____________________   Recitation Section:____________________

1. Do not open the exam booklet until told to do so. Before you begin the exam place your ID on the table in front of you. It will be checked at some time during the exam. The only other items allowed out are a calculator, your notecard(s), and a something to write with (preferably a pencil!). Any scratch paper you need will be provided. Be sure to fill out the information correctly on the top of this sheet. Also all backpacks, etc. should be placed underneath the chair you are sitting on.

2. There are four questions on this exam each consisting of multiple parts with question 4 consisting of 10 multiple choice questions. All questions are worth 10 points apiece. Partial credit will be given following the grading rules laid out in the course syllabus.

3. Only work on the front of the page will be graded. If you use scratch paper the work must then be copied into the exam booklet.

4. It is not necessary to show trivial computational details, but you should indicate clearly what important physical and mathematical steps you take and how you arrived at your conclusions. State your answers unambiguously, using diagrams to assist when helpful. Use and display the proper units wherever appropriate. It is the grader’s responsibility to evaluate your solution as fairly as possible, but it is not the grader’s responsibility to decipher unintelligible writing, mathematics, and figures, or to read your mind.

5. If you have a question you would like to ask, raise your hand and someone will come to you. Do not get out of your seat during the exam until you are finished with the exam or there is a fire alarm.

6. If there is a fire alarm during the exam leave your exam booklet on the table. Please close the exam booklet and exit the room immediately. The exams will be graded as they are.

7. If you finish the exam early you may leave after placing your exam in the box that will be in the front of the room.

8. All exam appeals must be submitted to the course instructor before the next exam which is scheduled for Friday, October 3, 2003.

Exam Score

1:____________   3:____________

2:____________   4:____________

Total: _____/40
Physical Constants:

Universal Gravitational Constant \( G \) \( \text{6.67} \times \text{10}^{-11} \text{ N m}^2/\text{kg}^2 \)
Gravitational acceleration at Earth’s surface \( g \) \( 9.8 \text{ m/sec}^2 \)
Fundamental charge unit \( e \) \( 1.60 \times \text{10}^{-19} \text{ C} \)
Electrostatic force constant \( k_e \) \( 9.00 \times \text{10}^9 \text{ N m}^2/\text{C}^2 \)
Permittivity of free space \( \varepsilon_0 \) \( 8.85 \times \text{10}^{-12} \text{ C}^2/\text{N m}^2 \)
Speed of light in free space \( c \) \( 3.00 \times \text{10}^8 \text{ m/sec} \)
Mass of electron \( m_e \) \( 9.10 \times \text{10}^{-31} \text{ kg} \)
Mass of proton/neutron \( m_p, m_n \) \( 1.67 \times \text{10}^{-27} \text{ kg} \)
Mass-energy of electron \( m_e c^2 \) \( 0.511 \text{ MeV} \)
Mass-energy of proton \( m_p c^2 \) \( 938.3 \text{ MeV} \)
Radius of Sun \( R_\odot \) \( 6.96 \times \text{10}^8 \text{ m} \)
Mass of Sun \( M_\odot \) \( 1.99 \times \text{10}^{30} \text{ kg} \)
Radius of Earth \( R_\oplus \) \( 6.37 \times \text{10}^6 \text{ m} \)
Mass of Earth \( M_\oplus \) \( 5.98 \times \text{10}^{24} \text{ kg} \)
Energy conversion \( 1 \text{ MeV} = 1.60 \times \text{10}^{-13} \text{ J} \)
Rydberg constant \( R_H \) \( 1.097 \times \text{10}^7 \text{ m}^{-1} \)

Trig Identities:

\( \cos^2 \theta + \sin^2 \theta = 1 \)
\( \cos 2\theta = \cos^2 \theta - \sin^2 \theta \)
\( \sin 2\theta = 2 \cos \theta \sin \theta \)

Simple derivatives:

\( \frac{d}{dx} x^n = nx^{n-1} \)
\( \frac{d}{dx} \ln x = \frac{1}{x} \)
\( \frac{d}{d\theta} \cos \theta = -\sin \theta \)
\( \frac{d}{d\theta} \sin \theta = \cos \theta \)

Approximations for \( \varepsilon << 1 \)

\( \sqrt{1 + \varepsilon} \approx 1 + \frac{\varepsilon}{2} \)
\( \frac{1}{1 + \varepsilon} \approx 1 - \varepsilon \)
\( \frac{1}{1 - \varepsilon} \approx 1 + \varepsilon \)