Midterm II
Physics 7C
Fall 1999
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Name:_____ SID_____

Discussion Section #_____

Work all problems. Do not perform any numerical calculation until you have a final boxed algebraic answer. In order to obtain maximum partial credit show all your work clearly. Cross out work that you do not wanted graded. Work the easiest problem first and then move on to harder ones. If you don't understand what is being asked in a problem, ask the proctor for clarification. All problems are weighted equally. Good luck.

1._____

2._____

3._____

4._____

Total _____

Integral table: $\int \frac{dx}{(1-x^2)^{\frac{3}{2}}} = \frac{x}{\sqrt{1-x^2}}$

Constants: $c=3\times10^{8}$m/s, $h=6.6\times10^{-34}$js, $e=1.6\times10^{-19}$C, $m_e=9\times10^{-31}$kg, $G=6.67\times10^{-11}$Nm^2/kg^2

1. A photon of energy $2x10^5$eV collides with a free electron, initially at rest. The photon emerges at an angle of 60°. A) At what angle will the electron emerge? B) What is the emerging electron's kinetic energy?

2. The Stanford Linear Accelerator (SLAC) accelerates electrons in a beam tube. Assume that the electric field along the tube is $E=7x10^6 V/m$. Calculate how much time it takes to reach 90% of the speed of light. Hint: F=dp/dt works in special relativity.

3. In principle, Bohr's theory can be used to describe the motion of the Earth around the Sun. The Earth plays the role of the electron, the Sun that of the nucleus and the gravitational force that of the electric force.
A) Derive the formula for the radii, r_n, of the circular Bohr orbits for the Earth-Sun system. (Derive does not mean take a formula and change the constants. It means start from F=ma, etc. and get the result)
B) The radius of the Earth's orbit is 1.5×10^{11}m. What value of the quantum number n does this correspond to. The mass of the Earth is 6×10^{24}kg. Mass of the Sun is 2×10^{30}kg.

4. A star whose surface temperature is 6000K is known to be 13 light years away. Looking at the star with the unaided eye permits 29 photons per second to enter the eye. Assume the eye's diameter is 5mm and that all of the star's radiation is at the peak of the thermal spectral distribution. Estimate the radius of the star.