

**King Fahd University of Petroleum and Minerals**  
**Physics Department**  
**Phys-212: Modern Physics**  
**Spring 2002**

**Assignment # 1**

**Date : Monday Feb.4.2002**

**Due Date : Wednesday Feb.14.2002**

I encourage group discussion, but not copying (cheating).

Problem.1

This is about Galilean Transformation. It will help you understand the mathematics of Michelson-Morley experiment.

A Boat will move from point A to B (distance L) across a river at a speed V and then back to A. A second boat will travel the same distance upstream and back. If the river is flowing at a speed v, find the difference in the time the two boats will take.

Problem.2

Go to web-page: <http://www.cco.caltech.edu/~phys1/java/phys1/Einstein/Einstein.html>

Do some of the experiments there and write your observations (in details please).

Problem.3

Show that, for speed V, close to the speed of light c, you can use the approximation

$$\frac{1}{\sqrt{1-V^2/c^2}} = \sqrt{\frac{c}{2\delta}}$$

where  $\delta \equiv c - V$ .

Problem.4

The Stanford Linear Accelerator is 3000 m long. It accelerates electrons to a speed that differs from the speed of light by only 8 parts in  $10^{11}$ . [That is  $c - V = (8 \times 10^{-11})c$ ]. How long does the accelerator appear to be from the point of view of an observer riding on one of these electrons? Hint: use the result of Problem.3.

Problem.5

Of all the chemical reactions, the one that releases the greatest amount of energy per unit mass of reactant is the reaction  $\text{H} + \text{F} \rightarrow \text{HF} + 2.79 \text{ eV}$ ,

in which hydrogen and fluorine combine to form hydrogen fluoride. The atomic mass of the hydrogen isotope  $^1\text{H}$  is 1.007 825 u; that of fluorine isotope  $^{19}\text{F}$  is 18.998 40 u. Find the proportional mass change

$\Delta M / M$  that occurs in the reaction.

Problem.6

An electron is accelerated through a potential difference of 500 kV. Find (a) its relativistic energy, (b) its relativistic mass (c) its momentum, and (d) its speed.

Problem.7. Textbook Prob.1.14

Problem.8. Textbook Prob.1.24

Problem.9. Textbook Prob.1.25

