

PROBLEM SET 2

PHY 255 - MODERN PHYSICS

PROBLEMS FROM TAYLOR CHAPTER 2

In this project you have to do some graphical representations. You may use any software at your disposal to show the required graphical representations. I do not want to see your code, just to final results. Remember when showing graphical representations you have to include axis labels, unit and also a description of the figures. As usual the problems in **bold** have to be handed in.

The following problems have to be done before or in the tutor class

1, 3, **5**, **6**, 7, 9, 10, **17**, 19, **20**, 24, **27**, 29, **31**, **35**, 36, 37, 40, 41, **44**, 48

PROJECT 2 - DUE DATE TO BE ANNOUNCED IN CLASS

(A) **Two “Pythagorean Relation”**

The relativistic momentum and energy are respectively given by the formulas

$$(1) \quad \bar{p} = \frac{m\bar{u}}{\sqrt{1 - \frac{u^2}{c^2}}}, \quad E = \frac{mc^2}{\sqrt{1 - \frac{u^2}{c^2}}}.$$

Show using equations (1) that we can write

$$(2) \quad E^2 = (pc)^2 + (mc^2)^2.$$

(B) **Programming**

A particle of mass m and charge q is released from rest in a uniform electric field \mathcal{E} directed along the x -axis. Find its speed u as a function of time (Hint: see Taylor definition 2.43). Now use graphical software to plot u as a function of $t \in [0, 10]mc/q\mathcal{E}$ (Hint: When making the plot you may as well assume that $m = c = q\mathcal{E} = 1$, this amounts to choosing your units in a convenient way. (I want to see your calculations, no calculations imply no marks!))