Physics 570 Homework 8

Due Wednesday, November 15, 2017

Problem 1 (20 points)

Prob. 3.10 of Thomson

Problem 2 (20 points)

Prob. 5.1 of Thomson

Problem 3 (15 points)

Prob. 5.3 of Thomson

Problem 4 (20 points)

Prove the following expressions for the γ-matrices:

$$\gamma_\mu \gamma^\mu = 4$$

$$\gamma_\mu \not{a} \gamma^\mu = -2 \not{a}$$

$$\gamma_\mu \not{a} \not{b} \gamma^\mu = 4a \cdot b$$

$$\gamma_\mu \not{a} \not{b} \not{c} \gamma^\mu = -2 \not{c} \not{b} \not{a}$$

$$\gamma_\mu \not{a} \not{b} \not{c} \not{d} \gamma^\mu = 2 \not{d} \not{a} \not{b} \not{c} + 2 \not{c} \not{b} \not{a} \not{d}$$

Problem 5 (25 points)

Prove the following trace theorems:

a) Trace of an odd number of $\gamma'_\mu s$ vanishes.

b) $\mathrm{Tr}(\not{a} \not{b} \not{c} \not{d}) = 4[(a \cdot b)(c \cdot d) - (a \cdot c)(b \cdot d) + (a \cdot d)(b \cdot c)]$

c) $\mathrm{Tr}(\gamma_5 \not{a} \not{b}) = 0$

d) $\mathrm{Tr}(\not{a}_1 \cdot \cdot \cdot \not{a}_n) = a_1 \cdot a_2 \ \mathrm{Tr}(\not{a}_3 \cdot \cdot \cdot \not{a}_n) - a_1 \cdot a_3 \ \mathrm{Tr}(\not{a}_2 \not{a}_4 \cdot \cdot \cdot \not{a}_n) + \cdot \cdot \cdot$
$+ a_1 \cdot a_n \ \mathrm{Tr}(\not{a}_2 \cdot \cdot \cdot \not{a}_{n-1})$