

HOMEWORK: INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

— PREPARED BY A HARADIAN

Problem 1: INELASTIC COLLISIONS

TWO PUTTY BALLS: $m = 4 \text{ kg}$ at $v_{1x} = 3/5$,
 $v_{2x} = -3/5$

COLLIDE AND STICK TOGETHER INTO MASS, M

WHAT IS THE TOTAL MASS M AFTER THE COLLISION ??

[Ex. Ans: 10 kg]

PROBLEM 2: ANNIHILATION (PARTICLE + ANTIPARTICLE PRODUCES LIGHT)

— MATTER-ANTIMATTER ROCKET ENGINE PRODUCES LIGHT PULSE. INITIALLY, ROCKET MASS, $M = 9 \times 10^4 \text{ kg}$
ROCKET FIRMS, EMITTING PULSE WITH ENERGY, E_L
ROCKET THEN MOVING AT $v = 4/5$

QUESTION: WHAT IS THE ROCKET'S FINAL MASS, m ??
[Ex. Ans: $30 \times 10^3 \text{ kg}$]

PROBLEM 3: KAON DECAYS TO 2 PIONS



KAON, K^0 MESON WITH $m = 498 \text{ MeV}$

PION, π^0 MESON WITH, $m = 135 \text{ MeV}$

DECAY, $\Delta\tau = 36 \text{ ns}$

QUESTION: AFTER DECAY WHAT IS THE SPEED OF THE PIONS ??

[Expected Ans: 0.84 MeV]

PROBLEM 4:

A PION ($m_{\pi} = 273 m_e$) AT DECAYS INTO A MUON ($m_{\mu} = 207 m_e$) AND A NEUTRINO ($m_{\nu} = 0$). FIND THE KINETIC ENERGY AND MOMENTUM OF THE MUON AND THE NEUTRINO IN MeV.

[Expected Ans: 4.08 MeV]

PROBLEM 5: INELASTIC RELATIVISTIC COLLISION

A PARTICLE OF MASS, m , MOVING AT SPEED, $v = 4c/5$, COLLIDES INELASTICALLY WITH A SIMILAR PARTICLE AT REST.

A) WHAT IS THE SPEED v_c OF COMPOSITE PARTICLE ?

B) WHAT IS ITS MASS OF COMPOSITE PARTICLE ??

PROBLEM 6: COMPTON SCATTERING

CALCULATE, λ' IN COMPTON SCATTERING

