

NYU General Physics 1—Problem set 5

Problem 1: You are in the passenger seat of a car traveling fast in a straight line. You have your seatbelt on. The driver slams on the brakes, so you are accelerating with a magnitude of 12 m s^{-2} .

(a) If your mass is 50 kg, calculate and also draw all of the forces acting on your body during the acceleration (which most normal people would call “deceleration”).

(b) If the car plus contents has a mass of 1300 kg, what is the total force of the car on the road, from all four tires? Give direction and magnitude.

(c) If the road is slippery, the car will go into a skid. What is the critical coefficient of friction μ below which the car will slide?

Problem 2: When you are on a roller coaster, you feel heavier when the roller coaster goes through the bottom of a dip, and you feel lighter when the roller coaster goes over the crest of a hill.

(a) What force on your body in the roller coaster is larger at the bottom of a dip and what force is smaller at the top of the hill? Hint: It isn’t the gravitational force!

(b) The astronauts in the Space Station feel weightless; why? Hint: It isn’t because the gravitational force on them is small!

Problem 3: (a) What combination of mass m and speed v have units of energy?

(b) What combination of pressure P and length L have units of energy?

(c) What combination of acceleration g , mass m , and length L have units of energy?

(c) What combination of density ρ , length L , and speed v have units of energy?

(d) What is an eV in J? This is the typical energies of what kinds of energetic events?

(e) What is a “ton of TNT equivalent” in J? What is its cultural significance?

(f) What is a “barrel of oil equivalent” in J? What is its economic significance?