

ASTR350 (Spring 2020) Homework 2

Newtonian Physics

(Due at the start of class on the 13th February 2020)

All questions are worth 10 points

1. Briefly explain why motion in a circle at constant speed is still considered to be accelerated motion? If you are in a car traveling at 40m/s (about 90 mph) and rounding a circular bend with radius 100m, what is your acceleration?
2. Mars has a mass of $M=6.41 \times 10^{23}$ kg and radius of $R=3.38 \times 10^6$ m. Using the relevant equation from the lecture, calculate the acceleration due to gravity at the surface of the Mars. [*You will also need to know that the value of the Newton's Constant of Gravitation in "SI" units is $G=6.673 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$*]
3. The Earth goes around the Sun in an elliptical orbit with a period of $P=365.256$ days at a semi-major axis of $R=149,597,871$ kilometers. Use the appropriate equation from the lectures to work out a precise mass for the Sun. [*Hint: you will need to convert the above numbers to basic "SI" units, i.e., seconds and meters, respectively. You will also need to know that the value of the Newton's Constant of Gravitation in "SI" units is $G=6.673 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$*]
4. A monkey in the Washington-DC zoo is hanging off a high-up tree branch and is watching, with some concern, the zoo-keeper approach from below carrying a tranquilizer dart gun. To the monkey's horror, the zoo keeper sees him, aims the tranquilizer gun straight at the monkey, and prepares to fire. But, this monkey is a clever one! The monkey decides that he will let go of the tree (and so start falling) the instant he sees the gun fire – surely, the monkey thinks, the dart will then miss. Is the monkey making the right decision – will he get shot or not? Does it matter how fast the dart is going, or what material makes up the dart? Explain your reasoning carefully. You may ignore air resistance in all of your considerations. [*Hint: You don't need to do any detailed calculations to answer this question.*]