Study Guide for Midterm 1

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1 Memory Bank

- $T^2 = R^3$ ... Kepler's 3rd Law, if T is the orbital period in years and R is the orbital radius in AU.
- $W = Fd$ ... Work (in Joules) is equal to force (in Newtons) times distance (in meters).
- $f = \mu mg$ ... The force of friction if f is in Newtons, m is the mass in kilograms, and $g = 9.18$ m/s^2. The number μ is called the coefficient of friction.
- $W = \mu mgd$ ... Combining the above two formulas, we find the work in pulling a load against friction for some distance.
- 1 kilocalorie, or 1 kcal, is equal to 4184 Joules.
- The following conversions are useful: 1 gram of fat has 9 kcal of energy. 1 gram of protein has 4 kcal of energy. 1 gram of carbohydrate has 4 kcal of energy.
- A distance *vector* can be expressed as an amount of distance in a given direction. We use the notation $\vec{x} = (a, b)$ to represent the amount of distance East (a), and the amount of distance North (b).
- Vectors add like lists of numbers: $(a, b) + (x, y) = (a + x, b + y)$.

2 The Planets

1. Kepler's Third Law states that if the orbital period of a planet is given in *years*, and the orbital radius is given in AU, then
$$T^2 = r^3 \tag{1}$$
For example, we can solve for the orbital radius like $r = T^{2/3}$. If the period of Venus is $T = 0.615$ years, then $r = (0.615)^{2/3} = 0.723$ AU. Given the following orbital periods, solve for the orbital radii of the planets:
   - Jupiter: 11.862 years
   - Saturn: 29.457 years
   - Pluto: 248 years

   Solve for the following orbital periods:
   - Mars: 1.524 AU
   - Uranus: 19.22 AU
   - Neptune: 30.11 AU

3 Navigation

4 Food Energy and Conversion