

**Problem Set #3 part 2**  
**(turn in as hard copy, on a separate sheet)**

**1. Pluto and Charon:** Pluto and Charon orbit each other with a period of 6.4 days with a semimajor axis of  $19.7 \times 10^3$  km. Calculate the combined mass of Pluto and Charon (ignore the other moon's of Pluto).

**2. Mars's gravity:** Mars has a diameter of 6780 km. It has two very small moons: 1) Phobos with an orbital period of 7.65 hrs and a semimajor axis of  $9.38 \times 10^3$  km and 2) Deimos with an orbital period of 30.3 hrs and a semimajor axis of  $23.5 \times 10^3$  km. Calculate the acceleration due to gravity  $g_{Mars}$  at its surface and compare it to Earth's ( $9.8 \text{ m/s}^2$ ).

**3. Momentum and Energy:** An object of mass  $m_1$  and velocity  $v_1$  is directed at a stationary object of mass  $m_2$ . After “colliding” with each other the objects “stick to each other” and travel as one with velocity  $v_{final}$ .

Note: Here “stick to each other” can mean “attached/glued to each other” or “orbit each other”.

a) Use conservation of momentum to calculate the  $v_{final}$ .

b) Calculate the total kinetic energy of the system before and after the collision (treat as one unit). Is energy conserved? Explain a process or possible processes for this result.

**4. Constellations:** Name and draw two constellations or asterisms (i.e., draw the principal stars, not the mythological character that it represents). Identify by name and location a star or stellar/celestial object that is located in or near each constellation.