Gravity Problems II

Constants: $M_{sun} = 2 \times 10^{30}$ kg $M_{earth} = 6 \times 10^{24}$ kg 1 AU = 1.5×10^{11} m R_{sun} = 700,000 km

1. How fast would an object be going if it "fell" from infinitely far away and hit the sun?

2. How fast is the earth moving in its orbit around the sun? (Assume it's a circular orbit.)

3. How fast would the earth have to move to get infinitely far away from the sun?

4. If you throw a rock with a speed of 2500 m/s from the surface of the earth, how high above the earth would it go? (Ignore air resistance.)

5. Two objects, m_1 and m_2 are separated by a distance of d. How much work would it take to triple their separation?

6. A satellite of mass m has a circular orbit of radius R around a planet of mass M. Show that the total energy of the satellite is given by the expression $E = -G\frac{mM}{2R}$. (It turns out this expression holds true even for elliptical orbits, as long as R is the semi-major axis.)

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7. For some reason, a 5000 kg satellite is put into orbit around the sun with a period of 7 years. What is the total energy of the satellite in this orbit?

8. An asteroid that is outside the orbit of the earth has a synodic period of 425 days. If its *maximum* speed in its orbit around the sun is 40,000 m/s, what is the eccentricity of its orbit?

Answers: 1) 617,000 m/s 2) 29,800 m/s 3) 42,200 m/s 4) 300 km
5) $(2/3)Gm_1m_2/d$ 6) hint: total energy = kinetic + potential 7) -6.1×10^{11} J 8) 0.74