Physics 12

Gravitation Review Worksheet

1. Cosmologists are finding new planets that orbit far away stars yearly. A newly discovered planet orbits its own sun at a distance of 3.0×10^{12} m and has a period of 2.7×10^{10} s.
    a. Determine the Kepler's constant for this system.
    b. Another planet about this same sun orbits with a period of 5.6×10^{9} s. What is the average orbital radius for this planet?
    c. Explain why Kepler's constant is not a true constant.
2. The orbiting Space Station orbits the Earth at 250000 m above the Earth's surface. Use the moon's period of 2.36×10^{6} s and orbital radius of 3.84×10^{8} m to find the period of the Space Station. (How many sunrises do the astronauts on board see every earth day?)
3. A 670 kg robotic spaceship is sitting on the surface of Venus which has a mass of 4.88×10^{24} kg and an average radius of 6.07×10^{6} m.
    a. Calculate the gravitation force acting on the robotic space ship while on the surface of Venus.
    b. Use this information to determine the gravitational field strength on the surface of Venus.
    c. High above the planet Venus is the Robots Mother ship, orbiting the planet with a period of 1.9×10^{4} s. What is the orbital radius of the Mother ship's orbital radius?
4. A newly discovered planet has a radius of 4.5×10^{6} m and a gravitational field strength on its surface of 6.2 m/s^2. What is the mass of this planet?
5. Mars has a moon called Demos which orbits at an average radius of 2.3×10^{7} m and an orbital period of 1.1×10^{5} s. Use this information to determine the mass of Mars.
6. A communication satellite having a mass of 2.1×10^{4} kg orbits the Earth with a period of 24 h called geo-stationary orbit).
    a. Determine the orbital radius for this satellite.
    b. Calculate the gravitational potential energy relative to zero at infinity for this satellite.
    c. Calculate the orbital velocity for this satellite?
    d. Determine the escape velocity of this satellite?
7. Calculate the gravitational potential energy of the Earth about the Sun at zero relative to infinity.
8. A rocket is able to lift a 240 kg payload to a vertical height of 120000 m above the Earth's surface.
    a. What is the gain in gravitational potential energy of payload in this situation?
    b. The payload is allowed to crash land back on the Earth's surface. Ignoring air resistance, what is the impact velocity of the payload?
9. Calculate the escape velocity from the surface of the Earth and of our Moon. Explain why future space ventures would be better launched from our Moon.
10. A 720 kg communication satellite is place in Geo-stationary orbit. Calculate the total energy of this satellite.