Practice Test#4 (Chapters 11 and 14 From Tipler)

1. The moon has a period of 27.3 d (days) and is an average distance from the earth of 3.84×10^5 km. A communications satellite is placed in an earth orbit at 4.23×10^4 km from the center of the earth. What is the period of this satellite?

2. A certain object weighs 22.2 N on the surface of the earth. If the radius of the moon is 0.276 times the radius of the earth and the mass of the moon is 0.0123 times the mass of the earth, the object's weight on the surface of the moon is approximately what?

3. Suppose a rocket is fired vertically upward from the surface of the earth with one-half of the escape speed. How far from the center of the earth will it reach before it begins to fall back? (Let $g = 9.8$ m/s^2 and $R_E = 6370$ km.)

4. If we neglect the effects of air resistance, calculate the impact speed of a body of mass m released from rest at an altitude of 2×10^8 m above the surface of the earth ($m_E = 5.99 \times 10^{24}$ kg, $r_E = 6.37 \times 10^6$ m).

5. A body of mass 0.50 kg moves in simple harmonic motion with a period of 1.5 s and an amplitude of 20 mm. Which of the following equations correctly represents this motion?
   A) $x = 40 \cos(t/1.5)$ mm
   B) $x = 40 \cos(2\pi t/1.5)$ mm
   C) $x = 20 \sin(t/1.5)$ mm
   D) $x = 20 \sin(1.5\pi t)$ mm
   E) $x = 20 \sin(2\pi t/1.5)$ mm

6. A 2.5-kg object is attached to a spring of force constant k = 4.5 kN/m. The spring is stretched 10 cm from equilibrium and released. What is the kinetic energy of the mass–spring system when the mass is 5.0 cm from its equilibrium position?

7. Both a mass–spring system and a simple pendulum have a period of 1 s. Both are taken to the moon in a lunar landing module. While they are inside the module on the surface of the moon,
   A) the pendulum has a period longer than 1 s.
   B) the mass–spring system has a period longer than 1 s.
   C) both a and b are true.
   D) the periods of both are unchanged.
   E) one of them has a period shorter than 1 s.

8. A pendulum is oscillating with a total mechanical energy E_0. When the pendulum is at its maximum displacement, the kinetic energy K and the potential energy U are
   A) $K = \frac{1}{2}E_0$; $U = \frac{1}{2}E_0$
   B) $K = 0$; $U = E_0$
   C) $K = E_0$; $U = E_0$
   D) $K = E_0$; $U = 0$
   E) $K = E_0$; $U = \frac{1}{2}E_0$

Universal gravitational constant $G = 6.67x10^{-11}\ N.m^2/kg^2$
Mass of the Earth $M_E = 5.98x10^{24}\ kg$
Radius of the Earth $R_E = 6370\ km$
Escape speed $v_e = 11.2\ km/s$
Atmospheric pressure $1\ atm = 101.325\ kPa$

Newton's Law of Gravity $F = \frac{Gm_1 m_2}{r^2}$ $G = 6.67x10^{-11}\ N.m^2/kg^2$

Gravitational Potential Energy $U(r) = -\frac{GM_E m}{r}$

Escape speed $v_e = \sqrt{\frac{2GM_E}{R_E}} = \sqrt{2gR_E} \approx 11.2 km/s$

Position function $x = A\cos(\omega t + \delta)$

Velocity $v = -A\omega \sin(\omega t + \delta)$

Acceleration $a = -A\omega^2 \cos(\omega t + \delta)$

Angular frequency $\omega = 2\pi f = \frac{2\pi}{T}$

Total Energy $E_{total} = K + U = \frac{1}{2}kA^2$

Mass on a spring $T = 2\pi\sqrt{\frac{m}{k}}$

Simple pendulum $T = 2\pi\sqrt{\frac{L}{g}}$