Test Corrections

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1 2. Consider the following kinetic system

A modified Atwood's machine with mass $m_1 = 1kg$, $m_2 = 4kg$, and $m_3 = 8kg$ is shown. The surface beneath m_2 has a coefficient of friction, $\mu_k = .2$.

1.1 Determine the tensions T_1 and T_2, friction force F_f and the acceleration a.

$$F_N = \mu_k F_N = \mu_k m_2 g = (.2)(4)(9.8)$$

$$\boxed{F_f = 7.84N}$$

$$F_{net} = ma = T_1 - m_1 g$$

$$F_{net,m_2} = T_2 - T_1 - F_f = (m_1 + m_2 + m_3)a$$

$$m_3 - F_f - m_1 g = (m_1 + m_2 + m_3)a$$

$$\boxed{a = 4.67\frac{m}{s^2}}$$

$$T_1 = m_1 a + m_1 g = 1(4.67) + 1 \times 9.8$$

$$\boxed{T_1 = 14.5N}$$

$$T_2 = m_3 g - m_3 a = (8)(9.8) - (8)(4.67)$$

$$\boxed{T_2 = 41.0N}$$

1.2 Determine the work by the friction force and the kinetic energy of the system after moving, $\Delta x = .3meters$.

$$W_f = -\mu_k F_N \Delta x = (7.84N)(.3m)$$

$$\boxed{W_f = 2.35J}$$

$$v^2 - v_o^2 = 2a(x - x_o)$$

$$v^2 = 2(4.67\frac{m}{s^2})(.3m)$$

$$v = 1.67\frac{m}{s}$$

$$KE = \frac{1}{2}(1 + 4 + 8)(1.67\frac{m}{s})^2$$

$$\boxed{KE = 18.13J}$$

2 4. Consider the earth and moon orbital system

2.1 Determine the potential, kinetic, and total mechanical energy of the moon.

$$PE = \frac{-Gm_1m_2}{r} = \frac{(6.674 \times 10^{-11}\frac{Nm^2}{kg^2})(5.98 \times 10^{24}kg)(7.36 \times 10^{22}kg)}{(3.84 \times 10^8 m)}$$

$$\boxed{PE = -7.65 \times 10^{28}J}$$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(7.36 \times 10^{22}kg)(1022.9\frac{m}{s})^2$$

$$\boxed{KE = 3.85 \times 10^{28}J}$$

$$E = PE + KE = -7.65 \times 10^{28}J + 3.85 \times 10^{28}J$$

$$\boxed{E = -3.8 \times 10^{28}J}$$

2.2 Determine the velocity required to launch an object from the surface of the moon so it never comes back (escapes).

$$V_{escape} = \sqrt{\frac{2GM}{r}} = \sqrt{\frac{2(6.674 \times 10^{-11} \frac{Nm^2}{kg^2})(7.36 \times 10^{22} kg)}{(1.74 \times 10^6 m)}}$$

$$\boxed{V_{escape} = 2380 \frac{m}{s}}$$