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General Physics-I, Quiz 1s
PHYS1000AA, Fall Semester-108
2019-10-08

St. ID:______________________,   Name:________________

Chapter 7

1. A 0.20-kg stone is held 1.3 m above the top edge of a water well and then dropped into it. The well has a depth of 5.0 m. Relative to the configuration with the stone at the top edge of the well, what is the gravitational potential energy of the stone–Earth system (a) before the stone is released and (b) when it reaches the bottom of the well? (c) What is the change in gravitational potential energy of the system from release to reaching the bottom of the well?

Ans:

Use $U = mgy$, where y is measured relative to a reference level. Here, we measure y to be relative to the top edge of the well, where we take $y = 0$.

(a) $y = 1.3$ m: $U = mgy = (0.20\text{ kg})(9.80\text{ m/s}^2)(1.3\text{ m}) = \boxed{+2.5\text{ J}}$

(b) $y = -5.0$ m: $U = mgy = (0.20\text{ kg})(9.80\text{ m/s}^{2)(}-5.0\text{ m}) = \boxed{-9.8\text{ J}}$

(c) $\Delta U = U_f - U_i = (-9.8\text{ J}) - (2.5\text{ J}) = -12.3 = \boxed{-12\text{ J}}$

Chapter 8

2. For saving energy, bicycling and walking are far more efficient means of transportation than is travel by automobile. For example, when riding at 10.0 mi/h, a cyclist uses food energy at a rate of about 400 kcal/h above what he would use if merely sitting still. (In exercise physiology, power is often measured in kcal/h rather than in watts. Here 1 kcal = 1nutritionist's Calorie = 4 186 J.) Walking at 3.00 mi/h requires about 220 kcal/h. It is interesting to compare these values with the energy consumption required for travel by car. Gasoline yields about $1.30X10^8$ J/gal. Find the fuel economy in equivalent miles per gallon for a person (a) walking and (b) bicycling.

Ans:

Your grandmother can accompany you.

(a) The fuel economy for walking is

$$\frac{1\text{ h}}{220\text{ kcal}}\left(\frac{3\text{ mi}}{\text{h}}\right)\left(\frac{1\text{ kcal}}{4\,186\text{ J}}\right)\left(\frac{1.30\times10^{8}\text{ J}}{1\text{ gal}}\right)=\boxed{423\text{ mi/gal}}$$

(b) For bicycling:

$$\frac{1\text{ h}}{400\text{ kcal}}\left(\frac{10\text{ mi}}{\text{h}}\right)\left(\frac{1\text{ kcal}}{4\,186\text{ J}}\right)\left(\frac{1.30\times10^{8}\text{ J}}{1\text{ gal}}\right)=\boxed{776\text{ mi/gal}}$$

3. Make an order-of-magnitude estimate of your power output as you climb stairs. In your solution, state the physical quantities you take as data and the values you measure or estimate for them. Do you consider your peak power or your sustainable power?

Ans:

At a pace I could keep up for a half-hour exercise period, I climb two stories up, traversing forty steps each 18 cm high, in 20 s. My output work becomes the final gravitational energy of the system of the Earth and me,

$$mgy=(85\text{ kg})(9.80\text{ m/s}^2)(40\times0.18\text{ m})=6\,000\text{ J}$$

making my sustainable power $\frac{6\,000\text{ J}}{20\text{ s}}=\boxed{\sim10^2\text{ W}}$.

Chapter-9

4. A garden hose is held as shown in Figure P9.32. The hose is originally full of motionless water. What additional force is necessary to hold the nozzle stationary after the water flow is turned on if the discharge rate is 0.600 kg/s with a speed of 25.0 m/s?

Ans:

The force exerted on the water by the hose is

$$F=\frac{\Delta p_{\text{water}}}{\Delta t}=\frac{mv_f-mv_i}{\Delta t}=\frac{(0.600\text{ kg})(25.0\text{ m/s})-0}{1.00\text{ s}}$$
$$=\boxed{15.0\text{ N}}$$

According to Newton’s third law, the water exerts a force of equal magnitude back on the hose. Thus, the gardener must apply a 15.0-N force (in the direction of the velocity of the exiting water stream) to hold the hose stationary.