

1. Each morning Dr. Peppley wakes up, gets dressed in a dashing athletic outfit and works out for 20 minutes on his Infiniti elliptical trainer equipped with a watt meter and cumulative calorie meter. On a typical day, Dr. Peppley generates power at a rate of 180 watts during the workout and the calorie accumulator registers that 320 calories of energy have been produced at the end of 20 minutes.

- a) How many joules of energy did Dr. Peppley actually generate in the 20 minute period based on the watt meter? (5)

$$\text{Power output} = 180 \text{ W} = 180 \text{ J/s}$$

$$\text{Energy} = \text{Power} \times \text{time} = 180 \text{ J/s} \times 20 \text{ min} \times 60 \text{ s/min} = 216 \text{ kJ}$$

- b) A calorie is approximately equivalent to 4.18 J. Is the calorie accumulator correct? What should it read? (5)

$$\text{Energy in Calories} = 216 \text{ kJ} \div 4.18 \text{ J/cal} = 51.7 \text{ kcal}$$

The calorie accumulator is not correct. It should read 51,700 cal (or 51.7 cal if it is using the fact that a food cal is actually a thermodynamic kcal)

- c) During the months of December and January last year Dr. Peppley's electrical bill indicated that 1650 kWh were consumed over a 60 day period. Assuming that on average each student can generate 180 W, how many CHEE 210 students would need to be on the trainer for one hour per day (every day) to provide the electrical energy for Dr. Peppley's house? (5)

$$\text{Energy used per day} = 1650 \text{ kWh} \div 60 \text{ days} = 27.5 \text{ kWh per day} = 27.5 \text{ kJ/s} \times 1 \text{ hour} = 27.5 \text{ kJ/s} \times 3600 \text{ s} = 99,000 \text{ kJ per day}$$

$$\text{Time required on the trainer for one day's worth of energy is } 99,000 \text{ kJ} \div 0.180 \text{ kJ/s} = 550,000 \text{ s} = 153 \text{ hrs.}$$

To produce the electrical energy requirements for Dr. Peppley's house 153 students would need to be on the trainer for one hour per day.