RESPIRATION

For an average biology student who weighs 70 kilograms, each liter of oxygen consumed releases 4.8 usable kilocalories of energy. Each mole of glucose consumed yields 686 kcal of energy.

During an awake but restful period, the biology student uses 20 kilocalories per kilogram of body weight per day (basal metabolic rate). During a normally active period, the metabolic rate averages 40 kcal/kg body wt/day for a male and 35 kcal/kg body wt/day for a female. During sleep, the metabolic rate averages 1.2 kcal/kg body wt/day.

- How many liters of O2 is consumed per hour by a student who is resting but awake?
- If air is 20% oxygen, what is the minimum amount of air moved per hour by a student when resting?
- If a student were respiring only glucose, how many grams of glucose would be needed per hour when at the basal rate?
- A female biology student, who is a distance runner, uses 14.3 kilocalories per kg of body weight per hour when running. If she practices her running techniques for 2 hours a day in preparation for a race, how many kilocalories would she use per day?

A Student's Solution:

1. ? LO_2/hr

$$\frac{20\,kcal}{kg/day}\left(\frac{1\,day}{24\,hrs}\right)=\frac{0.83\,kcal}{kg/hr}\left(\frac{70\,kg}{s}\right)\left(\frac{1\,LO_2}{4.8\,kcal}\right)=12.15\,LO_2/hr$$

2. $$\frac{12.15\,LO_2}{hr}\rightarrow\frac{amt\ of\ air}{hr}$$

$$\frac{12.15\,LO_2}{hr}\left(\frac{100\,air}{20\,O_2}\right)=60.75\,air/hr$$

3. $$\frac{20\,kcal}{kg/day}\left(\frac{1\,day}{24\,hrs}\right)\left(\frac{70\,kg}{s}\right)\left(\frac{1\,mol\,C_6H_{12}O_6}{686\,kcal}\right)\left(\frac{180\,g\,C_6H_{12}O_6}{1\,mol\,C_6H_{12}O_6}\right)=15.31\,g\,C_6H_{12}O_6/hr$$

4.

$$\frac{70\,kg}{s}\left(\frac{2\,hr}{day}\cdot\frac{14.3\,kcal}{kg/hr}+\frac{8\,hr}{day}\cdot\frac{1.2\,kcal}{kg/day}\cdot\frac{1\,day}{24\,hr}+\frac{7\,hr}{day}\cdot\frac{35\,kcal}{kg/day}\cdot\frac{1\,day}{24\,hr}+\frac{7\,hr}{day}\cdot\frac{20\,kcal}{kg/day}\cdot\frac{1\,day}{24\,hr}\right)=3150\,kcal$$