

ABE 202, 2017

### Homework 3 solution

1.  $11\text{g glucose} \times 15.6 \text{ kJ (g glucose)}^{-1} = 171.6\text{kJ}$
2. The energy expended  $= mg\Delta z = 70\text{kg} \times 9.8\text{m/s}^2 \times 6\text{m} = 4.1\text{kJ}$ . This is the minimum energy required to climb the stairs. The energy conversion process in the body does not involve complete oxidation.
3. From problem 1, the energy of oxidation of 11g glucose  $= 171.6 \text{ kJ}$   
 $\Delta z = w / (mg) = 171.6 \text{ kJ} / 70\text{kg} / 9.8\text{m/s}^2 = 250 \text{ m}$
4. Because the energy is conserved, you should set  $T_3 = \text{final temperature}$   
 $m_1 C_{p1} (T_1 - T_R) + m_2 C_{p2} (T_2 - T_R) = m_1 C_{p1} (T_3 - T_R) + m_2 C_{p2} (T_3 - T_R)$   
where  
 $m_1 = 60\text{kg}$ ,  $C_{p1} = 0.8 \text{ kcal/kg K} = 0.8 \text{ kcal/kg C}^\circ$ ,  $T_1 = 37 \text{ C}^\circ$   
 $m_2 = 0.25\text{kg}$ ,  $C_{p2} = 1 \text{ kcal/kg K} = 1 \text{ kcal/kg C}^\circ$ ,  $T_2 = 62 \text{ C}^\circ$   
 $T_R$  will be canceled on both side  
Thus we can solve the solution of  $T_3 = 37.12 \text{ C}^\circ$   
Body temperature is raised by  $0.12 \text{ C}^\circ$

PS:

We made a mistake during office hours by telling some of the students that we can assume that the body absorbs the water and the final  $C_p$  is the  $C_p$  for the body. We got that from the solutions manual. However, we can tell that is incorrect because doing that will produce different answers for Kelvin and Celsius. On this homework we will give full credit for this question if you made that mistake, however, be sure to understand the correct method for the exam.