SUBMAXIMAL EXERCISE OXYGEN CONSUMPTION

Introduction:
Our bodies have consumed oxygen since conception, and will continue consuming oxygen until we die. Oxygen consumption increases linearly with metabolism as a support mechanism. The body always uses the exact amount of oxygen needed, no more, no less. The body’s support systems, such as respiratory and circulatory, respond to what is needed by making necessary adjustments moment by moment and reaching a steady state for the needs of the moment.

Purpose:
The purpose of the study is to observe the changes in oxygen consumption, called VO₂ during exercise. Also, to practice using a manual equation for calculating an individual’s VO₂ at a given level.

Equipment/Personnel:
Metabolic cart, face mask/mouthpiece, headgear, blood pressure cuff, sphygmomanometer, RPE scale, one subject, and five assistants.

Definitions:
1. **Steady State** - A bodily condition where the energy expenditure is balanced with the energy required to perform exercise at that specific intensity level.
2. **Oxygen Consumption (VO₂)** - The amount of oxygen taken up, transported, and used at the cellular level.
3. **Metabolic Equivalent (MET)** - A unit that represents the metabolic equivalent in multiples of the resting rate of oxygen consumption of any given activity.

Procedures:
The subject will be performing a submaximal test on the treadmill. While the subject is exercising we will be observing changes in oxygen consumption, called VO₂. The subject will have a VO₂ number at rest and while exercising, however those numbers will change at each different level.

Using volume of expired air, O₂ percentage, and CO₂ percentage of expired air, an equation for calculation of oxygen consumption can be used. Most of the time, the metabolic cart runs this calculation instead of you pressing the keys on a calculator. However, it is possible to complete the calculations by yourself. I will always give the equation whenever I want you to use it; no need to memorize it, agreed?! One important step to remember is that the O₂ percentage and CO₂ percentage can’t be plugged directly into the equation. The percentage of each must first be converted to decimal fraction form. So, 16.95% O₂ becomes 0.1695 and 2.97% CO₂ becomes 0.0297. Not a difficult conversion but a major step that must be taken before the equation will work. Enter all the number of the equation from left to right taking full advantage of the () keys on your calculator. After all entries, be sure to press = ; like remember to press = = = , OK!!!!

Equation for use with calculator parentheses:

\[ \text{VO}_2 = V_{E \text{STPD}} \times \left( \left(1 - (F_{E O_2} + F_{E CO_2}) \right) \div .7903 \right) \times .2093 - (V_E \times F_{E O_2}) \]

Sample Problem: If \( V_{E \text{STPD}} = 30\text{L/min} \), %O₂ = 17, %CO₂ = 3, calculate VO₂ _________L/minSTPD
Readings:
Plowman – 285-290, 123-131, 134-137

Questions and Speculations:

1. Summarize the Bruce protocol that is used for this treadmill lab exercise
   
<table>
<thead>
<tr>
<th>Stage</th>
<th>Duration</th>
<th>Mph</th>
<th>%Grade</th>
<th>METS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>_______</td>
<td>___</td>
<td>_______</td>
<td>_____</td>
</tr>
<tr>
<td>II</td>
<td>_______</td>
<td>___</td>
<td>_______</td>
<td>_____</td>
</tr>
<tr>
<td>III</td>
<td>_______</td>
<td>___</td>
<td>_______</td>
<td>_____</td>
</tr>
<tr>
<td>IV</td>
<td>_______</td>
<td>___</td>
<td>_______</td>
<td>_____</td>
</tr>
<tr>
<td>V</td>
<td>_______</td>
<td>___</td>
<td>_______</td>
<td>_____</td>
</tr>
<tr>
<td>VI</td>
<td>_______</td>
<td>___</td>
<td>_______</td>
<td>_____</td>
</tr>
</tbody>
</table>

2. Resting %O₂ ______; at the end of stage 1 %O₂_______ = ḞO₂_______ (decimal fraction)
   
   Resting %CO₂______; at the end of stage 1 %CO₂_______ = ḞO₂_______ (decimal fraction)

3. Subject’s resting VO₂______ L/min; body weight______ lb _____ kg
   
   Subject’s resting VO₂______ ml/kg•min

4. Subject’s peak VO₂______ L/min as listed on metabolic cart printout

5. Subject’s peak VO₂______ ml/kg•min as listed on metabolic cart printout. Look closely at this value and the value in number 4 above. How do they relate?

6. Kcal at peak oxygen consumption______/min
   
   What is the relationship between L/min of O₂ and kcal?
   
   (In other words, VO₂ x _____ = kcal/min) see page 135

7. Ventilation (aka V̇ₚ) = ______ x ______

8. METS is an entry on the data printout. What is METS an acronym for?

9. What is the subject’s METS level when at rest?_______
   
   What is the METS level at peak exercise?_______