How to......Calculate VO_2, VCO_2, and RER

Worked example

Required data

$\%O2_E$ (Oxygen expired) = 16.40%
$\%O2_I$ (Oxygen inspired) = 20.93%
$\%CO2_E$ (Carbon Dioxide expired) = 4.53%
$\%CO2_I$ (Carbon Dioxide inspired) = 0.04%
V_E ATPS= 30 L

Pressure ATPS = 760 mmHg
Temperature = 20°C
Body mass = 70Kg

In the laboratory gas is measured at ATPS – (Ambient Temperature, Pressure, and Saturated with water vapour). To be able to compare this assessment of VO_2 measured in different environments it must be converted to STPD (Standard Temperature and Pressure Dry).

Converting ATPS to STPD

You will need to calculate the correction factor for the given conditions

(See table in labs for correction factor according to given pressure (760 mmHg) and temperature (20°C) the correction factor is this example is **0.907**)

Calculating V_E

$$V_E\ STPD = \left(\left[\frac{Volume\ of\ air\ collected}{Collection\ time}\right] x\ 60\right)\ x\ correction\ factor$$

$$V_E\ STPD = \left(\left[\frac{30}{60}\right]\ x\ 60\right)\ x\ \ 0.907$$

∴ **V_E STPD = 27.21 L.min^{-1}**

Calculating VO_2 ($L.min^{-1}$)

$$VO_2\ (L.min^{-1})\ = VE\ (STPD)\ x\ \frac{(\%N_{2E}\ x\ 0.265) - \%O_{2E}}{100}$$

$$VO_2(L.min^{-1})\ = 27.21\ x\ \frac{(79.07\ x\ 0.265) - 16.4}{100}$$

$$VO_2(\mathrm{L}.min^{-1}) = 27.21\ \mathrm{x}\ \left(\frac{4.55}{100}\right)$$

∴ VO_2 = 1.24 ($L.min^{-1}$)

NB:

$\%N_{2E} = 100 - \%O_{2E} - \%CO_{2E}$

$\%N_{2E} = 100 – 16.4 – 4.53$

∴ $\%N_{2E} = 79.07$

Calculating VCO_2 ($l.min^{-1}$)

$$VCO_2\ (L.min^{-1}) =\ V_E\ (STPD)x\ \frac{(\%CO_{2E} - \%CO_{2I})}{100}$$

$$VCO_2\ (L.min^{-1}) = 27.21\ x\ \frac{(4.53 - 0.04)}{100}$$

$$VCO_2(L.min^{-1}) = 27.21\ x\ 0.0449$$

∴ $VC0^2$ = 1.22 $L.min^{-1}$

Calculating RER

$$RER\ = \frac{VCO_2}{VO_2}$$

$$RER\ = \frac{1.22}{1.24}$$

∴ RER = 0.98

Calculating VO_2 ($ml.kg^{-1}.min^{-1}$)

$$VO2\ (ml.kg^{-1}.min^{-1})\ = \left(\frac{VO_2\ (L.min^{-1})}{Body\ Mass}\right)\ x\ 1000$$

$$VO2\ (ml.kg^{-1}.min^{-1})\ = \left(\frac{1.24}{70}\right)\ x\ 1000$$

∴ VO^2 = 17.7 $ml.kg^{-1}.min^{-1}$

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