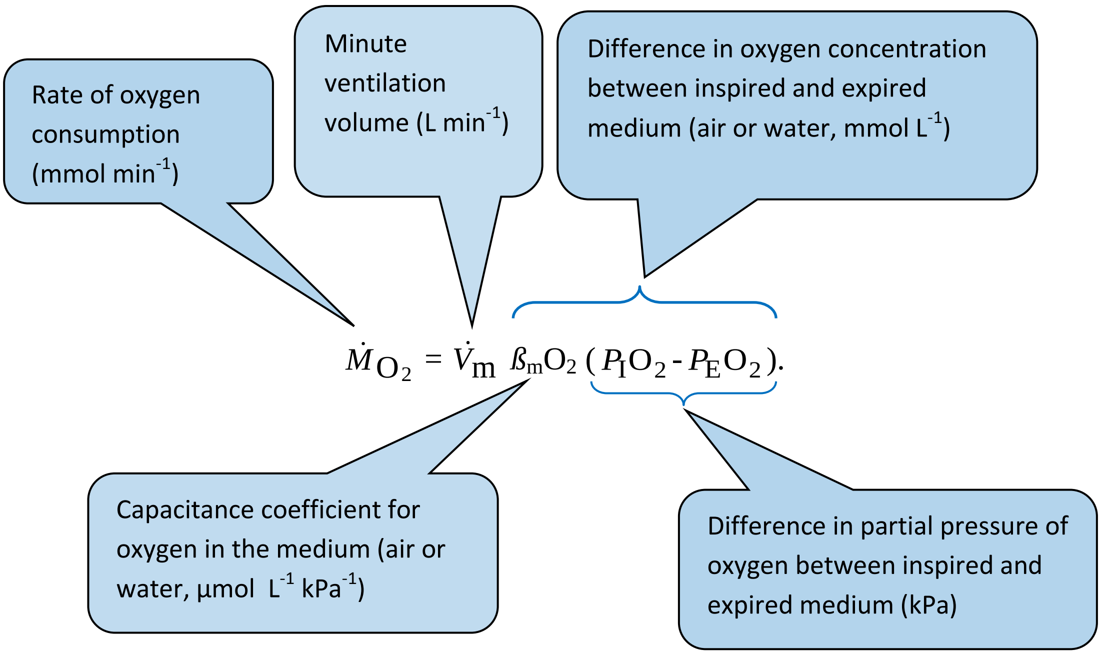
Chapter 12

Question 12.10

With each breath 100 – 30 mL, 70 mL, of air reaches the alveoli. So, with a respiratory frequency of 25 breaths min^{-1}, alveolar ventilation is 0.07 x 25 = **1.75 L min^{-1}**

Question 12.12



The proportion of oxygen in a given volume of air is: $\frac{410}{13.65}$ = 30 times greater than that in a similar volume of water. However, the air breather extracts a smaller proportion of that oxygen than the water breather: $\frac{12}{40}$ = 0.3. So, if both animals have the same $\dot{M}_{O_2}$, ventilation volume would be 30 × 0.3 = **9 times greater in the water breather.**

Question 12.13

Assuming that the temperature and pressure are close to standard conditions, the rate of oxygen consumption of the insect is 0.6 × 22.4 = 13.44 μL min^{-1} = 0.01344 mL min^{-1}.

As oxygen is used by the insect, PO_2 in the bubble tends to decrease and the partial pressure of nitrogen (PN_2) tends to increase, so oxygen diffuses in from the surrounding water and nitrogen diffuses out. As there is $\frac{0.79}{0.21}$ = 3.8 times as much nitrogen in the bubble than oxygen, the oxygen should last 3.8 times as long than if the bubble acted merely as a store. What is more, nitrogen diffuses out of the bubble 45% more slowly than oxygen diffuses in. This means that the bubble would actually last for about $\frac{3.8}{0.45}$ = 8.4 times longer than if it was used only as a store.

Thus, if the bubble was used only as a store, the oxygen would last for: $\frac{0.1 \times 0.21}{0.01344}$ = 1.56 min. In reality, it should last for about 1.56 × 8.4 = **13.1 min**