

## Instructions:

- This quiz lasts 30 minutes. Answer all questions (on both sides of the sheet)
- You may have a 8.5" × 11" sheet of notes and a non-network-connected calculator
- Formula:  $C_xO_2 = (1.34 \frac{\text{mL } O_2}{\text{g Hb}}) \times [\text{Hb } \frac{\text{g Hb}}{\text{mL blood}}] \times S_xO_2$

Q1a: (10 marks) Various physical and psychological tests measure  $\dot{V}_{O_2}$  as an indication of the level of effort.

1. (5 marks) What does  $\dot{V}_{O_2}$  measure (1 sentence)?
2. (5 marks) How does an increase in red blood cell concentration (hematocrit) help increase the maximum  $\dot{V}_{O_2}$ ?
3. (5 marks) A subject at a steady level of effort is breathing room air and has a  $\dot{V}_{O_2} = 750$  ml/min. Every 4 seconds, they take a breath of 1 L. What is the fraction  $O_2$  in exhaled air?

Q2a: (15 marks) Using light transmitted through the a fingertip it is possible to measure both i) arterial blood volume changes and the ii) saturation of arterial blood in the finger.

1. (5 marks) Sketch a diagram and describe (1–2 sentences) how (i) changes in arterial blood volume are measured with this technology.
2. (5 marks) Why is only arterial (and not venous) blood volume measured (1–2 sentences)?
3. (5 marks) Typically the technology uses pulses of light and periods of no light (silence) between them. How does this pulsatile behaviour help cancel the effect of ambient (leakage) light? (use a diagram and 1–2 sentences)

## Instructions:

- This quiz lasts 30 minutes. Answer all questions (on both sides of the sheet)
- You may have a 8.5" × 11" sheet of notes and a non-network-connected calculator
- Formula:  $C_xO_2 = (1.34 \frac{\text{mL } O_2}{\text{g Hb}}) \times [\text{Hb } \frac{\text{g Hb}}{\text{mL blood}}] \times S_xO_2$

Q1b: (10 marks) Various physical and psychological tests measure  $\dot{V}_{O_2}$  as an indication of the level of effort.

1. (5 marks) What does  $\dot{V}_{O_2}$  measure (1 sentence)?
2. (5 marks) How does hyperventilation (and thus decreasing  $[CO_2]$  in the blood) affect blood acidity?
3. (5 marks) A subject has a normal hemoglobin concentration  $[\text{Hb}] = 0.15 \text{ g Hb/mL blood}$ . While exercising, the subject's heart beats 1.5 times a second with a stroke volume of 100 mL. If  $S_aO_2 = 98\%$  and  $S_vO_2 = 70\%$ , what is  $\dot{V}_{O_2}$  [ml  $O_2$ /min]?

Q2b: (15 marks) Using light transmitted through the a fingertip it is possible to measure both i) arterial blood volume changes and the ii) saturation of arterial blood in the finger.

1. (5 marks) Sketch a diagram and describe (1–2 sentences) how (ii) arterial blood saturation is measured with this technology.
2. (5 marks) Why is only arterial (and not venous) blood saturation measured (1–2 sentences)?
3. (5 marks) If a pulse oxymeter measures just two light wavelengths, it will get confused by the presence of another gas in the blood (such as carbon monoxide). Why does this “confusion” occur? (use a diagram or a formula and 1–2 sentences)