Deacon's Challenge No. 22 Answer

A patient's arterial blood results showed a P_{O2} of 12 kPa, haemoglobin concentration of 150 g/L and an oxygen saturation of 98%. Calculate the total oxygen content of his blood in mL/L.

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Total O_2 = O_2 bound to Hb + Dissolved O_2

$$O_2 \text{ content (mL/L)} = \frac{(Hb \times S_{O2} \times 1.39)}{100} + (P_{O2} \times 0.23)$$

where P_{O2} = oxygen tension in kPa = 12
Hb = haemoglobin concentration in g/l = 150
S_{O2} = oxygen saturation (i.e. % Hb present as HbO_2) = 98

Substituting these values:

$$O_2 = \frac{(150 \times 98 \times 1.39)}{100} + (12 \times 0.23)$$

$$= 204.3 + 2.8$$

$$= \mathbf{207\ mL/L}$$

Without using the above equation an approximate answer can be calculated as follows:

The majority of oxygen is bound to haemoglobin, therefore ignore the dissolved oxygen component.

Convert Hb to molar concentration (MW of Hb approx 65000)

$$Hb = 150 \text{ g/L} = \frac{150}{65000} = 0.00231 \text{ mol/L}$$

Each molecule of haemoglobin contains 4 oxygen binding sites and we are told these are 98% saturated, therefore:

$$O_2 \text{ content} = \frac{0.00231 \times 4 \times 98}{100} = 0.00906 \text{ mol/L}$$

The oxygen content can be converted to volume using the gram molecular volume of a gas (GMV):

GMV = 22.4 litres at STP (i.e. normal atmospheric pressure and 0°C)

O_2 content = 0.00906 x 22.4 = 0.203 L/L = **203 mL/L**

If necessary this volume could be converted to any other pressure or temperature using the gas laws. ■

Question No. 23

A five day faecal fat collection was homogenised and diluted to 1500 mL. A 10 mL aliquot of the homogenate was subjected to hydrolysis and the fatty acids were extracted. The volume of 0.05 M sodium hydroxide required to effect neutralisation was 22 mL. Calculate the fat excretion in mmol/24h.

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