Deacon's Challenge No. 1 – Answer

a) Calculate the hydrogen ion concentration of blood with a pH of 7.12

$$pH = \log_{10} \frac{1}{[H^+]}$$

where $[H^+]$ = hydrogen ion concentration in mol/L

Substitute pH = 7.12 and solve for $[H^+]$:

$$7.12 = \log_{10} \frac{1}{[H^+]}$$

$$\text{antilog } 7.12 = \frac{1}{[H^+]}$$

$$[H^+] = \frac{1}{\text{antilog } 7.12} = \frac{1}{1.318 \times 10^7} = 7.6 \times 10^{-8} \text{ mol/L}$$

To convert to the more familiar nmol/L multiply by 10^9 to give 76 nmol/L.

b) Treatment with barbiturate halves the hydrogen ion concentration, what is the new pH?

New $[H^+] = 76/2 = 38$ nmol/L $= 3.8 \times 10^{-8}$ mol/L

$$\text{New pH} = \log_{10} \frac{1}{[H^+]} = \log_{10} \frac{1}{3.8 \times 10^{-8}} = \log_{10} 2.63 \times 10^7 = 7.42$$

Exam tip: Fully familiarise yourself with your calculator beforehand. It is not much fun trying to find out how to do antilogs in the exam!

Deacon's Challenge No. 2

During the course of treatment of a patient with diabetic ketoacidosis, 6 litres of physiological saline (0.9%) and 3 litres of dextrose (5%) were infused before the patient's urine output became equal to the rate of infusion. By this time the cumulative urinary output since starting treatment was 2 litres of fluid containing 70 mmol sodium. The patient had been catheterised on admission and the residual urine discared.

Estimate the extracellular fluid deficit at the time treatment was begun, indicating any assumptions that you made.

MRCPath November 1999 - modified

Thanks to the Royal College of Pathologists for allowing us to reproduce these questions. ■