# Deacon's Challenge No. 46 Answer

A plasma contains 140 mmol/L of sodium and 95% water by volume. Neglecting sodium binding by plasma proteins, calculate the apparent plasma sodium concentration determined from measurements with an electrode system which responds to water sodium (a) in undiluted plasma, and (b) in plasma diluted 1 in 20 with water.

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a) If the plasma contains 95% water i.e. 95 mL per 100 mL

Then 1 litre will contain 950 mL of water

and the concentration of sodium in plasma water will be 140 mmol/950 mL

1 mL of plasma water will contain $\frac{140}{950}$ mmol sodium

and 1 L will contain $\frac{140 \times 1000}{950} = 147.4$ mmol

So that the concentration of plasma sodium measured will be **147 mmol/L**

b) If the plasma is diluted 1 in 20 with water
(equivalent to 0.05 L plasma diluted to 1 L)

Amount of sodium in 1L of dilution = 140 x 0.05 = 7.0 mmoL

Amount of water in l L of dilution = Water in 0.05 L plasma + water added

= 0.95 x 0.05 + (1 – 0.05)

= 0.0475 + 0.95

= 0.9975 L





Concentration of sodium in water = $\frac{\text{Amount of sodium (mmol)}}{\text{Amount of water (L)}}$

= $\frac{7.0}{0.9975}$ = 7.018 mmol/L

Apparent concentration in undiluted plasma

= Measured concentration x dilution

= 7.018 x 20

= 140.35 mmol/L (**140 mmol/L** to 3 sig figs)

NB It is common practice for manufacturers to "fiddle" the calibration of their direct reading ISE instruments to ensure that the measured concentration of a sample with "normal" water content (i.e. normal protein and lipid concentrations) gives the same "concentration" reading as would be obtained by flame photometry. Discrepancies only become apparent when protein or lipid concentrations are markedly different from "normal". ■

## Question 47

A specimen of spinal fluid from a patient who had suffered head trauma was noted to be bloodstained. The CSF protein was found to be 1183 mg/L on clear colourless supernatant after centrifuging (no scan done). The CSF contained red cells 10,200 cells per cubic millimeter.

As the diagnosis was not clear, the doctors looking after the patient wondered how much of the CSF protein may have come from the traumatic tap. On the same day, the patient's serum total protein was 73 g/L, and the RBC from the full blood count was 4.5 x $10^{12}$ cells/L.

Estimate the percentage of the measured CSF protein that may have come from the serum.

*MRCPath, November 2004*