Deacon's Challenge No 187 - Answer

A solution contains 250 mg NADH disodium salt (formula $C_{21}H_{27}N_7O_{14}P_2Na_2$) per Litre. A 1 in 5 dilution transmits 36% of incident light at 340 nm (versus an appropriate blank) in a cell with 1 cm path length.

- a) Calculate the molar absorptivity of NADH.
 b) How much of the original solution will be needed to prepare 1 L of a solution with an absorbance at 340 nm of 0.5 when measured in a cell with a path length of 0.5 cm?

The Beer-Lambert equation relates concentration to absorbance:

where	^		
where	А	=	absorbance = $\log_{10} \frac{100}{\%7}$ = $\log_{10} \frac{100}{36}$ = $\log_{10} 2.778$ = 0.444
	а		molar absorptivity = unknown
			light path = 1.0 cm
	с	=	concentration = 1 in 5 dilution of 250 mg/L = 50 mg/L = 0.050 g/L
			Convert to mol/L since molar absorptivity is required: First calculate MW of NADH:
			$C_{21} = 12 \times 21 = 252$ $H_{27} = 1 \times 27 = 27$
			$N_7 = 14 \times 7 = 98$
			$O_{14} = 16 \times 14 = 224$ $P_2 = 31 \times 2 = 62$
			$Na_2 = 23 \times 2 = 46$
			Total = 709
			Concentration (mol/L) = <u>Concentration (g/L)</u> = <u>0.050</u> = 0.0000705 mol/L MW 709
a)	Su	bstit	ute these values and solve for a:
			$0.444 = a \times 1 \times 0.0000705$
			a = 0.444 = 6298 L.mol ⁻¹ .cm ⁻¹ 0.0000705 x 1
			or 6.3 x 10 ³ L.mol ⁻¹ .cm ⁻¹ (to 2 sig figs since %T only given to 2 figs)
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ACD INE	ws	issu	e 644 December 2016
			Practice FRCPath Style Calculations 11
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5)			Practice FRCPath Style Calculations 11 e Beer Lambert equation to calculate the final concentration which will give an ance of 0.5 in a cell with a path length of 0.5 cm:
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5)	ab	sorb	e Beer Lambert equation to calculate the final concentration which will give an ance of 0.5 in a cell with a path length of 0.5 cm: 0.5 a = 6.3 x 10 ³ L.mol ⁻¹ .cm ⁻¹ b = 0.5 cm c = unknown (mol/L) 0.5 = 6.3 x 10 ³ x 0.5 x c
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5)	ab A	sorb =	e Beer Lambert equation to calculate the final concentration which will give an ance of 0.5 in a cell with a path length of 0.5 cm: 0.5 $a = 6.3 \times 10^3$ L.mol ⁻¹ .cm ⁻¹ $b = 0.5$ cm $c =$ unknown (mol/L) 0.5 $= 6.3 \times 10^3$ x 0.5 x c c = 0.5 $= 0.000159$ mol/L
5)	ab A Vo	sorb =	e Beer Lambert equation to calculate the final concentration which will give an ance of 0.5 in a cell with a path length of 0.5 cm: 0.5 $a = 6.3 \times 10^3 \text{ Lmol}^{-1} \text{ cm}^{-1}$ $b = 0.5 \text{ cm}$ $c = \text{unknown (mol/L)}$ 0.5 $= 6.3 \times 10^3 \times 0.5 \times c$ $c = \frac{0.5}{6.3 \times 10^3 \times 0.5}$ $= 0.000159 \text{ mol/L}$ e required $= \frac{\text{Required concentration}}{2} \times 1000000000000000000000000000000000000$
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Q The t	ab A Vo Sto Th	sorb = lum ock c eref esho Fest /MA	The Beer Lambert equation to calculate the final concentration which will give an ance of 0.5 in a cell with a path length of 0.5 cm: $0.5 a = 6.3 \times 10^3 \text{ Lmol}^{-1} \text{ cm}^{-1} b = 0.5 \text{ cm} c = \text{ unknown (mol/L)}$ $0.5 = 6.3 \times 10^3 \times 0.5 \times c$ $c = 0.5 = 0.000159 \text{ mol/L}$ $c = 0.5 cm c = \text{ unknown (mol/L)}$ $concentration = 5 \times 0.0000705 = 0.000159 \text{ mol/L}$ $concentration = 5 \times 0.0000705 = 0.0003525 \text{ mol/L (since it was diluted 1 in 5)}$ $core volume required = 0.000159 \times 1000 \\ 0.0003525 = 450 \text{ mL} (to 2 \text{ sig figs})$ $concentration the detection of phaeochromocytoma:$ $concentration two urinary screening tests for the detection of phaeochromocytoma:$ $concentration Specificity (%) \\ 96.7 \qquad 99.1 \\ metanephrines \qquad 100 \qquad 98$
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