Deacon's Challenge No. 71 Answer

Enzymologists recommend that whenever possible the substrate concentration in an enzyme assay should be at least ten times the Michaelis constant (K_m). What is the rate of reaction achieved (expressed as multiples of the maximal velocity), for an enzyme reaction which obeys simple Michaelis-Menten kinetics, when the substrate concentration is exactly ten times the K_m value?

The Michaelis-Menten equation relating initial velocity to substrate concentration is:

$$v = \frac{V_{max}\ [s]}{K_m + [s]}$$

v = initial velocity

V_{max} = maximal velocity (at infinite substrate concentration)

K_m = Michaelis-Menten constant = substrate concentration at half-maximal velocity

$[s]$ = initial molar substrate concentration

Substituting $10\ K_m$ for $[s]$:

$$v = \frac{V_{max}\ 10\ K_m}{K_m + 10\ K_m}$$

then cancelling K_m gives the value of:

$$v = \frac{V_{max}\ 10\ K_m}{11\ K_m} = \frac{10\ V_{max}}{11} = \mathbf{0.91\ V_{max}}\ (2\ \text{sig figs})$$

Therefore the initial rate is approximately 90 per cent of the maximal rate (V_{max}).

Question 72

You receive two blood samples from a General Practice, each of which is labelled with the same pre-printed label, but you suspect that they are actually from two different patients. The measured serum sodium concentrations of the two samples are 140 and 143 mmol/L respectively. Given that the high control for your sodium assay runs a standard deviation of 1.07 mmol/L at 151.6 mmol/L and the intra-individual biological variation of serum sodium concentration is quoted as 0.6%, determine whether it is possible that these samples are indeed from the same patient, stating any assumptions that you make.

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