Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

$[S] = K_m$: $\frac{1}{2}V_{max}$

$[S] = 9K_m$: $\frac{9}{10}V_{max}$

2.2

$40(K + 2)/2 = 60(K + 6)/6$

$20K + 40 = 10K + 60$: $K_m = \mathbf{2}$ mM

$V_{max} = 40 \times 4/2 = \mathbf{80}$ µmol/min

2.3

competitive: K_m up, V_{max} the same

non-competitive: V_{max} down, K_m the same

only competitive inhibition is overcome by more substrate

2.4

$V_{max} = 1/0.0125 = \mathbf{80}$

$K_m = 1/0.5 = \mathbf{2}$ mM

3.1

(a) $v = 50 = V_{max}/2$ at 2 mM, so $K_m = \mathbf{2}$ mM

(b) $57.1 = 100 \times 8/(K + 8)$; $K \approx \mathbf{6}$ mM

(c) competitive: K_m rose from 2 to 6 mM while the rates still approach 100 at high $[S]$

(d) raise the substrate concentration

3.2

(a) hexokinase: $5/5.1 \approx \mathbf{0.98}$; glucokinase: $5/15 \approx \mathbf{0.33}$; at 10 mM: $\mathbf{0.5}$

(b) the brain's enzyme is almost full even when glucose is low, so its supply is steady; the liver's rate rises with blood glucose, so it takes up and stores glucose mainly after a meal

3.3

(a) formic acid builds up and makes the blood acidic, and it damages the optic nerve; methanol itself is far less toxic, so slowing its breakdown limits harm

(b) no ethanol: $1/(1 + 1) = \mathbf{0.5}\,V_{max}$; with ethanol: $1/(1 + 1 + 20) \approx \mathbf{0.045}\,V_{max}$, about 11 times slower

(c) it stays in the blood and slowly leaves through the kidneys and lungs; dialysis can remove it faster

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(d) fomepizole: it blocks ADH at a steady dose without making the patient drunk, and is easier to dose and monitor than ethanol