## Solutions

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

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

**2.1**

- the region of the enzyme (a few amino acids) where the substrate binds and the reaction happens

**2.2**

- intracellular enzymes act inside the cell that made them, e.g. catalase, DNA polymerase
- extracellular enzymes are secreted and act outside, e.g. amylase, trypsin

**2.3**

- 2.0 min = 120 s
- $36/120 = \mathbf{0.30\ cm^3\ s^{-1}}$

**2.4**

- arrow from reactants to the top of the higher curve: without enzyme
- arrow from reactants to the top of the lower curve: with enzyme

**3.1**

- the active site has a specific shape (set by the tertiary structure)
- only a substrate with a complementary shape fits
- forming an enzyme–substrate complex; other molecules do not fit

**3.2**

- the active site is not exactly complementary at first
- it changes shape slightly as the substrate binds, moulding around it

**3.3**

- binding puts strain on bonds in the substrate / brings reacting groups close together in the right orientation
- so less energy is needed to break or form bonds

**3.4**

(a) a gas syringe connected to the flask / an upturned measuring cylinder over water; read the volume at regular time intervals

(b) tangent at $t = 0$ drawn; about 1.5 to 2.0 $\mathrm{cm^3\,s^{-1}}$

(c) substrate is used up; so fewer enzyme–substrate collisions per second

(d) the final volume depends on the amount of substrate; more enzyme only makes it finish sooner

(e) a lower curve, levelling at half the volume

(f) any two: temperature; pH (buffer); volume of hydrogen peroxide; amount / source of catalase

**3.5**

(a) iodine turns blue-black while starch remains; the end point is the first drop that stays orange-brown

(b) $1/125 = \mathbf{0.0080\ s^{-1}}$

(c) it measures colour objectively, not by eye / gives continuous readings

(d) the end point is found more precisely

**3.6**

(a) the substrate (casein disappearing)

(b) so that any colour or cloudiness not due to casein is excluded from the readings

(c) $(0.80 - 0.20)/150 = \mathbf{0.0040\ s^{-1}}$