3. Enzymes

3.1 Mode of Action of Enzymes

Paper 2

Marking Scheme

Q1.

(a)	*any **three** from:* active site with a specific shape as part of a lysozyme molecule drawn and active site labelled or included in an annotation ; complementary shaped peptidoglycan drawn and, peptidoglycan / **s**ubstrate, labelled or included in an annotation; enzyme-substrate complex drawn and labelled ; lysozyme with same shaped active site and, two products / NAM and NAG drawn (formed from hydrolysed peptidoglycan) ; AVP ; e.g. water shown enzyme active site labelled 'lock' and substrate labelled 'key' *max 2 if no ref. to specific example e.g. label for lysozyme **or** peptidoglycan **or** murein **or** the products NAG and NAM* *max 1 no labels but otherwise clearly lock and key* ***or** by gaining the enzyme-substrate complex mark if induced fit drawn*	**3**

Q2.

(b)(ii)	*any **two** from:* improves accuracy of results / results not by eye / results not subjective ; **A** detects smallest change in, (intensity of) colour / concentration / quantity provides quantitative results / obtain numerical values ; **A** described e.g. absorbance values / can measure absorbance/ gives percentage transmission / absorbance readings *idea that* different, intensities / shades of, colour / magenta / red-purple, relate to different, quantities / concentrations, of nitrites ; **A** relate to (rates of) nitrate uptake can produce calibration curve (for quantitative results) ; AVP ; e.g. can detect, (very) low concentrations / faintly coloured samples	**2**

Q3.

(c)	extracellular (enzymes) ;	**1**

Q4.

(b)	*any **one** from:* *idea that* area to be, hydrolysed / AW, could be between same amino acids ; **A** *ref. to* (always), hydrolyses / breaks down / acts on, peptide bonds suggestion that active site has (some) flexibility for, hydrolysing / binding to / AW, similar substrates ; (proteins / substrates) similar shape(s) so fit active site ; active site and, substrates / proteins, (still) have complementary shapes ; **R** 'complementary to the antigen or the shape' AVP ; e.g. (large enzyme / enzyme complex, with) more than one active site	**1**

Q5.

(b)	*any **one** from:* similar / same, active site ; have the same catalytic amino acids ; similar / same, tertiary structure ; **A** same quaternary structure	**1**

Q6.

(a)	**1** active site, shape / tertiary structure ; **2** complementary to, substrate(s) / (intracellular) protein / ATP ;	**2**

Q7.

(c)	*any **two** from:* no change in, shape / tertiary structure / conformation, of active site ; **ora** (same) substrate able to bind to active site ; **ora** consequence ; e.g. so viruses can leave host cell to infect other cells the mutation is not occurring in the, gene / section of gene coding for amino acids in active site for neuraminidase ; the gene for neuraminidase is essential for survival ; AVP ;	**2**

Q8.

(a)	*idea* of *shape needs to be in the answer for mp2 and mp4* **I** *'substrate changes shape'* *any three from* **1** active site is not (fully) complementary to substrate ; **2** active site, changes shape / moulds around, to fit the substrate ; **A** conformational change for shape change **3** enzyme-substrate complex / ESC, forms ; **4** active site returns to original shape on release of product ; **5** AVP ; e.g. change of shape (to give complementary fit) lowers activation energy / puts strain on bonds / AW *ref. to* binding site / catalytic site (of active site)	**3**

Q9.

(b)(iii)	*max three if describing breakdown of sucrose* *allow points from diagrams* *any four from* *induced fit* shape of, substrates / UDP and glucose, not (fully) complementary to shape of active site (of sucrose synthase) ; *lock and key* shape of, substrates / UDP and glucose, complementary to shape of active site (of sucrose synthase) ; *allow ecf if no ref. to shape* *induced fit* active site flexible / moulds around, substrates / UDP and glucose ; AW *lock and key* active site does not change shape / is not flexible / AW ; *induced fit* (active site moulds around so) *idea of* provides better fit / fully complementary ; *lock and key* substrate fits into active site ;	**4**

Q10.

(b)(i)	macromolecule and extracellular enzyme ;	**1**

Q11.

(b)	*any **two** from:* formation of enzyme-substrate complex / substrate fits into active site ; **A** substrate binds to active site (so) reactants held close together (e.g. for bond formation) ; lowers, activation energy / energy of activation ; **A** Ea / Ae *can award annotated on a sketch* detail ; e.g. transfer of electrons strain on bonds alternative pathway holds substrate in a way that the bonds needed to be broken are exposed	**2**

Q12.

(b)(ii)	*three from* active site of enzyme **Y** is, not (fully) complementary / partially complementary ; active site, moulds to fit / becomes fully complementary to, cell signalling molecule ; enzyme-substrate complex forms ; **A** ESC forms *ref. to* interaction between substrate and R groups of enzyme amino acids ; lowers activation energy ; products leave the active site ; enzyme molecule unchanged / able to be re-used ; AVP ; e.g. detail of how activation energy is lowered	**4**

Q13.

(c)	induced fit ;	**1**

Q14.

(a)(i)	*any two from:* (Neutrase® breaks down / hydrolyses) protein to, peptides / amino acids / smaller molecules ; **A** idea of increase in solubility during the reaction / AW, more light passes through / more light is transmitted / less light is absorbed ; *idea that* 100 s is long enough to see the progress of the reactions ; **I** 'the rate of reaction can be calculated' **I** 'allow time for reaction to complete'	**2**

Q15.

(a)(i)	*any two from:* correct ref. to time ; correct ref. to volume of oxygen ; **A** gas for oxygen **A** volume of water displaced by oxygen **A** measuring height of water level (decreasing) **A** cm^3 instead of volume AVP ; subtract volume of gas displaced by H_2O_2 addition	**2**