7.6 Enzymes – summary of mark schemes

7.6.1 State that metabolic pathways consist of chains and cycles of enzyme-catalysed reactions.

Mark Scheme

A. enzymes are specific for their substrate / lock and key model / energy requirements
B. for reactions with substrates vary;
C. each step of the pathway is unique / different substrate at each step;
D. finer control of metabolic pathways;

7.6.2 Describe the induced-fit model.

Mark Scheme

A. change in shape of enzyme’s active site;
B. improves fit of enzyme and substrates;
C. brought about when the substrate molecules bind with the enzyme;
D. enzyme changes from inactive to active form;
E. permits some enzymes to bind with several substrates;
F. distorts / weakens bonds in substrates;
G. lowers activation energy:

7.6.3 Explain that enzymes lower the activation energy of the chemical reactions that they catalyse.

Mark Scheme

H. I. enzyme binds to substrate;
J. lowers activation energy;
K. by weakening bonds;
L. making substrate more likely to react;

7.6.4 Explain the difference between competitive and non-competitive inhibition, with reference to one example of each.

Mark Scheme

non-competitive:

A. inhibitor binds (to the enzyme)
B. away from the active site / at allosteric site;
C. shape / (intramolecular) bonding / conformation of the protein / enzyme is altered;
D. shape / properties of active site altered;
E. substrate no longer fits the active site / no enzyme-substrate / ES complex formed;
F. no enzyme activity / works more slowly (until the inhibitor dissociates);
G. eg CN inhibition of cytochrome oxidase by binding to SH groups / other valid example;
H. allosteric inhibition is a form of non-competitive inhibition;
I. most allosteric enzymes have multiple allosteric sites;
J. metabolites can act as allosteric inhibitors of enzymes earlier in a metabolic pathway to regulate metabolism;
K. binding (of end product) to an allosteric site changes shape of enzyme;

competitive:

L. a molecule structurally similar to the substrate binds to the active site;
M. preventing substrate binding;
N. eg inhibition of butanedioic acid (succinate) dehydrogenase by propanedioic acid (malonate) in the Krebs cycle / other valid example;
O. competitive inhibition is reversible;

7.6.5 Explain the control of metabolic pathways by end-product inhibition, including the role of allostERIC sites.

**Mark Scheme**

A. allosteric enzyme has binding site(s) away from / other than the active site;
B. (shape of an) allosteric enzyme alternates between active and inactive (form);
C. non-competitive inhibitor binds to allosteric site / away from active site;
D. non-competitive inhibitor changes shape of active site;
E. non-competitive inhibitors do not compete with substrate for the active site;
F. end-product can inhibit enzyme needed for early / first step in metabolic pathway;
G. negative feedback since increased level of product decreases rate of its own production;
H. metabolic pathway regulated according to the requirement for its end-product;
I. idea that inhibition is reversible;