AQA Biology A-level

Topic 1.4 - Proteins

Flashcards

What is the general structure of an amino acid?

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-COOH carboxyl/ carboxylic acid group

-R variable side group consists of carbon chain & may include other functional groups e.g. benzene ring or -OH (alcohol)

-NH_2 amine/ amino group

Describe how to test for proteins in a sample.

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Biuret test confirms **presence of peptide bond**

1. Add equal volume of **sodium hydroxide** to sample at room temperature.
2. Add drops of **dilute copper (II) sulfate solution**. Swirl to mix. (steps 1 & 2 make Biuret reagent)
3. **Positive result:** colour changes from blue to purple

   Negative result: solution remains blue.

How many amino acids are there and how do they differ from one another?

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differ only by side ‘R’ group

How do dipeptides and polypeptides form?

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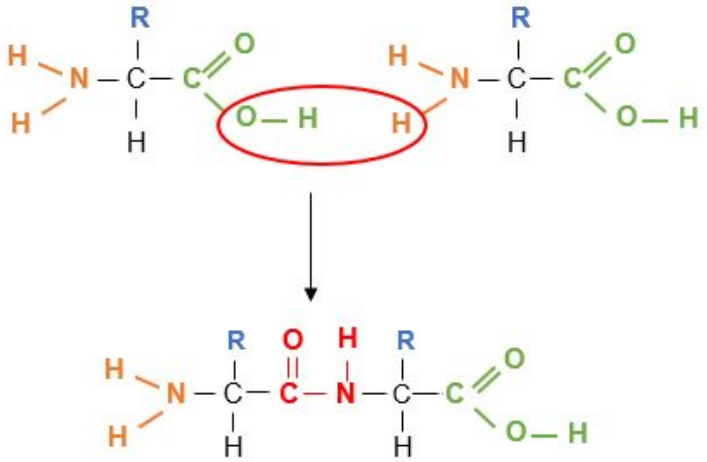
- Condensation reaction forms peptide bond (-CONH-) & eliminates molecule of water
- **Dipeptide**: 2 amino acids
- **Polypeptide**: 3 or more amino acids



How many levels of protein structure are there?

How many levels of protein structure are there?

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Define ‘primary structure’ of a protein.

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- Sequence, number & type of amino acids in the polypeptide.
- Determined by sequence of codons on mRNA.

Define ‘secondary structure’ of a protein.

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Hydrogen bonds form between O δ- (slightly negative) attached to –C=O & H δ+ (slightly positive) attached to –NH.

Describe the 2 types of secondary protein structure.

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α-helix:

- all N-H bonds on same side of protein chain
- spiral shape
- H-bonds parallel to helical axis

β-pleated sheet:

- N-H & C=O groups alternate from one side to the other

Define ‘tertiary structure’ of a protein.
Name the bonds present.

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3D structure formed by further folding of polypeptide

- disulfide bridges
- ionic bonds
- hydrogen bonds

Describe each type of bond in the tertiary structure of proteins.

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- **Disulfide bridges:** strong covalent S-S bonds between molecules of the amino acid **cysteine**
- **Ionic bonds:** relatively strong bonds between charged R groups (pH changes cause these bonds to break)
- **Hydrogen bonds:** numerous & easily broken

Define ‘quaternary structure’ of a protein.

Define ‘quaternary structure’ of a protein.

- Functional proteins may consist of more than one polypeptide.
- Precise 3D structure held together by the same types of bond as tertiary structure.
- May involve addition of prosthetic groups e.g metal ions or phosphate groups.

Describe the structure and function of globular proteins.

Describe the structure and function of globular proteins.

- Spherical & compact.
- Hydrophilic R groups face outwards & hydrophobic R groups face inwards = usually water-soluble.
- Involved in metabolic processes e.g. enzymes & haemoglobin.

Describe the structure and function of fibrous proteins.

Describe the structure and function of fibrous proteins.

- Can form long chains or fibres
- insoluble in water.
- Useful for structure and support e.g. collagen in skin.

Outline how chromatography could be used to identify the amino acids in a mixture.

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1. Use capillary tube to spot mixture onto pencil origin line & place chromatography paper in solvent.
2. Allow solvent to run until it almost touches other end of paper. Amino acids move different distances based on relative attraction to paper & solubility in solvent.
3. Use revealing agent or UV light to see spots.
4. Calculate R_f values & match to database.

What are enzymes?

What are enzymes?

- **Biological catalysts** for intra & extracellular reactions.
- Specific tertiary structure determines shape of **active site**, complementary to a **specific substrate.**
- Formation of **enzyme-substrate (ES) complexes** lowers **activation energy** of metabolic reactions.

Explain the induced fit model of enzyme action.

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- Shape of active site is not directly complementary to substrate & is flexible.
- Conformational change enables ES complexes to form.
- This puts strain on substrate bonds, lowering activation energy.

How have models of enzyme action changed?

How have models of enzyme action changed?

- Initially **lock & key** model: rigid shape of active site complementary to only 1 substrate.
- Currently induced fit model: also explains why binding at allosteric sites can change shape of active site.

How could a student identify the activation energy of a metabolic reaction from an energy level diagram?

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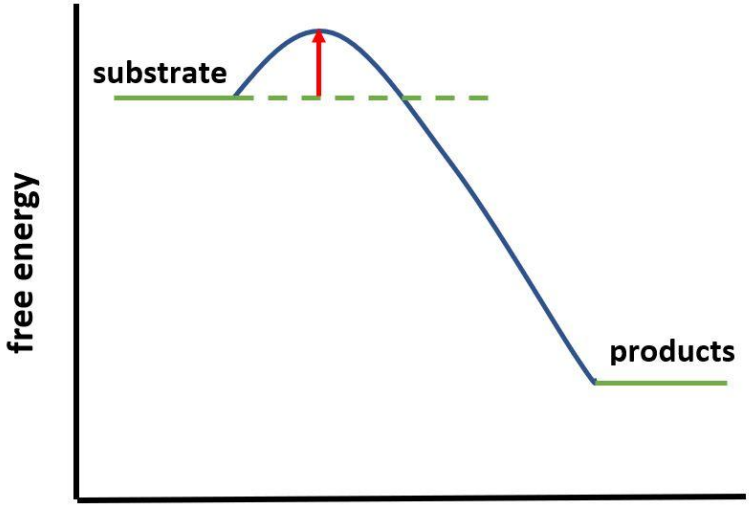
Difference between free energy of substrate & peak of curve.



Name 5 factors that affect the rate of enzyme-controlled reactions.

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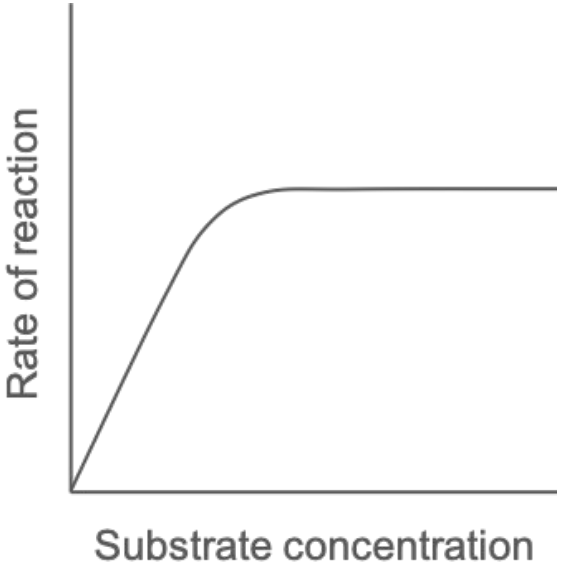
- enzyme concentration
- substrate concentration
- concentration of inhibitors
- pH
- temperature

How does substrate concentration affect rate of reaction?

How does substrate concentration affect rate of reaction?

Given that enzyme concentration is fixed, rate increases proportionally to substrate concentration.

Rate levels off when maximum number of ES complexes form at any given time.



How does enzyme concentration affect rate of reaction?

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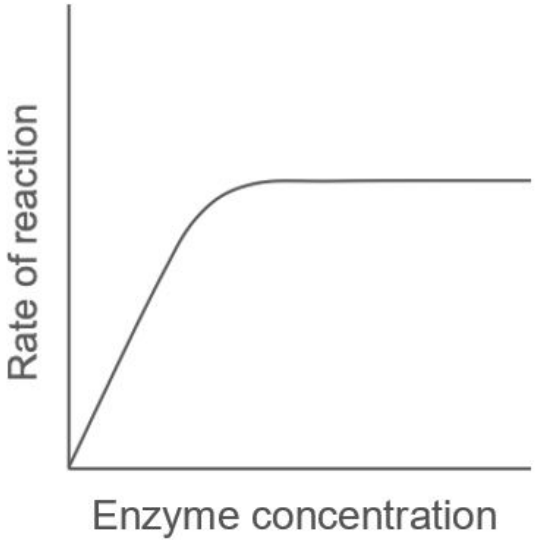
Given that substrate is in excess, rate increases proportionally to enzyme concentration

Rate levels off when maximum number of ES complexes form at any given time.

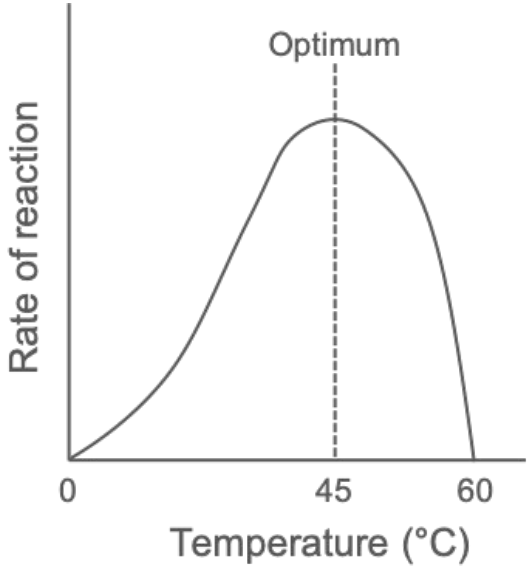


How does temperature affect rate of reaction?

How does temperature affect rate of reaction?

Rate increases as kinetic energy increases & peaks at optimum temperature.

Above optimum, ionic & H-bonds in 3° structure break = active site no longer complementary to substrate (denaturation).



How does pH affect rate of reaction?

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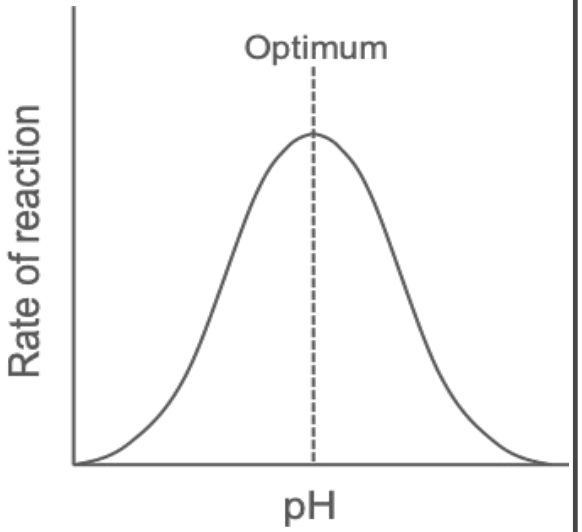
Enzymes have a narrow optimum pH range.

Outside range, H^+/ OH^- ions interact with H-bonds & ionic bonds in 3° structure = denaturation.



Contrast competitive and non-competitive inhibitors.

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Competitive inhibitors	Non-competitive inhibitors
similar shape to substrate = bind to active site	bind at allosteric binding site
do not stop reaction; ES complex forms when inhibitor is released	may permanently stop reaction; triggers active site to change shape
increasing substrate concentration decreases their effect	increasing substrate concentration has no impact on their effect

Outline how to calculate rate of reaction from a graph.

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- calculate gradient of line or gradient of tangent to a point.
- initial rate: draw tangent at t = 0.

Outline how to calculate rate of reaction from raw data.

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Change in concentration of product or reactant / time.

Why is it advantageous to calculate initial rate?

Why is it advantageous to calculate initial rate?

Represents maximum rate of reaction before concentration of reactants decreases & ‘end product inhibition’.

State the formula for pH.

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$$pH = -\log_{10}[H^+]$$