2.1 Cells molecules and enzymes

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

Objective

Build the skills to answer exam questions on **cells, biological molecules and enzymes** : cell structures, levels of organisation, stem cells, food molecules and food tests, and how temperature and pH affect enzymes.

You must be able to:

- describe the functions of cell structures
- name the building blocks of carbohydrates, proteins and lipids
- describe food tests and their results
- explain and investigate how temperature affects enzyme activity

1 Key knowledge and worked examples

Cells, molecules and enzymes

idea	rule
cell structures	nucleus (controls the cell); cell membrane (controls what enters and leaves); mitochondria (aerobic respiration); ribosomes (make proteins)
levels of organisation	organelle → cell → tissue → organ → organ system → organism
carbohydrates	made of simple sugars, e.g. glucose; starch and glycogen are long chains of glucose
proteins	made of amino acids
enzymes	proteins that are biological catalysts; the substrate fits the active site
rate of reaction	$1 \div$ time taken (unit: s^{-1})

Worked example 1: rate. Amylase digests the starch in a tube in 40 s. Find the rate.

1. Known: time = 40 s.
2. Rule: rate = $1 \div$ time.
3. Numbers: $1 \div 40$.
4. Result: 0.025 s^{-1}.

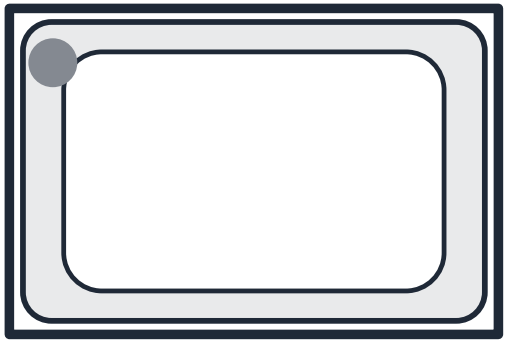
Worked example 2: levels of organisation. Put these in order, smallest first: organ, cell, organ system, tissue.

1. Known: four levels.
2. Rule: cells form tissues; tissues form organs; organs form systems.
3. Numbers: cell, tissue, organ, organ system.
4. Result: **cell → tissue → organ → organ system**.

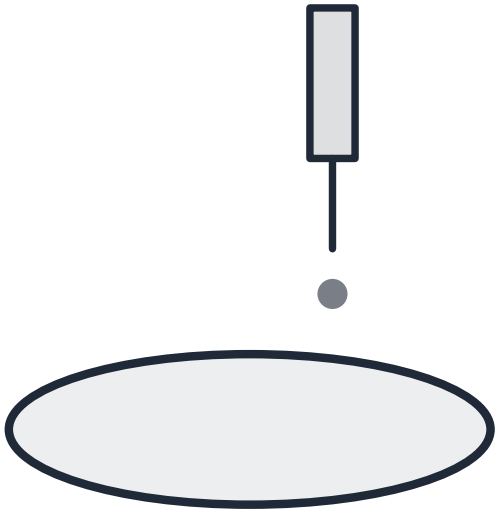
Answer shapes: for enzymes, use the words *active site*, *substrate* and *denatured*.

2 Practice

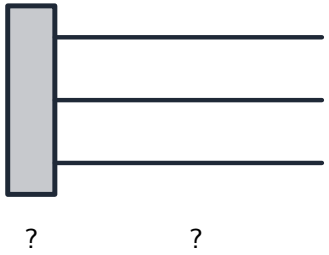
2.1 Name **two** structures found in plant cells but not in animal cells. [2]



2.2 Describe the test for starch, and give the positive result. [2]

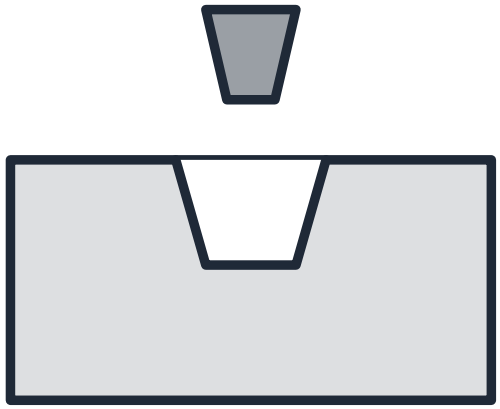


2.3 Name the **two** kinds of molecule that join to make a lipid. [2]

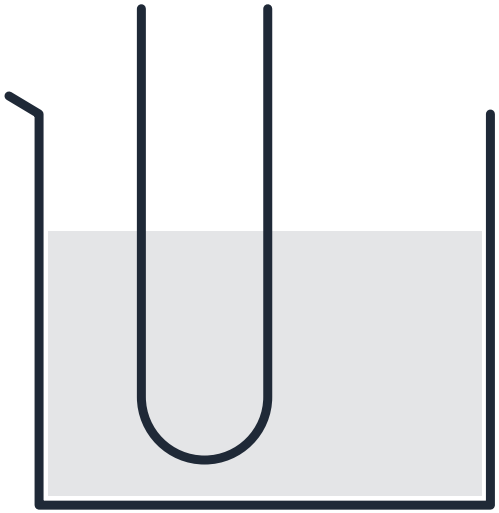


3 Exam-style questions

3.1 Explain why an enzyme stops working at a high temperature. [3]



3.2 Describe how to test a food sample for glucose (a reducing sugar), and give the positive result. [3]



3.3 A student mixes amylase with starch at different temperatures. Every 10 s she puts a drop of the mixture into iodine on a spotting tile and records the time until the iodine stays orange-brown. The results are shown.



temperature / °C	10	20	30	40	50	60
time / s	300	150	80	50	120	never

(a) Calculate the rate at 40 °C and at 20 °C, and state how many times faster the reaction is at 40 °C. [3]

(b) Explain the results from 40 °C to 60 °C. [3]

(c) Describe how the student should carry out this investigation to get valid results. [6]

Solutions

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

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

2.1

Any two (1 mark each):

- cell wall
- chloroplasts
- a large permanent vacuole

2.2

- add iodine solution
- it turns from orange-brown to blue-black

2.3

- fatty acids
- glycerol

3.1

- the enzyme is denatured: the shape of its active site changes
- the substrate no longer fits the active site
- so no enzyme-substrate complexes form and the reaction stops

3.2

- add Benedict's solution to the food in water
- heat in a boiling water bath for a few minutes
- the colour changes from blue to green, yellow or brick red

3.3

(a) $1 \div 50 = 0.020\ \text{s}^{-1}$; $1 \div 150 = 0.0067\ \text{s}^{-1}$; **3** times faster

(b) 40 °C is near the optimum temperature; above it the active site changes shape and the enzyme starts to denature, so the rate falls at 50 °C; at 60 °C the enzyme is fully denatured, so the starch is never digested

(c) points to include:

- put starch solution and amylase in separate tubes in a water bath at the chosen temperature for a few minutes before mixing (K)
- mix and start the timer; every 10 s put one drop into iodine on the spotting tile (K)
- record the time when the iodine no longer turns blue-black (K)
- keep the same volume and concentration of starch and amylase (App)
- keep the pH the same with a buffer solution (App)
- repeat each temperature and calculate a mean (An)

Levels: **5–6** a full, logical answer with correct biology and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.