Unit 2 · Life and Life Process

ANSWER KEY · FOR TEACHERS

Full marks 46

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. filament
2. pyrenoids
3. scalariform
4. osmosis
5. plasmolyzed
6. isotonic
7. potometer
8. ATP

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. mucilage
2. vacuole
3. nucleus
4. septum
5. pyrenoid
6. chloroplast

K · 3

Each carries 0.5 mark.

3 Multiple choice

i. **b.** lateral conjugation — K · 1

Lateral conjugation happens within one filament, between neighboring cells. Scalariform conjugation is between cells of two filaments lying side by side.

ii. **d.** tetranucleate (four-nucleate) cyst — K · 1

Only the mature cyst with four nuclei infects: its wall survives the stomach, and it hatches in the small intestine.

iii. **c.** swells and bursts — U · 1

Distilled water is hypotonic to the cell, so water enters by osmosis. An animal cell has no wall, so it swells until it bursts (hemolysis). Plasmolysis happens only in cells with a wall, in a hypertonic solution.

iv. **b.** a boiled potato osmometer used as a control — U · 1

In the boiled potato, the cell membranes are destroyed and the level of sugar solution doesn't rise, so the semipermeable membranes of living cells are needed for osmosis.

v. **d.** carbon dioxide and water — K · 1

Aerobic respiration breaks glucose down completely to carbon dioxide and water, releasing energy.

4 Very short answers

a. MARKING SCHEME — K · 1

✓ One filament.

b. MARKING SCHEME — K · 1

✓ The mature, four-nucleate cyst.

c. MARKING SCHEME — U · 1

✓ It has met water.

d. MARKING SCHEME — K · 1

✓ The cytoplasm.

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5 Short answers

a. MARKING SCHEME — U · 2

- ✓ The two gametes look exactly alike, equal in size and shape.
- ✓ One moves through the tube and the other stays: they differ only in behavior.

b. MARKING SCHEME — U · 2

- ✓ Water also evaporates from moist soil and a clay pot, and could collect on the jar.
- ✓ With them covered, the water can only have come from the plant.

c. MARKING SCHEME — U · 2

- ✓ A carrier passes cysts, which stay alive for weeks outside the body.
- ✓ A patient passes mostly trophozoites, which die outside the body.

d. MARKING SCHEME — U · 2

- ✓ Any one difference, e.g. osmosis needs a semipermeable membrane; diffusion needs none.
- ✓ Any second difference, e.g. in osmosis only the water moves; in diffusion any substance moves.

e. MARKING SCHEME — A · 2

- ✓ Water enters both by osmosis, since pure water is hypotonic.
- ✓ The plant cell's wall holds it (turgid); the animal cell has no wall, so it bursts.

6 Long answers

a. ANSWER — U · 4

Two filaments lie side by side; facing cells push out papillae, which meet, and the wall between them dissolves to make conjugation tubes. Each protoplast shrinks and rounds off into a gamete, and the gametes of one filament creep through the tubes into the cells of the other and fuse, making a diploid zygote, which forms a thick wall: a zygospore. On germination its nucleus divides by meiosis into four haploid nuclei, three of which degenerate, and the zygospore grows a germ tube, which divides by mitosis into one new filament.

MARKING SCHEME

- ✓ Facing cells form papillae, which join as conjugation tubes (a ladder).
- ✓ Protoplasts round off into gametes; those of one filament creep into the other.
- ✓ The gametes fuse into a diploid zygote, which forms a thick-walled zygospore.
- ✓ Meiosis gives four nuclei, three degenerate, and a germ tube grows into one new filament.

b. ANSWER — U · 4

Glycolysis, in the cytoplasm: glucose is split into two pyruvic acid, with 2 ATP. **Krebs cycle**, in the matrix of the mitochondria: carbon leaves as carbon dioxide, hydrogen goes to carriers, 2 ATP. **Electron transport chain**, on the cristae: most of the ATP is made, and oxygen forms water. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ energy.

MARKING SCHEME

- ✓ Glycolysis: cytoplasm; two pyruvic acid and 2 ATP.
- ✓ Krebs cycle: matrix; carbon dioxide, 2 ATP.
- ✓ Electron transport chain: cristae; most of the ATP, and water.
- ✓ $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ energy.

7 Numerical problems

a. ANSWER — A · 2

Percentage change $= (2.88 - 3.20) \div 3.20 \times 100\% = -0.32 \div 3.20 \times 100\% =$ **−10%**.
The strip lost mass, so water left its cells by exosmosis: the solution was **hypertonic** to the potato cells.

MARKING SCHEME

- ✓ $(2.88 - 3.20) \div 3.20 \times 100\% = -10\%$.
- ✓ Hypertonic, since the strip lost water.

b. ANSWER

Volume taken up $= 1.0\ mm^2 \times 60\ mm = 60\ mm^3$ each time.
Still air: $60 \div 5 =$ **12 mm^3 per minute**. With the fan: $60 \div 3 =$ **20 mm^3 per minute**.

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The wind blows away the water vapor around the leaves, keeping the air next to them dry, so water vapor diffuses out of the stomata faster; the shoot transpires faster and draws up water faster. A · 3

MARKING SCHEME

✓ Volume = 1.0 mm^2 × 60 mm = 60 mm^3.
✓ 12 mm^3 per minute in still air, 20 mm^3 per minute with the fan.
✓ The wind sweeps away the vapor round the leaves, so the shoot transpires faster.

c. **ANSWER** A · 4

Moles of glucose = 360 ÷ 180 = 2 mol.

a. ATP = 2 × 38 = 76 mol; energy stored = 76 × 30.5 kJ = **2,318 kJ** (out of 2 × 2,870 = 5,740 kJ released, about 40%).
b. Anaerobic respiration gives 2 ATP per glucose: 2 × 2 = **4 mol of ATP**, a nineteenth as much.

MARKING SCHEME

✓ 360 g = 2 mol of glucose.
✓ 2 × 38 = 76 mol of ATP.
✓ 76 × 30.5 kJ = 2,318 kJ.
✓ Anaerobic: 2 × 2 = 4 mol of ATP.

8 Think

ANSWER HA · 3

During the sprint her muscles needed more energy than their oxygen supply could provide, so part came from anaerobic respiration, leaving lactic acid. After the race extra oxygen is needed: much of the lactic acid is carried to the liver and heart, which respire it or turn it back into glucose, and the muscles refill their oxygen and energy stores. She keeps panting until this is done.

MARKING SCHEME

✓ Too little oxygen in the sprint, so anaerobic respiration made lactic acid.
✓ Extra oxygen is needed to deal with the lactic acid (in the liver and heart).
✓ The muscles also refill their oxygen and energy stores, so she goes on panting.

9 Activity: Potato strips in sugar solutions

(not marked)

WHAT STUDENTS SHOULD FIND

The strips gain mass in water and weak solutions (hypotonic) and lose it in strong ones (hypertonic). Between them is a solution in which a strip would neither gain nor lose: it is isotonic with the cell sap. Percentage change compares strips fairly, since they don't start with exactly the same mass.

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **Plant Terrarium** (exhibit): Look for drops on the glass: some of that water came up through the roots and left the leaves as vapor, by transpiration.
- **Touch-Me-Not Plant** (exhibit): Touch a leaf gently: cells at the base of each leaflet suddenly lose water and their turgor, so the leaflets fold shut.
- **Cobweb Spiderwort** (garden): Its leaves are wrapped in white, woolly hairs, which hold still, damp air against the leaf and slow its transpiration in dry weather.
- **Animal Cell Model** (exhibit): Find the mitochondria: aerobic respiration is completed there, using oxygen to release most of the energy stored in glucose.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	13	19	11	3	**46**

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