Respiration & Photosynthesis Revision

A Level

Part A Respiration

Name the molecule that is produced during glycolysis and which is converted to acetyl CoA during the link reaction.

Name the molecule that reacts with acetyl CoA during the Krebs cycle to produce citric acid.

Name the part of the mitochondrion in which the Krebs cycle takes place.

Part B Photosynthesis: light-dependent reaction

Photosynthesis involves two main stages:

- the light-dependent stage, which involves photosystems
- the light-independent stage, which involves the Calvin cycle.

Photosynthetic pigments are arranged in groups known as photosystems I and II.

Name the primary photosynthetic pigment in these photosystems.

Name an accessory pigment.

Name the compound that is synthesised in the light-dependent stage as a result of the generation of an electrical and pH gradient across the thylakoid membrane.

Part C Photosynthesis: light-independent reaction

Name the part of the chloroplast in which the Calvin cycle takes place.

Name the enzyme that catalyses the fixation of carbon dioxide.

Name the first stable product of carbon dioxide fixation.

Name the compound that is regenerated in the Calvin cycle so that more carbon dioxide can be fixed.

Parts B and C adapted with permission from OCR A Level Biology A, June 2014, Communication, Homeostasis and Energy, Question 1.

ATP and NAD

A Level

ATP and NAD both play important roles in respiration. Both compounds are modified nucleotides. **Figure 1** represents the molecular structures of ATP and NAD.

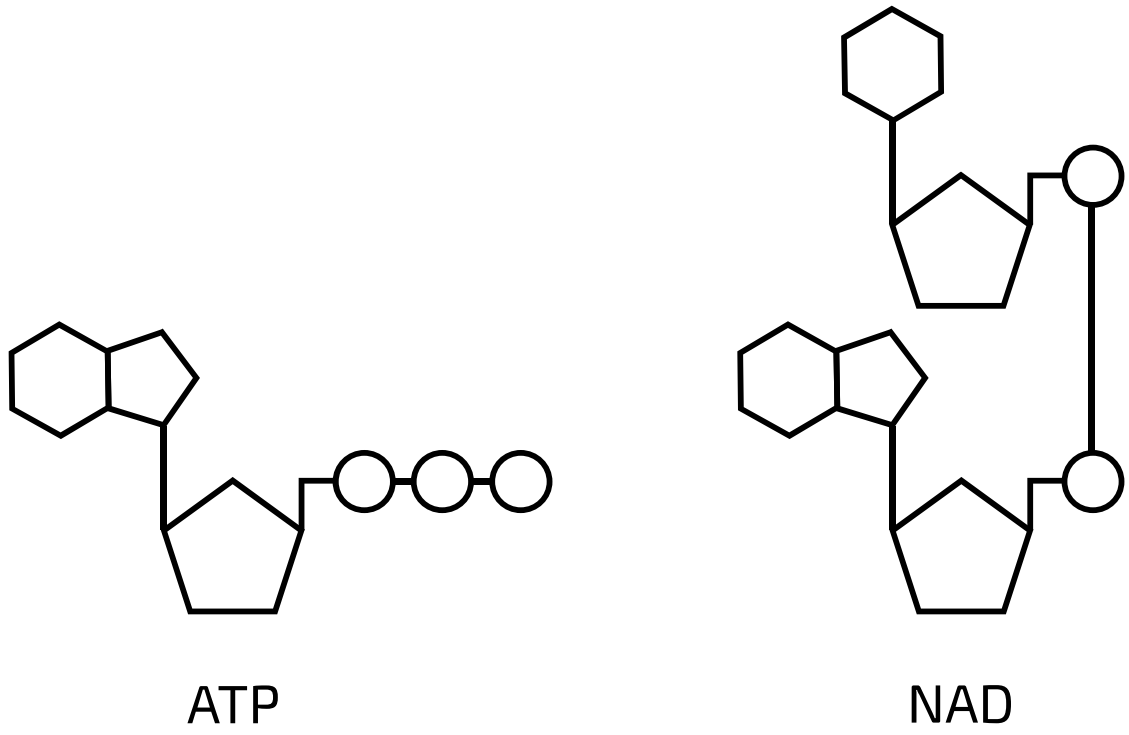

Figure 1: ATP and NAD.

Part A Structural similarities

Which of the following are structural **similarities** between ATP and NAD? Select all that apply.

- [ ] both contain adenine
- [ ] both contain a hexose sugar
- [ ] both contain phosphate groups
- [ ] both contain ribose
- [ ] both contain deoxyribose

Part B Structural differences

Which of the following are structural **differences** between ATP and NAD? Select all that apply.

- [ ] ATP contains three phosphate groups whereas NAD contains two phosphate groups.
- [ ] NAD contains two pentose sugars whereas ATP only contains one pentose sugar.
- [ ] ATP contains a purine base whereas NAD does not.
- [ ] ATP contains ribose whereas NAD does not.
- [ ] NAD contains nicotinamide whereas ATP does not.

Part C ATP synthesis

Name the type of chemical reaction by which ATP is made during the Krebs cycle.

Part D NAD functions

Which of the following are functions of NAD^+ in the **cytoplasm** of a eukaryotic cell? Select all that apply.

- [ ] accepts electrons from the electron transport chain
- [ ] donates electrons to the electron transport chain
- [ ] accepts electrons from other molecules
- [ ] phosphorylates other molecules

Adapted with permission from CIE A Level Biology, June 2016, Paper 4, Question 1

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STEM SMART Biology Week 48 - Revision - Respiration & Photosynthesis

Mitochondrial Molecules and Numbers

A Level

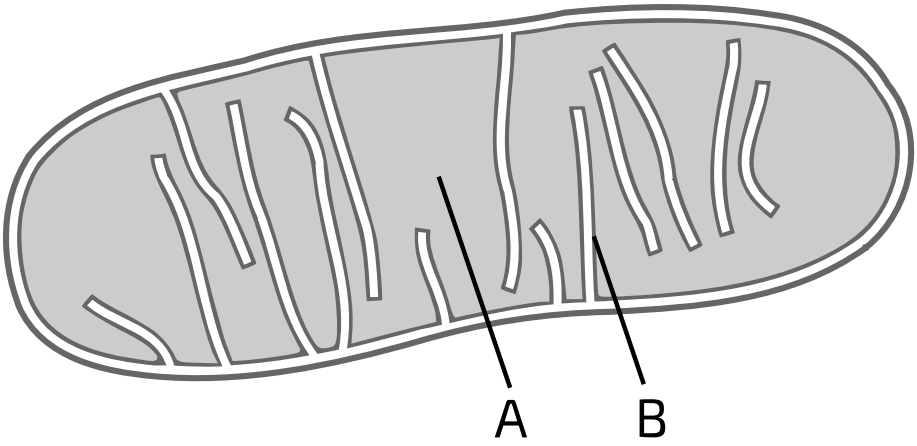

Figure 1: Simplified diagram of a transmission electron micrograph of a section through a mitochondrion.

Part A Aerobic respiration

The table below shows some structures and compounds involved in aerobic respiration.

Use letter **A** or **B** from **Figure 1** to show where each structure/compound is found/used.

Compound or structure	Location
ATP synthase	
acetyl CoA	
phospholipid bilayer	
oxaloacetate	

Items:

A B

Part B Cell types & mitochondrial numbers

The table below shows the mean number of mitochondria per cell and the mean cell volume for three types of mammalian cells.

Cell type	Mean number of mitochondria per cell	Mean cell volume / μm^3
fat cell	100	600 000
heart cell	2000	45 000
liver cell	2000	125 000

Calculate the mean number of mitochondria per μm^3 for each cell. Give your answers to 2 significant figures.

fat cell:

heart cell:

liver cell:

Part C Fat cell vs heart cell

Which of the following statements explain the difference in mean number of mitochondria per μm^3 between the fat cell and the heart cell in part B? Select all that apply.

- [ ] fat cells have a higher mean number of mitochondria per μm^3 than heart cells because they require more energy
- [ ] heart cells have a higher mean number of mitochondria per μm^3 than fat cells because they require more energy
- [ ] mitochondria produce ATP by aerobic respiration
- [ ] mitochondria produce ATP by photophosphorylation
- [ ] ATP is required for lipogenesis
- [ ] ATP is required for muscle contraction

Adapted with permission from CIE A Level Biology, June 2018, Paper 4, Question 6

Gameboard:
STEM SMART Biology Week 48 - Revision - Respiration & Photosynthesis

Respiratory Systems Revision

A Level

Part A Fish gills

Which of the following statements describe how fish gills take in oxygen? Select all that apply.

- [ ] water moves in through the mouth and **out** across the gills
- [ ] water moves **in** across the gills and out through the mouth
- [ ] blood is pumped through the gills in the **same** direction to the flow of water across the gills
- [ ] blood is pumped through the gills in the **opposite** direction to the flow of water across the gills
- [ ] because blood and water flow in the **same** direction, a steep diffusion gradient is maintained across the gill capillaries, thus increasing gas exchange efficiency
- [ ] because blood and water flow in **opposite** directions, a steep diffusion gradient is maintained across the gill capillaries, thus increasing gas exchange efficiency

Part B Mammalian lungs adaptations

Fill in the table below by matching the feature of the mammalian lungs to the description of how this feature improves efficiency of gas exchange between the air and the bloodstream.

Feature	How this feature improves efficiency of gas exchange
	ensures a very small distance for gases to diffuse across
	increases the surface area for diffusion of gases to occur
	increases the concentration gradient of oxygen by ensuring that the lungs are continuously supplied with oxygen-poor blood
	increases concentration gradient of oxygen by ensuring that the lungs are continuously filled with oxygen-rich air

Items:

alveoli are lined with a thin layer of cells (squamous epithelium)

lungs are actively ventilated

alveoli are surrounded by blood capillaries

lungs are composed of a large number of alveoli

Part C Mammalian ventilation

Which of the following statements describe how mammalian lungs take in air? Select all that apply.

- [ ] The diaphragm **contracts**, changing from a more domed shape to a flatter shape, causing the lungs to expand downwards.
- [ ] The diaphragm **relaxes**, changing from a flatter shape to a more domed shape, causing the lungs to expand downwards.
- [ ] The external intercostal muscles **contract**, causing the lungs to expand outwards and upwards.
- [ ] The external intercostal muscles **relax**, causing the lungs to expand outwards and upwards.
- [ ] The expansion of the lungs **increases** thoracic pressure, which causes air to move into the lungs from outside the body.
- [ ] The expansion of the lungs **decreases** thoracic pressure, which causes air to move into the lungs from outside the body.

Part D Pulmonary ventilation

A group of students were investigating the effect of exercise on pulmonary ventilation.

The table below shows some of the results recorded for one of the students in the group.

Tidal volume	$0.45\ \text{dm}^3$
Vital capacity	$3.45\ \text{dm}^3$
Mean breathing rate at rest	$14\ \text{min}^{-1}$
Mean breathing rate during exercise	$18\ \text{min}^{-1}$

Calculate the total volume of air that moved in and out of this student's lungs in a five minute period **before** the start of exercise.

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Circulatory Systems Revision

A Level

Part A Double circulation

Which of the following statements about double circulation are correct? Select all that apply.

- [ ] double circulation refers to the fact that the heart has two types of chambers: atria and ventricles
- [ ] double circulation refers to the fact that blood passes through the heart twice for each complete circuit of the circulatory system
- [ ] all vertebrates have a double circulatory system
- [ ] mammals and birds have a double circulatory system, whereas fish have a single circulatory system
- [ ] double circulation ensures that blood travels through the body at a higher pressure and faster speed than in a single circulatory system
- [ ] double circulation ensures that blood travels through the body at a lower pressure and slower speed than in a single circulatory system

Part B Systole vs diastole

In the table below, show which process each statement refers to: systole or diastole.

Statement	Systole or Diastole
blood moves from the vena cava and pulmonary veins into the atria	
blood moves from the ventricles out into the aorta and pulmonary artery	
the semi-lunar valves open	
the atrioventricular valves open	
caused by electrical excitation (i.e. depolarisation)	

Items:

systole diastole

Part C Oxygen saturation

In mammalian blood, oxygen is mainly transported combined with haemoglobin. The presence of haemoglobin greatly increases the oxygen carrying capacity of blood.

- $100\,\text{cm}^3$ of plasma contains $0.3\,\text{cm}^3$ of oxygen when fully saturated.
- $100\,\text{cm}^3$ of blood contains $20.1\,\text{cm}^3$ of oxygen when fully saturated.

Calculate the percentage increase in oxygen carried in fully saturated blood compared with oxygen carried in fully saturated plasma. Give your answer to the nearest percent.

Part D Cardiac output

The average stroke volume of a particular person is $60\,\mathrm{ml}$, and their average heart rate is $82\,\mathrm{bpm}$.

Calculate this person's cardiac output.

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Plant Physiology Revision

A Level

Part A Xylem vs phloem

Fill in the table below to compare xylem and phloem.

Xylem	Phloem
xylem transports water and [ ]	phloem transports [ ]
xylem vessel walls are reinforced with [ ]	sieve tube walls have no additional support
xylem vessel walls contain [ ] that allow water to pass into adjacent vessels	there are many gaps in the cell walls between companion cells and sieve tube elements called [ ]

Items:

mineral ions e.g. nitrates and phosphates | lignin | chitin | pits | assimilates e.g. sucrose and amino acids | plasmodesmata

Part B Phloem loading

A scientist isolated companion cells and conducted some experiments to investigate the mechanism involved in loading sucrose into the sieve tubes. The scientist recorded the following observations:

- Observation 1: isolated companion cells became slightly negatively charged compared with their surroundings.
- Observation 2: companion cells could decrease the pH of the surrounding solution from 7.0 to 5.6.
- Observation 3: the pH inside the companion cells rose from 7.0 to 8.2.
- Observation 4: treatment with cyanide (which stops aerobic respiration) prevents the change in pH occurring.

Which of the following conclusions can be drawn from the observations above? Select all that apply.

- [ ] hydrogen ions are moving from the companion cells to the surrounding solution
- [ ] hydrogen ions are moving from the surrounding solution into the companion cells
- [ ] hydrogen ions are moving by passive transport
- [ ] hydrogen ions are moving by active transport

Part C Xerophytes

Xerophytes are plants that are adapted to living in dry conditions.

The table below describes four general features of leaves. In each section, one leaf belongs to a xerophyte.

Presence of hairs on leaves	
Leaf **A**	no
Leaf **B**	yes
Leaf **C**	no
Mean number of stomata (cm^{-2})	
Leaf **D**	30 000
Leaf **E**	23 000
Leaf **F**	13 000
Mean surface area of one leaf (cm^{2})	
Leaf **G**	0.2
Leaf **H**	10.0
Leaf **I**	23.0
Thickness of cuticle $(\mu\mathrm{m})$	
Leaf **J**	4.25
Leaf **K**	8.50
Leaf **L**	2.00

Which four leaves belong to xerophytes? Choose one from each section.

- [ ] A
- [ ] B
- [ ] C
- [ ] D
- [ ] E
- [ ] F
- [ ] G
- [ ] H

- [ ] I
- [ ] J
- [ ] K
- [ ] L

Adapted with permission from OCR AS Level Biology A, June 2013, Cells, Exchange and Transport, Question 6 and OCR AS Level Biology A, June 2014, Cells, Exchange and Transport, Question 4

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STEM SMART Biology Week 48 - Revision - Respiration & Photosynthesis

Sucrose Reactions and Transport

A Level

Figure 1 shows how sucrose is broken down.

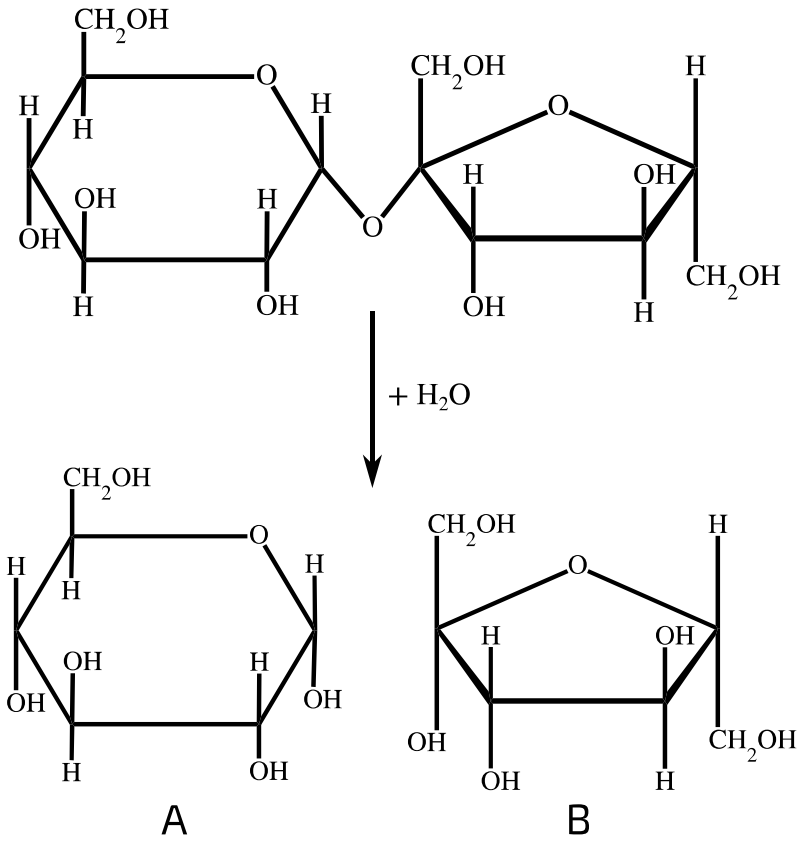

Figure 1: Sucrose breakdown. A sucrose molecule reacts with water to form two monosaccharides.

Part A Products

Name product **A** from the reaction shown in **Figure 1**.

Name product **B** from the reaction shown in **Figure 1**.

Part B Bond

Name the type of bond that is broken in the reaction shown in **Figure 1**.

Part C Reaction

State the type of reaction shown in **Figure 1**.

Part D Transport

Drag the items below into the correct order on the right to show how sucrose is transported from photosynthetic tissue in the leaves of plants to storage tissues in the roots.

Available items

- sucrose moves from companion cells into other cells in the roots either by diffusion through plasmodesmata or by active transport
- liquid moves away from high pressure regions towards low pressure regions (where the water potential is higher due to low sucrose concentrations)
- sucrose moves from sieve tube elements into companion cells by diffusion through plasmodesmata
- the water potential in this region decreases, and so water moves in from surrounding tissues, increasing the hydrostatic pressure here
- sucrose moves from companion cells into sieve tube elements by diffusion through plasmodesmata
- sucrose moves from mesophyll tissue into companion cells either by diffusion through plasmodesmata or by active transport

Adapted with permission from CIE AS Level Biology, June 2018, Paper 2, Question 2