



14 The serial endosymbiotic theory suggests that some eukaryotic organelles came about as a result of close associations between early unicellular organisms.

The following statements describe oxidative phosphorylation in bacteria:

- 1 The enzymes involved in electron transport and oxidative phosphorylation are on the inner layer of the bacterial membrane.
- 2 The inner layer of the membrane is folded, increasing its surface area.
- 3 The membrane contains cytochromes and ATP-synthase complexes.

Which of the statements above demonstrates a link between bacterial cells and the mitochondria of eukaryotes?

- A 1, 2 and 3
- B Only 1 and 2
- C Only 2 and 3
- D Only 1

Your answer

[1]

6 (c) Respiration produces more ATP per molecule of glucose in the presence of oxygen than it does when oxygen is absent. Explain why.

[2 marks]

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(b) Describe **two** ways in which the structure of mitochondrial membranes is related to the function of a mitochondrion.

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[2]



18 Oxidative phosphorylation is a stage in aerobic respiration, which occurs in mitochondria.

Fig. 18 is a diagram of part of a mitochondrion, showing components, regions and processes involved in oxidative phosphorylation.

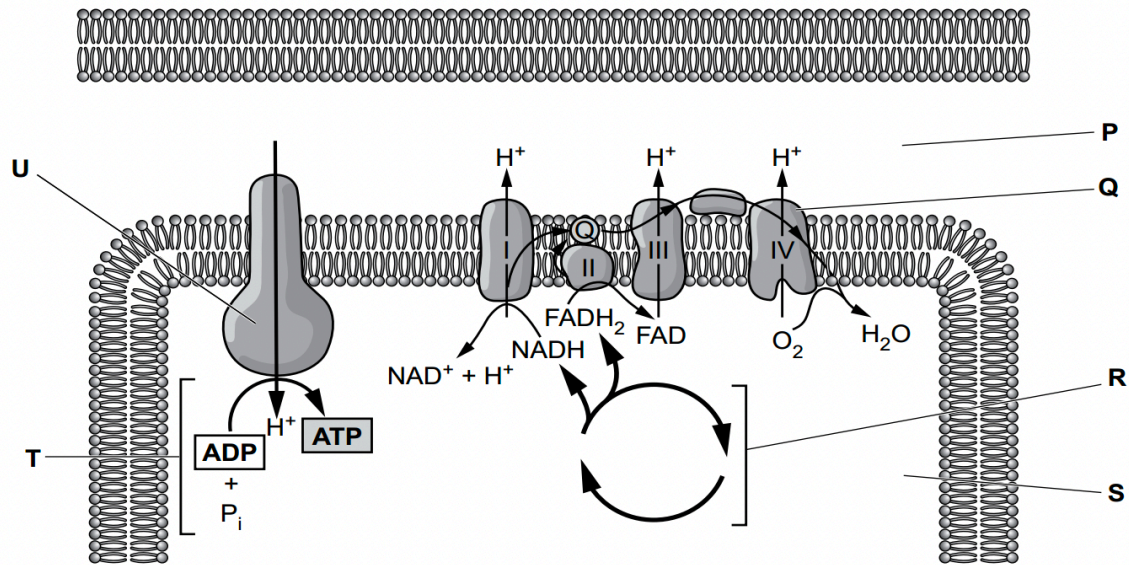


Fig. 18

*1 15 Q18a (PRACTICE 2)

(a) (i) Name the **components** labelled **U** and **Q**.

[2]

(ii) Name the two **regions** labelled **P** and **S**.

[2]

(iii) Name the two **processes** labelled **R** and **T**.

[2]

(b) (i) What properties of the mitochondrial inner membrane allow chemiosmosis to occur?

[2]

(ii) Describe **two** quantitative changes in region **P** which occur as a result of oxidative phosphorylation.

[1]



(c)* Some individuals can eat large quantities of fatty and carbohydrate-rich food without putting on weight. One possible hypothesis that could explain this is related to the mitochondrial inner membrane.

Scientists have suggested that some individuals may have a larger number of proton pores in their inner mitochondrial membrane than normal.

Explain how having a larger number of proton pores in the inner mitochondrial membrane would result in a person being less likely to gain weight.

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[6]



7 CREB is a transcription factor in the mitochondria of neurones.

7 (b) CREB leads to the formation of a protein that removes electrons and protons from reduced NAD in the mitochondrion.

Huntington's disease (HD) causes the death of neurones. People with HD produce a substance called huntingtin. Some scientists have suggested that binding of huntingtin to CREB may lead to the death of neurones.

Suggest how binding of huntingtin to CREB may lead to the death of neurones.

[3 marks]

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[Extra space]

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7 (c) CREB is a protein synthesised in the cytoplasm of neurones. Transport of CREB from the cytoplasm into the matrix of a mitochondrion requires two carrier proteins.

Use your knowledge of the structure of a mitochondrion to explain why transport of CREB requires **two** carrier proteins.

[2 marks]

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- 14** The serial endosymbiotic theory suggests that some eukaryotic organelles came about as a result of close associations between early unicellular organisms.

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- 2 The inner layer of the membrane is folded, increasing its surface area.
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- A** 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer

A

[1]

4 2014 JUN 6c

6(c)	<ol style="list-style-type: none"> 1. Oxygen is final/terminal (electron) acceptor / oxygen combines with electrons and protons; 2. Oxidative phosphorylation / electron transport chain provides ATP; 3. Only glycolysis occurs without oxygen / no Krebs / no link reaction; 	2 max	
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- (b)** Describe **two** ways in which the structure of mitochondrial membranes is related to the function of a mitochondrion.

2 max

1. contain / location of , (named) electron carriers / ETC / ATP synth(et)ase / proton pumps ✓
2. (provide , site / location / surface) for , chemiosmosis / ATP synthesis / oxidative phosphorylation ✓
3. allow , formation / maintenance , of ,H⁺ / proton / hydrogen ion , gradient ✓
4. outer membrane is highly permeable to allow movement of (named) molecules ✓

Mark as continuous prose

[2]



18 Oxidative phosphorylation is a stage in aerobic respiration, which occurs in mitochondria.

Fig. 18 is a diagram of part of a mitochondrion, showing components, regions and processes involved in oxidative phosphorylation.

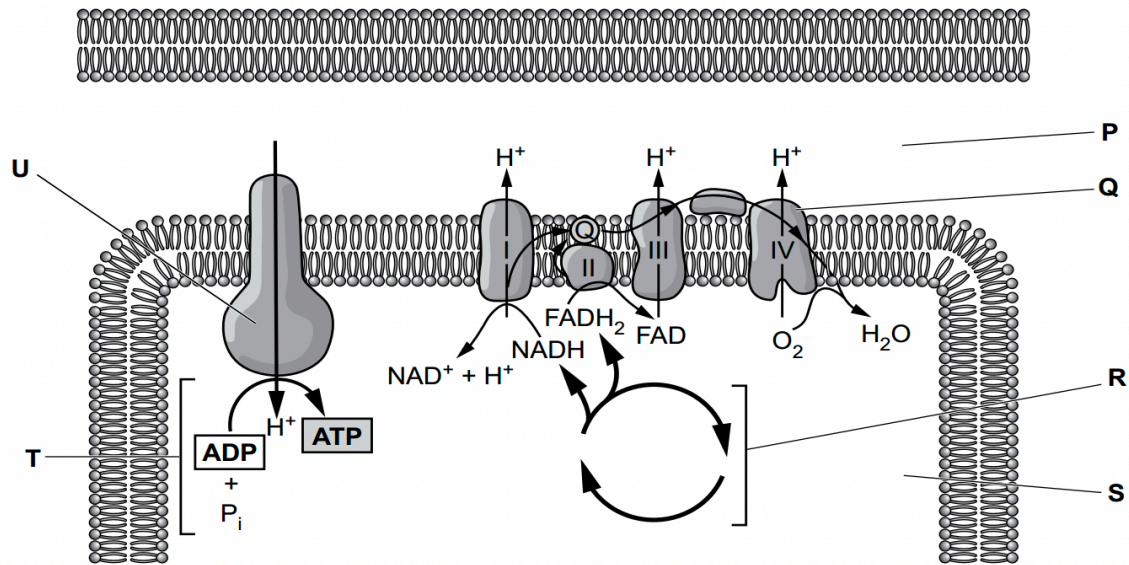


Fig. 18

*1 15 Q18a (PRACTICE 2)

(a) (i) Name the **components** labelled **U** and **Q**.

U ATP synthase ✓
Q electron carrier ✓

ALLOW ATP synthetase / F1 complex
ALLOW cytochrome / proton pump

[2]

(ii) Name the two **regions** labelled **P** and **S**.

P inter-membrane space ✓
S matrix ✓

[2]

(iii) Name the two **processes** labelled **R** and **T**.

R Krebs cycle ✓
T ATP synthesis ✓

ALLOW citric acid / tricarboxylic acid / TCA

[2]

(b) (i) What properties of the mitochondrial inner membrane allow chemiosmosis to occur?

(mostly) impermeable to H^+ ions / protons ✓
large surface area ✓
presence of , ATP synthase / stalked particles ✓

DO NOT ALLOW H / hydrogen

IGNORE ETC / cytochromes

[2]

(ii) Describe **two** quantitative changes in region **P** which occur as a result of oxidative phosphorylation.

pH decreases
AND
becomes more positive(ly charged) ✓

[1]



- (c)* Some individuals can eat large quantities of fatty and carbohydrate-rich food without putting on weight. One possible hypothesis that could explain this is related to the mitochondrial inner membrane.

Scientists have suggested that some individuals may have a larger number of proton pores in their inner mitochondrial membrane than normal.

Explain how having a larger number of proton pores in the inner mitochondrial membrane would result in a person being less likely to gain weight.

Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

*Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.) Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, **Level 1, Level 2 or Level 3**, best describes the overall quality of the answer.*

Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):

o award the higher mark where the Communication Statement has been met.

o award the lower mark where aspects of the Communication Statement have been missed.

In summary:

• **The science content determines the level.**

• **The Communication Statement determines the mark within a level.**

Level 3 (5–6 marks)

Full and detailed explanation of how increased proton channels in inner mitochondrial membranes results in less likelihood of fat deposition in the body. Learner demonstrates a detailed understanding of the different processes involved and explains their implications.

There is a well-developed line of reasoning supported by clear scientific detail. The information presented is relevant and clearly explained.

Level 2 (3–4 marks)

Generally clear explanation of how increased proton channels in inner mitochondrial membranes results in less likelihood of fat deposition in the body. Learner demonstrates a reasonable understanding of the different processes involved and explains their implications.

There is an attempt at a line of reasoning supported by some scientific detail. The information presented is largely relevant and clearly explained.

Level 1 (1–2 marks)

Limited explanation of how increased proton channels in inner mitochondrial membranes results in less likelihood of fat deposition in the body. Learner demonstrates a limited understanding of the different processes involved and explains their implications.

There is little attempt at a line of reasoning supported by basic scientific detail. The information presented may be unclear and lack organisation.

0 marks

No response or no response worthy of credit.

Indicative scientific points may include...

- larger number of protons pores results in protons leaking back into matrix
- reduces yield of ATP from chemiosmotic gradients
- less ATP is made from oxidative phosphorylation
- more energy wasted as heat
- energy from chemiosmosis decoupled from ATP synthesis
- energy yield from aerobic respiration reduced per molecule of glucose
- food not converted to ATP as efficiently
- less excess energy intake in diet
- less deposition of fat
- fat stores may be respired for energy

[6]

OXIDATIVE PHOSPHORYLATION



14 JUN 7b

7(b)	<ol style="list-style-type: none">1. (Binding to CREB) prevents transcription/mRNA formation;2. (Binding of huntingtin) prevents production/translation of protein (that removes electrons/protons from NAD);3. Fewer electrons to electron transport chain/electron transport chain slows/stops/stops/slower oxidative phosphorylation;4. Fewer protons for proton gradient;5. Not enough ATP produced/energy supplied to keep cells alive / anaerobic respiration not enough to keep cell alive;	3 max	<ol style="list-style-type: none">1. Accept that lack of protein leaves NAD reduced 5. Accept neurones require ATP for active transport of ions 5. Ignore references to resting potential
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14 JUN 7c

7(c)	<ol style="list-style-type: none">1. CREB/protein is too large/is water soluble so cannot cross membrane/phospholipid bilayer;2. Mitochondrion has two membranes/inner and outer membranes;3. For each (different) membrane a (different) carrier required;	2 max	<ol style="list-style-type: none">2. Accept cristae for inner membrane 3. Ignore reference to channel proteins
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