Respiration (5.2.2): OCR A Level Biology Exam Questions by Topic

17 questions · 37 marks · about 44 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 3 · June 2024 · Q4(b) · 1 mark

(b) Outline why cellular respiration is necessary in cells that are carrying out DNA replication.

.....

..... **[1]**

Question 2 · A level Paper 1 · June 2017 · Q19(c)(i) · 3 marks

(c) Fig. 19.2 is a transverse section of a sperm cell. The mitochondria of sperm cells form a spiral around the central flagellum.

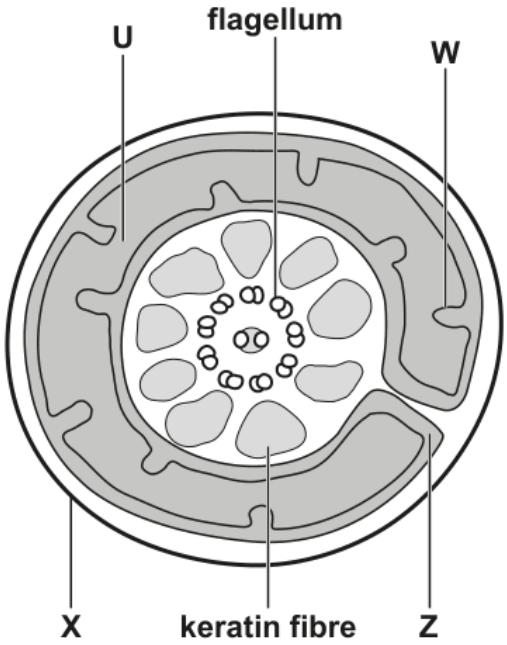


Fig. 19.2

(i) Identify the structures labelled with the following letters:

U .....

W .....

Z .....

[3]

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Question 3 · A level Paper 3 · June 2018 · Q2(a) · 4 marks

2 ATP can be produced in various ways. Each stage of respiration contributes to the production of ATP.

(a) Describe the production of ATP by **substrate-level phosphorylation** in different stages of respiration with reference to the number of ATP molecules produced.

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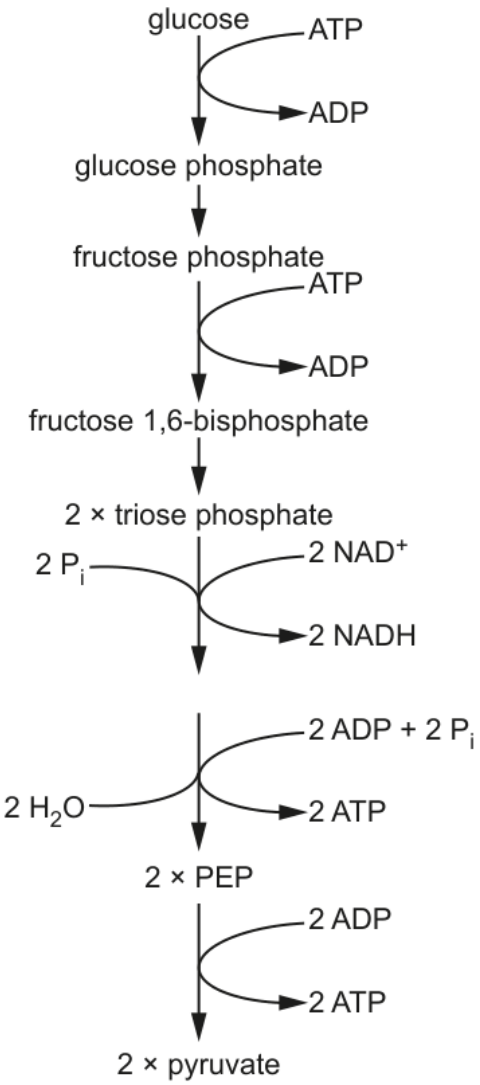
..... **[4]**

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Question 4 · A level Paper 1 · June 2025 · Q17(a)(i) · 1 mark

17

(a) The diagram shows some of the steps in glycolysis.



The enzyme phosphofructokinase (PFK) catalyses the conversion of fructose phosphate to fructose 1,6-bisphosphate (hexose bisphosphate).

(i) State the type of reaction that is catalysed by PFK.

..... **[1]**

Question 5 · A level Paper 1 · June 2025 · Q17(c)(i) · 1 mark

(c) The chemical equation for aerobic respiration with glucose as substrate is:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

(i) State the name of the type of reaction in aerobic respiration that produces CO_2.

..... **[1]**

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Question 6 · A level Paper 1 · June 2025 · Q17(c)(ii) · 2 marks

(ii) State the names of the **two** stages in respiration where CO_2 production occurs.

1 .....

2 .....

[2]

Question 7 · A level Paper 1 · June 2025 · Q17(c)(iii) · 2 marks

(iii) Respiration of glucose involves a series of oxidation reactions.

Explain how oxidation occurs in glycolysis.

.....

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.....

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..... **[2]**

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Question 4(b) begins on page 16

(b) Amino acids can be converted to other molecules and used in respiration.

Fig. 4.1 shows the formulae of five amino acids that can be used in respiration.

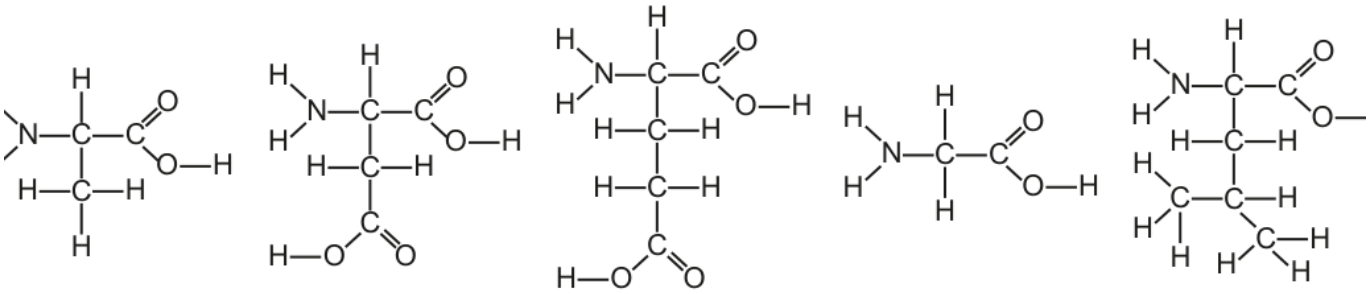


Fig. 4.1

Fig. 4.2 shows an outline of the link reaction and the Krebs cycle.

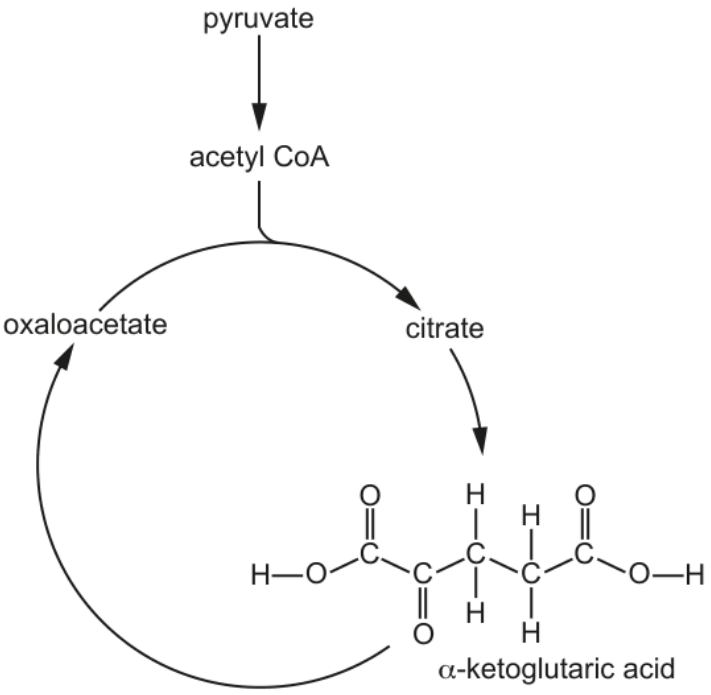


Fig. 4.2

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Question 8 · A level Paper 3 · November 2021 · Q4(b)(ii) · 2 marks

(ii) Outline the reactions that must occur to convert α-ketoglutaric acid to oxaloacetate in **Fig. 4.2**.

.....

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.....

..... **[2]**

Question 9 · A level Paper 3 · November 2021 · Q4(c) · 3 marks

(c) Most ATP is produced in mitochondria by chemiosmosis.

Outline how ATP is produced in mitochondria by chemiosmosis.

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.....

.....

.....

.....

..... **[3]**

Turn over

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(c) Cells can use fatty acids instead of carbohydrates as respiratory substrates. A process called beta oxidation is used to break down fatty acids to acetyl CoA for use in respiration.

Fig. 2 shows a simplified example of beta oxidation.

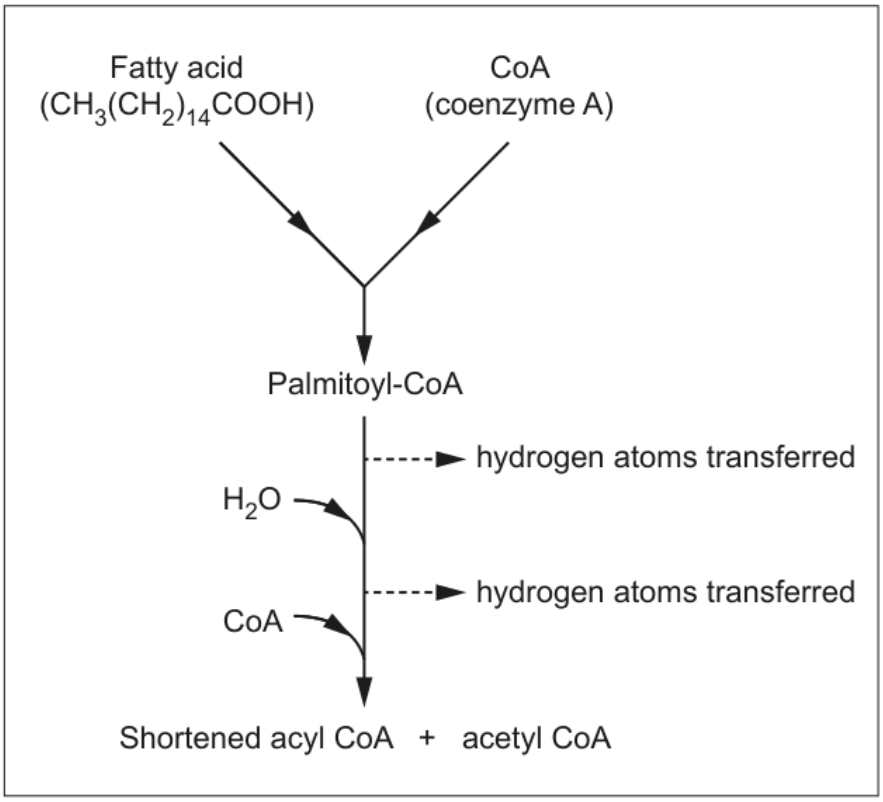


Fig. 2

(i) Using the information in Fig. 2, calculate the percentage of carbon atoms in the fatty acid that are able to enter the Krebs cycle.

Answer = ... % **[1]**

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Question 10 · A level Paper 3 · June 2018 · Q2(c)(iii) · 1 mark

(iii) Fig. 2 shows the role of coenzyme A in beta oxidation.

Suggest a role for coenzymes **other than coenzyme A** in beta oxidation.

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..... **[1]**

Turn over

Question 11 · A level Paper 3 · June 2023 · Q2(c)(i) · 2 marks

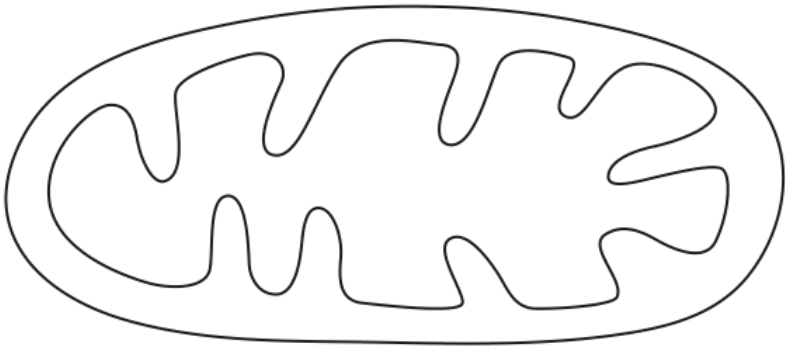
(c) Vitamin B_2 is used by the body to make FAD. Vitamin B_3 is used by the body to make NAD.

(i) A mitochondrion is shown in **Fig. 2.3**.

Label **Fig. 2.3** to show the locations where FAD gains H atoms and where FAD releases H atoms during respiration.

- Use the letter **E** to show where FAD gains H atoms.
- Use the letter **F** to show where FAD releases H atoms.

Fig. 2.3



[2]

Questions, mark schemes and examiners' report extracts © OCR.

Question 12 · A level Paper 3 · June 2023 · Q2(c)(ii) · 2 marks

(ii) The table lists features that are correct for FAD, NAD, both or neither.

Complete the table by adding a tick (✓) to a box where the feature is correct and a cross (✗) where the feature is incorrect. You should add either a tick or a cross to every box in the table.

Feature	FAD	NAD
Is a prosthetic group		
Is reduced in the link reaction		
Oxidises molecules in the electron transport chain		

[2]

Question 13 · A level Paper 3 · June 2024 · Q4(c)(ii) · 2 marks

(ii) André Jagendorf provided evidence for chemiosmosis in an experiment carried out in the 1960s.

In his experiment, Jagendorf:

- broke open chloroplasts to expose thylakoids, in the dark
- placed the thylakoids into a solution buffered at pH 4 (solution 1)
- after a short time period, transferred some of these thylakoids to a new solution buffered at pH 4 that contained ADP and P_i (solution 2)
- transferred other thylakoids from solution 1 to a new solution buffered at pH 8 that contained ADP and P_i (solution 3).

ATP production was measured in solution 2 and solution 3.

Explain what you would expect to observe in solution 2 and solution 3 after the transfer of the thylakoids.

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..... **[2]**

Questions, mark schemes and examiners' report extracts © OCR.

Question 14 · A level Paper 3 · June 2019 · Q2(d)(i) · 2 marks

(d) Naked mole rats can survive without oxygen for up to 18 minutes. This is several times longer than other mammals of a similar size.

The following information might help to explain how naked mole rats can survive without oxygen for a long time:

- In normal glycolysis, the enzymes needed to convert glucose to triose phosphate may be inhibited by lactate.
- Naked mole rats can use fructose as a respiratory substrate.
- Fructose is converted to triose phosphate.
- Triose phosphate can then enter the glycolysis pathway.

(i) Suggest why the use of fructose allows naked mole rats to survive without oxygen for a long time.

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..... **[2]**

Question 15 · A level Paper 3 · June 2023 · Q5(b)(ii) · 3 marks

(ii) Complete the sentences using appropriate words or phrases.

This is the method that the student uses in their experiment:

- To avoid contamination, place the yeast in glucose solutions that are produced using ..... water.
- Culture each species of yeast in different flasks.
- Ensure anaerobic conditions by using a ..... flask.
- Use the rate of CO_2 production as a measure of respiration rate.
- Standardise all other variables.
- Repeat the measurements with 10 populations from each species and calculate two means and two ..... .
- Analyse the data using a Student's *t*-test.

[3]

Questions, mark schemes and examiners' report extracts © OCR.

19 Honeypot ants belong to several different genera. Some specialised individuals are used as food storage vessels. These individuals have swollen abdomens that store various foods, which can be given to members of the colony when required.

One such individual is shown in Fig. 19.1.



Fig. 19.1

An investigation was carried out into the respiratory substrate of three different genera of honeypot ant, by measuring oxygen uptake and carbon dioxide production.

The data are shown in Table 19.1.

Genus	CO_2 produced ($mm^3 s^{-1}$)	O_2 consumed ($mm^3 s^{-1}$)
Camponotus	0.89	0.88
Melophorus	0.59	0.66
Cataglyphis	1.01	1.47

Table 19.1

21

(a) Use the data in Table 19.1 to suggest the likely diet of each genus of honeypot ant.

Justify your answer.

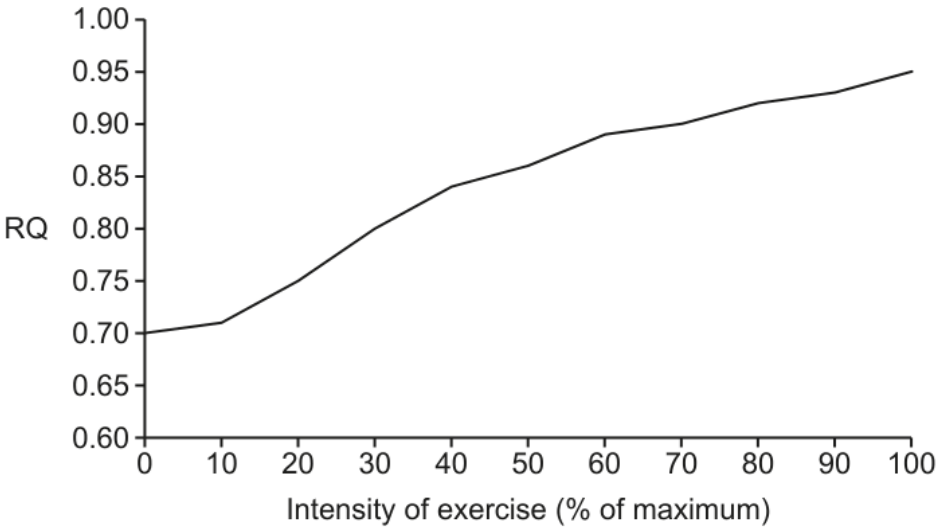
Genus	Diet	Justification
Camponotus	mainly carbohydrate	.....
		.....

Questions, mark schemes and examiners' report extracts © OCR.

Question 17 · information from earlier in the question

(c) **Fig. 20.3** shows how the respiratory quotient (RQ) of an athlete changed during exercise, from rest (0%) up to 100% maximum effort.

Fig. 20.3



(i) State the **two** measurements that you would need to make during the experiment to calculate RQ.

1 .....

2 .....

[1]

Question 17 · A level Paper 1 · June 2024 · Q20(c)(ii) · 3 marks

(ii) Explain what **Fig. 20.3** shows about the respiratory substrate(s) used at different intensities of exercise.

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..... **[3]**

Questions, mark schemes and examiners' report extracts © OCR.

Mark schemes

Question 1 · A level Paper 3 · June 2024 · Q4(b) · 1 mark

4	(b)	(produces) ATP to provide (chemical) energy / AW ✓ (DNA replication) requires ATP / AW ✓	1

Question	Answer	Mark

DO NOT ALLOW 'produces energy'
ALLOW requires ATP as it is an active process

ALLOW 'because ATP is needed'

Guidance

e.g. need for ATP (in, DNA replication / to break bonds between bases / form phosphodiester bonds)

Question 2 · A level Paper 1 · June 2017 · Q19(c)(i) · 3 marks

19	(c)	(i)	**U** matrix ✓ **W** crista(e) / inner (mitochondrial) membrane ✓ **Z** inter-membrane space ✓	3

IGNORE ETC / ATP synthase / cytochromes

ALLOW inter-membranal space

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Question 3 · A level Paper 3 · June 2018 · Q2(a) · 4 marks

2	a	2 (ATP molecules per glucose) from, glycolysis	**4 max**

/ (breakdown of) triose (bis)phosphate ✓

(when) triose (bis)phosphate / TP, converted / broken down, to pyruvate ✓

ref to net yield of 2 (ATP) / 4 (ATP) made but 2 used up (in glycolysis) ✓

1 ATP (produced) per, (turn of the) Krebs cycle / acetyl (coA) ✓

when 5-carbon compound is converted to, 4-carbon compound / oxaloacetate ✓

ALLOW '4 ATP made from 2 TP's'

'net yield of 2 ATP's in glycolysis' = mp1 and 3 for 2 marks

ALLOW 2ATP, per glucose in Krebs cycle / from every 2 acetyl (coA)

ALLOW 'when citrate converted to oxaloacetate'

ALLOW 'when succinyl CoA converted into succinate'

ALLOW 'between (intermediate) 4C compounds'

Question 4 · A level Paper 1 · June 2025 · Q17(a)(i) · 1 mark

17	(a)	(i)	phosphorylation ✓	**1**	2.5	**DO NOT ALLOW** 'substrate level' phosphorylation

Question 5 · A level Paper 1 · June 2025 · Q17(c)(i) · 1 mark

17	(c)	(i)	(oxidative) decarboxylation ✓	**1**	1.2

Question 6 · A level Paper 1 · June 2025 · Q17(c)(ii) · 2 marks

17	(c)	(ii)	link (reaction) ✓ Krebs (cycle) ✓	**2**	1.2	**ALLOW** any order

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Question 7 · A level Paper 1 · June 2025 · Q17(c)(iii) · 2 marks

Question			Answer	Marks	Element
17	(c)	(iii)	*Oxidation occurs in glycolysis when* Dehydrogenation / removal of H (from TP) ✓ H goes to, NAD / coenzyme / H acceptor ✓	2	1.2

ALLOW '$H^+ + e^-$' for 'H'

IGNORE triose bisphosphate

ALLOW to reduce, NAD/ coenzyme
ALLOW NAD(+) ⟶ NADH
Max 1 if H^+ / e-, only stated

Award 2 marks for:
e.g.

- *a hydrogen is removed to form NADH*
- *NAD accepts hydrogen from TP*

Guidance

Question 8 · A level Paper 3 · November 2021 · Q4(b)(ii) · 2 marks

ii	decarboxylation / carbon dioxide produced ✓ dehydrogenation / hydrogen removal / reduced NAD produced / reduced FAD produced ✓ ATP produced ✓ succinyl co-A / succinate / fumarate / malate / 4 C intermediate, produced ✓

2 max	1.2 2.5	ALLOW mp's from correct equations

Question 9 · A level Paper 3 · November 2021 · Q4(c) · 3 marks

	c		*idea of* establishment of H^+ ion gradient ✓ H^+ ions, flow down a concentration gradient / AW ✓ from intermembrane space to matrix ✓ through ATP synthase ✓ energy, provided / AW, to join ADP and Pi (to form ATP) ✓	**3 max**	1.1	e.g. ' pumping protons into intermembranal space' **DO NOT ALLOW** 'H^+ ions pumped (from intermembrane space / through ATP synthase) **DO NOT ALLOW** 'energy produced to join ADP and Pi'

Question 10 · A level Paper 3 · June 2018 · Q2(c)(iii) · 1 mark

		iii	(FAD/NAD) accepts / is reduced by/ transfers / AW, hydrogen (atoms) ✓	1	**DO NOT ALLOW** hydrogen, ions / molecules **ALLOW** 'carries / transports / picks up, hydrogens' **IGNORE** 'removes, hydrogens'

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Question 11 · A level Paper 3 · June 2023 · Q2(c)(i) · 2 marks

Question			Answer	Mark	AO Element
2	(c)	(i)	label E anywhere in the mitochondrial matrix ✓ label F on inner mitochondrial membrane ✓	2	1.1 2.1

Guidance

CON a second label E in the cytoplasm
ALLOW a line to the inner membrane or any part of the letter F touching the membrane

Question 12 · A level Paper 3 · June 2023 · Q2(c)(ii) · 2 marks

2 (c) (ii) — 2 marks — 1.1

Feature	FAD	NAD
Is a prosthetic group	✓	×
Is reduced in the link reaction	×	✓
Oxidises molecules in the electron transport chain	×	×

✓ ✓

2 rows correct = 1 mark
3 rows correct = 2 marks

DO NOT ALLOW hybrid ticks
ALLOW 'yes' or 'no' in place of '✓' or '×'
ALLOW if only '✓' or '×' used in table

ALLOW '×' for FAD is a prosthetic group

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Question 13 · A level Paper 3 · June 2024 · Q4(c)(ii) · 2 marks

4	(c)	(ii)	*(ATP produced in 3 / pH 8 solution, but not 2 / pH 4 solution, because)* proton gradient between thylakoid (lumen / space) and solution 3 ✓ protons diffuse through ATP synthase (into solution 3) ✓	2

If ATP produced in 2 but not 3 or ATP production is, higher / highest, in 3 or more ATP produced in 3 than 2 = 0 marks

ALLOW H^+ / hydrogen ions for protons throughout
DO NOT ALLOW H / hydrogen for protons throughout (but penalise only once)

ALLOW electrochemical gradient for proton gradient
ALLOW higher concentration of protons in thylakoid (lumen / space) than in solution 3
ALLOW no proton gradient / equal proton concentration, between thylakoid (lumen) and solution 2

ALLOW no protons diffuse through ATP synthase into solution 2
DO NOT ALLOW 'pumped through by diffusion'
ALLOW 'pass' / move / travel' for 'diffuse'

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Question 14 · A level Paper 3 · June 2019 · Q2(d)(i) · 2 marks

d	**i**	glycolysis / anaerobic respiration, can continue / AW ✓ because, conversion of glucose to TP is not needed / lactate inhibition is irrelevant / AW ✓ ATP is produced when TP is converted to pyruvate ✓

2 max	**IGNORE** lactate pathway **ALLOW** description of glycolysis e.g. 'enzymes needed to convert fructose to triose phosphate are not inhibited by lactate'

Question 15 · A level Paper 3 · June 2023 · Q5(b)(ii) · 3 marks

5	**(b)**	**(ii)**	sterilised / boiled / distilled ✓ sealed / vacuum / airtight / closed / described ✓ standard deviation(s) ✓	**3**	3.3	e.g. 'put bung in (flask)'

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19 (a) 3

Genus	Diet	Justification
Camponotus	mainly carbohydrate	(RQ is) 1.0
Melophorus	protein **OR** lipid **and** carbohydrate	(RQ is) 0.9
Cataglyphis	lipid	(RQ is) 0.7

✓✓✓

DO NOT ALLOW all three substrates for *Melophorus*
ALLOW amino acids for protein for *Melophorus*
ALLOW fat / oil / triglyceride / fatty acid for lipid for *Cataglyphis*

ALLOW THREE marks for correctly completed table
ALLOW RQs to greater number of sig.figs. e.g. 1.01 / 0.89 / 0.687
If **Rf or RV** is stated instead of RQ allow **max 1** for **justification** column

ALLOW TWO marks for all correctly calculated RQ values in **justification** column / on Fig.19.1
OR
ALLOW TWO marks for:
correct two responses in **diet** column
AND
for correct three **justifications** written in words i.e.
Camponotus – CO_2 produced is , similar / equal to O_2 consumed
Melophorus - CO_2 produced is 0.07 less than O_2 consumed
Cataglyphis - CO_2 produced is 0.46 less than O_2 consumed

If RQ values have not been calculated or are incorrect

ALLOW ONE mark for correct **diet** column
OR

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Question 17 · A level Paper 1 · June 2024 · Q20(c)(ii) · 3 marks

20	(c)	(ii)	RQ of carbohydrate is 1 / RQ of fat is (approx) 0.7 ✓ at rest fat is used ✓ as intensity increases (more) carbohydrate is used ✓ (even) at highest intensity some fat is used **OR** (even) at highest intensity not just carbohydrate is used ✓	**max 3**
			Total	**15**

Question	**Answer**	**Mark**

ALLOW named carbohydrates e.g. sugars
ALLOW fatty acids / named fats e.g. lipids
IGNORE ref to protein at 0.8 (approx.)

ALLOW 0% / low / 0-10% intensity for at rest

ALLOW at 100% intensity
ALLOW at high intensities mixed respiratory substrates / mainly carbohydrate being used
IGNORE protein and fat / carbohydrate and fat

Guidance

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