Assignment 01: Energy, respiration and testing a hypothesis

General: Read this before you start!

The total marks for this assignment is 50.

Recommended time: 60 minutes

- Candidates will answer on the question paper.
- It is recommended that this assignment should be done under test conditions.
- Write in black ink.
- You may use an HB pencil for any diagrams or graphs.
- Do not use red ink, staples, paper clips, highlighters, glue or correction fluid.
- Answer **all** questions.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
- The use of an electronic calculator is expected, where appropriate.
- You are reminded of the need for clear presentation in your answers.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- At the end of this assignment is a feedback section. Please feel free to make suggestions about the course or bring any issues to my attention.

Layout of the assignment

Section A: Shorter questions [24]

This section consists of a variable number of structured questions, each with a variable mark value. All questions will be based on the A-Level syllabus but may require knowledge of material first encountered in the AS-Level syllabus.

Section B: Shorter questions [15]
Free response style questions

Section C: Planning, analysis and evaluation [11]
Hypothesis-type question

Please fill in the section below before you start:

Name and Surname: _____ Date: _____

Method of completion (Indicate with a tick):

Under **test conditions**: Without any resources, such as textbooks, notes or online resources.		**Open book:** Used resources, such as textbooks, notes or online resources.	

Sign_____

Be sure to scan this together with your assignment for marking. No marking of assignments will be done without this declaration.

SECTION A [24]

Question 1

(a) The link reaction and Krebs cycle take place in the mitochondrion. The main stages of the link reaction and Krebs cycle are listed in **Table 1.1** below. They are not listed in the correct order.

Table 1.1

Stage	Description of stage
A	acetyl group combines with coenzyme A to form acetyl CoA
B	citrate is formed
C	hydrogen atoms are accepted by NAD and FAD
D	oxaloacetate is regenerated
E	pyruvate enters the mitochondrial matrix
F	acetyl group is formed
G	acetyl CoA enters Krebs cycle
H	ATP is made by substrate-linked phosphorylation
I	pyruvate is decarboxylated and dehydrogenated
J	acetyl CoA combines with oxaloacetate
K	citrate is decarboxylated and dehydrogenated

Complete **Table 1.2** below to show the correct order of the stages.
Three of the stages have been done for you.

Table 1.2

Correct order	Letter of stage
1	E
2	
3	
4	
5	
6	J
7	
8	
9	
10	
11	D

[4]

(b) Outline the role of NAD in respiration in aerobic conditions.

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(c) Carbon dioxide is removed from compounds in both the link reaction and Krebs cycle by decarboxylation.

(i) State the total number of molecules of carbon dioxide removed in the link reaction and Krebs cycle for each molecule of glucose respired.

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(ii) In a mammal, carbon dioxide diffuses from cells into the blood to be transported to the lungs. Suggest why carbon dioxide is transported in the blood, mainly as hydrogen carbonate ions and not as carbonic acid.

..... [1]

[Total: 10]

Question 2

ATP and NAD both play important roles in respiration. Both compounds are nucleotides.

Figure 2.1 represents the molecular structures of ATP and NAD.

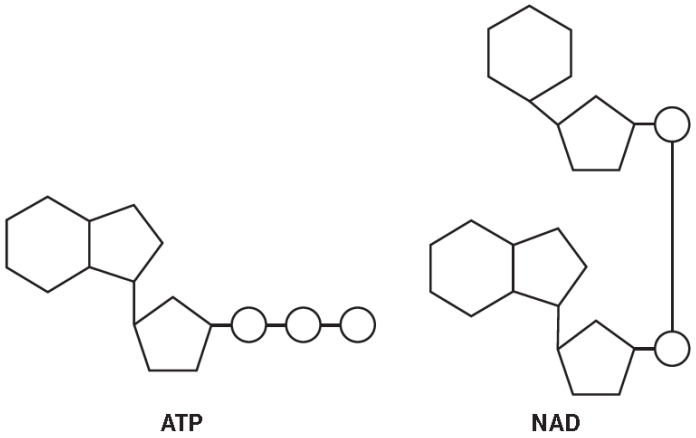

Fig. 2.1

(a) Using Figure 2.1, compare the structures of ATP and NAD.

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(b) ATP provides an immediate energy source for metabolic processes, such as anabolic reactions. State two examples of anabolic reactions in a mammal that require ATP as an energy source.

1.....

2.....[2]

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

..... [1]

(d) Carbohydrates and lipids are used as respiratory substrates.

Table 2.1 shows the energy values of carbohydrates and lipids.

Table 2.1

Respiratory substrate	Energy value / kJ g^{-1}
Carbohydrate	15.8
Lipid	39.4

Explain why lipids have a higher energy value than carbohydrates.

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[Total: 8]

Question 3

(a) The poison cyanide binds with cytochrome oxidase, one of the carriers in the electron transport system.

Suggest how ingestion of cyanide by humans leads to death by muscle failure.

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(b) Tripalmitin is a triglyceride. The chemical equation for the aerobic respiration of tripalmitin is:

$$2C_{51}H_{98}O_6 + 145O_2 \longrightarrow 102CO_2 + 98H_2O$$

(i) Calculate the RQ value for tripalmitin.

Give your answer to 2 decimal places.

Show your working.

answer .....[2]

[Total: 6]

SECTION B [15]

(a) Describe how ATP is synthesised by oxidative phosphorylation. [9]

(b) Explain how rice is adapted to grow with its roots submerged in water. [7]

SECTION C [11]

Figure 1.1 shows an aquatic crustacean belonging to the genus *Daphnia*. These animals usually measure between 1–5 mm in length. They have a two-chambered heart, which can be seen through the exoskeleton when viewed using a low-powered microscope.

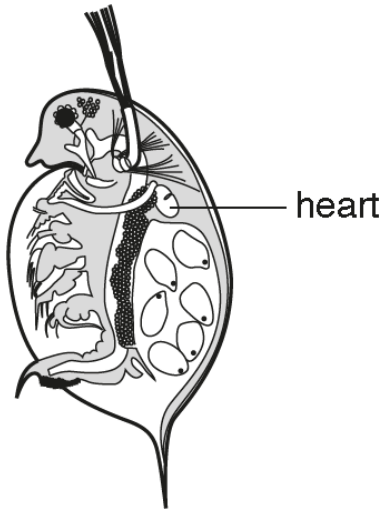

Fig. 1.1

A biology teacher told a class that caffeine can temporarily relieve tiredness in people by increasing their heart rate.

Table 1.1 shows the caffeine content of various products.

Table 1.1

product	caffeine per serving / mg
1 cup of strong coffee	100
50 g dark chocolate	45
1 caffeine tablet	50
1 can of cola drink	20

One group of students in the class used *Daphnia* to test the hypothesis:

Heart rate increases when caffeine concentration increases.

(a) Identify the following variables in this investigation:

Independent.....

Dependent .....

Controlled variable.....[3]

The group of students decided to use the caffeine tablets to make a 100 mg dm^{-3} caffeine solution.

(b) Describe a procedure that the students should use to prepare the 100 mg dm^{-3} caffeine solution.

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A culture of healthy *Daphnia* was supplied to the students in a tank containing fresh water and a suitable food source.

Each student followed the same basic procedure:

- A *Daphnia* was placed on some cottonwool fibres in a cavity microscope slide, as shown in Figure 1.2 on the next page.
- A few drops of 100 mg dm^{-3} caffeine solution were immediately added to the slide.
- The *Daphnia* was observed using the low power objective lens of a microscope.
- The number of heart beats of the *Daphnia* was counted.

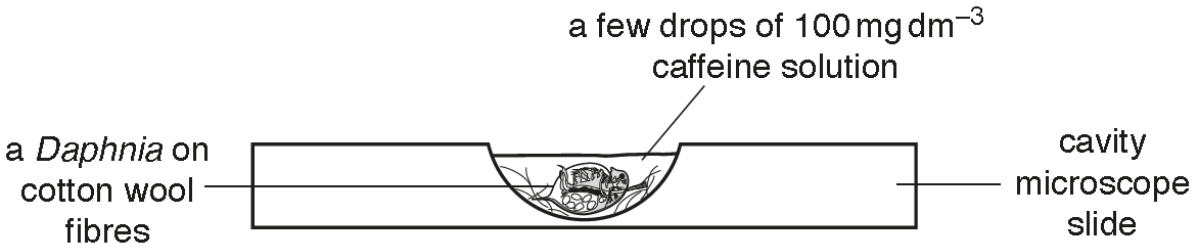

Fig. 1.2

(ii) The students decided to adapt their basic procedure to test their hypothesis that:

Heart rate increases when caffeine concentration increases.

Describe a method that the students could use to test this hypothesis.

Your method should be detailed enough for another person to follow.

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Feedback – This is absolutely voluntary!
Please note that this section will not affect your assignment mark in any way!
Here you can make your voice heard! Please take two minutes to answer a few questions and write down any comments (good and/or bad ☺) you would like me to look at.

About the course
Rate how you find the following using the rating scale. You can colour in the blocks or simply make a tick.

1 = strongly disagree,
5 = strongly agree

1. I enjoyed the course material.

1	2	3	4	5

Comments……
……

2. The teacher helped me to understand the work better.

1	2	3	4	5

Comments……
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General
I found the following challenging about this section:
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I did not like___ about this section:
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I liked ___ about this section:
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Thank you for completing this section! I really appreciate it. I will get back to you if you had any suggestions/queries.