11. One of the main functions of the liver cells is the formation of urea by the ornithine cycle, an outline of which is shown in **Fig. 17.2**.

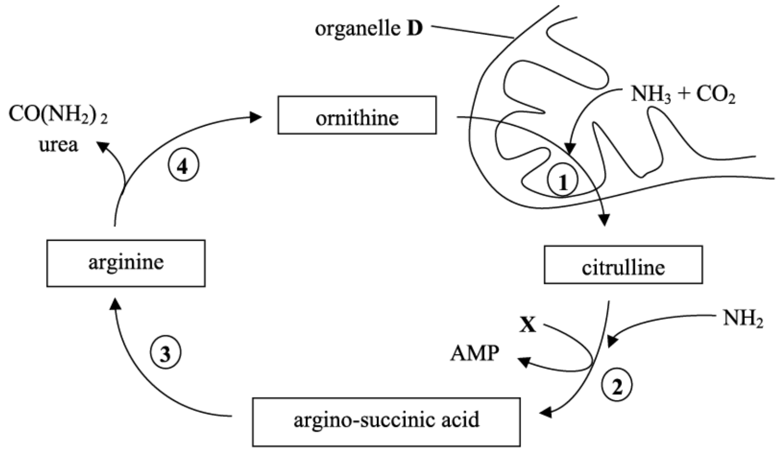

Fig. 17.2

i. Step **1** of the cycle takes place in the organelle represented by **D**.

Identify organelle **D**.

____ **[1]**

ii. During the cycle ornithine moves into organelle **D** and citrulline moves out of the organelle.

Suggest the method by which these molecules move into and out of the organelle during the cycle. Give reasons for your choice.

____

____

____

____ **[2]**

iii. How has the ammonia that is used in step **1** been formed?

____

____ **[1]**

iv. Identify the compound labelled **X** in **Fig. 17.2**.

____ **[1]**

12. A group of students set up a simple respirometer, as shown in **Fig. 1.1**, and used it to determine the rate of respiration in germinating mung beans.

- They placed a small muslin bag of soda lime into the syringe and then added five germinating mung beans, which were held in place with the syringe plunger.
- The students measured the movement of the red fluid in the capillary tube.
- After each set of readings the plunger was reset to return the fluid to its original position.

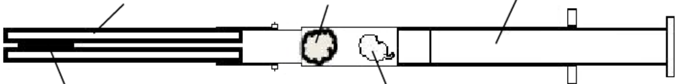

Fig. 1.1

The results are shown in **Table 1.1**.

Time (s)	**Distance moved by the red fluid in capillary tube (mm)**		
	1	**2**	**3**
0	0.0	0.0	0.0
30	11.5	12.0	12.5
60	22.5	21.5	17.5
90	31.0	32.0	32.5
120	41.5	42.0	42.5
150	53.0	54.0	53.5
180	63.0	63.0	64.0
210	72.5	71.0	71.5
240	78.5	79.5	79.0
270	87.5	88.5	87.0

Table 1.1

a. Give **one** limitation of using this method to investigate respiration rate.

____

____ **[1]**

b. Read the procedure carefully. Identify **one** variable that had not been controlled in this experiment **and** suggest an improvement to control that variable.

Variable ____

Improvement ____

____

[2]

c. Describe how you would add the red fluid to the capillary tube at the start of the experiment.

____

____

[1]

d. The data shows an anomalous result at 60 seconds.

Explain why the result is considered to be anomalous **and** describe one correct way of dealing with this type of result.

____

____

____

____

[2]

e. Using the data the student obtained, calculate the mean rate of respiration for germinating mung beans between 90 and 150 seconds.

Answer.. **[1]**

f. What additional information would be needed to calculate:

i. the volume of oxygen taken up by the seconds.

____ **[1]**

ii. the oxygen uptake for this batch of seeds to be comparable with data from another type of bean.

____ **[1]**

g. * The group of students wanted to find out if the rate of respiration of a small invertebrate animal was comparable to that of the mung beans.

Adapt the procedure used to investigate the respiration rate of a small invertebrate, such as a woodlouse or caterpillar, with that of mung beans.

Comment on the results you might expect from this experiment and the conclusions you might draw.

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____ **[6]**

13(a). Termites are highly social insects. They are thought to have evolved from earlier forms of insect at least 150 million years ago, in the Jurassic geological period. They are related to cockroaches.

i. How might scientists a century ago have known that termites evolved in the Jurassic geological period?

____

____ **[1]**

ii. What new source of evidence might help today's scientists to find out how closely related termites are to cockroaches?

____

____ **[1]**

(b). Fig. 5.1 shows a termite mound, the nest of approximately one million individuals. The photograph was taken in Queensland Australia, about 3000 kilometres south of the equator.

i. **Fig. 5.1** shows that the interior of the termite mound is full of interconnecting chambers. At the top of the mound some of these chambers open to the air outside.

ii. Worker termites spend all their time working in brood chambers low in the mound, where eggs and larvae develop.

Explain how carbon dioxide produced in the respiring body cells of worker termites is removed to the air outside the termite mound.

____

____

____

____

____

____ **[4]**

iii. In Africa, closer to the equator, the mounds built by some species of termite are blade-shaped, with the long axis pointing North–South. **Fig. 5.2** shows an example of a termite mound in Africa.

Fig. 5.2

Suggest why the African termites need to build mounds in this shape and orientation.

____

____

____ **[2]**

14. An investigation was carried out into the effect of adding different volumes of water on the survival of seedlings.

There were 60 seedlings in each group.

The results are shown in Table 18.

Volume of water added to soil (cm^3)	Day	Number of seedlings surviving
10	3	60
	6	59
	9	59
	12	58
	15	57
	18	57
20	3	60
	6	57
	9	54
	12	54
	15	54
	18	53
30	3	60
	6	58
	9	56
	12	50
	15	50
	18	48
40	3	60
	6	48
	9	40
	12	34
	15	26
	18	20
60	3	60
	6	41
	9	21
	12	6
	15	2
	18	2

Table 18

i. Summarise the conclusions that can be drawn from these data.

____

____

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____

____ **[3]**

ii. Water can fill air spaces in the soil surrounding the roots.

This prevents oxygen from reaching root hair cells.

Using your knowledge of aerobic and anaerobic respiration, explain why overwatering can kill plants.

[6]

15. The endosymbiosis theory suggests that mitochondria may have evolved from bacteria that were taken inside other cells.

These cells then evolved into eukaryotes.

i. Give **two** structural features of mitochondria that support this theory.

1 ____

____

2 ____

____

[2]

ii. Explain why early eukaryotes were able to grow more quickly than cells that did not possess mitochondria.

____

____

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____

____

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____ **[3]**

16. Fig. 16.1 shows the structure of ATP.

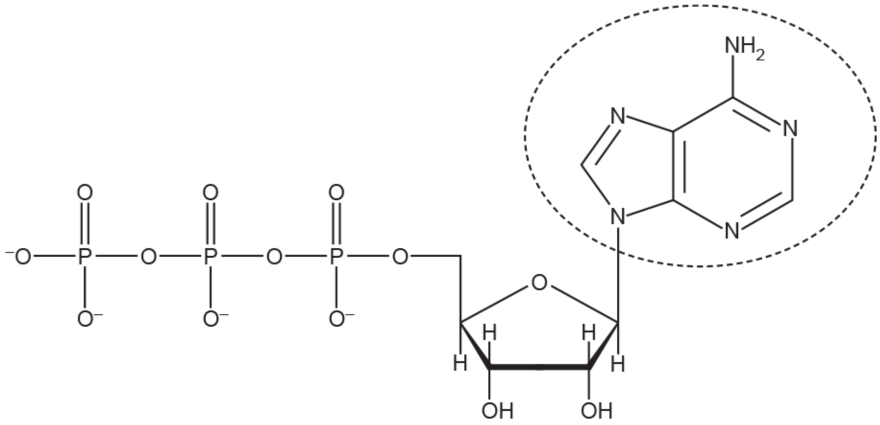


Fig. 16.1

i. Name the circled component in Fig. 16.1.

______________________________ **[1]**

ii. Name the type of reaction that occurs when ATP is converted to ADP.

______________________________ **[1]**

iii. A teacher told his students that the human body makes the equivalent of its own mass in ATP every day.

Explain why, at the end of the day, only a small proportion of the students' mass was ATP.

____

____

____

______________________________ **[2]**

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

1 ______________________________

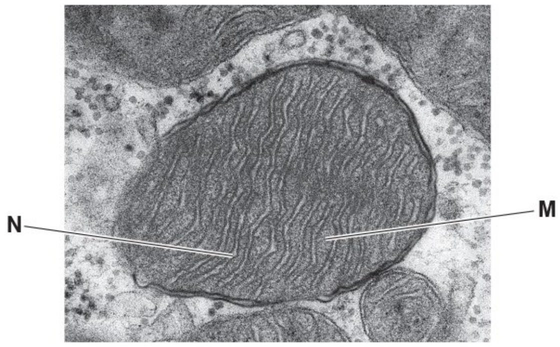
____

2 ______________________________

____

[2]

(b). The image below is a photomicrograph of a mitochondrion.



i. State the type of microscope used to produce this image.

____ **[1]**

ii. Identify the structures labelled **M** and **N** in the photomicrograph.

M ....

N ....

[2]

18. Brown fat is a type of tissue.

Brown fat has a higher need for oxygen because fat cells in this tissue carry out aerobic respiration at a higher rate than fat cells in other tissues.

Suggest which organelle is present in higher numbers in brown fat cells than in other fat cells.

____ **[1]**

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

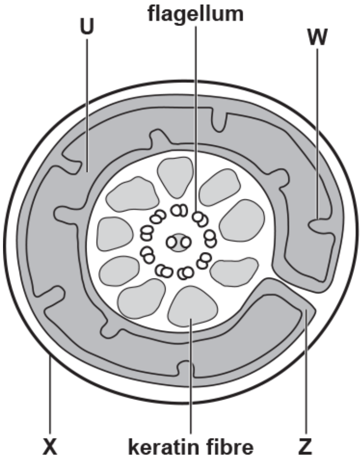


Fig. 19.2

i. Identify the structures labelled with the following letters:

U ______________________________

W ______________________________

Z ______________________________

[3]

ATP, $FADH_2$ and hexose 1,6-bisphosphate are three organic products of respiration in sperm cells.

Table 19 shows how the production of ATP, $FADH_2$ and hexose 1,6-bisphosphate in sperm cells is affected by three different substances.

Substance	**Organic products of respiration per sperm cell**		
	ATP (10^{-10} mol s^{-1})	**$FADH_2$ (10^{-11} mol s^{-1})**	**Hexose 1,6-bisphosphate (10^{-11} mol s^{-1})**
Cyanide	2.54	0.00	5.78
Fluoride	0.00	0.00	0.00
Sucrose	6.89	2.53	5.42

Table 19

ii. What can be concluded about the difference between the effects of **cyanide** and **fluoride** on respiration in sperm?

____

____

______________________________ **[1]**

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

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

____

____

____

____

____

____

____ **[4]**

21. Fig. 2.1 shows a naked mole rat, *Heterocephalus glaber*.

Fig. 2.1

The naked mole rat is a mammal. However, it has several features that are unusual for mammals.

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.

____

____

____

____ **[2]**

ii. Suggest **one** other aspect of the physiology of naked mole rats that explains how they are able to survive without oxygen for a long time.

____

____

____ **[1]**

22. 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.

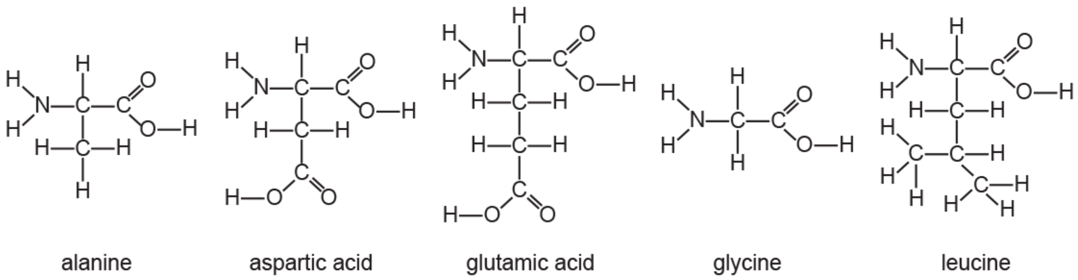


Fig. 4.1

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

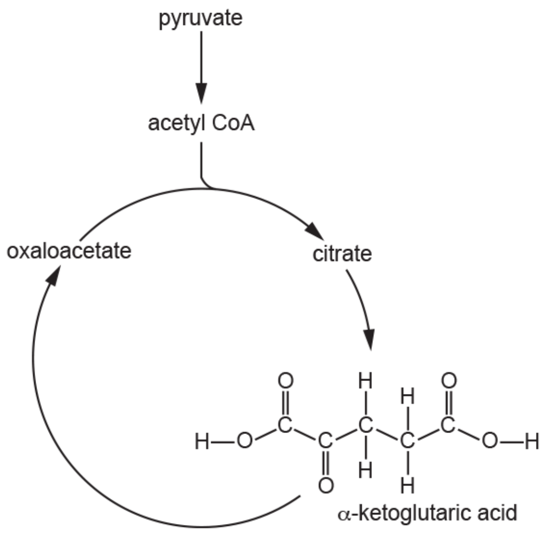


Fig. 4.2

i. The table below contains information about three amino acids.

Use **Fig. 4.1** and **Fig. 4.2** and your own knowledge to draw a conclusion about which amino acid is being described.

Write your conclusions and a justification for each conclusion in the table.

Information about amino acid	Conclusions	
	Name of amino acid	**Justification**
Converted to pyruvate with the fewest changes		....
Converted to α-ketoglutaric acid with the fewest changes		....
The amino acid with the highest RQ		....

[4]

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

____

____

____

____

____ **[2]**

23. NAD, FAD and Coenzyme A (CoA) are molecules that are involved in cellular respiration.

Which of the following statements about these molecules is / are correct?

1 NAD and FAD are examples of coenzymes.
2 NAD is reduced by accepting hydrogen atoms.
3 CoA delivers the three carbon atoms of pyruvate to the Krebs cycle in the form of an acetyl group.

A 1, 2 and 3 are correct
B only 1 and 2 are correct
C only 2 and 3 are correct
D only 1 is correct

Your answer

[1]

24. Respiration is an important metabolic process that takes place in all living cells.

What is the **precise** location of the link reaction within cells?

____ **[1]**

25. 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.

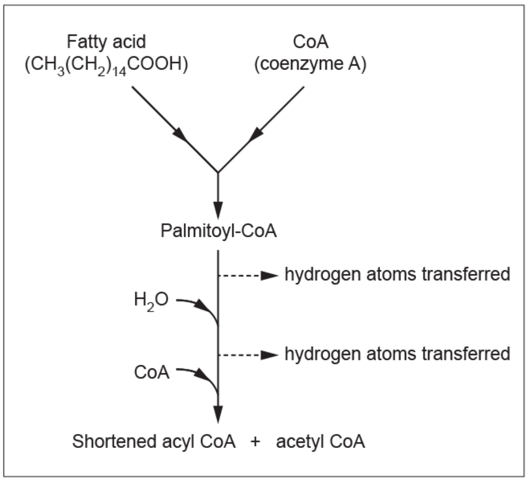


Fig. 2

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]**

ii. The percentage of carbon atoms that a reaction makes available for use in the Krebs cycle can be described as the efficiency of the reaction.

Calculate the efficiency of the **link reaction**. Using your answer to part (i), state whether the link reaction is **more, less** or **equally** efficient when compared to the reactions described in Fig. 2.

Show your working.

Answer = ____ %

Link reaction is ______________________________________ efficient

[1]

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

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

____

____ **[1]**

26. Respiration is an important metabolic process that takes place in all living cells.

Fig. 19.1 is an outline of the Krebs cycle.

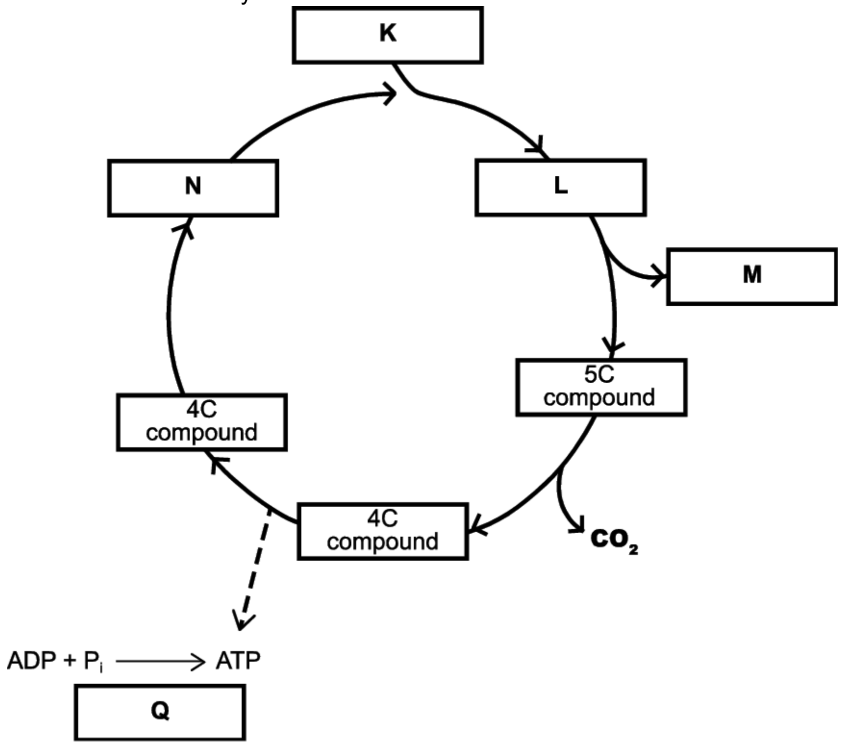


Fig. 19.1

i. For each of the letters below write the **molecule** that is missing from the diagram.

K ____

L ____

M ____

N ____

[4]

ii. Name the **process** represented by the letter **Q**.

____ **[1]**

27. * The light-independent stage requires coenzymes. For example, NADPH reduces molecules by adding electrons, and ATP phosphorylates molecules by adding phosphate groups.

Coenzymes are involved in other cellular processes, including respiration.

Summarise the importance of coenzymes in **respiration**. You should include details of the molecules and processes involved.

____

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____ **[6]**

28(a). *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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____

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____

____

____

____

____ **[6]**

(b). 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.

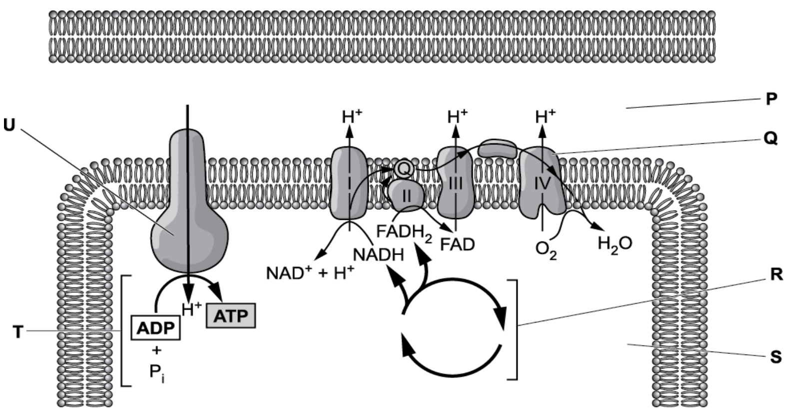

Fig. 18

i. Name the **components** labelled **U** and **Q**.

U ____

Q ____

[2]

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

P ____

S ____

[2]

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

R ____

T ____

[2]

(c).

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]**

29. * Insects use glucose to generate ATP.

Outline the processes involved in the generation of ATP through **chemiosmosis**.

[6]

30. Most ATP is produced in mitochondria by chemiosmosis.

Outline how ATP is produced in mitochondria by chemiosmosis.

[3]

31(a). A student carried out an investigation into the production of CO_2 in five different species of yeast.

The yeast cells were placed in different environments and the CO_2 production was measured.

Table 20 shows the results of the experiment. The mean values for these data are also represented as a graph in Fig. 20.

Conditions		Carbon dioxide produced (bubbles min^{-1}) Species				
		S. cerevisiae	*C. krusei*	*C. albidus*	*C. albicans*	*A. pullulans*
	Trial					
Aerobic	1	23	18	34	12	22
	2	18	17	20	15	21
	3	23	19	32	26	24
	4	24	23	26	13	22
	5	25	19	28	14	26
	6	15	17	29	12	22
	7	16	19	20	15	25
	8	17	23	36	13	27
	9	23	19	20	10	27
	10	25	17	19	13	25
	11	25	16	34	11	25
	12	23	16	20	11	25
Standard deviation		4	2	7	4	2
	Trial					
Anaerobic	1	12	6	22	8	34
	2	10	9	29	22	36
	3	12	10	19	6	29
	4	13	12	34	12	32
	5	15	7	25	19	28
	6	9	8	19	10	26
	7	10	9	23	14	27
	8	15	10	27	9	29
	9	15	5	35	6	35
	10	14	7	26	7	20
	11	15	8	19	21	30
	12	11	9	25	13	34
Standard deviation		2	2	5	6	....

Table 20

Using the information in Table 20, calculate the standard deviation for the number of CO_2 bubbles produced by *A. pullulans* in anaerobic conditions.

Write the answer into the space provided in Table 20. Give your answer to **one** significant figure. Show your working.

[Answer on Table 20] **[3]**

(b). Fig. 20 is a graph showing the mean values of the data from Table 20.

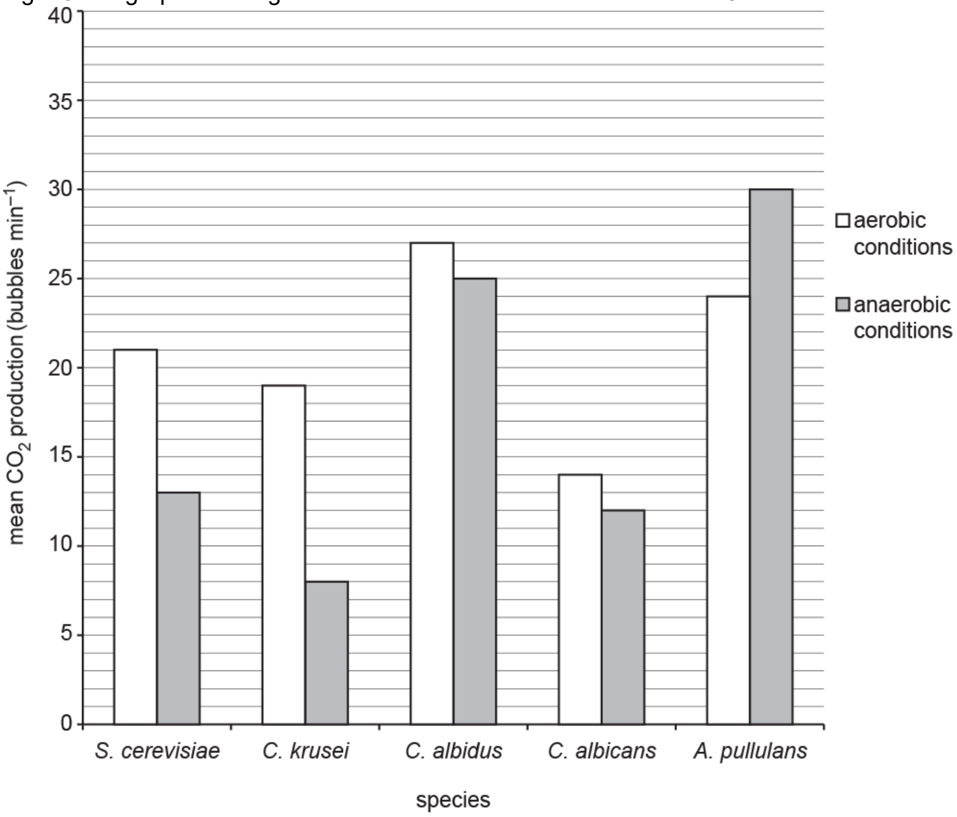

Fig. 20

Plot the standard deviations for all data on Fig. 20.

[Answer on Fig. 20] **[2]**

(c). Calculate the mean percentage change in CO_2 production for *S. cerevisiae* when moving from anaerobic to aerobic respiration. Give your answer to **four** significant figures.

Show your working.

Answer = ... **[3]**

(d).

i. The student drew the following conclusions:

1	All the yeast I investigated produced more CO_2 during aerobic respiration than anaerobic respiration.
2	There is a significant difference between the CO_2 production in aerobic and anaerobic conditions in *C. albidus*.

For each conclusion, state and explain whether the student is correct.

1

____

____

____

2

____

____

____ **[2]**

ii. The student found the following definitions of errors in a text book:

Random errors:

mistakes during measurements caused by low-resolution equipment

Systematic errors:

repeated inaccurate measurements in the same direction caused by problems with equipment

Which type of error is suggested by the student's data? Justify your answer.

____

____

____ **[1]**

(e). Anaerobic respiration in yeast cells requires enzymes.

Which organelle is responsible for synthesising these enzymes?

____ **[1]**

32. Bread contains a mixture of polypeptides known as gluten.

Gluten consists of two types of polypeptide: gliadins and glutenins.

Gluten helps to trap carbon dioxide within bread dough. This enables bread to rise when it is baked.

The carbon dioxide is produced by baker's yeast, *Saccharomyces cerevisiae*. This species of yeast is able to convert ethanol to acetyl CoA at low glucose concentrations.

Fig. 2 shows the oxygen consumption and carbon dioxide production of a population of *S. cerevisiae* grown in batch culture. The population was provided with glucose as their only initial source of carbon.

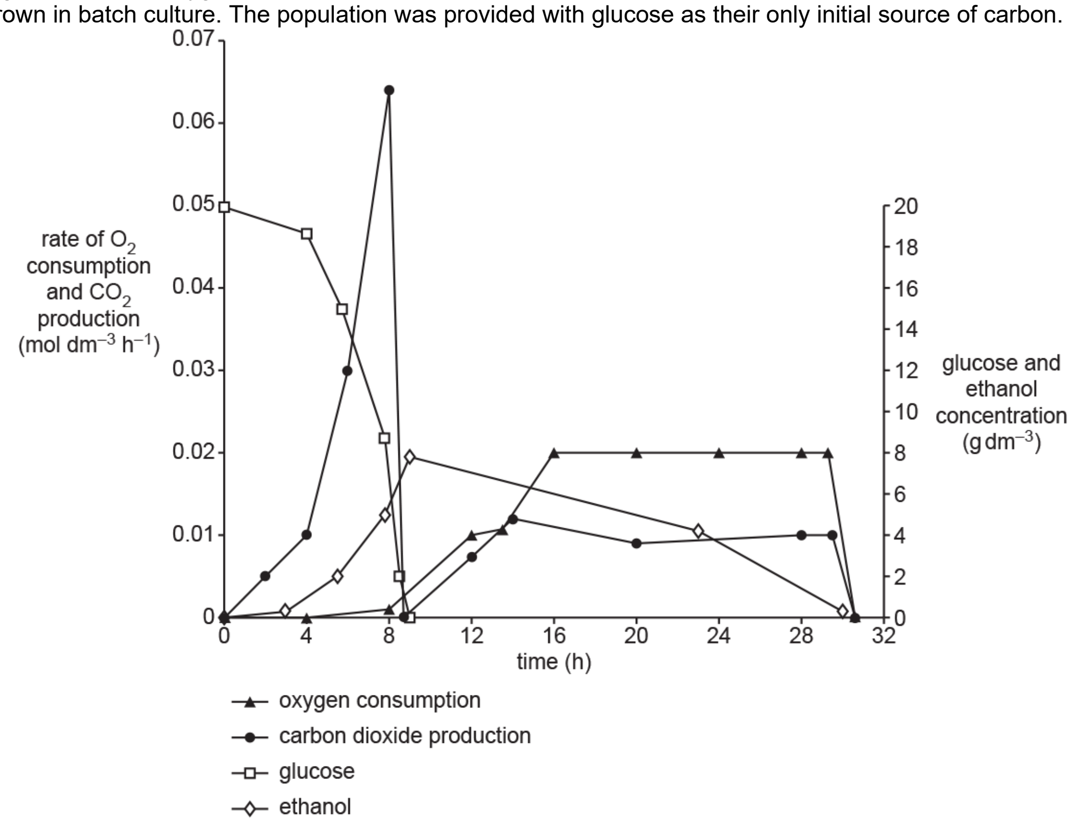

Fig. 2

i. Suggest and explain what conclusions can be drawn from Fig. 2 about the factors that affected the rate and type of respiration carried out by *S. cerevisiae* in this batch culture.

____

____

____

____

____

____

____

____ **[3]**

ii. Describe **two** practical considerations to ensure the *S. cerevisiae* population grows successfully when the initial culture is established.

____

____

____

____

____ **[2]**

iii. Scientists wanted to estimate the number of yeast cells in a 25 cm^3 solution of *S. cerevisiae*. They carried out the following two dilutions:

- 1 cm^3 of the original solution was mixed with 9 cm^3 of nutrient solution to make solution 2.
- 1 cm^3 of solution 2 was mixed with 9 cm^3 of nutrient solution to make solution 3.

The scientists transferred 0.1 cm^3 of solution 3 onto an agar plate. 15 separate colonies grew on the plate.

Calculate the number of yeast cells in the original 25 cm^3 solution.

Express your answer in standard form to **three** significant figures. Show your working.

Answer: .... **[2]**

33. Botulism is a condition resulting from the action of botulinum toxin. The main symptom of botulism is skeletal muscle weakness, which can be fatal.

i. Botulinum toxin is produced by the anaerobic bacterium *Clostridium botulinum.* What information does the word 'anaerobic' suggest about the bacterium?

____

____ **[1]**

ii. The toxin is initially produced as a large single polypeptide that has low potency. After the toxin has been acted upon by a protease, two chains are produced which remain connected by a disulfide bond. In this form it is far more toxic.

Describe the action of the protease when it acts on the toxin.

____

____ **[1]**

34(a). Athletic sprinters require large amounts of energy in short periods of time. Many elite sprinters can run 100 metre races in under 10 seconds.

Under normal conditions, exercise requires an increased rate of breathing. It has been observed that some of the best sprinters only take one breath at the start of the race and do not inhale again until the end of the race.

Suggest how these sprinters can expend so much energy without needing to carry out aerobic respiration.

____

____

____

____ **[2]**

(b). Part of the body's response 'fight or flight' is to run away from the threat. Prolonged vigorous exercise puts high demands on the body's metabolism.

The muscle cells require an adequate supply of oxygen for respiration. If insufficient oxygen is available, the cells must respire anaerobically.

Fig. 20.2 outlines the process of anaerobic respiration in muscle cells.

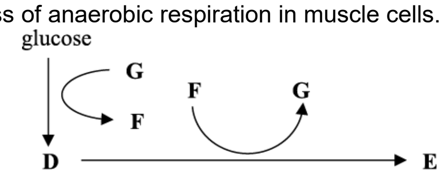

Fig. 20.2

i. Identify the compounds labelled **D** and **E** in **Fig. 20.2**.

D ____

E ____

[2]

ii. What is the role of compound **D** in anaerobic respiration?

____

____ **[1]**

iii. Why is it important that compound **G** is formed during the reaction in which compound **D** is converted into compound **E** in anaerobic respiration?

____

____

____ **[2]**

iv. Compound **E** is toxic and is removed from the muscle cell. It is transported to an organ in the body.
Which organ is compound **E** transported to **and** how does it reach this organ?

____

____ **[1]**

35(a). The following passage describes the use of alternative substrates in respiration. Complete the passage by writing in the missing words.

Glucose is not the only substrate that can be used for respiration in cells. Fats are hydrolysed to fatty acids and glycerol during digestion. Glycerol is converted to ...., which can then be decarboxylated to produce an acetyl group which is combined with coenzyme A and can then enter the .... cycle. Fatty acids are also converted to acetyl coenzyme A. Proteins need to be converted into amino acids which must then be deaminated in the .... The resulting molecule can then be converted to pyruvate which enters the .... reaction. Because energy is required for these processes, the respiration of protein gives a lower yield of .... than the respiration of carbohydrates.

[5]

(b).

i. Different foods contain different respiratory substrates, so have different energy content. Food labels often give the energy content of foods in kcal.

Table 17 describes the typical energy content of different foods.

Food	Energy content per 100 g (kcal)
Chocolate	478
Pasta	567
Fish	145
Apple	68
Cheese	831

Table 17

How much energy per unit mass does the highest energy food in Table 17 contain compared to the lowest energy food in Table 17?

Express the answer as a percentage to **three** significant figures.

Answer = ... % **[2]**

ii. The following facts relate to energy release from foods during respiration:

- The energy required for the synthesis of one mole of ATP is 30.5 kJ
- 1 kcal is equal to 4.18 kJ
- 1 mole is equal to 6.02×10^{23} molecules.

Calculate the theoretical yield of ATP molecules from the respiration of a 35 g chocolate bar. Show your working. Give your answer in standard form to **three** significant figures.

Answer = ... **[3]**

iii. Suggest and explain why cheese has the highest energy content of the foods in Table 17.

____

____

____

____

____ **[2]**

36(a). Some companies offer snack foods that contain a higher protein content than usual. 'Protein cookies' are an example of this kind of food. Some protein cookies contain up to 37 g of protein per cookie.

A student examined these foods by measuring the respiratory quotient (RQ) of maggots that were fed different types of cookie.

The student measured the oxygen consumption and carbon dioxide production of maggots when they were fed protein cookies and normal cookies.

The cookies were powdered and treated to remove all fat before being fed to the maggots.

Table 21 is a summary of the results.

Cookie	Carbon dioxide produced (cm^3 min^{-1})	Oxygen absorbed (cm^3 min^{-1})
1	13.29	13.56
2	13.04	13.87

Table 21

Use the information in Table 21 to deduce which of the two cookies is the protein cookie. Explain your choice.

____

____

____

____

____ **[3]**

(b). The student then changed the experiment to investigate whether respiration of the cookies by yeast was different from respiration of the cookies by maggots.

The student planned to allow yeast cells and maggots to respire the cookie powder in anaerobic conditions and measure the RQ over 2 minutes.

State and explain **one** problem with the student's method.

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____ **[3]**

37. 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 produced (mm^3 s^{-1})**
Camponotus	0.89	0.88
Melophorus	0.59	0.66
Cataglyphis	1.01	1.47

Table 19.1

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	....
Melophorus	....	....
Cataglyphis	....	....

[3]

38. A person’s RQ changes when they exercise.

Fig. 4.3 shows how RQ changes with the power a person exerts during exercise. Power, measured in watts (W), increases as the intensity of physical exercise increases.

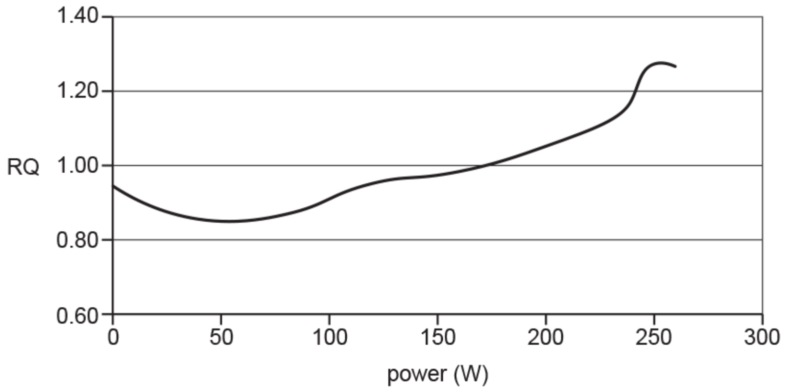

Fig. 4.3

What can you conclude about respiration at 0, 50 and 250 W based on the RQ values?

0 W____

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50 W____

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250 W____

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[3]

39. A student investigated the effect of different sugars on the respiration rate in yeast.

The student wanted to study the effect of the different sugars on the rate of growth of a yeast population.

They used a colorimeter to measure the absorbance of a culture of yeast cells.

The absorbance of the yeast culture is proportional to the concentration of yeast cells.

As the yeast multiplied, it was necessary to dilute the sample to obtain a reading on the colorimeter.

i. Describe how the student could use 1 cm^3 pipettes and 10 cm^3 measuring cylinders to dilute the sample so that it was 10 000 times less concentrated.

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____ **[3]**

ii. A light microscope can be used to observe yeast cells.

State the equipment that would be needed, in addition to a microscope, to measure the average diameter of yeast cells.

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____ **[2]**

iii. The student prepared a starter culture using 2.5×10^{-3} g yeast cells in 1 dm^3 nutrient broth.

The average mass of a yeast cell is 2.0×10^{-11} g.

Calculate the number of cells in the starter culture.

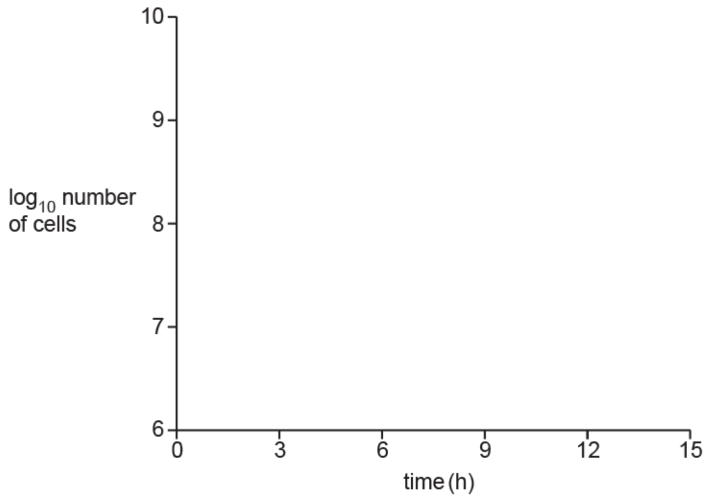
Give your answer in standard form.

number of cells = ... **[2]**

iv. The population of this yeast doubles every 90 minutes when growing under ideal conditions.

A different starter culture was prepared containing 1×10^7 cells.

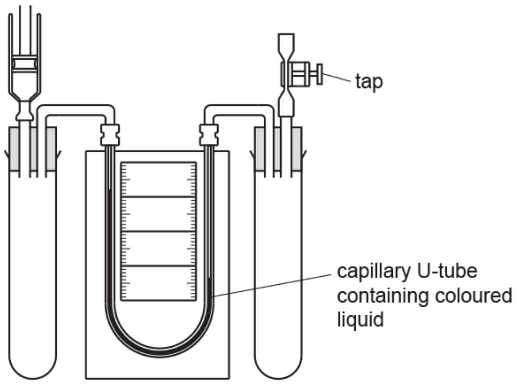
Use the axes below to sketch the growth curve you would expect for the yeast culture over the first 15 h.



[3]

40. A respirometer, shown below, can be used to investigate respiration.

A student placed 5 cm^3 of potassium hydroxide solution in the left-hand tube of the respirometer. The student suspended a basket above the liquid and placed 10 g of respiring seeds in the basket.



Which of the following statements about this investigation is **not** correct?

A The level of the liquid in the left-hand arm of the capillary tube would decrease (move downwards) with time.

B The potassium hydroxide solution absorbs carbon dioxide.

C The rate of movement of the liquid in the capillary tube is a measure of the rate of respiration.

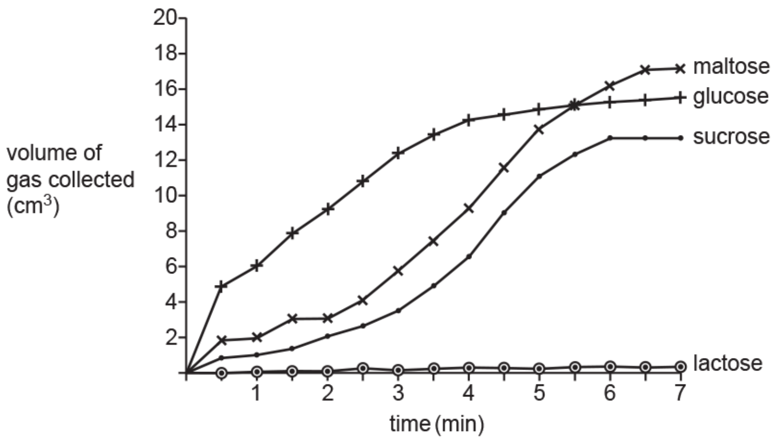
D The tap can be opened to equalise the pressure in each tube.

Your answer

[1]

41(a). A student investigated the effect of different sugars on the respiration rate in yeast.

The student calculated mean values for each sugar and plotted the results on a graph. The graph is shown below.



i. Describe how the student could use the graph to calculate the rate of respiration for each type of sugar.

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____ **[3]**

ii. * The student concluded the following from the graph:

- The rates of respiration with glucose, maltose and sucrose were very similar.
- The yeast could not hydrolyse disaccharides.

Evaluate the student's conclusions.

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[6]

(b). The following procedure was used:

- Prepare a stock solution of yeast containing 10 g of dried yeast in 250 cm^3 of pH5 buffer.
- Prepare solutions of each sugar containing 5 g of sugar in 250 cm^3 of distilled water.
- Keep the yeast and sugar solutions in a water bath at 35 °C until required.
- Set up the apparatus with a 250 cm^3 conical flask connected by a rubber tube to a 100 cm^3 gas syringe.
- Add 25 cm^3 of yeast solution and 25 cm^3 of sugar solution to the flask, immediately connect the flask to the gas syringe and start the clock.
- Record the volume of gas produced after 30 s and then every 30 s for 7 min.
- Repeat the experiment 5 times for each different sugar.
- Prepare a fresh yeast solution for each set of sugars.

i. Describe **two** precautions the student should take between each experiment to ensure repeatable results.

1____

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2____

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[2]

ii. The student's procedure did not include a negative control.

Describe **one** negative control that the student could have used.

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____ **[1]**