

1. All cells respire.

(i) Name **two** parts of animal cells that are involved in the process of respiration. Describe the function of each part.

Part 1

Function

Part 2

Function

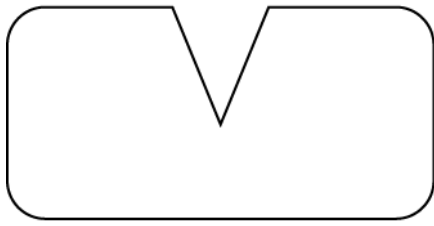
[4]

(ii) Methanol is a type of alcohol.

In the body, methanol is broken down by an enzyme.

The products of this process are poisonous.

Ethanol is a different type of alcohol. It can be used to treat methanol poisoning.



Enzyme



Ethanol



Methanol

The diagrams show the shapes of the molecules of enzyme, ethanol and methanol.

Use your knowledge of enzymes to explain why ethanol is used to treat methanol poisoning.

[3]

(iii) During beer and wine making, yeast cells respire anaerobically to produce ethanol.
Write down one other useful application of anaerobic respiration in microorganisms.

[1]

2(a). Living organisms obtain energy using respiration.

Look at the equations for the two different types of respiration.

They show the energy released from the same amount of glucose.



Calculate the ratio:

$$\frac{\text{energy released in Type A}}{\text{energy released in Type B}}$$

Show your working.

ratio =

[2]

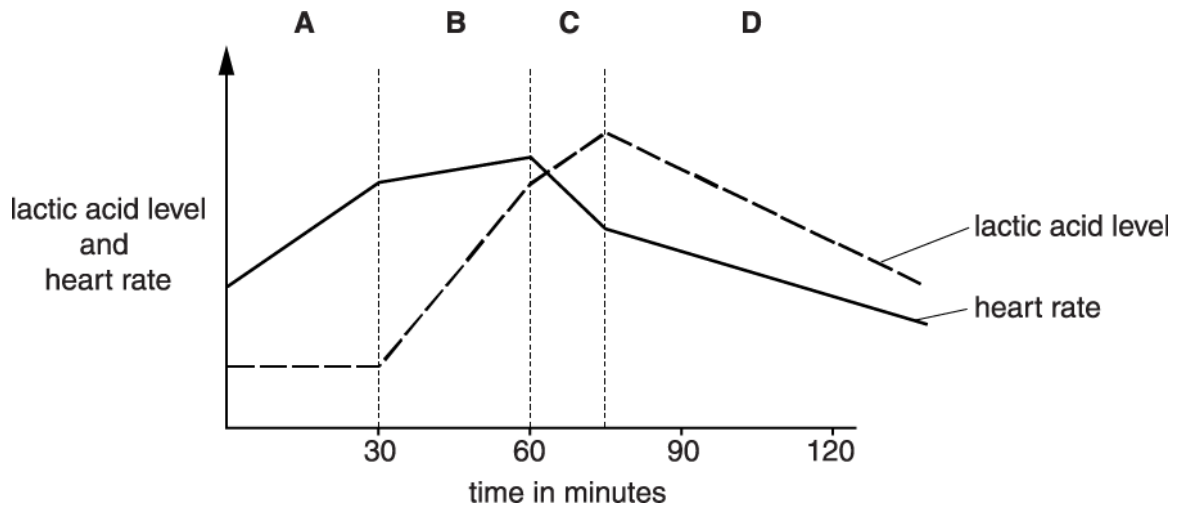
(b). Jenny is running in a 26 mile marathon race.

For most of the race Jenny respire using Type A respiration.

Suggest reasons why this is important.

[2]

(c). The graph shows Jenny's heart rate and the lactic acid level in her blood during a training session.



(i) Jenny makes this conclusion.

There is always the same correlation between my heart rate and my lactic acid level, however long or fast I run.



Discuss how well her conclusion fits the data in the graph.

Use information from sections A, B, C and D in your answer.

[4]

(ii) Jenny thinks that some of her data is incorrect.

What should she do to become more confident in her conclusion?

Put a tick (✓) in the box next to the correct answer.

Repeat the same training a number of times.

Repeat her training but only run for 60 minutes.

Run more slowly so that her heart rate does not rise too much.

Repeat the same experiment on other runners.

[1]

3(a). Yeast is a single-celled microorganism.

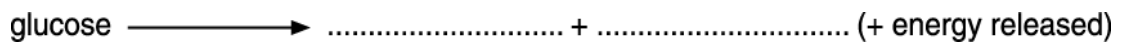
Yeast can be grown in a fermenter.

The yeast cells are grown in a liquid containing nutrients.

The nutrients are needed for them to grow and reproduce.

Yeast can carry out both aerobic and anaerobic respiration.

Complete the **word** equation for **anaerobic** respiration in yeast.



[1]

(b). How is anaerobic respiration in **animal** cells different from that in yeast?

----- [1]

(c). Some yeast cells are put into a solution into two fermenters, **A** and **B**.

The lid is closed tight so that no air can get in or out of fermenter **A**.

Air containing oxygen is bubbled through fermenter **B**.

A scientist counts the number of yeast cells in samples taken from both fermenters.

She records her results in a table.

Time when samples were taken (hours)	Number of yeast cells in 1 mm ³	
	Fermenter A	Fermenter B
0	100	100
1	200	200
2	300	400
3	350	800
4	390	1600
total % increase in yeast cells in 1 mm ³	290	-----

(i) Complete the table to show the % increase in yeast cells in 1 mm³ in fermenter **B**.

[1]

(ii) The results show that the yeast reproduces faster in fermenter **B** than in fermenter **A**.

Explain why this happens.

[2]

(iii) The scientist adds a chemical called adriamycin to the yeast culture in fermenter **B** after the first 4 hours of the study.

Adriamycin is quick-acting and prevents the copying of chromosomes.

The scientist continues to count the number of yeast cells in samples from this fermenter for a further two hours.

Describe and explain how this chemical will affect the yeast cells during the next two hours of the study.

Use your knowledge of the **cell cycle** in your answer.



The quality of written communication will be assessed in your answer.

[6]

4(a).

Aerobic and anaerobic respiration are two types of respiration used in human cells.

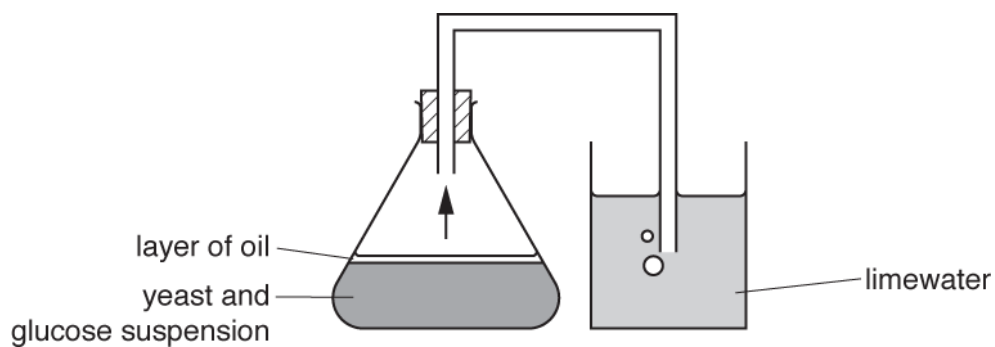
Put ticks (✓) in the boxes to show which type of respiration each statement describes.

Statement	Aerobic respiration	Anaerobic respiration	Both types of respiration
Uses oxygen			
Produces lactic acid			
Uses glucose			
Produces carbon dioxide			
Occurs in the mitochondria			

[3]

(b). A student investigates the effect of temperature on fermentation.

She uses this apparatus.



The student puts a layer of oil over the glucose and yeast suspension.

Explain why.

[2]

(c). The student does the experiment at three different temperatures.

Every 30 minutes, she counts the number of bubbles of carbon dioxide produced in one minute.

Her results are shown in the table.

Temperature (°C)	Number of bubbles of carbon dioxide produced in one minute after ...				
	30 minutes	60 minutes	90 minutes	120 minutes	150 minutes
15	22	24	23	26	24
30	32	36	37	36	32
45	44	48	44	32	12

(i) Write down **two** conclusions that the student can make from this data **and** use your knowledge of respiration to explain each conclusion.

Conclusion 1 and explanation

Conclusion 2 and explanation

[4]

(ii) Counting bubbles may not be the best way to estimate the volume of carbon dioxide produced.

Suggest why.

----- [1]

(iii) Suggest an alternative way to measure the volume of carbon dioxide produced.

----- [1]

(d). Fermentation by yeast cells is an example of anaerobic respiration.

When oxygen is in short supply animal cells can also respire anaerobically.

Give an example of when animal cells would respire anaerobically.

----- [1]

[Total: 12]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1		i	<p><i>any two from the following correct parts – max 2 marks</i></p> <p>mitochondria; <u>cell</u> membrane; nucleus or DNA; cytoplasm;</p> <p><i>one mark for each correct function - max 2 marks</i></p> <p>(mitochondria) – contain enzymes / proteins / site of aerobic respiration / produce ATP;</p> <p>(cell membrane) – allows gases / CO₂ / O₂ / water / reactants / products to pass through/in and/or out of the cell;</p> <p>(nucleus) – contains DNA / genetic code for making enzymes (for respiration);</p> <p>(cytoplasm) – where enzymes are made / site of anaerobic respiration;</p>	4	<p>ignore 'membrane' on its own</p> <p>allow ribosomes</p> <p>the function must be linked to correct structure.</p> <p>do not accept contains enzymes for anaerobic respiration</p> <p>if cell membrane mark not given, still accept correct function. ignore substances accept proteins instead of enzymes</p> <p>accept (ribosomes) site of enzyme/protein manufacture accept proteins instead of enzymes accept glycolysis/first part of respiration occurs in cytoplasm</p> <p>Examiner's Comments</p> <p>Most candidates were able to identify two cell parts correctly but did not always achieve the second mark for the function. They often omitted aerobic or anaerobic from their answer when referring to respiration in the cytoplasm or mitochondria; several stated that enzymes were made in the mitochondria. There was fairly common use of vague terms like substances in relation to the cell membrane along with equally vague statements like <i>keeps the cell together</i>, not understanding that the question was asking about the role in respiration. Many candidates who gave nucleus as a cell part then struggled to score for the function as they did not refer to containing genetic code for making enzymes. A few candidates still gave cell wall as an animal cell part and a very small minority gave</p>

Question		Answer/Indicative content	Marks	Guidance
				named plant organelles, or even referred to blood and lungs.
	ii	<p>any three from</p> <p>similar shape in methanol and ethanol / tip of methanol and ethanol (which fits into active site) same shape</p> <p>ethanol will fit into the <u>active site</u> / has a complementary / similar shape to <u>active site</u>;</p> <p>idea that prevents methanol from binding/ reduces methanol entering active site;</p> <p>methanol is not broken down;</p> <p>idea of reducing the (concentration of) toxic product / harmful substances;</p>	3	<p>ignore 'same shape' on its own</p> <p>ignore ethanol has same shape as active site</p> <p>Examiner's Comments</p> <p>Many candidates failed to score here for lack of precision in their answers e.g. same shape was often seen. Common misconceptions included ideas such as ethanol breaks down methanol, that they both reacted with the enzyme at the same time, that ethanol itself was an enzyme, or that the products of ethanol breaking down would neutralise or remove the toxins produced by methanol. Few candidates appeared to understand that the ethanol would prevent the methanol from binding to the active site. The most common mark achieved was for the idea that ethanol would also fit into the active site of the enzyme. Most candidates did not appear to know what methanol poisoning was, which may have impaired their ability to answer this question successfully. A large proportion talked about lock and key model, but failed to mention the active site and so failed to score a mark.</p>

Question			Answer/Indicative content	Marks	Guidance
		iii	<i>one from the following</i> (making) bread; (producing) biogas;	1	<p>do not accept alcohol production accept sewage (processing) ignore biofuel</p> <p>Examiner's Comments</p> <p>Bread making appeared to be the most common correct response but a significant minority of those who did score gave biogas. There seemed to be a high level of candidates giving no response, and some rather obscure answers such as microbes under the skin. Making lactic acid, getting energy anaerobically and references to fermentation were common incorrect answers.</p>
			Total	8	

Question		Answer/Indicative content	Marks	Guidance
2	a	$\frac{2880}{150}$ <p>19.2 / 19 / 19.2:1 / 19:1 / 96:5;</p>	2	<p>Accept</p> <p>$\frac{1440}{75}$ or $\frac{960}{50}$ or $\frac{288}{15}$ or $\frac{96}{5}$ or $\frac{480}{25}$ for first MP</p> <p>Correct answer = 2 marks Ignore units</p> <p>Examiner's Comments</p> <p>This question is about energy and respiration.</p>
	b	<p>Type A provides a lot of energy / type B provides little energy;</p> <p>To prevent / reduce production of lactic acid / type B produces lactic acid;</p>	2	<p>Accept prevent cramp / pain</p> <p>Examiner's Comments</p> <p>Most candidates realised that Type A released more energy with fewer scoring the lactic acid mark. Weaker answers focussed on the provision of oxygen as being necessary to survive/ complete the race and/or the need for water/hydration. Some candidates didn't answer the question and just discussed what aerobic / anaerobic respiration were and the fact that marathon runners need lots of oxygen.</p>

Question			Answer/Indicative content	Marks	Guidance								
	c	i	<p>A no correlation or description;</p> <p>B positive correlation or description;</p> <p>C negative correlation or description;</p> <p>D positive correlation or description;</p>	4	<p>e.g. In A / 1st section / 0 – 30 mins, one goes up and one stays the same</p> <p>e.g. In B / 2nd section / 30 – 60 mins, both go up</p> <p>e.g. In C / 3rd section / 60 – 75 mins, one goes up , the other goes down</p> <p>e.g. In D / 4th section / 75 – end, both go down</p> <p>Examiner's Comments</p> <p>Candidates often lost marks because the sections (A, B, C and D) weren't specified. Some lost marks as they seemed to run out of steam or maybe space as they gave good answers for the first couple of sections then didn't do the others. They can obviously look at graphs and pick out patterns. They talked in terms of increase / decrease and not really in terms of positive/ negative correlation. Correlations were generally not well understood with many thinking that C showed no correlation and D a negative one. Candidates do not appear to understand negative correlation, candidates think that going down is negative correlation, i.e. in D they said negative correlation (instead of positive) as both decrease.</p>								
		ii	<table border="1"> <tr> <td>Repeat the same training a number of times.</td> <td>✓</td> </tr> <tr> <td>Repeat her training but only run for 60 minutes.</td> <td></td> </tr> <tr> <td>Run more slowly so that her heart rate does not rise too much.</td> <td></td> </tr> <tr> <td>Repeat the same experiment on other runners.</td> <td></td> </tr> </table>	Repeat the same training a number of times.	✓	Repeat her training but only run for 60 minutes.		Run more slowly so that her heart rate does not rise too much.		Repeat the same experiment on other runners.		1	<p>One tick one mark</p> <p>Each extra tick negates one correct tick</p> <p>Examiner's Comments</p> <p>Generally candidates knew that confidence in a conclusion means repeating things on the same person. The most common wrong answer was the last box – repeating the same experiment with other runners.</p>
Repeat the same training a number of times.	✓												
Repeat her training but only run for 60 minutes.													
Run more slowly so that her heart rate does not rise too much.													
Repeat the same experiment on other runners.													
			Total	9									

Question			Answer/Indicative content	Marks	Guidance
3	a		carbon dioxide + ethanol (1)	1	<p>both answers required for one mark allow any order</p> <p>allow correct formula for carbon dioxide (CO₂)</p> <p>Examiner's Comments</p> <p>Generally this was well answered with most candidates scoring the mark. A few candidates incorrectly suggested that oxygen was produced.</p>
	b		(animal cells) produce lactic acid (1)	1	<p>do not allow lactic acid if given with carbon dioxide / oxygen</p> <p>ignore references to lack of oxygen / use of glucose as the substrate / ref to energy / ATP released</p> <p>Examiner's Comments</p> <p>This was also well answered and most candidates could correctly describe the production of lactic acid in animal cells.</p>
	c	i	1500(%) (1)	1	<p>if no response in the table, check whole page for the answer</p> <p>Examiner's Comments</p> <p>The majority of candidates correctly calculated this as 1500. Other answers were seen and on occasions this question was not answered at all. It was unclear whether candidates could not answer the question or whether they had missed it because it was at the bottom of the page and did not have a clear 'space' to write the answer. Candidates needs to be reminded to read all of the paper so that they don't miss questions which may ask them to label something or write somewhere other than in the usual lined space.</p>

Question	Answer/Indicative content	Marks	Guidance
	<p>ii</p> <p><i>(link between oxygen and respiration):</i> more oxygen means more aerobic respiration in B / less oxygen means anaerobic respiration / less aerobic respiration in A (1)</p> <p><i>(link between energy and cell division):</i> more energy in B means more cell division / growth / less energy in A means less cell division / growth (1)</p>	2	<p>'B has oxygen and is aerobic respiration' = 0 marks</p> <p>'B has oxygen and is aerobic respiration. A does not have oxygen and is anaerobic respiration' = 1 mark</p> <p>do not allow 'reproduction' (as given in the question)</p> <p>Examiner's Comments</p> <p>This question was poorly answered with only the very best candidates able to pick out the important points and present them in a logical sequence. It was a question that demanded the candidate to make comparisons between A and B and therefore comments about only one fermenter was not sufficient to gain credit. The first mark point looked for the link between oxygen and respiration. It was common to see candidates refer to oxygen being present in B and then identify more respiration here. But it was rare to see a specific reference to aerobic and/or anaerobic respiration which made it difficult to be certain that candidates were describing the correct process in the correct fermenter. It was also necessary for the description of respiration to be comparative. This raised the demand of the question so that only the very best candidates scored. The second mark point linked energy and reproduction and was an easier mark to get. However, many candidates fell down by simply repeating the information in the stem of the question, the idea that the yeast in B reproduces faster. For the second mark, candidates were expected to write more than this – and to link the energy with the process of cell division or growth.</p>

Question	Answer/Indicative content	Marks	Guidance
iii	<p>(Level 3) Answer describes the effect of adriamycin on the cell cycle and includes a detailed explanation of this effect. Explanation is logically sequenced and includes most key points. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>(Level 2) Answer describes the effect of adriamycin on the cell cycle and includes some explanation of this effect. Explanation may not be logically sequenced or may be missing some key points. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>(Level 1) Answer may describe the effect of adriamycin on the cell cycle and includes some attempt at an explanation of this effect. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>(Level 0) Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A*</p> <p>do not allow idea that adriamycin stops the chromosomes copying (this is given in the stem)</p> <p>Indicative scientific points include:</p> <p>description:</p> <ul style="list-style-type: none"> • rate of growth / reproduction / number of new yeast cells produced will stop / be reduced / stay the same • more cells will die than be produced • this will happen quickly / immediately <p>explanation:</p> <ul style="list-style-type: none"> • (copying of chromosomes) is part of the cell cycle • it takes place during the phase of cell growth • chromosome replication / DNA copying • two strands of DNA / chromosomes separate • nucleus divides • new (daughter) cells are formed • mitosis • adriamycin prevents this happening • cell division / mitosis can not take place <p>ignore ref to individual cell growth ignore ref to meiosis</p> <p>Examiner's Comments</p> <p>A six-mark extended-writing question on the paper. Candidates generally made a good attempt at this question with most scoring at least a Level 1 answer. The majority of candidates correctly identified that the adriamycin would slow down the reproduction of the yeast. Some candidates developed this further and described how the number of cells would be likely to level off for a while and then decrease, as more cells would die than be produced. Some also made reference to the fast-acting nature of the adriamycin. A</p>

Question			Answer/Indicative content	Marks	Guidance
					<p>very small number of candidates believed that the adriamycin would speed up the rate of reproduction in the yeast cells. With regards to an explanation, the majority of the candidates recognised that the adriamycin would stop the cells dividing but their reason was very commonly that which was given in the stem, i.e. the idea that the chromosomes would not be able to copy themselves. A significant number of candidates continually repeated this point as their explanation without developing it at all. This meant that they were unable to move beyond Level 1. To move to Level 2 or 3, candidates needed to make some reference to the events in the cell cycle. Many candidates correctly stated mitosis as the process that was occurring and it was pleasing to see some extremely detailed and accurate descriptions of this process, with reference to DNA replication, the chromosomes separating and the formation of two new daughter cells. Candidates need to learn the importance of sequencing their answers as it was very common to see lots of points just randomly scattered throughout the response and it was difficult to credit these responses with maximum marks. A small but significant number of candidates confused mitosis with meiosis.</p>
			Total	11	

Question		Answer/Indicative content				Marks	Guidance
4	a	Statement	Aerobic respiration	Anaerobic respiration	Both types of respiration	3	Mark by row: 5 rows correct 3 marks 4 rows correct 2 marks 3 rows correct 1 mark A row does not score if it contains an additional incorrect tick. For 'uses glucose' row: - accept three ticks. - accept two ticks, but only if they appear in 'aerobic respiration' and 'anaerobic respiration' columns
		uses oxygen	√				
		produces lactic acid		√			
		uses glucose			√		
		produces carbon dioxide	√				
		occurs in the mitochondria	√				
	b	yeast needs to respire anaerobically to produce alcohol / for the fermentation process / ensures anaerobic respiration takes place (1) (layer of oil) prevents contact (between yeast / glucose) with air / oxygen / prevents aerobic respiration (1)				2	

Question		Answer/Indicative content	Marks	Guidance
	c i	<p><i>Conclusion 1</i> Idea that temperature affects the reaction (1)</p> <p><i>Explanation 1</i> (as temperature increases) enzymes and substrates have more (kinetic) energy/ (as temperature increases) more collisions between enzyme and substrates/ as temperature increases / at optimum temperature, enzymes will work better / faster</p> <p>ORA (1)</p> <p><i>Conclusion 2</i> at 45(°C), idea that as time increases, the rate of reaction decreases / is low (1)</p> <p><i>Explanation 2</i> the glucose is used in the reaction / less glucose is available for respiration (1)</p>	4	<p>accept conclusions in any order</p> <p>accept glucose for substrate</p> <p>accept more enzyme-substrate complexes</p> <p>accept temperature is a limiting factor to enzyme action</p> <p>ignore references to denaturation accept build-up of alcohol poisons yeast</p>
	ii	<p><i>Any one from:</i></p> <p>Idea that each bubble may be different (in size) (1) Idea that bubbles are difficult to count (1)</p>	1	<p>accept difficult to count accurately / human error</p>
	iii	any method which allows gas to be collected (to measure its volume) e.g. use a burette / use a (gas) syringe	1	<p>accept measure mass-loss accept over-water; ignore under water ignore references to a balloon</p>
	d	Idea of vigorous exercise	1	<p>accept named exercise e.g. running / swimming etc. accept swimming underwater</p>
		Total	12	