DSE M.C. Questions - Respiration
(sort by difficulty)

Challenging
/

Average

2013 Q.10 (67%)
Which of the following combination best describes the process involved in respiration?

	Oxygen is required	Carbon dioxide is released
A.	Conversion of pyruvate to acetyl CoA	Glycolysis
B.	Conversion of pyruvate to acetyl CoA	Krebs Cycle
C.	Oxidative phosphorylation	Glycolysis
D.	Oxidative phosphorylation	Krebs Cycle

2014 Q.14 (45%)
Which of the following processes produce ATP?
(1) Glycolysis
(2) Krebs cycle
(3) Conversion of pyruvate to lactic acid

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

2015 Q.6 (53%)
Which of the following combinations correctly compares the aerobic respiration and anaerobic respiration of muscle cells?

	Aerobic respiration	*Anaerobic respiration*
A.	occurs only when oxygen is present	occurs only when oxygen is absent
B.	produces more NADH	produces less NADH
C.	glycolysis takes place	no glycolysis
D.	takes place only inside the mitochondria	takes place only in the cytoplasm

Average

2016 Q.26 (65%)
Which of the following processes in aerobic respiration release NADH?
(1) glycolysis
(2) Krebs cycle
(3) oxidative phosphorylation

A. (1) and (2) only B. (1) and (3) only C. (2) and (3) only D. (1), (2) and (3)

2017 Q.7 (58%)
Which of the following combinations correctly matches the reaction in aerobic respiration with the location where it takes place?

	Reaction in aerobic respiration	*Location*
A.	regeneration of NAD	cytoplasm
B.	production of carbon dioxide	cytoplasm
C.	conversion of pyruvate to acetyl-coA	mitochondrion
D.	conversion of triose phosphate to pyruvate	mitochondrion

2018 Q.11 (69%)
Which of the following processes takes place at the inner membrane of mitochondria?

A. Glycolysis
B. Conversion of pyruvate to acetyl CoA
C. Krebs cycle
D. Oxidative phosphorylation

2018 Q.26 (50%)
After vigorous exercise, the blood lactic acid concentration of an athlete increases. Which of the following word equation correctly shows the process that leads to the formation of lactic acid?

A. Glucose → lactic acid
B. Glucose → lactic acid + water
C. Glucose → lactic acid + carbon dioxide
D. Glucose + oxygen → lactic acid + carbon dioxide

Average

2019 Q.3 (61%)

Which of the following process(es) in the respiratory pathways release(s) carbon dioxide?

(1) Oxidative phosphorylation
(2) Reactions in the Krebs cycle
(3) Conversion of glucose to pyruvate

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

Easy

/

2020 Q.4

4. Which of the following descriptions of anaerobic respiration in muscles is correct?

A. It involves glycolysis.
B. It produces lactic acid and carbon dioxide.
C. It takes place in the matrix of mitochondria.
D. It takes place on the inner membrane of mitochondria.

2020 Q.5

5. Which of the following combinations correctly matches the stages of cellular respiration and the metabolites produced?

	Stage	*Metabolite produced*
A.	Glycolysis	acetyl-CoA
B.	Glycolysis	ATP
C.	Krebs Cycle	NAD
D.	Krebs Cycle	pyruvate

Answers

Challenging

Average

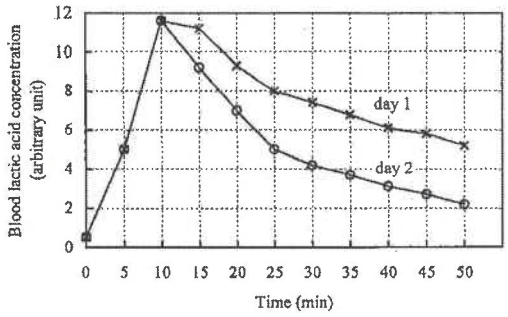
2013	2014	2015	2016	2017	2018	2019
10 [D]	14 [A]	6 [B]	26 [A]	7 [C]	11 [D]	3 [B]
					26 [A]	

Easy

2020
4 [A]
5 [B]

CE - 2004

4. (a) An experiment was carried out to study the changes in blood lactic acid concentration of an athlete during and after exercise. On day I, the athlete ran for 10 minutes and then sat down to rest for 40 minutes. On day 2, she performed the same exercise, followed by slow jogging for 40 minutes. The results of the experiment are shown in the graph :



(i) Account for the increase in blood lactic acid concentration in the first 10 minutes (3)

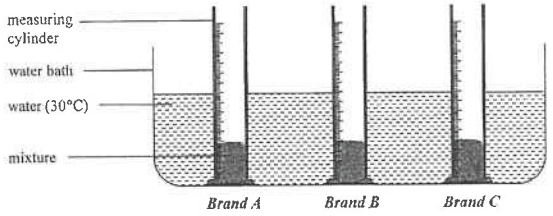
(ii) The rate of carbon dioxide production also increased in the first 10 minutes. Write a word equation to show how carbon dioxide is produced. (2)

(iii) Why is it harmful to the body cells if the blood contains a high level of lactic acid ?(1)

(iv) Referring to the graph, which method, sitting down or slow jogging, is more effective in removing lactic acid from the blood after exercise ? Based on your biological knowledge, explain why this method is more effective. (4)

CE - 2007

4. A student carried out an investigation to compare the activity of three brands of yeast. He added a mixture of fixed amounts of dough and yeast into a measuring cylinder and recorded the volume of the mixture. After putting the measuring cylinder in a water bath at 30oC for one hour, the volume of the mixture was recorded again. The diagram below shows his set-up:



(a) The results of the investigation are shown in the table below. Complete the table by finding out the percentage change in the volume of mixture for brand C. (1 mark)

Brand of yeast	Initial volume of mixture (cm^3)	Volume of mixture after 1 hour (cm^3)	Percentage change in the volume of mixture (%)
A	20	28	40
B	20	49	145
C	20	46	

(b) Draw a bar chart to show the activity of the three brands of yeast in terms of the percentage change in the volume of mixture. (3 marks)

(c) Explain why the yeast can make the mixture rise. (3 marks)

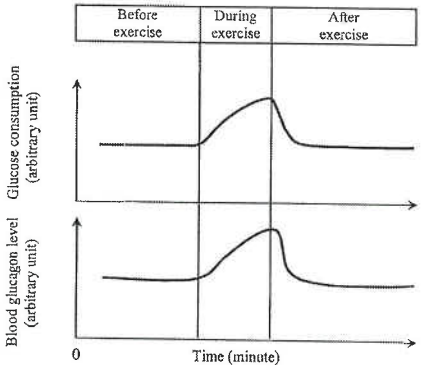
(d) The student wants to make a cake that is the most spongy. Based on the above results, which brand of yeast should be used? (1 mark)

(e) Why should the set-up be kept in a water bath? (1 mark)

(f) If the student wanted to study the effect of temperature on the activity of yeast, suggest two changes that should be made in his experimental design. (2 marks)

CE - 2007

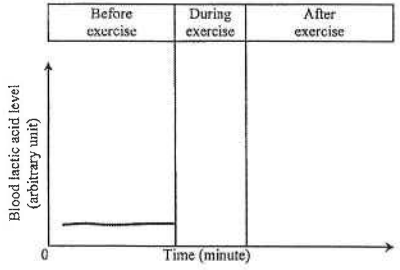
8. (b) The graphs below show the changes in the glucose consumption and the blood glucagon level in a person before, during and after exercise:



(i) Explain the change in glucose consumption during exercise.(3)

(ii) During exercise the blood glucose level remains relatively steady. Explain this phenomenon by referring to the change in the blood glucagon level. (3)

(iii) Draw a line on the graph below to show the change in the blood lactic acid level during and after vigorous exercise. (2 marks)



CE - 2010

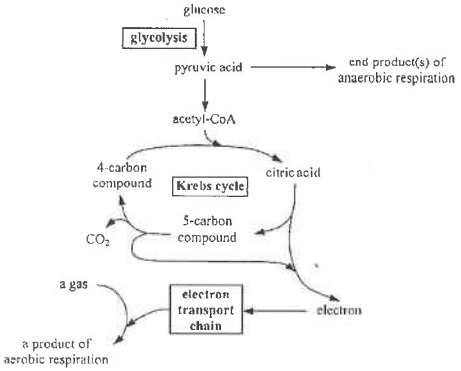
6. The following table shows the comparison of two vital processes -- photosynthesis and aerobic respiration. Complete the table with suitable words. (5)

	Photosynthesis	Aerobic respiration
Type of metabolic process	Anabolism	(a)
Organelle where the process occurs	Chloroplasts	(b)
Raw materials needed	(c)	Glucose and oxygen
Energy conversion	from (d) _____ energy to chemical energy in glucose	from chemical energy in glucose to chemical energy in ATP and (e)_____ energy

Total: 5 marks

AL - 2005 1A

2. The diagram below oulines the biochemical pathway of respiration in animal and plant cells:



(a) (i) State the end product(s) of anaerobic respiration:

Animal cells

Plants cells (2)

(ii) Based on your knowledge of biochemical reactions, suggest a reason why the same substrate (pyruvic acid) can be broken down into different end products in the anaerobic respiration of animal and plant cells. (1)

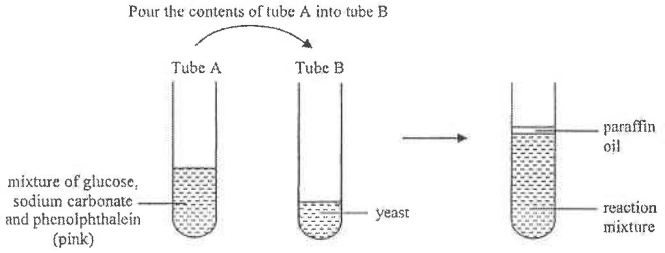
(b) Give one carrier that transfers electrons from the Krebs cycle to the electron transport chain. (1)

(c) Explain why the electron transport chain cannot operate under anaerobic conditions. (1)

(d) Indicate on the diagram two other sites where carbon dioxide is released in the aerobic pathway. (2)

AL - 2009 1A

5. To estimate the rate of anaerobic respiration of yeast at room temperature, a student poured the contents of tube A into tube B and covered the reaction mixture with a layer of paraffin oil as shown below:



N.B. Phenolphthalein is an indicator which is colourless at round pH 8 or below, but pink at higher pH.

The time taken for the disappearance of the pink colour in the reaction mixture can be used to indicate the rate of anaerobic respiration of yeast.

(a) Account for the colour change in the reaction mixture. (3 marks)

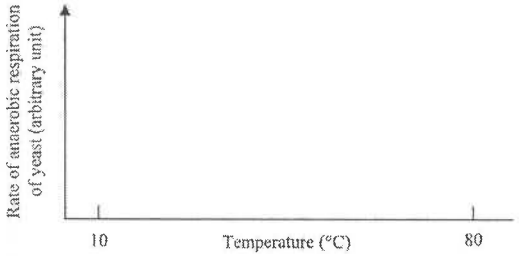
(b) The above method can be used to study the effect of temperature on the rate of anaerobic respiration of yeast.

(i) List three variables that have to be kept constant for the results to be comparable. (3 marks)

(ii) What additional steps are necessary to manipulate the independent variable of the experiment? (3 marks)

(iii) After recording the time taken for the disappearance of the pink colour, what further manipulation of the data is necessary to obtain the rate of anaerobic respiration of yeast? (1 mark)

(iv) In the space below, sketch a graph to show the effect of temperature on the rate of anaerobic respiration of yeast. (1 mark)



AL - 2010 2C

7. Both chloroplast and mitochondria are important organelles for handling energy transformation. Explain how the structural similarities of the two organelles contribute to efficient energy transformation. (11 marks)

DSE-2012 1B

9. Drugs X and Y may inhibit enzymes involved in glycolysis, the Krebs cycle or oxidative phosphorylation. To study the effects of the drugs, some muscle cells were isolated and treated with these two drugs separately in the presence of oxygen. The cellular levels of ATP, NADH, and pyruvate were determined. The results are shown in the table below:

	ATP	NADH	Pyruvate
Control (without treatment)	100%	100%	100%
Drug X	2%	3%	5%
Drug Y	20%	15%	150%

The data for the control are set as 100% for comparative purpose.

(a) Suggest the key process that is inhibited by drug X. Explain your answer. (3 marks)

(b) Suggest the key process that is inhibited by drug Y. Explain why there is an accumulation of pyruvate in the muscle cells after treatment with drug Y. (3 marks)

(c) Instead of incubating in the presence of oxygen, the untreated muscle cells were incubated under anaerobic conditions. Predict the change in the cellular ATP, NADH and lactate levels. (3 marks)

(d) A student would like to study the enzymes involved in glycolysis, the Krebs cycle and oxidative phsophorylation separately. Suggest which cellular components he needs to isolate for the investigation. (3 marks)

DSE-2014 1B

1. For each of the brain parts listed in column 1, select from column 2 one phrase that matches it. Put the appropriate letter in the space provided. (3 marks)

Column 1		Column 2
NADPH	____	A. a product of oxidative phosphorylation
pyruvate	____	B. a product of photochemical reactions
NAD	____	C. a product of carbon dioxide
		D. a product of glycolysis

Past Papers Marking Scheme – Respiration

CE - 2004 Q.4 (a)

(i) The muscles carry out anaerobic respiration 1
to release additional energy for muscle contraction 1
As anaerobic respiration produces lactic acid 1
it will lead to an increase in blood lactic acid concentration

(ii) glucose + oxygen → carbon dioxide + water 2 or 0

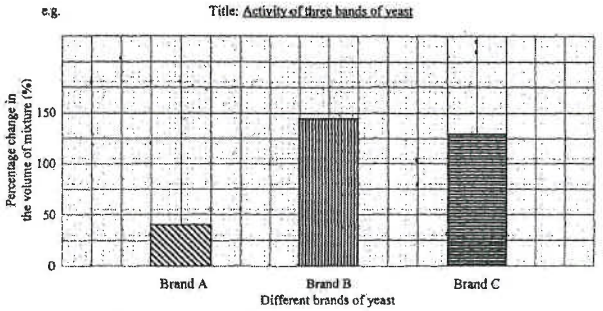
(iii) Because it lowers the pH of the blood / tissue fluid which adversely affects cellular activities/ it inactivates enzymes 1

(iv) Slow jogging 1
Because slow jogging can maintain a relatively high rate of heart beat / blood flow / breathing 1
which increases the rate of oxygen supply to the body 1
thus enhances the breakdown of lactic acid / conversion of lactic acid to glycogen 1

CE - 2007 Q.4

(a) 130 1

(b) correct title ½
correct labeling of axes ½,½
correct drawing and labeling of bars 1½



(c) Anaerobic respiration of yeast 1
produce carbon dioxide 1
which is trapped inside the dough 1
making it rises 1

(d) Brand B 1

(e) To ensure the temperature of the three mixtures are the same / maintain the temperature at 30°C throughout the investigation 1

(f) Use only one brand of yeast 1
Put the measuring cylinder in water baths at different temperatures 1

CE - 2007 Q.8 (b)

(i) Glucose consumption increases during exercise 1
because glucose is used in respiration / respiration rate is faster 1
to provide more energy for muscle concentration 1

(ii) More glucagons is released during exercise 1
which stimulates the conversion of glycogen to glucose in liver 1
to restore the blood glucose level / compensates for the increase in glucose consumption 1

(iii) Trends:
Increase during exercise 1
Decrease after exercise 1

CE - 2010 Q.6

(a) catabolism/ catabolic process/ breaking down process (1)

(b) mitochondria (1)

(c) carbon dioxide and water (1 or 0)

(d) light/ solar (1)

(e) heat (1)

AL - 2005 1A

2. (a) (i) Animal cells: lactic acid (1) 2
Plant cells: ethanol and carbon dioxide (1)
(ii) because the enzyme(s) involved in the breaking down of pyruvic acid in animal cells is / are different from those in plant cells (1) 1

(b) $NADH / FADH_2$ (1) 1

(c) because oxygen is required as the final electron acceptor (1) 1

(d) On the diagram: CO_2 is released from the steps of pyruvic acid → acetyl-CoA (1), citric acid → 5-C compound (1) 2

(7)

AL - 2009 1A

5. (a)
- yeast carries out anaerobic respiration to produce carbon dioxide and alcohol (1)
- carbon dioxide dissolves in water to form carbonic acid / a weak acid (1)
- which neutralizes the sodium carbonate (1) / which lowers the pH to / below 8

Therefore, the pink colour disappears (3)

(b) (i)
- amount of yeast (1) / use yeast solution from the same culture
- amount of glucose (1)
- amount of sodium carbonate (1) (3)

(ii)

Concept for mark award: (3)
- vary the temperature (1)
- for each temperature, kept the tubes in a water bath for equilibration before mixing (1)
- maintain the reaction mixture at the target temperature after mixing (1)

e.g.
- prepare water baths set at different temperatures, e.g. 10℃, 20℃, 30℃, 40℃, 50℃, 60℃, 70℃ and 80℃ (1)
- for each temperature, keep tubes A & B in the water bath for 10 minutes (1) (3)
- after mixing, keep the reaction mixture in its corresponding water bath (1)

(iii) Convert the time to rate by taking the reciprocal of the time taken (1)
(iv) Correct shape of curve (1)

AL - 2010 2C

7.

Structural similarities	Significance for energy transformation
· both are double-membrane bounded organelles (1)	· to provide an isolated environment (1) so that the energy transformation processes will not be interfered by other cellular processes (1)
	· substrate concentration can be increased (1) by entrapping the necessary raw materials inside the organelles (1)
· contain large amount of internal membrane (1) / i.e. thylakoid and grana in chloroplast and cristae in mitochondrion	· provide large surface area (1) to hold more membrane-bound enzymes (1) for more efficient energy transformation
· presence of membrane-bound enzyme systems (1)	· related enzymes are located next to one another (1) to allow the passage of metabolic product from one pathway to another pathway (1)
· presence of own circular DNA (1)	· produce specific enzymes and structures (1) which are required for their related energy transformation processed
(4)	(9)

max.12

DSE-2012 1B

9. (a)
- drug X inhibits glycolysis (1) (do not accept more than 1 process) (1)
- as glycolysis is the first step in the respiratory pathway, the inhibition of glycolysis will halt the processes that follow, i.e. Krebs cycle and oxidative phosphorylation (1) (1)
- hence, the overall production of pyruvate, ATP and NADH are greatly reduced, showing that the whole respiratory pathway was jeopardized (1) (1)

Remarks:
- No mark will be given to bullet point 1 when minor steps in each process instead of the key process are mentioned.

Alternative answer:
- Pyruvate is the product of glycolysis (1)
- As the production of pyruvate is greatly reduced after treating with drug X (1)
- Glycolysis is inhibited in this case (1)

(b)
- drug Y inhibits Krebs cycle (1) (do not accept more than 1 process) (1)
- when the respiratory pathway is halted at Krebs cycle, pyruvate would not be metabolised (1) (1)
- but glycolysis still proceeds as usual and produce pyruvate (1), as a result, pyruvate will accumulate (1)

(c)
- in anaerobic conditions, muscle cells undergoes anaerobic respiration and produce less ATP (1) and less NADH (1) than aerobic respiration (1,1)
- at the same time, lactic acid level rises as it is produced (1) as a result of incomplete oxidation (1)

(d)
- glycolysis: cytoplasm (1) (1)
- Krebs cycle: mitochondrial matrix (1) (1)
- oxidative phosphorylation: mitochondrial inner membrane (1) (1)

Remarks:
- if the key processes are not mentioned but the three cellular components are mentioned in the correct sequence, 3 marks will be given
- if only two or one cellular component(s) are mentioned, no mark will be scored

12 marks

DSE-2014 1B

1. B (1)
D (1)
A (1)

3 marks