# 2017 Respiration and Photosynthesis MCQ

**2017 / H2 / ACJC PRELIM / P1 Q20**

**1** Which of the following statements explains the mechanism for chemiosmosis in the synthesis of ATP?

**A** The energy released by the reduction and subsequent oxidation of components of the electron transport chain is transferred to ATP synthase for the synthesis of ATP.

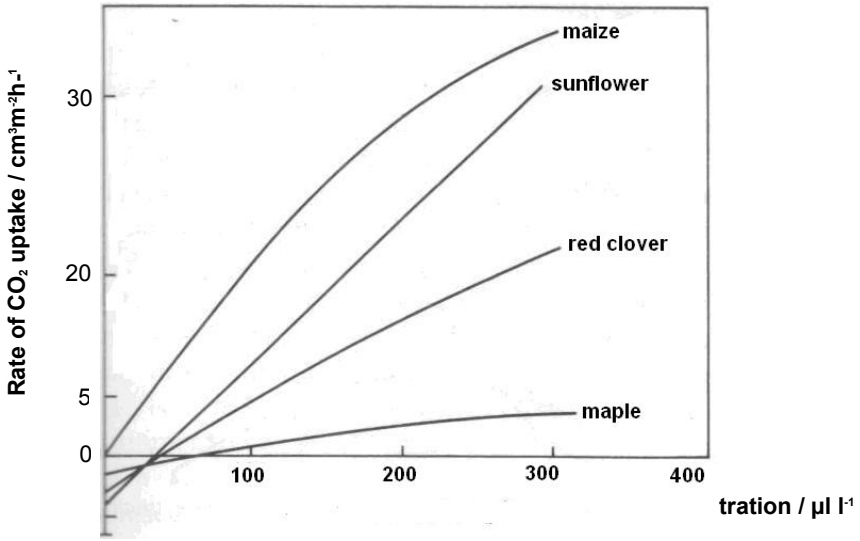
**B** Phosphorylation of ADP is linked to the proton gradient established by the electron transport chain.

**C** The difference in pH between the intermembrane space and the cytosol drives the formation of ATP.

**D** The flow of $H^+$ through ATP synthase into the intermembrane space drives the synthesis of ATP.

**2017 / H2 / ACJC PRELIM / P1 Q21**

**2** The diagram below shows the rate of photosynthesis of four different plants at different concentrations of carbon dioxide.




Which of the following conclusions can be made?

1 At $CO_2$ concentrations below 150 µl $l^{-1}$, $CO_2$ concentration is the main limiting factor for all the plants.
2 $CO_2$ compensation point is around 40 µl $l^{-1}$ for sunflower and red clover, and it measures the light intensity when the rate of $CO_2$ uptake equals to the rate of $CO_2$ given off.
3 Rate of $CO_2$ uptake was zero for maize at $CO_2$ concentration of 0 µl $l^{-1}$ as the amount of $CO_2$ released from respiration is used for photosynthesis.

4 Of the four plants, maple has the lowest amount of organic compound produced at $CO_2$ concentration of 200 µl $l^{-1}$.

**A** 1, 2 and 3 only

**B** 1, 3 and 4 only

**C** 1 and 2 only

**D** 3 and 4 only

**2017 / H2 / ACJC PRELIM / P1 Q22**

**3** Dinitrophenol is a metabolic poison that can lodge within the thylakoid membranes of chloroplasts. It then provides an alternative route for $H^+$ ions to diffuse across the thylakoid membranes. In what way will the Calvin cycle be affected in chloroplasts poisoned by dinitrophenol?

**A** No change in rate as Calvin cycle occurs in the stroma and not at thylakoid membranes.

**B** The rate of Calvin cycle will increase as pH in the stroma will decrease towards the optimum for enzymes involved in the cycle.

**C** The rate of Calvin cycle will decrease with the accumulation of glycerate-3-phosphate.

**D** The rate of Calvin cycle will decrease with the accumulation of glyceraldehyde-3-phosphate.

**2017 / H2 / AJC PRELIM / P1 Q18**

**4** Which of the following is true about both cyclic and non-cyclic photophosphorylation?

1 Establishes an electrochemical gradient across the thylakoid membrane
2 Involve photosystem II
3 Require oxygen as the final electron acceptor
4 Photolysis of water occurs

**A** 1 only

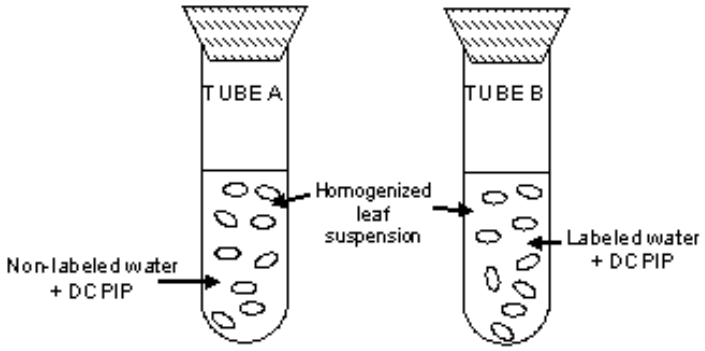
**B** 1 and 2 only

**C** 2 and 4 only

**D** 1, 3 and 4 only

**2017 / H2 / AJC PRELIM / P1 Q19**

**5** The experimental setup below was created by homogenizing leaf cells to break their cell walls. The leaf suspensions containing the cytoplasm and organelles were then placed in test-tubes containing non-labeled water ($H_2{}^{16}O$) and $^{18}O$-labeled water ($H_2{}^{18}O$) respectively. A few drops of DCPIP, a hydrogen acceptor, were added to each test-tube. DCPIP will turn from blue to colourless when it is reduced and this colourless DCPIP can be reoxidized to blue.




The test-tubes were then exposed to blue light for 30 minutes. Which of the following shows the results of the two test-tubes after 30 minutes?

| | Tube A | | Tube B | |
|---|---|---|---|---|
| | **Gas evolved** | **DCPIP colour** | **Gas evolved** | **DCPIP colour** |
| **A** | $C^{16}O_2$ | Blue | $C^{18}O_2$ | Blue |
| **B** | $^{16}O_2$ | Blue | $^{16}O_2$ | Blue |
| **C** | $C^{16}O_2$ | Colourless | $C^{18}O_2$ | Colourless |
| **D** | $^{16}O_2$ | Colourless | $^{18}O_2$ | Colourless |

**2017 / H2 / AJC PRELIM / P1 Q20**

**6** From which substrate is the first carbon dioxide molecule released during cellular respiration?

**A** Glucose

**B** Pyruvate

**C** Acetyl-coA

**D** Citrate

**2017 / H2 / ACJC PRELIM / P1 Q21**

**7** Four tubes containing preparations from animal tissue were set up as shown in the table.

| Tube | Contents |
|---|---|
| 1 | Glucose + homogenized cells |
| 2 | Glucose + cytoplasm lacking organelles |
| 3 | Pyruvic acid + homogenized cells |
| 4 | Pyruvic acid + mitochondria |

After incubation, in which tube/ tubes would at least 36 ATP be produced?

**A** 1 only

**B** 1 and 3 only

**C** 1, 2 and 4 only

**D** 1, 3 and 4 only

**2017 / H2 / CJC PRELIM / P1 Q22**

**8** Sodium azide is a strong inhibitor to the ETC in mitochondria. An experiment was conducted with isolated mitochondria, 2 molecules of glucose, 10 molecules of pyruvic acid along with oxygen, ADP and $NAD^+$ which was supplied in excess.
What would be the expected production of ATP from the experiment?

**A** 2

**B** 4

**C** 10

**D** 22

**2017 / H2 / CJC PRELIM / P1 Q23**

**9** Which of the following is not true of photosynthesis.

**A** The spectra of light in which photosynthesis is most efficient is in the red and violet region.

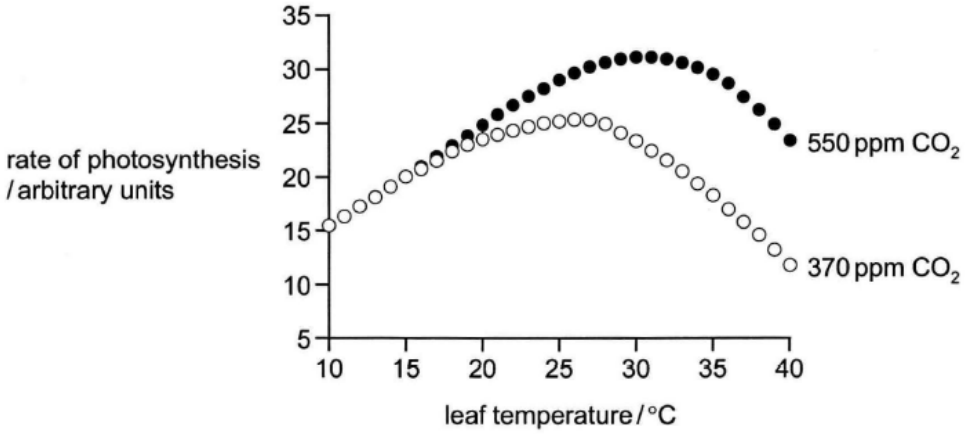
**B** Rate of ATP synthesis depends on the differential proton gradient across the thylakoid membrane.

**C** Photosynthesis starts first with the photolysis of water.

**D** Oxygen concentration affects the efficiency of the light independent reaction.

**2017 / H2 / DHS PRELIM / P1 Q23**

**10** The graph shows the results of increased concentrations of carbon dioxide on soy bean photosynthesis at various leaf temperatures. Carbon dioxide concentration is measured in ppm (parts per million). Light intensity was at an optimum level.




Which conclusion concerning the data in the graph is valid?

**A** At all temperatures up to 15ºC, carbon dioxide concentration is limiting. Above 15ºC, temperature becomes the limiting factor.

**B** Supplementing plants with carbon dioxide is only effective at temperatures above 25ºC.

**C** The photosynthetic rate obtained at the optimum temperature for 370ppm $CO_2$ could be achieved at a temperature 5ºC lower using an increased concentration of $CO_2$.

**D** When light intensity and temperature are limiting, increased carbon dioxide concentration increases the rate of photosynthesis.

**2017 / H2 / DHS PRELIM / P1 Q24**

**11** Some apples can be stored in controlled atmospheric conditions for up to a year. Taste and texture are maintained by using conditions that reduce the production of a fruit-ripening plant hormone while limiting the build-up of ethanol. Ethanol damages the fruit.

The storage conditions needed include low temperature (1ºC), high carbon dioxide concentration (1.2%) and low oxygen concentration (0.9%).

Why are these conditions needed?

1 Low oxygen concentration favours anaerobic respiration.

2 Enzyme activity is reduced.

3 Conversion of sugar to ethanol is minimised.

4 High carbon dioxide concentration promotes photosynthesis.

**A** 1, 2 and 3

**B** 1, 2 and 4

**C** 2 and 3 only

**D** 3 and 4 only

**2017 / H2 / JJC PRELIM / P1 Q22**

**12** Isolated chloroplasts, suspended in buffer solution, are often used to study the light dependent stage of photosynthesis.

During this stage, electrons ($e^-$) are transferred by carriers and provide energy so that a proton ($H^+$) gradient can be formed. Protons diffuse through membrane proteins that are linked to synthase enzymes.

Three compounds that can be added to isolated chloroplasts are:

1 DCMU, which inactivates a carrier that accepts electrons from photosystem II

2 DCPIP, which can act as a final electron acceptor

3 ammonium hydroxide solution, which absorbs protons

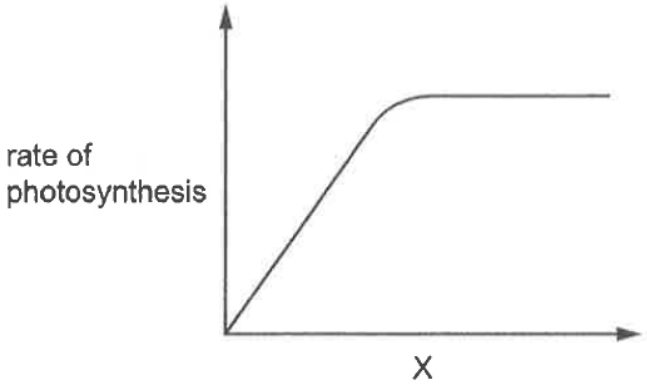
Which compounds, when added separately to isolated chloroplasts, would allow the light dependent stage of photosynthesis to occur and which would inhibit it?

| | allow | inhibit |
|---|---|---|
| **A** | 1 | 2 and 3 |
| **B** | 1 and 3 | 2 |
| **C** | 2 | 1 and 3 |
| **D** | 2 and 3 | 1 |

**2017 / H2 / JJC PRELIM / P1 Q23**

**13** The rate of photosynthesis in pondweed was measured when one variable was changed and all others were standardised.

The graph shows the rate of photosynthesis at different values of a variable, X.




Which variables could be represented by X?

1 carbon dioxide availability

2 light intensity

3 oxygen availability

4 temperature

5 leaf area exposed to direct light

**A** 1, 2 and 5

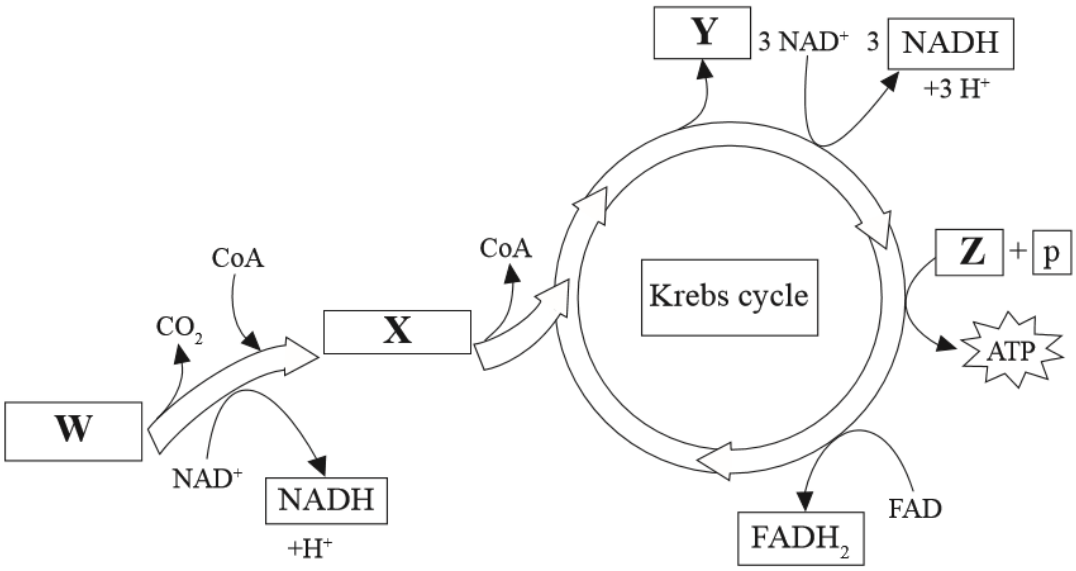
**B** 1 and 2 only

**C** 2, 4 and 5

**D** 3 and 4

**2017 / H2 / JJC PRELIM / P1 Q24**

**14** The diagram below shows the link reaction and stages of the Krebs cycle. Which molecules are represented by the letters W, X, Y and Z?




| | W | X | Y | Z |
|---|---|---|---|---|
| **A** | acetyl CoA | carbon dioxide | ADP | pyruvate |
| **B** | pyruvate | acetyl CoA | carbon dioxide | ADP |
| **C** | ADP | carbon dioxide | acetyl CoA | pyruvate |
| **D** | acetyl CoA | pyruvate | carbon dioxide | ADP |

**2017 / H2 / MJC PRELIM / P1 Q20**

**QUESTION 15**

Which of the following statement(s) is/are true with regards to cyclic and non-cyclic photophosphorylation?

**1** Only cyclic photophosphorylation produces oxygen.

**2** Only cyclic photophosphorylation can function in the absence of photosystem II.

**3** Only non-cyclic photophosphorylation will be affected in the absence of NADP reductase.

**4** The plant switches from cyclic to non-cyclic photophosphorylation when only ATP is required.

**A.** 1 only

**B.** 1 and 4 only

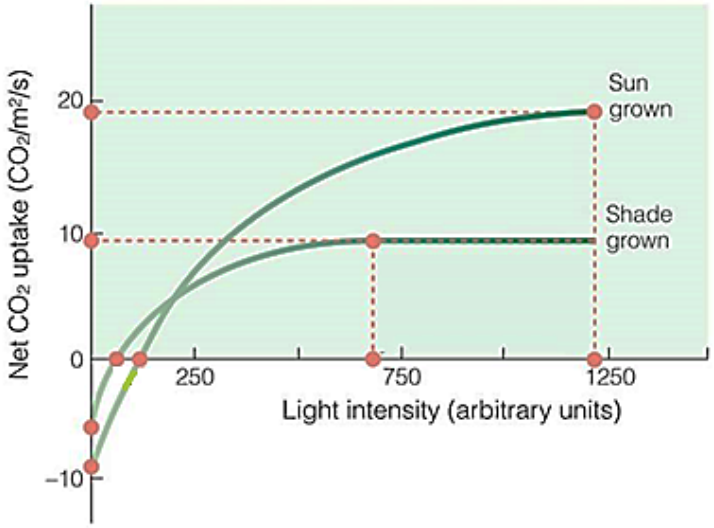
**C.** 2 and 3 only

**D.** 2 and 4 only

**2017 / H2 / MJC PRELIM / P1 Q21**

**QUESTION 16**

The effect of light intensity on photosynthetic rate was investigated in sun-grown and shade-grown leaves. The results obtained from this investigation are shown in the graph below.




Which of the following statement is a conclusion that can be drawn from the graph?

**A.** There are more chloroplast-containing cells in sun-grown leaves than shade-grown leaves, thus light saturation point for sun-grown leaves is higher.

**B.** Shade-grown leaves are more efficient at harnessing light energy at high light intensity.

**C.** Compensation point of sun-grown leaves is higher than shade-grown leaves as sun-grown leaves require less carbon dioxide to carry out photosynthesis.

**D.** Rate of Calvin cycle is faster in sun-grown leaves than shade-grown leaves at very low light.

**2017 / H2 / MJC PRELIM / P1 Q22**

**QUESTION 17**

An experiment was conducted to investigate respiration of yeast cells.

**Tube 1:** Radioactive glucose solution + suspension of yeast cells + oxygen

**Tube 2:** Radioactive glucose solution + suspension of yeast cells + oxygen + antimycin

All the six carbon atoms of the radioactive glucose were $^{14}C$. The initial radioactivity measured in each test tube was 60 arbitrary units.

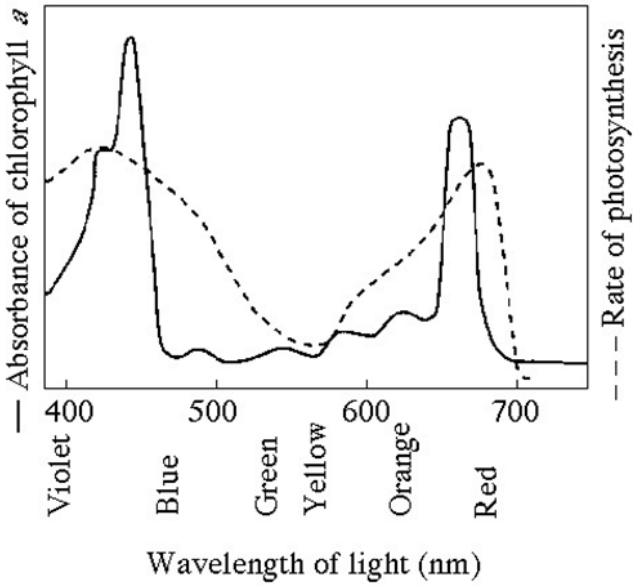
Antimycin is an electron transport chain inhibitor.

After all the glucose was metabolized, the amount of radioactivity in the gaseous product and the content of the tubes were measured. Which of the following shows the expected result?

| | tube 1 (radioactivity / arbitrary units) | | tube 2 (radioactivity / arbitrary units) | |
|---|---|---|---|---|
| | Content in tube 1 | gaseous product | Content in tube 2 | gaseous product |
| **A.** | 40 | 20 | 0 | 60 |
| **B.** | 0 | 60 | 20 | 40 |
| **C.** | 0 | 60 | 40 | 20 |
| **D.** | 60 | 0 | 40 | 20 |

**2017 / H2 / NJC PRELIM / P1 Q21**

**18** The graph shows the absorption spectrum for chlorophyll *a* and the photosynthetic action spectrum of a plant.




Why are they different?

**A** Chlorophyll *a* absorbs different wavelengths of light to different extents.

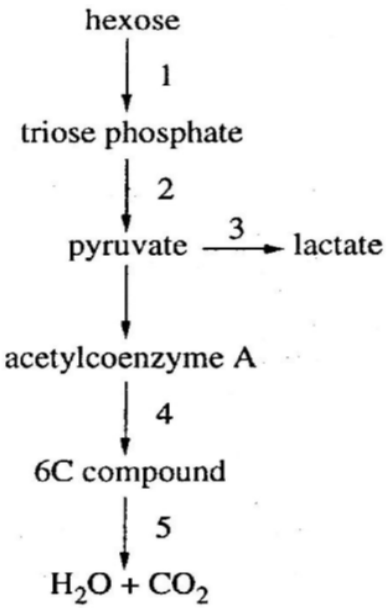
**B** Chlorophyll *a* is not present in the plant.

**C** Chlorophyll *a* is not the only pigment in the plant that absorbs light.

**D** Chlorophyll *a* is the main pigment responsible for photosynthesis in the plant.

**2017 / H2 / NJC PRELIM / P1 Q22**

**19** The diagram summarises the pathway of glucose breakdown.




Which two steps result in a net increase of ATP?

**A** 1 and 4

**B** 2 and 4

**C** 2 and 5

**D** 3 and 5

**2017 / H2 / NYJC PRELIM / P1 Q21**

**20** In a series of experiments, actively photosynthesizing plants were supplied with labelled reactants.

**1** water containing $^{18}O$ isotope

**2** carbon dioxide containing $^{17}O$ isotope

**3** carbon dioxide containing $^{13}C$ isotope

Where in the chloroplast would the products of photosynthesis from these reactants be formed?

| | $^{18}O$ | $^{17}O$ | $^{13}C$ |
|---|---|---|---|
| **A** | stroma | stroma | thylakoids |
| **B** | stroma | thylakoids | stroma |
| **C** | thylakoids | stroma | stroma |
| **D** | thylakoids | stroma | thylakoids |

**2017 / H2 / NYJC PRELIM / P1 Q22**

**21** In an experiment, four tubes were set up as shown in the table below.

| tube | contents |
|---|---|
| **1** | Glucose + homogenized animal cells |
| **2** | Glucose + mitochondria |

| | |
|---|---|
| **3** | Glucose + cytoplasm lacking organelles |
| **4** | Pyruvate + homogenized animal cells |

If all other conditions are kept constant, which of the following shows the amount of ATP produced in each tube in **increasing** order?

**A** 1 – 3 – 4 – 2

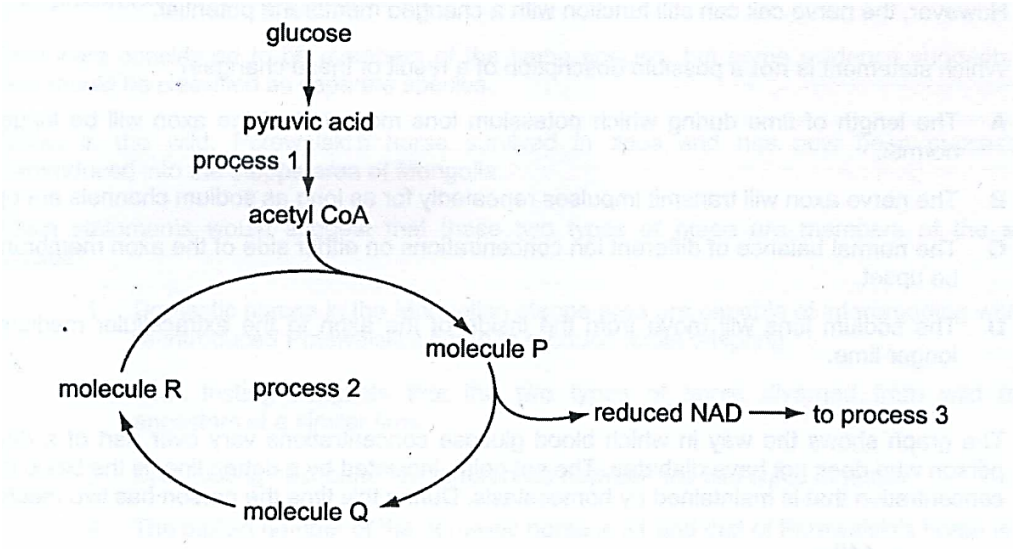
**B** 2 – 3 – 4 – 1

**C** 4 – 2 – 3 – 1

**D** 3 – 2 – 1 – 4

**2017 / H2 / PJC PRELIM / P1 Q22**

**22** The diagram shows a summary of aerobic respiration.




Which statements are correct?

1 Process 1 occurs in cytosol and process 2 occurs in mitochondrial matrix.

2 Process 2 and 3 occur in mitochondrial matrix.

3 Process 1 occurs in mitochondrial matrix and process 3 occurs in inner mitochondrial membrane.

4 Process 1 produces 2 ATP and 2 NADH per glucose molecule oxidized.

5 Process 2 produces 2 ATP, 10 NADH and 2 FADH2 per glucose molecule oxidized.

6 Process 3 is responsible for producing about 90% of the total yield of ATP from the hydrogen carriers reduced per glucose molecule oxidized.

**A** 2 and 4

**B** 1 and 5

**C** 3 and 6

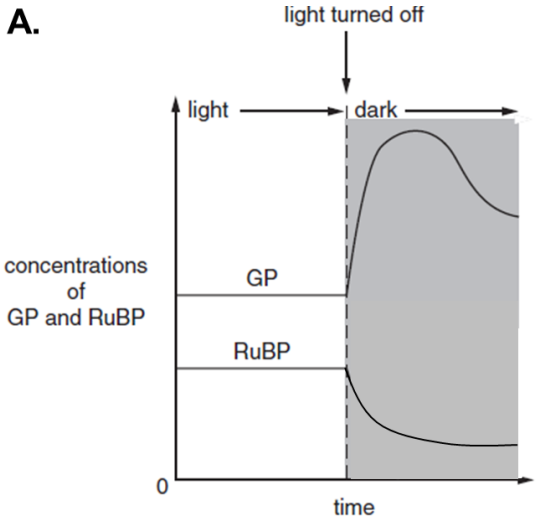
**D** 1 and 6

**2017 / H2 / PJC PRELIM / P1 Q23**

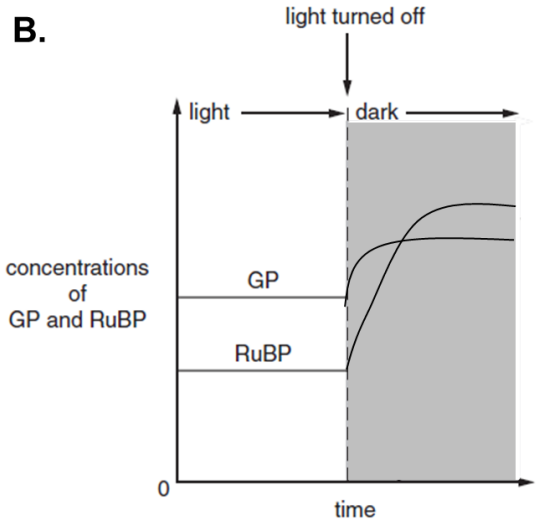
**23** Concentrations of glycerate-3-phosphate (GP) and ribulose bisphosphate (RuBP) were measured from samples of actively photosynthesising green algae in an experimental chamber.

Which of the following graphs show how the concentration of these compounds changed when the light source was turned off?

**A** **A.**



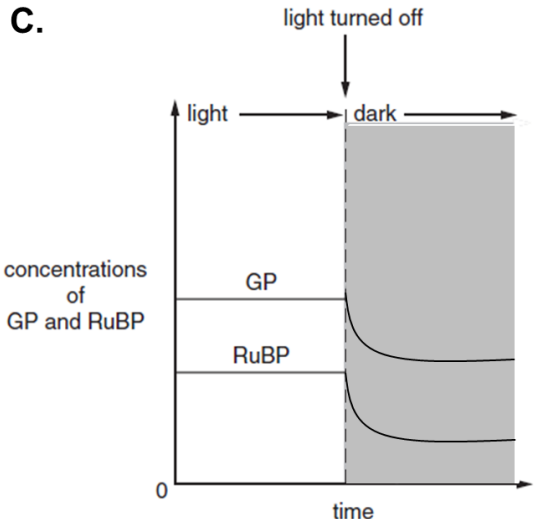

**B** **B.**



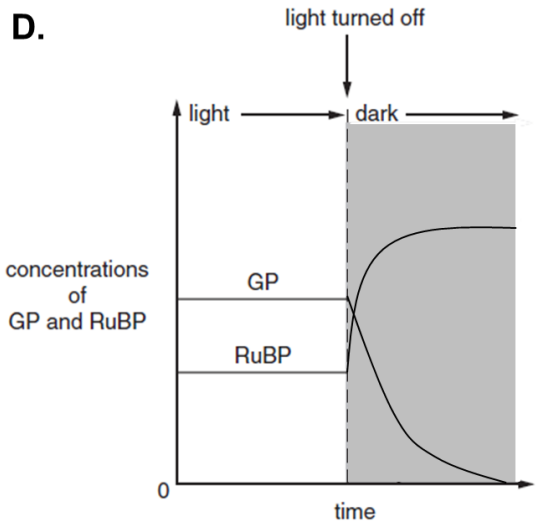

**C**

**D**

**C.**

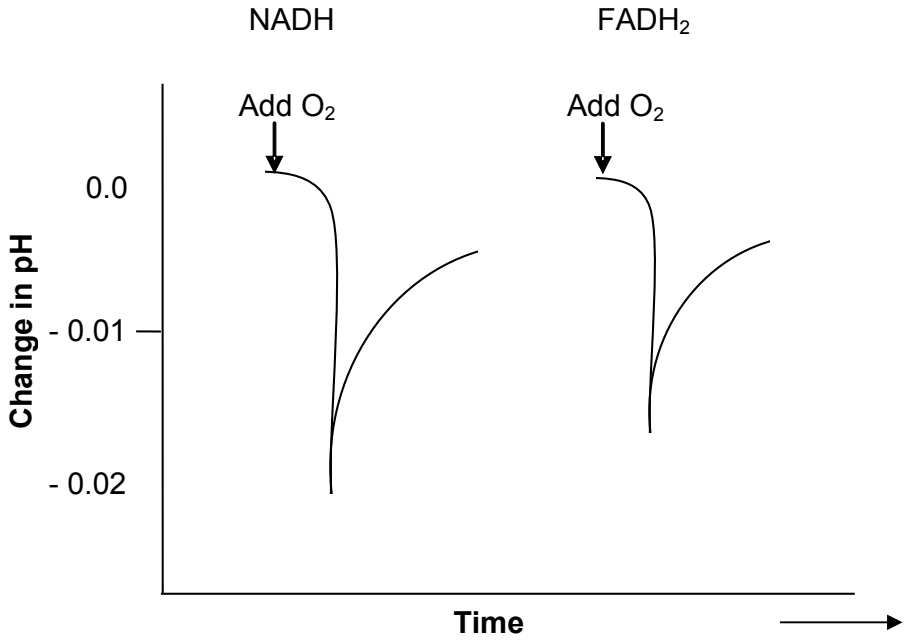

light turned off
light
dark
concentrations of GP and RuBP
GP
RuBP
0
time

**D.**


light turned off
light
dark
concentrations of GP and RuBP
GP
RuBP
0
time

**2017 / H2 / PJC PRELIM / P1 Q24**

**24** Isolated mitochondria were incubated with NADH in one experiment and an equal amount of FADH2 in another experiment. The mitochondria were initially deprived of oxygen. The pH of the intermembrane space was then monitored as a known quantity of oxygen was added. The results are shown in the graph.




Which of the following can be concluded based on the results?

1 Upon the addition of oxygen, glycolysis and subsequently, link reaction, Krebs cycle and oxidative phosphorylation occurred.

2 Electron transfer was initiated by the addition of oxygen.

3 The pH drop was greater with NADH than with FADH2, which is consistent with the greater ATP yield that accompanies the oxidation of NADH.

4 The rapid decline in pH indicates that protons were pumped into the intermembrane space when oxygen was available.

**A** 1 only

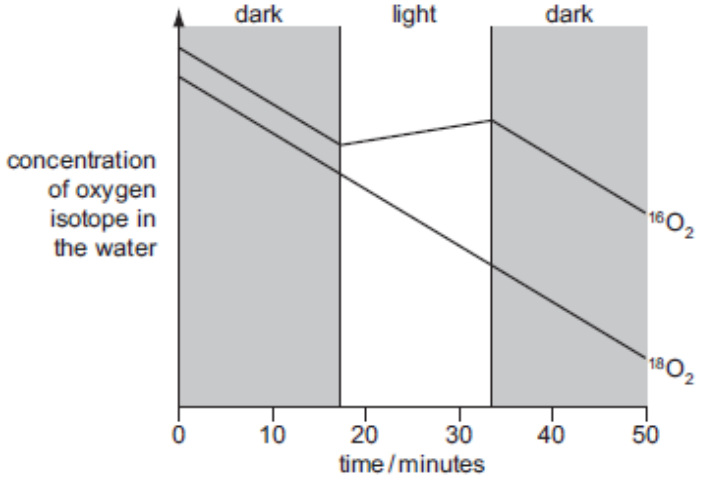
**B** 2 and 4 only

**C** 2, 3 and 4 only

**D** All of the above

**2017 / H2 / RVHS PRELIM / P1 Q21**

**25** The common isotope of oxygen is $^{16}O$. Air containing $^{16}O_2$ and $^{18}O_2$ was bubbled through a suspension of algae for a limited period. After this, the concentration of these two isotopes of oxygen in the water was monitored for the next 50 minutes whilst the algae were subjected to periods of dark and light. The results are shown in the diagram.




What is the best explanation for these results?

**A** Both isotopes of oxygen are used by the algae in the dark in respiration, but in the light oxygen is produced from water in photorespiration.

**B** The algae can distinguish chemically between the two isotopes.

**C** The algae produce oxygen from the water used in photosynthesis, but only in the light.

**D** The two isotopes have different rates of diffusion.

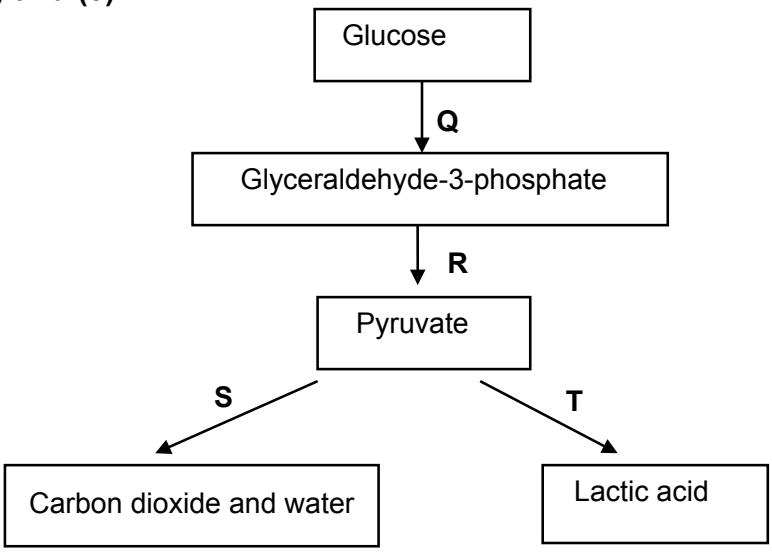
**2017 / H2 / RVHS PRELIM / P1 Q22**

**26** After vigorous exercise, changes occur in the muscle tissue. Compared with 'at rest' conditions, what will the changes be?

| | ATP | lactate | pH |
|---|---|---|---|
| **A** | decreased | increased | decreased |
| **B** | increased | increased | increased |
| **C** | decreased | decreased | increased |
| **D** | increased | decreased | decreased |

**2017 / H2 / SAJC PRELIM / P1 Q20**

**27** With reference to the diagram below, relate processes **P, Q, R, S, T** to statements **(1), (2) and (3).**




(1) NAD is regenerated without the use of the electron transport system

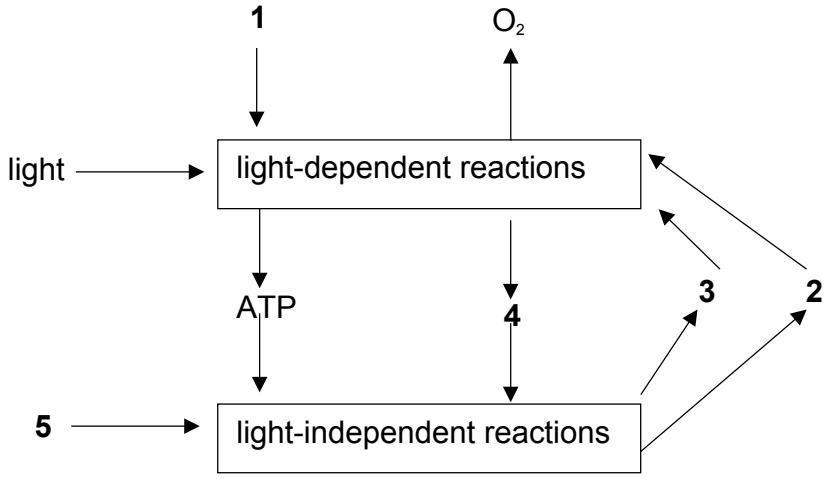
(2) ATP is synthesised via substrate level phosphorylation

(3) It can take place under anaerobic conditions.

| | **(1)** | **(2)** | **(3)** |
|---|---|---|---|
| **A** | T only | R only | Q,R,T only |
| **B** | T only | R,S only | Q,R,T only |
| **C** | S,T only | R only | Q,R,S,T |
| **D** | S,T only | R,S only | Q,R,S,T |

**2017 / H2 / SAJC PRELIM / P1 Q21**

**28** The diagram summarises the process of photosynthesis.

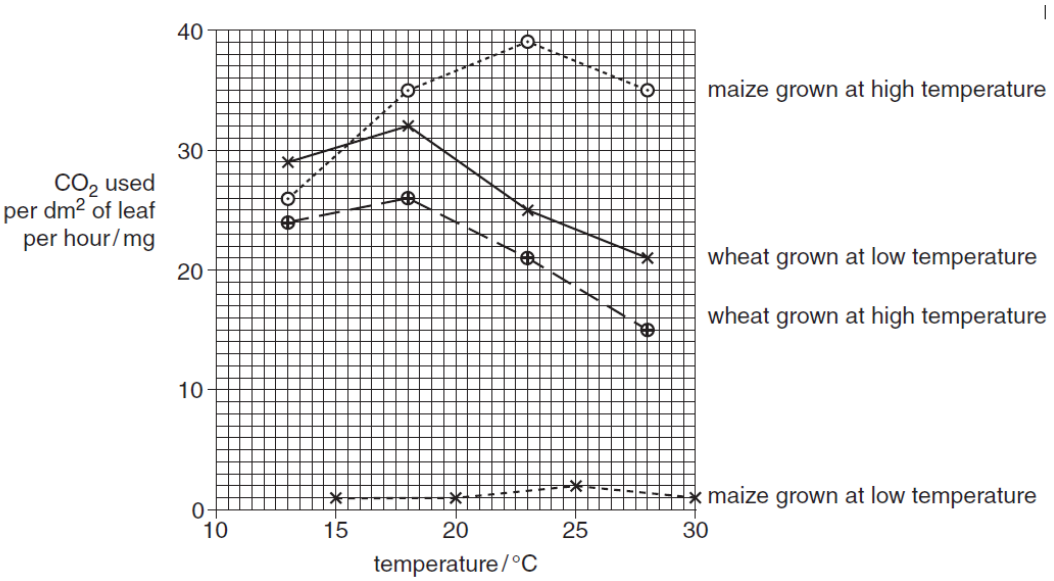



Which row identifies the reactants **1,2,3, 4** and **5**?

| | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| **A** | Carbon dioxide | ADP + phosphate | reduced NAD | NAD | water |
| **B** | Carbon dioxide | reduced NAD | ADP + phosphate | NADP | water |
| **C** | water | NAD | reduced NAD | ADP + phosphate | Carbon dioxide |
| **D** | water | NADP | ADP + phosphate | reduced NADP | Carbon dioxide |

**2017 / H2 / SAJC PRELIM / P1 Q22**

**29** Young maize and wheat plants were grown to maturity at high and low temperatures. The rate of photosynthesis in each of these mature plants was measured at different temperatures. The rate of photosynthesis was measured as the amount of $CO_2$ used per $dm^3$ of leaf per hour. The results are shown in the graph below



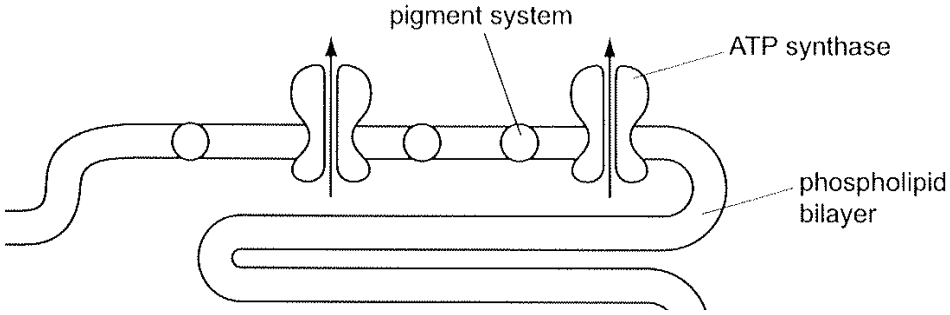

What information can be concluded from the graph above?

1 For plants grown at high temperature, the rate of photosynthesis is optimum at 25°C in maize and 18°C in wheat.
2 For plants grown at high temperature, maize had a greater increase in rate of photosynthesis compared to wheat until optimum temperature was reached.
3 The rate of photosynthesis was affected more significantly in maize plants than in wheat plants when grown at low temperatures.
4 Low temperatures slowed down the formation of membranes in maize plants but not in wheat plants which caused a decrease in lamellae formation.

**A** 2 and 3 only
**B** 1 and 4 only
**C** 1, 2 and 3 only
**D** All of the above

**2017 / H2 / TJC PRELIM / P1 Q23**

**30** The diagram shows a small part of a thylakoid membrane. The arrows represent the movement of a particular reaction product through the ATP synthase.

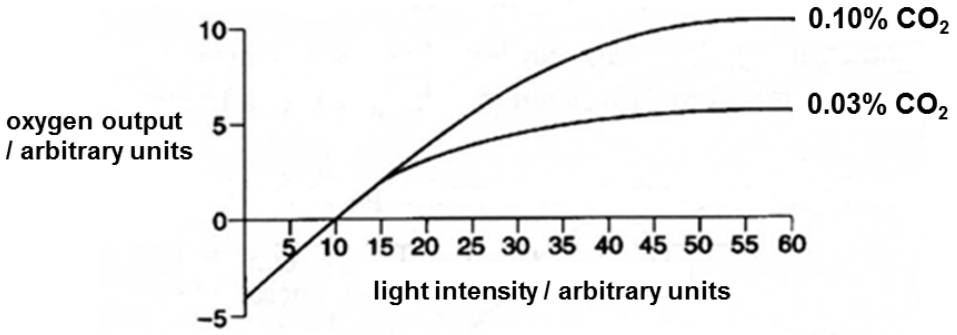



From which chemical was this product derived from?

**A** NADH **B** NADPH **C** Oxygen **D** Water

**2017 / H2 / VJC PRELIM / P1 Q20**

**31** The graph shows the oxygen output of a green plant at different light intensities in two separate setups with different concentrations of carbon dioxide in the surrounding air.




What can be deduced from the graph above?

1 At 10 arbitrary units of light intensity, the rate of photosynthesis is equivalent to the rate of respiration.

2 Concentration of carbon dioxide limits the rate of photosynthesis when light intensity exceeds 15 arbitrary units.

3 Enzymes catalysing carbon fixation are saturated at high light intensities (above 30 arbitrary units) in both experiments.

4 Oxygen output can be used to quantify the rate of photosynthesis due to their role as final acceptor of protons and electrons.

**A** 1 only

**B** 1 and 2 only

**C** 3 and 4 only

**D** 2, 3 and 4 only

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**21** Which of the following statements show a difference between cyclic and non-cyclic photophosphorylation?

**A** Cyclic photophosphorylation involves PSI and PSII only whereas non-cyclic photophosphorylation involves PSI, PSII and NADP.

**B** Light energy is required to boost electrons in cyclic photophosphorylation whereas for non-cyclic photophosphorylation, the energy comes from photolysis of water.

**C** Only non-cyclic photophosphorylation produces protons which is required for the generation of the proton gradient for ATP synthesis.

**D** Oxygen is produced in non-cyclic photophosphorylation only.

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**22** Two respirometers (one shown in Fig 22) were set up to investigate the rate of respiration in spiders. To one setup, the spiders were fed a diet containing a drug before the experiment. For this setup, the drop of fluid remained stationary after a short distance from the starting position. Distance moved is shorter than the control setup.

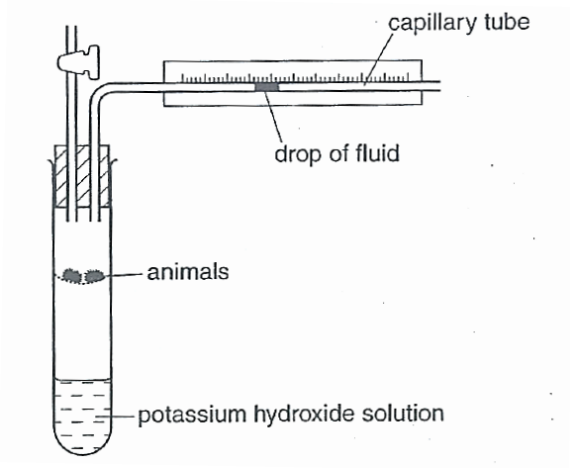


Fig 22

What could be a possible explanation for this observation?

**A** The oxygen content in the boiling tube was depleted.

**B** A mutation occurred that causes the ATP synthase to become hyperactive.

**C** A drug was introduced that act as an ion channel on the mitochondrial membrane.

**D** Inhibitor of the electron carriers in the electron transport chain was added to the animal's diet.

| | | | |
|---|---|---|---|
| 4 | **A** | 24 | **C** |
| 5 | **D** | 25 | **C** |
| 6 | **B** | 26 | **A** |
| 7 | **A** | 27 | **B** |
| 8 | **C** | 28 | **D** |
| 9 | **C** | 29 | **A** |
| 10 | **C** | 30 | **D** |
| 11 | **C** | 31 | **B** |
| 12 | **C** | 32 | **D** |
| 13 | **B** | 33 | **D** |
| 14 | **B** | | |
| 15 | **C** | | |
| 16 | **A** | | |
| 17 | **C** | | |
| 18 | **C** | | |
| 19 | **C** | | |
| 20 | **C** | | |

| Question | Answer |
|---|---|
| | |
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