

Bioenergetics practice questions

21 questions • 68 marks • mark scheme at the back

For AQA GCSE Biology 8461 and Combined Science: Trilogy 8464. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Name

Total / 68

Photosynthesis Spec 4.4.1

- 1** Which row correctly shows the reactants and products of photosynthesis? [1 mark]
- A. ☐ Reactants: glucose and oxygen. Products: carbon dioxide and water.
- B. ☐ Reactants: carbon dioxide and water. Products: glucose and oxygen.
- C. ☐ Reactants: carbon dioxide and oxygen. Products: glucose and water.
- D. ☐ Reactants: glucose and water. Products: carbon dioxide and oxygen.

- 2** Photosynthesis is an endothermic reaction. Describe what this means in terms of energy and where it is transferred to. [2 marks]

- 3** A student measured the oxygen released by pondweed. (a) The pondweed released 18 cm³ of oxygen in 6 minutes. Calculate the rate of photosynthesis. Give the unit. (b) The lamp was moved closer and the rate increased to 4.5 cm³ per minute. Calculate how long it would now take the pondweed to release 18 cm³ of oxygen. [4 marks]

Answer =

4 Explain how an increase in temperature affects the rate of photosynthesis. **[4 marks]**

5 A graph shows the rate of photosynthesis against light intensity. The rate rises steeply, then becomes constant at high light intensities. Explain the shape of the graph. Name one factor that could be limiting the rate when the graph is flat. **[3 marks]**

6 **Higher tier** **[4 marks]**

A graph shows the rate of photosynthesis against light intensity at two carbon dioxide concentrations, 0.04% and 0.12%, at the same temperature. At low light intensity the two lines are together. At higher light intensity the line for 0.04% levels off, but the line for 0.12% keeps rising. (a) Explain the shape of the 0.04% line. (b) Explain why the lines are together at low light intensity. (c) State the limiting factor for the 0.04% line at high light intensity.

7 Higher tier

[3 marks]

A lamp placed 10 cm from a plant gives a light intensity of 80 arbitrary units. Calculate the light intensity when the lamp is 40 cm from the plant.

Answer =

8 Higher tier

[4 marks]

A grower uses a greenhouse to grow tomatoes. Evaluate whether it is worth the grower adding extra heating when the light intensity is the limiting factor.

9 Describe how you would investigate the effect of light intensity on the rate of photosynthesis using pondweed. Include how you would control other variables. [6 marks]

- 10** (a) State two ways in which a plant can use the glucose made in photosynthesis, other than for respiration. (b) Plants use nitrate ions to make proteins. State where plants absorb nitrate ions from. **[3 marks]**

- 11** Which substance is made from glucose and strengthens the plant cell wall? **[1 mark]**

- A. ☐ Starch
B. ☐ Cellulose
C. ☐ Protein
D. ☐ Oil

Respiration Spec 4.4.2

- 12** Which equation represents anaerobic respiration in yeast? **[1 mark]**

- A. ☐ glucose $\rightarrow$ lactic acid
B. ☐ glucose $\rightarrow$ ethanol + carbon dioxide
C. ☐ glucose + oxygen $\rightarrow$ carbon dioxide + water
D. ☐ carbon dioxide + water $\rightarrow$ glucose + oxygen

- 13** Respiration is an exothermic reaction. (a) Explain what is meant by an exothermic reaction. (b) Give two uses of the energy transferred by respiration. **[3 marks]**

- 14** Compare aerobic respiration and anaerobic respiration in muscle cells. **[4 marks]**

- 15** Yeast cells can respire anaerobically. (a) Name this process. (b) State the two products. (c) **[3 marks]**
Give one industry that uses it.

- 16** During exercise, the heart rate, breathing rate and breath volume all increase. Explain why **[3 marks]**
this happens.

- 17** An athlete's muscles respire anaerobically during a long period of vigorous exercise. **[3 marks]**
Explain why this happens and describe the effect on the muscles.

- 18** **Higher tier** **[3 marks]**
After the exercise, the athlete continues to breathe heavily. Explain what happens to the
lactic acid and what is meant by the term oxygen debt.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B (1)

2. [2]

- energy is transferred from the environment / surroundings (1) allow energy is taken in
- to the chloroplasts by light (1)

3. [4]

- (a) $\text{rate} = \text{volume} \div \text{time} = 18 \div 6$ (1)
- 3 cm^3 per minute / $3 \text{ cm}^3/\text{min}$ (1) allow 1 mark for correct working if the answer or the unit is wrong
- (b) $\text{time} = \text{volume} \div \text{rate} = 18 \div 4.5$ (1)
- 4 minutes (1) correct answer with no working scores 2

4. [4]

- as temperature rises (to the optimum), the rate increases (1)
- because molecules move faster / collide more often (1) allow enzymes work faster; ignore more energy unqualified
- above the optimum temperature the rate falls (1)
- because enzymes are denatured / the shape of the active site changes (1)

5. [3]

- at low light intensity, light intensity is the limiting factor (1)
- so increasing light intensity increases the rate (1)
- at the flat part, a different factor is limiting, for example carbon dioxide concentration / temperature / amount of chlorophyll (1)

6. [4] **Higher tier**

- (a) light intensity is limiting at first so the rate rises (1)
- then carbon dioxide concentration becomes the limiting factor / light no longer limiting so the line levels off (1)
- (b) at low light intensity light is the limiting factor for both, so carbon dioxide has no effect (1)
- (c) carbon dioxide concentration (1)

7. [3] **Higher tier**

- distance increases by a factor of 4 (1)
- so intensity decreases by a factor of $4^2 = 16$ (1)
- $80 \div 16 = 5$ (arbitrary) units (1)

8. [4] **Higher tier**

- when light intensity is limiting, increasing temperature will not increase the rate (1)
- so there is no increase in growth / yield (1)
- but the heating costs money (1)
- so the grower would lose profit / it is not cost effective (1) allow better to spend money on extra lighting, if cost-effective

9. [6]

Level 3 5-6	A clear, logical method that is easy to follow and replicate, including how light intensity is changed, how the rate is measured, and at least two control variables with how they are controlled. Results are repeated and a mean is taken.
Level 2 3-4	A method with most steps, including how the light intensity is changed and the rate is measured, with some attempt to control a variable. Some steps may be missing or unclear.
Level 1 1-2	A few relevant points, for example that a lamp is moved or bubbles are counted, but the method is incomplete or not in a logical order.

Indicative content

- place pondweed in water in a beaker, with a lamp at a measured distance from the beaker
- change the distance of the lamp (independent variable) using a ruler, for example 10, 20, 30, 40, 50 cm
- measure the rate by counting bubbles of oxygen in a set time (for example one minute) or measuring the volume of gas collected
- repeat at each distance and calculate a mean
- control the temperature, for example using a water bath or heat shield between the lamp and the beaker
- control carbon dioxide, for example with sodium hydrogencarbonate in the water
- use the same piece of pondweed and the same time period
- allow the pondweed to adjust to each new distance before counting

10. [3]

- (a) any two from: converted into starch for storage / used to produce fat or oil for storage / used to produce cellulose for cell walls / used to produce amino acids (1 each) ignore protein
- second correct use (1)
- (b) the soil (1)

11. [1]

B B (1)

12. [1]

B B (1)

13. [3]

- (a) energy is transferred to the surroundings / environment (1)
- (b) any two from: chemical reactions to build larger molecules / movement / keeping warm (1 each)
- second correct use (1)

14. [4]

- aerobic respiration needs oxygen but anaerobic respiration does not (1)
- aerobic respiration produces carbon dioxide and water (1)
- anaerobic respiration produces lactic acid (1)
- aerobic respiration transfers more energy / anaerobic transfers much less energy because glucose is not completely oxidised (1)

15. [3]

- (a) fermentation (1)
- (b) ethanol and carbon dioxide (1) both needed; allow alcohol for ethanol
- (c) bread making / alcoholic drinks / brewing (1)

16. [3]

- muscles need more energy / respire faster during exercise (1)
- so need more oxygen (and glucose) (1)
- so these changes supply the muscles with more oxygenated blood (1)

17. [3]

- insufficient oxygen is supplied to the muscles (1)
- lactic acid builds up (1)
- muscles become fatigued / stop contracting efficiently (1)

18. [3] Higher tier

- lactic acid is carried in the blood to the liver (1)
- where it is converted back into glucose (1)
- oxygen debt is the extra oxygen needed after exercise to react with the accumulated lactic acid / remove lactic acid from the cells (1)

19. [6]

Level 3 5-6	A clear and logical explanation that links the increased demand for energy to the changes in heart rate, breathing rate and breath volume, and explains anaerobic respiration, lactic acid and fatigue.
Level 2 3-4	Some explanation linking energy demand to at least two of the changes, and some mention of anaerobic respiration or lactic acid. Links may be incomplete.
Level 1 1-2	A few relevant statements, for example that the heart rate or breathing rate increases, with little or no explanation.

Indicative content

- muscles need more energy for contraction, so respire faster
- heart rate, breathing rate and breath volume increase
- this supplies muscles with more oxygenated blood / more oxygen and glucose
- if insufficient oxygen is supplied, muscles respire anaerobically
- glucose is incompletely oxidised, so lactic acid builds up
- this creates an oxygen debt
- long periods of vigorous activity cause muscle fatigue so muscles stop contracting efficiently

20. [3]

- (a) the sum of all the reactions in a cell or the body (1)
- (b) glycerol (1)
- (three molecules of) fatty acids (1)

21. [4]

- (a) glucose and nitrate ions are used to form amino acids (1)
- amino acids are then used to synthesise proteins (1)
- (b) urea (1) for excretion
- (c) any two from: starch / glycogen / cellulose (1 for two correct)