

**AQA, OCR, Edexcel**

**A Level**

# **A Level Biology**

## **Haemoglobin Questions**

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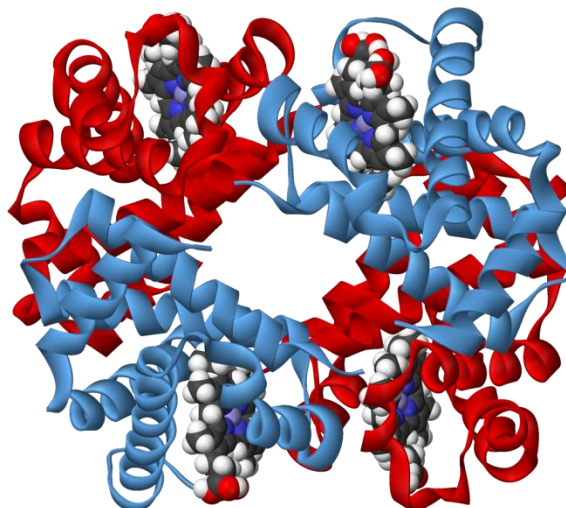
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**Total Marks:     /33**

## Haemoglobin

1. Haemoglobin is the iron containing protein found in the red blood cells of almost all known vertebrates. Its role is to transport oxygen from the exchange surface in the lungs to the respiring cells.

a) Haemoglobin, pictured below, is a globular protein.

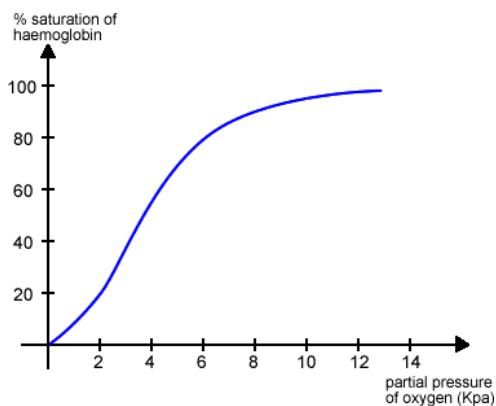


- i) Use haemoglobins quaternary structure to explain how many oxygen molecules can be carried by one haemoglobin protein. (2 marks)
  - ii) The binding of oxygen to haemoglobin is a reversible reaction; draw the equation for this reaction. (2 marks)
  - iii) What does the term 'affinity' mean in relation to haemoglobin? (1 mark)
- b) Oxygen concentration is measured by partial pressure.
- i) Explain how partial pressure of oxygen affects how oxygen binds to haemoglobin in different areas of the body. (4 marks)

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2. Dissociation curves are used to show how oxygen binds to haemoglobin.

a) The diagram below shows a standard dissociation curve.



- Draw two arrows on the graph to indicate haemoglobin in the lungs and haemoglobin in the respiring tissues. (2 marks)
- Explain the 'S' shaped curve of the graph. (4 marks)
- On the graph above, draw the curve for foetal haemoglobin. (1 mark)
- Explain the foetal haemoglobin dissociation curve (1 mark)

b) Haemoglobin varies in different organisms and is adapted to the environment in which they live in.

- Cheetahs have a high demand for oxygen. How does this affect their haemoglobin affinity and why? (2 marks)
- Moles live underground where there is less oxygen. Which way is the dissociation curve for mole haemoglobin shifted and why? (2 marks)

3. It is not just the partial pressure of oxygen that affects how haemoglobin binds with oxygen in order to deliver more oxygen to the cells that require it. Carbon dioxide concentration alters the way oxygen binds to haemoglobin. Carbon dioxide is produced by respiring cells.

- What relationship does the concentration of  $\text{CO}_2$  have on the pH of the blood? (2 marks)
  - What affect does pH have on the oxygen affinity of haemoglobin? (1 mark)
  - Describe the significance of the Bohr effect in terms of the haemoglobin oxygen dissociation curve? (2 mark)

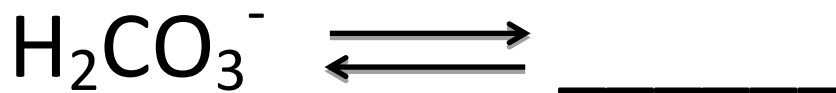
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b)  $\text{CO}_2$  is carried from the respiring cells to the lungs in the blood. Most of the carbon dioxide in the blood is transported to the lungs as carbonic acid. The equation below shows how carbonic acid is formed.



i) What enzyme catalyses this reaction? (1 mark)

ii) Complete the equation below to show the dissociation of carbonic acid. (1 mark)



iii) Explain the term 'chloride shift'. (3 marks)

iv) How and why does the dissociation of  $\text{HCO}_3^-$  affect the pH of the blood? (2 marks)

v) In the lungs, what causes the  $\text{HCO}_3^-$  and  $\text{H}^+$  to recombine? (1 mark)