# **Transport in animals**

### Model Answers 2

| Level      | A Level                |
|------------|------------------------|
| Subject    | Biology                |
| Exam Board | OCR                    |
| Module     | Exchange and transport |
| Торіс      | Transport in animals   |
| Booklet    | Model Answers 2        |

| Time allowed:     | 57 minutes           |
|-------------------|----------------------|
| Score:            | /42                  |
| Percentage:       | /100<br>AISTRYONLINE |
| Grade Boundaries: |                      |

| A*   | А   | В   | С   | D   | E   |
|------|-----|-----|-----|-----|-----|
| >69% | 56% | 50% | 42% | 34% | 26% |

### **Question 1**



Fig. 4.1 shows the oxygen dissociation curves for fetal haemoglobin (A) and adult haemoglobin (B).

Fig. 4.1

(a) (i) Curve A represents fetal haemoglobin.

Explain why the fetal haemoglobin curve is to the left of the adult haemoglobin curve.

[3]

- The fetal haemoglobin curve is to the left of the adult haemoglobin curve because the placenta has a low partial pressure of oxygen
- Adult haemoglobin will release oxygen at low partial pressures of oxygen
- Fetal haemoglobin has a higher affinity for oxygen
- So fetal haemoglobin is still able to take up oxygen at lower partial pressures of oxygen in the placenta

**Exam tip**: Ensure you make a comparison (i.e. that the fetal haemoglobin pick up more oxygen than the adult haemoglobin at any given partial pressure of oxygen). Then you also need to make the point that fetal haemoglobin can still take up some oxygen even when there is little available in the placenta.

(ii) Sickle cell anaemia is an inherited disorder in which haemoglobin crystallises when the partial pressure of oxygen (pO<sub>2</sub>) is low. The red blood cells change shape and oxygen transport is disrupted.

Treatment with drugs, such as hydroxyurea, can stimulate adults to produce fetal haemoglobin rather than adult haemoglobin.

Suggest why this treatment might be of benefit to adults with sickle cell anaemia. [2]

• The treatment may have benefits because fetal haemoglobin may not crystallise

much at low partial pressures of oxygen

- This could result in the red blood cells not changing shape
- Therefore the fetal haemoglobin can pick up more oxygen at low partial

pressures of oxygen

• Ensuring that more oxygen being transported around the body

**Exam tip**: Ensure you state that fetal haemoglobin is able to pick up more oxygen that the sickle haemoglobin.

(b) Describe and explain how substances that are dissolved in the blood plasma, such as oxygen or glucose, enter the tissue fluid from the capillaries.



In your answer you should use appropriate technical terms, spelled correctly. [4]

- Substances dissolved in the blood plasma move into the tissue fluid via diffusion
- Down a concentration gradient
- Hydrostatic pressure in the capillary is higher than in the tissue fluid
- Capillary walls are leaky
- So fluid is forced out of the capillary down a pressure gradient
- As the fluid moves out of the capillary, small molecules such as glucose, leaves with the fluid

Exam tip: To gain the QWC mark, you need to ensure you use the key words shown here in bold

#### Diagram to show tissue fluid formation:



[Total:9]

# CHEMISTRY ONLINE — TUITION —

### **Question 2**

Fig. 3.1 provides information about the blood pressure in different parts of the mammalian blood circulatory system.

Fig. 3.1 also shows the **total** cross-sectional area of the vessels, relative to one another, in parts of the blood circulatory system.



(a) Place a tick (✓) in the box below that most closely describes the mammalian blood circulatory system.
[1]

|                           | open circulatory system | closed circulatory system |
|---------------------------|-------------------------|---------------------------|
| single circulatory system |                         |                           |
| double circulatory system |                         | $\checkmark$              |

It is closed as blood is enclosed in blood vessels and it is a double system as mammals have

a pulmonary system going to the lungs and a systemic system supplying the body.

(b) The pressure fluctuates as the blood flows along the aorta, as shown in Fig. 3.1.

(i) Explain what causes this fluctuation.

There is fluctuation of pressure in the aorta because:

• contraction (systole) of muscle in left ventricle increases pressure

relaxation (diastole) decreases pressure

As the muscle in the heart contracts this forces the blood at a high pressure into the arteries.

*Exam tip:* be really specific with which part of the heart is contracting i.e. the *muscle*. And it asks about the aorta, so this is in the *left ventricle* wall.

(ii) State the term used to describe the number of fluctuations per minute.

[1]

[2]

The number of fluctuations per minute is known as the

heart rate

### CHEMISTRY ONLINE — TUITION —

- (c) Using the information in Fig. 3.1, describe the pressure changes in the blood as it flows through the circulatory system from the aorta to the veins.
  - pressure drops, as distance from heart increases
    - the greatest pressure drop is while the blood is in the arteries
  - pressure is constant in the veins

•

- fluctuation decreases from aorta to arteries
- there is no fluctuation in capillaries and veins
- use of comparative figures with units to back up one of these points.

**Exam tip:** this is a **describe** question. Therefore you need to ensure that you state what the graph shows, using data (and units) to support your points. Do **not** explain **why** this is occurring

(d) (i) Using the information in Fig. 3.1, explain what causes the overall change in pressure as blood flows from the aorta to the arteries and from the arteries to the capillaries.

#### The pressure decreases because:

- blood flows into larger number of vessels
- the total cross-sectional area of the arteries is greater than the aorta
- and the total cross-sectional area of the capillaries is greater than the arteries

Pressure decreases as you have the same volume of blood 'shared' out across more vessels,

so the overall area of the vessels increases.

**Exam tip:** this is an **explain** question; you need to state **why** pressure decreases, rather than describing the trend, as in the previous question.

[3]

(ii) Explain why it is important that the pressure changes as blood flows from the aorta to the capillaries.

[2]

It is important for pressure to drop before the blood reaches the capillaries because:

- The capillary wall is only one cell thick
- And so high pressure would damage the capillary
- By reducing the pressure, there is a reduced chance of tissue fluid build-up (oedema)



#### Diagram to show the structure of a capillary:

[Total: 11]

Three examples of fluids in the mammalian body are blood, tissue fluid and lymph.

(a) Complete Table 3.1 below comparing different features of arterial blood, tissue fluid and lymph.

| feature                       | arterial blood | tissue fluid | lymph |
|-------------------------------|----------------|--------------|-------|
| hydrostatic<br>pressure       | high           | low          | low   |
| presence of large<br>proteins | yes            | no           | no    |
| presence of neutrophils       | yes            | yes          | yes   |
| presence of<br>erythrocytes   | yes            | no           | no    |

#### Table 3.1

Arteries take blood away from the heart, so are therefore at a relatively high pressure, due to the force exerted by the heart muscle.

Tissue fluid bathes cells and is made by plasma and dissolved substances leaking out of the endothelial pores of capillaries. Large proteins and erythrocytes are too large to fit through these gaps. Neutrophils can be found. Lymph is similar in composition to tissue fluid and is the body's drainage system. A diagram of tissue fluid and lymph formation can be seen below:



(b) In a closed circulatory system, blood is kept inside blood vessels.

(i) Suggest two advantages of keeping the blood inside vessels.

Two advantages of keeping blood inside vessels are (any two of):

- This maintains a high blood pressure
- Higher blood pressure means that there is an increased rate of blood flow to tissues
- Blood can also be directed and diverted to certain tissues
- (ii) Describe and explain how the wall of an artery is adapted both to withstand and maintain high hydrostatic pressure. [5]



*In your answer you should use appropriate technical terms, spelt correctly.* 

#### The artery wall is adapted:

To withstand pressure by

- Having a thick wall
- With a layer of collagen
- This collagen layer provides strength
- Its endothelium is folded
- This allows it to stretch, which prevents damage

#### To maintain pressure by

- Having a thick layer of **elastic** fibres
- Which cause **recoil** when the artery wall is stretched so that it returns to its original size
- It also has a layer of **smooth muscle**
- Which can constrict the **lumen** of the artery
- The restriction of blood in one area allows pressure to be maintained elsewhere

**Exam tip:** to ensure you gain marks here you should talk about both how the artery withstands and maintains pressure. You also need to use your key terminology to gain the QWC mark. These are shown here in bold.

[2]

Diagram to show the structure of the artery and components of the wall that allow it to withstand and maintain high blood pressure:



[Total: 11]

# CHEMISTRY ONLINE — TUITION —



Large animals, such as mammals, need efficient transport systems.

(a) Fig. 3.1 shows a section through the mammalian heart.





- (i) Name the parts labelled X, Y and Z.
  - x Right atrium
  - Y Aorta
  - Z Left pulmonary artery

**Exam tip:** make sure you learn the names and locations of these structures well; this sort of question always comes up! **Remember** that the left and right hand sides are as if you are looking at a patient's heart.

[3]



#### Diagram to show the structure of the mammalian heart:

(ii) Explain why the wall of the left ventricle is thicker than the wall of the left atrium. [3]

The wall of the left ventricle is thicker than the wall of the left atrium because:

- It has more muscle to create a stronger force
- It has more muscle in order to create higher pressure
- To push blood against a greater resistance
- Because the left ventricle pumps blood to all parts of the body

(iii) Explain how pressure changes in the heart bring about the closure of the atrioventricular (bicuspid) valve.

The atrioventricular valve is closed due to:

- Ventricular systole (ventricle muscle contracts)
- This raises ventricular pressure
- Higher than the atrial pressure
- This change in pressure pushes the valve shut
- The chordae tendinae prevent inversion

#### Diagram to show the closing of the atrioventricular valve:



[2]

(b) The mammalian transport system is a double circulatory system.

An efficient circulatory system consists of a pump, a means of maintaining pressure, a transport medium and exchange surfaces.

State the component of the mammalian circulatory system that fulfils each of these roles.

The first one has been done for you.

| pump                          | h e a r t<br>Arteries |
|-------------------------------|-----------------------|
| means of maintaining pressure |                       |
| transport medium              | Blood                 |
| exchange surface              | Capillaries           |
|                               | [Total: 11]           |
|                               |                       |
|                               |                       |
|                               |                       |
|                               |                       |
|                               |                       |
|                               |                       |

[3]