**1.** What defines the terms *ventilation*, *gas exchange* and *cell respiration* in mammals?

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Ventilation** | **Gas exchange** | **Cell respiration** |
| A. | providing fresh air | replacing oxygen with carbon dioxide in blood in lungs | cellular energy production from glucose |
| B. | muscle movement to move fresh air into alveoli | replacing carbon dioxide with oxygen in blood in lungs | gases crossing the plasma membrane of a cell |
| C. | muscle movement to move fresh air into alveoli | replacing carbon dioxide with oxygen in blood in lungs | cellular energy production from glucose |
| D. | providing fresh air | replacing oxygen with carbon dioxide in blood in lungs | gases crossing the plasma membrane of a cell |

(Total 1 mark)

**2.** Capillaries surround the alveoli in the lungs. Which pair of statements correctly describes the concentrations of oxygen and carbon dioxide in the lungs?

|  |  |  |
| --- | --- | --- |
|  | **Oxygen** | **Carbon dioxide** |
| A. | Higher in the capillaries | Higher in the alveoli |
| B. | Lower in the capillaries | Higher in the alveoli |
| C. | Lower in the alveoli | Higher in the capillaries |
| D. | Higher in the alveoli | Higher in the capillaries |

(Total 1 mark)

**3.** Many processes in living organisms, including ventilation and gas exchange, involve moving materials. State the differences between ventilation and gas exchange in humans.

(Total 4 marks)

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

**4.** Describe how carbon dioxide is carried by the blood.

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

(Total 4 marks)

**5.** Explain the oxygen dissociation curve for adult hemoglobin and how it is affected by the Bohr shift.

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

(Total 6 marks)

**6.** A major requirement of the body is to eliminate carbon dioxide (CO2). In the body, carbon dioxide exists in three forms: dissolved CO2, bound as the bicarbonate ion, and bound to proteins (eg hemoglobin in red blood cells or plasma proteins). The relative contribution of each of these forms to overall CO2 transport varies considerably depending on activity, as shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **CO2 Transport in Blood Plasma at Rest and During Exercise** | | | |
|  |  | **Rest** | **Exercise** |
| **Form of transport** | Arterial | Venous | Venous |
|  | mmol l–1 blood | mmol l–1 blood | mmol l–1 blood |
| dissolved CO2 | 0.68 | 0.78 | 1.32 |
| bicarbonate ion | 13.52 | 14.51 | 14.66 |
| CO2 bound to protein | 0.3 | 0.3 | 0.24 |
| Total CO2 in plasma | 14.50 | 15.59 | 16.22 |
| pH of blood | 7.4 | 7.37 | 7.14 |

[Source: Geers and Gros, *Physiological Reviews* (2000), **80**, pages 681–715]

(a) Calculate the percentage of CO2 found as bicarbonate ions in the plasma of venous blood at rest.

.....................................................................................................................................

.....................................................................................................................................

(1)

(b) (i) Compare the changes in total CO2 content in the venous plasma due to exercise.

...........................................................................................................................

...........................................................................................................................

(1)

(ii) Identify which form of CO2 transport shows the greatest increase due to exercise.

...........................................................................................................................

...........................................................................................................................

(1)

(c) Explain the pH differences shown in the data.

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(3)

(Total 6 marks)

**7.** Explain how and why the breathing rate varies with exercise.

(Total 9 marks)

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................

...............................................................................................................................................