ADVANCED SUBSIDIARY GCE
HUMAN BIOLOGY
Molecules, Blood and Gas Exchange

INSTRUCTIONS TO CANDIDATES
Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
Use black ink. Pencil may be used for graphs and diagrams only.
Read each question carefully and make sure that you know what you have to do before starting your answer.
Answer all the questions.
Do not write in the bar codes.
Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 60.
Where you see this icon you will be awarded marks for the quality of written communication in your answer.
You may use an electronic calculator.
You are advised to show all the steps in any calculations.
This document consists of 16 pages. Any blank pages are indicated.

FOR EXAMINER’S USE

<table>
<thead>
<tr>
<th>Qu.</th>
<th>Max.</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td></td>
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<tr>
<td>2</td>
<td>10</td>
<td></td>
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<tr>
<td>3</td>
<td>14</td>
<td></td>
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<tr>
<td>4</td>
<td>8</td>
<td></td>
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<tr>
<td>5</td>
<td>9</td>
<td></td>
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<tr>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

Monday 1 June 2009
Afternoon
Duration: 1 hour

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SPA (SHW 00227 4/08) V02624/4
Turn over
1 (a) The human body contains many different cells and molecules.

Place the following in order of **increasing** size, starting with the smallest.

- amino acid
- enzyme
- epithelial cell
- phospholipid
- water molecule

*smallest* ...................................................................................................................................................
   ..........................................................................................................................................................
   ..........................................................................................................................................................
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   ..........................................................................................................................................................

*largest* .................................................................................................................................................. [3]

(b) Taking blood samples may pose risks.

Explain why each of the following precautions is necessary when a blood sample is taken.

(i) Sterile equipment is used.
   ...........................................................................................................................................................
   ................................................................................................................................................... [1]

(ii) A tourniquet is placed around the arm, above the sampling point.
   ...........................................................................................................................................................
   ................................................................................................................................................... [1]

(iii) The blood sample is taken from a vein, rather than an artery.
   ...........................................................................................................................................................
   ................................................................................................................................................... [1]
(c) Once a blood sample has been taken, a blood smear (film) may be prepared and then stained.

Fig. 1.1, on the insert, is a light micrograph of a blood smear.

(i) The cell labelled A in Fig. 1.1 is a monocyte.

Monocytes are a type of leucocyte. Other types of leucocyte include neutrophils and lymphocytes.

Describe how monocytes can be distinguished from other types of leucocyte in a stained blood smear such as the smear shown in Fig. 1.1.

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........................................................................................................................................... [2]

(ii) Monocytes develop into macrophages. One role of macrophages is to engulf and break down nuclei from maturing red blood cells (erythrocytes).

Suggest where the digestion and breakdown of red blood cell nuclei may occur.

........................................................................................................................................... [1]

(iii) State one advantage of removing the nuclei from maturing red blood cells.

........................................................................................................................................... [1]

Blood smears may appear different from that shown in Fig. 1.1. The appearance of a smear can reveal information about the person from whom the blood sample was taken.

(d) Suggest why a blood smear may show:

(i) a large number of leucocytes;

........................................................................................................................................... [1]

(ii) a large number of platelets.

........................................................................................................................................... [1]

(e) Suggest one reason why an abnormally large number of erythrocytes may be found in a blood sample.

........................................................................................................................................... [1]

[Total: 13]
2 (a) The respiratory tract is lined with epithelium.

Describe the structure of the epithelium that lines the trachea.

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

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Various measurements of lung function are used to help diagnose lung disease and to monitor its treatment.

(b) State what is meant by the following terms:

(i) vital capacity;
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................................................................................................................................................... [1]

(ii) forced expiratory volume 1 (FEV1).
...........................................................................................................................................
................................................................................................................................................... [1]

One measure of lung function is:

\[
\text{percentage lung function} = \frac{\text{FEV1}}{\text{vital capacity}} \times 100
\]

This is particularly useful in identifying possible obstructive disorders of the airways and lungs, such as asthma or chronic obstructive pulmonary disease (COPD).

• Asthma is a condition that responds to, and can be controlled by, the use of bronchodilators. These are drugs that dilate the airways and improve airflow.

• COPD lasts for a long period of time and is caused by progressive and permanent damage to the lung tissue.

When the value calculated for the percentage lung function is less than or equal to 70%, this indicates an obstructive disorder. A 'normal' value is approximately 80%.
Table 2.1 shows data relating to three patients, C, D and E, before and after treatment with a bronchodilator drug.

### Table 2.1

<table>
<thead>
<tr>
<th>patient</th>
<th>age (years)</th>
<th>vital capacity (dm³)</th>
<th>FEV1 (dm³)</th>
<th>percentage lung function</th>
<th>vital capacity (dm³)</th>
<th>FEV1 (dm³)</th>
<th>percentage lung function</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>18</td>
<td>5.5</td>
<td>3.8</td>
<td>69</td>
<td>5.6</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>45</td>
<td>5.3</td>
<td>3.6</td>
<td>68</td>
<td>5.5</td>
<td>4.0</td>
<td>73</td>
</tr>
<tr>
<td>E</td>
<td>78</td>
<td>3.8</td>
<td>2.2</td>
<td>58</td>
<td>3.8</td>
<td>2.2</td>
<td>58</td>
</tr>
</tbody>
</table>

(c) (i) Calculate the percentage lung function for patient C after treatment with the bronchodilator drug.

Show your working and give your answer to the nearest whole number.

Answer = .................................................... % [2]

(ii) Using the information in Table 2.1 and your answer to (c)(i), indicate with a tick (√) in the table below a diagnosis for each patient.

<table>
<thead>
<tr>
<th>diagnosis</th>
<th>patient</th>
<th>asthma</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[3]

[Total: 10]
3 (a) Fig. 3.1 is a diagram showing the conduction pathways in the human heart.

(i) Identify X and Y.

X ........................................................................................................................................

Y ........................................................................................................................................... [2]

(ii) Describe the roles of X and Y in the coordination of the heartbeat.

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(b) An electrocardiogram (ECG) can be used to detect certain heart abnormalities.

Fig. 3.2 shows two ECG traces.

![ECG Traces]

**key:**

I trace showing heart abnormality – atrial fibrillation

II normal trace

**Fig. 3.2**

(i) State three ways in which trace I differs from trace II.

1. ........................................................................................................................................

2. ........................................................................................................................................

3. ........................................................................................................................................

(ii) In atrial fibrillation, blood flow slows and can even stop. This can result in ‘pooling’ of the blood in certain places in the circulatory system.

Using the information in Fig. 3.2 to help you, suggest why blood flow slows.

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........................................................................................................................................... [2]
People with atrial fibrillation are often given warfarin, an anticoagulant.

Warfarin interferes with vitamin K metabolism, with the result that prothrombin is not activated.

Explain how the blood clotting process is affected when warfarin is given to a patient.

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

[4]

[Total: 14]
'World Blood Donor Day' is celebrated in June each year. In the UK, this day publicises the work of the National Blood Service (Blood Transfusion Service), which collects the 8,000 donations of blood required each day to provide patients with blood products for treatment.

(i) State **two** blood products that are obtained from donated blood.

1 ........................................................................................................................................

2 ........................................................................................................................................  [2]

(ii) Donated blood is screened for certain diseases before it is used for treatment.

Name **one** disease that donated blood is screened for.

........................................................................................................................................  [1]

(b) Donated blood for transfusion is buffered and stored at 4 °C.

Explain why donated blood for transfusion needs to be kept under these conditions.

In your answer you should refer to enzyme activity.

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[Total: 8]
Fig. 5.1, on the insert, is a light micrograph of a section through two blood vessels.

(i) Name the type of blood vessel labelled G.

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(ii) How does the structure of the vessel type labelled H relate to its function?

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........................................................................................................................................... [3]
(b) Fig. 5.2 shows the changes in blood pressure as blood passes through the circulatory system.

**Fig. 5.2**

Complete the following passage by writing the most appropriate word or term in each of the spaces.

Use the information in Fig. 5.2 to help you.

Blood is distributed around the human body by mass flow. The blood flow in the circulatory system is contained within blood vessels and the system is therefore said to be a system. The pressure in the different vessels varies with the type of vessel. The pressure is lowest in vessels of type E, which are called , and which return blood to the heart. These vessels have to prevent the backflow of blood. Pressure fluctuates in vessels of type B, which are known as , because of the pulsing of blood from the heart. Pressure then falls as the blood passes through vessels of type C, known as , where materials are exchanged between the blood and tissue fluid.  

[Total: 9]
(a) Table 6.1 shows the concentration of certain ions inside an erythrocyte and in the plasma surrounding it.

Table 6.1

<table>
<thead>
<tr>
<th>ion</th>
<th>concentration (arbitrary units)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>erythrocyte</td>
</tr>
<tr>
<td>chloride</td>
<td>7</td>
</tr>
<tr>
<td>hydrogencarbonate</td>
<td>15</td>
</tr>
<tr>
<td>potassium</td>
<td>136</td>
</tr>
<tr>
<td>sodium</td>
<td>12</td>
</tr>
</tbody>
</table>

Using the information in Table 6.1, suggest which of these ions corresponds to each of the statements below.

Write ‘none’ if none of these ions corresponds to the statement.

(i) Enters the erythrocyte by active transport.

........................................................................................................................................... [1]

(ii) Leaves the erythrocyte by active transport.

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(iii) Moves through the cell surface membrane by exocytosis.

........................................................................................................................................... [1]
(b) Diuretics are drugs that remove water from the body by increasing the production of urine.

One key to success in horse racing requires jockeys to maintain a low weight.

- This can often be a problem for the individual, and taking diuretics has been seen as a way to assist with weight loss.

- Excessive use of diuretics is potentially life-threatening.

- The use of diuretics has been banned by The Jockey Club since 1999.

Suggest what effect the excessive use of diuretics has on the cells of the body.

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[Total: 6]
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