**Answer ALL questions.**

**1** Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

## Making Enough Blood for the World

A blood transfusion is the transfer of blood from a donor into a patient. Blood transfusions are routine medical procedures that save the lives of millions of people every year.

(Source: beerkoff/Shutterstock)

The first successful blood transfusions were performed in the early twentieth century after scientists discovered that there are four main blood groups, A, B, AB and O. The blood groups are due to the presence of proteins, called antigens, on the surface of red blood cells. There are two main protein antigens called A and B. If a patient is given blood with antigens different to their own cells, their immune system will make antibodies against that antigen. The antigens present on the surface of red blood cells for each blood group are shown in the table.

| Blood group | Antigens present |
|---|---|
| A | A |
| B | B |
| AB | A and B |
| O | neither A nor B |

Currently, blood transfusions are carried out with blood that has been donated by healthy people. The World Health Organisation calculates that there are 118.5 million blood donations collected globally every year. Of these donations, 40% are collected from a small group of high-income countries. This means that there is a shortage of blood in many countries so the hunt is on to find an alternative.

Scientists have found a way to make artificial red blood cells. They made spheres of cell membranes filled with haemoglobin. These artificial cells are then suspended in sodium chloride solution. These artificial red blood cells have no proteins on their surface. Another way of making red blood cells is being developed in the United Kingdom. A research team has used stem cells to produce red blood cells with blood group O. The red blood cells produced are then suspended in sodium chloride solution.

Both methods produce large quantities of safe red blood cells. There may be other advantages as well, artificial blood would always have the same concentration of solutes and will not clot when stored. Critics have pointed out that the artificial blood will only transport oxygen and that blood has many more functions.