Reading Passage 3

*You should spend about 20 minutes on **Questions 28 – 40**, which are based on Reading Passage 3 below.*

Man-Made Blood

A The word 'artificial' is not new in the field of biomedical engineering. Biomedical engineering is known for creating life-support systems. These life-support systems are the artificial body parts created to be used as substitutes for the real ones, especially when they are damaged or weak. One example of these substitutes is an artificial heart which takes over the real heart to pump blood. In addition, a severely injured hip and knee bone would return to its normal shape when replaced by artificial joints. Furthermore, artificial lungs are used to provide oxygen to the patient during open-heart surgery. These switching and swapping are very much acceptable because of their usefulness and benefits.

B On the contrary, the use of artificial blood is unimaginable since blood is a more complicated component of the human body. Its functions are much more complex because it carries nutrients and oxygen throughout the system. Aside from its duty as the carrier of substances in the body, blood plays an important role in religion, culture and language. For religious people, blood is a symbol of life. That is why they do not eat blood, as in animal blood, while people in some societies do. There are also individuals belonging to certain cultures or religions who shun the idea of blood transfusion. In terms of culture, one refers to his or her family traits as being 'in one's blood'. The family members are also called blood relatives. In English idioms, one may say 'My blood boils' when he or she is extremely angry, and 'My blood runs cold' when he or she is petrified.

C In science and biology, blood is the red fluid that flows inside the body and is visibly seen when one cuts or hurts himself or herself. Blood is composed of white cells, red cells, platelets and plasma. These blood components have a variety of functions in the body. The plasma is a yellow-colored liquid which is made up of water, salts, and various proteins. On the other hand, platelets are the irregularly shaped, colorless substances. The plasma and the platelets are responsible for making the blood clot. The proteins in the plasma react with air and harden to prevent further bleeding. The white blood cells (WBCs) play a vital part in immune defense. They fight invading organisms or materials and minimize the effect of these microorganisms in the body. The red blood cells (RBCs), which are the source of the red color of blood, float in the plasma. A very important function of RBCs is carrying oxygen from the lungs to all the cells in the body. RBCs also assist

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in the release of carbon dioxide and other bodily wastes. The 'blood typing' system is also based on the unique characteristics of RBCs. On the membranes of these cells are proteins that the body recognizes as its own. For this reason, a person can use only blood that is compatible with his or her type.

D Having all these multifaceted features of real blood, how then can artificial blood be a replacement? The substitute blood will not do all the authentic blood's work. It will only replace one of the many functions of the red blood cells, transporting oxygen when RBCs cannot do it on their own. In this case, the surrogate blood is more appropriately called 'oxygen therapeutics.' Since this is artificial blood, it cannot replace blood loss. However, it is intended to carry oxygen-rich blood; doctors can give this to patients regardless of blood type. What is more, it can be sterilized to kill bacteria and viruses. Also, it does not need to be refrigerated because it has a longer shelf life than real blood. Hence, this could be used during emergencies and in combat zones.

E Bioengineers' researches about blood substitutes have led to the development of hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbon emulsions (PFCs). HBOCs are from the RBCs of real, expired human or cow blood or from human placentas. On the other hand, PFCs are entirely man-made, and they are usually white in color. PFCs are completely made of hydrogen and fluorine. These chemical components are different from previous varieties of artificial blood. The HBOC and PFC compounds can be more risky than the earlier types of blood substitutes invented because the former had caused complications such as myocardial infarctions or heart attacks that have sometimes endangered humans under clinical trials.

F HBOCs and PFCs work through 'passive diffusion.' Passive diffusion is a kind of procedure in which molecules or ions move freely across the cell membrane. Because of passive diffusion, HBOCs and PFCs can transport oxygen to cells without any assistance since these blood substitutes take advantage of the elements' tendency to move from an area of high concentration to an area of low concentration. These blood surrogates, though, are still under meticulous study to ensure its effectiveness and safety for human use.

G The future of blood substitutes is not far from reality though it has created many controversies. Even though real blood is irreplaceable, physicians are looking forward to the time when they can really use artificial blood in medical procedures such as surgeries; for instance, the use of artificial blood in treating traumatic brain injury by transporting oxygen to the swollen tissues. The promising benefits of blood surrogates are unquestionable, and it is hoped that the use of these in hospitals will be widespread in a few years. Biomedical engineers will make artificial blood more sophisticated and safer than it is today and perhaps it could then function as real blood.

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Questions 28 – 40

Questions 28 – 31

Reading Passage 3 has seven paragraphs, A – G.

Choose the correct heading for each section from the list of headings below.

Write the correct number i – viii in boxes 28 – 31 on your answer sheet.

	List of Headings
i	The spiritual importance of blood
ii	The dangers of using artificial blood
iii	Successful research about other kinds of blood substitutes
iv	How passive diffusion aids artifical blood in the distribution of oxygen in the body
v	The significance of blood in society
vi	The failure of artificial blood to function as real blood
vii	Passive diffusion: the process that involves chemical energy
viii	The blood's compositions and their functions

28 Paragraph B
29 Paragraph C
30 Paragraph E
31 Paragraph F

Questions 32 – 36

Complete the sentences.

Choose NO MORE THAN THREE WORDS from the passage for each answer.

Write your answers in boxes 32 – 36 on your answer sheet.

32 An _____ is a life-support device that is used to pump blood when a person's heart is injured.
33 During a heart surgery, _____ are used to supply oxygen.
34 According to some religious beliefs, _____ blood is not food.
35 The process of _____ allows particles to move freely in cells.
36 In the future, the _____ of real blood may be done by artificial blood.

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Questions 37 – 40

Complete the summary.

Choose NO MORE THAN THREE WORDS from the passage for each answer.

Write your answers in boxes 37 – 40 on your answer sheet.

The blood's duty in the human body is definitely irreplaceable. Two of its main functions are to transport ___37___ throughout the body and to carry substances that are necessary to help us grow and become strong. However, there are times when the blood cannot distribute oxygen properly; surrogate blood is needed to do the task. In this situation, the substitute is called ___38___. This sounds good for others; however, there are some serious controversies related to this medical breakthrough. Blood surrogates in development, like HBOCs and PFCs, had caused heart attacks and had even ___39___ during clinical tests. But new alternatives are being studied to hopefully aid doctors in surgical procedures in the future. For example, it would be possible to use these blood substitutes to cure ___40___.

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