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

Therapeutic Cloning versus Reproductive Cloning

Some people find the idea of cloning frightening. They have an image of identical human beings being created by scientists. This is why some people were concerned when Dolly the sheep was created by reproductive cloning.

Therapeutic cloning is different as it could help to repair damaged tissue, for example in the treatment of diabetes, heart disease or the loss of photoreceptors in the eye that cause blindness.

The procedure involves putting an adult body cell nucleus into an enucleated egg cell. This egg cell is then stimulated to divide into an embryo. Some cells in this embryo are called stem cells. This means they have the ability to develop into many different cell types. The stem cells are removed and can be used to treat diseases in any body organ or tissue by replacing the damaged cells.

This type of therapy reduces the risk of rejection by the immune system. Cells from another person would be recognised as being foreign and would be attacked by the immune system. This rejection of foreign tissue is a major challenge of organ transplants, alongside the fact that there is a huge shortage of available organs for donation.

Some scientists hope that the stem cells created by therapeutic cloning might be useful in the treatment of heart disease. Heart disease is a major cause of death in the UK. It reduces the transport of oxygen to heart muscle cells and eventually kills them. The remaining living cells attempt to keep the heart pumping but heart failure may occur. Replacing damaged heart muscle tissue using stem cells, created by therapeutic cloning, may offer people a chance to survive heart failure. Studies show that stem cells injected directly into damaged heart tissue improve heart function and help with the formation of new capillaries.

Therapeutic cloning does result in the destruction of an embryo after the stem cells are removed and this destruction has caused concern over the morality of the procedure. Also, because therapeutic cloning uses a body cell nucleus, there is still concern that a scientist may attempt to move beyond therapeutic cloning and create a cloned human being.

(a) In cloning, an adult body cell nucleus is put into an enucleated egg cell.

What is meant by the term **enucleated** (line 7)?

(1)

(b) Name the part of the eye that contains photoreceptors (line 5).

(1)

(c) Explain why reducing the transport of oxygen to heart muscle cells will make them contract less efficiently and may kill these cells (lines 19 and 20).

(4)

(d) The formation of new capillaries helps to improve heart function (line 24).

Explain how the structure of a capillary is adapted to help improve heart function.

(2)

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(e) Give two advantages of using organs produced by therapeutic cloning compared to using donated organs.

(2)

1 .....

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2 .....

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(f) Dolly the sheep was created by reproductive cloning (line 3).

Explain how a mammal such as Dolly the sheep has been cloned.

(5)

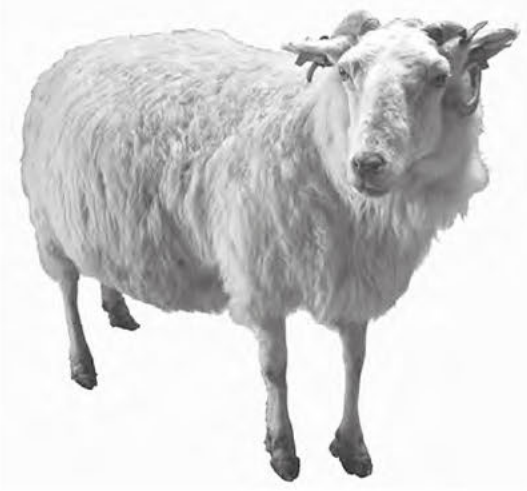
(Total for Question = 15 marks)

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

Transgenic animals

The term 'transgenic' means the transfer of genetic material from one species to a different species. Cattle, pigs or sheep are made to superovulate and their eggs are collected. The eggs are fertilised and a desired gene is injected into them using a needle. Some of the fertilised eggs take up the gene, which becomes part of one of the animal's chromosomes. The fertilised eggs develop into embryos which are cultured and then implanted into surrogate mothers to complete their development.

In 1993, the world's first transgenic lamb, known as Tracy, was produced from a fertilised egg which had been injected with a human gene. When Tracy became an adult sheep she was able to produce milk containing the human protein AAT. This protein can be used to treat human lung diseases such as emphysema and cystic fibrosis.



© Science Museum/SSPL

Tracy looked like a normal sheep and was able to reproduce. She gave birth to two lambs, one of which inherited her ability to produce AAT milk. Tracy showed that human proteins could be made in other mammals and extracted from their milk. This technique can now be used to obtain milk that contains specific antibodies or blood clotting factors.

Another potential use of transgenic animals is to produce organs for transplanting into humans. This is important because of the decreasing availability of human organ donors and the increasing demand for organs.

Transgenic technology can also be used to transfer genes into cattle for disease resistance, increased meat production and increased ability to digest cellulose.

(a) Explain what is meant by the term **gene** (line 3).

(2)

(b) Suggest what is meant by the term **superovulate** (line 2).

(1)

(c) In which part of the surrogate mother are the embryos implanted (lines 6 to 7)?

(1)

(d) Name the human behaviour that can lead to emphysema (line 11).

(1)

(e) What percentage of eggs produced by Tracy were known to contain transgenic DNA (lines 13 to 14)?

(1)

(f) (i) To be able to work, the blood clotting factors must be extracted from the milk.

Suggest why drinking milk containing blood clotting factors will not help to clot blood (line 17).

(1)

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(ii) Suggest why it is an advantage to increase the ability of cattle to digest cellulose (line 22).

(2)

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(g) Suggest the benefits of producing transgenic hearts.

(3)

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(Total for Question = 12 marks)

3 The photograph shows a Siberian tiger.



Siberian tigers are very rare and are in danger of becoming extinct. Scientists hope to use cloning as a method to increase the number of Siberian tigers.

The passage below describes the process of cloning. Complete the passage by writing a suitable word on each dotted line.

(6)

A nucleus is taken from a body ..... of an adult Siberian tiger.

This nucleus is put into an enucleated ..... cell, a cell that has had its nucleus removed. The cell is given a mild electric shock to help it divide by a type of cell division called ..... . A ball of cells is produced called an ..... . The ball of cells is placed into the ..... of a female Bengal tiger. This female tiger is called a ..... mother.

(Total for Question = 6 marks)

4 Many hardwood trees are cut down and used to make outdoor furniture. This is because hardwood is less likely to decompose than other types of wood.

(a) Describe the process that decomposes wood.

(2)

(b) Some hardwood tree species are becoming rare because of deforestation. To solve this problem scientists hope to use micropropagation (tissue culture) to produce clones of some hardwood tree species.

(i) Describe the process of micropropagation to clone plants such as hardwood trees.

(5)

(ii) State two ways in which deforestation can lead to poor quality soil.

(2)

1 .....

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2 .....

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(Total for Question = 9 marks)

5 (a) Explain what is meant by the term **transgenic organism**.

(2)

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(b) Give one example of the use of transgenic organisms.

(1)

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(Total for Question = 3 marks)