

- 1 The photograph below shows an X-ray of a dachshund. The dachshund is a breed of dog that is at higher risk of paralysis due to spinal injury.

Scientists have successfully used stem cells to reverse this paralysis.



Magnification $\times 0.02$

- (a) Suggest why stem cells can be used to reverse this paralysis.

(2)

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- (b) The trial experiment was carried out on a dog that was paralysed due to a spinal injury and was unable to use its back legs.

The scientists extracted stem cells from the lining of the dog's nose. These cells were cultured for one month to increase their numbers. The stem cells were then injected into the injury site of this dog.

Suggest why stem cells were taken from this dog and not from another dog.

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- (c) A further investigation was carried out on 34 dogs with spinal injuries. Some had stem cells injected into the site of the spinal injury. The others were injected with a fluid containing no stem cells. This fluid is called a neutral fluid.

Neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

The dogs that were given stem cells recovered the use of their back legs.

- (i) Explain the reason for giving some of the dogs a neutral fluid instead of stem cells.

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- (ii) Suggest why neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

(1)

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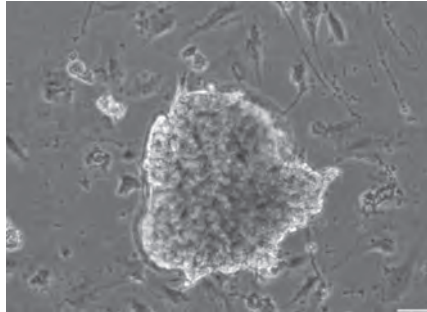
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(Total for Question 1 = 7 marks)

- 2 Scientists have used stem cells collected from a patient's own heart tissue to heal tissue damaged by heart attacks.

The photograph below shows a stem cell extracted from heart tissue.



Magnification $\times 200$

After collection, the stem cells were grown in a laboratory to increase their numbers. These stem cells were then put into the coronary arteries surrounding the heart of the patient.

The stem cells developed into heart muscle cells, which repaired the damaged heart tissue.

- (a) (i) Place a cross (☒) in the box that best identifies the name of the property that would enable these stem cells to give rise to heart muscle cells.

(1)

- A** cardiopotency
- B** omnipotency
- C** pluripotency
- D** totipotency

(ii) Explain how these stem cells become specialised and develop into heart muscle cells.

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(b) Explain the advantages of using stem cells from the patient instead of using stem cells from a donor.

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(c) Suggest why this form of stem cell therapy is less controversial than embryonic stem cell therapy.

(2)

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(Total for Question 2 = 9 marks)

3 Induced pluripotent stem cells (iPS cells) are a new type of stem cell.

(a) To produce iPS cells, four genes that code for different transcription factors are added to the genome of somatic (body) cells. The transcription factors produced cause the somatic cells to be converted into iPS cells.

(i) Suggest why it may be better to produce differentiated cells from iPS cells than from pluripotent stem cells.

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(ii) Explain how these transcription factors may cause the somatic cells to be converted into iPS cells.

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4 Stem cells can differentiate into specialised cells and tissues.

(a) There are about 23 000 genes in a human body cell. The table below shows the number of genes that have not been switched off, in three different cells, A, B and C.

Cell	Number of genes that have not been switched off
A	11 000
B	18 000
C	23 000

Suggest which of these cells is a totipotent stem cell.
Give reasons for your answer.

(3)

Cell

Reasons

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(b) A fertilised egg can be used as a source of human pluripotent stem cells.

(i) Explain what is meant by the term **pluripotent stem cell**.

(2)

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(ii) Describe how a fertilised egg can be used as a source of human pluripotent stem cells.

(3)

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(Total for Question 4 = 8 marks)

5 Stem cells are considered to be a potential treatment for many conditions. However, research on stem cells needs to be regulated.

*(a) Explain the meaning of the term **stem cell**.

(2)

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(b) State **three** potential sources of human stem cells.

(3)

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(c) (i) Suggest **two** reasons why there are regulating authorities for human embryo research.

(2)

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(ii) Suggest why these regulating authorities should include people involved in human embryo research and people not involved in embryo research.

(2)

People involved in embryo research

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People not involved in embryo research

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