



ANSWER BOOK

Stem cells: what a cell can still become, and what fixes it

Cell cycles, reproduction and development · Unit B06

AQA 3.8.2.1 · OCR A 2.1.6 · Edexcel A Topic 3

8 questions · 26 marks

NAVY EDITION

SECTION A · Short, 1 to 2 marks

- A1** **B1** it is unspecialised and can differentiate into one or more specialised cell types. **B1** it can divide repeatedly by mitosis to produce more cells like itself, which is self-renewal. [2]
- A2** **B1** pluripotent; totipotent is not accepted, because the cell cannot form extra-embryonic tissue such as the placenta. [1]
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SECTION B · Standard, 3 to 5 marks

- B1** **B1** totipotent: can become every cell type of the organism and the extra-embryonic tissues, for example a zygote or a cell of the first few divisions. **B1** pluripotent: can become every cell type of the body but not extra-embryonic tissue, for example a cell of the inner cell mass of a blastocyst. **B1** multipotent: can become a limited number of related types, for example a haematopoietic stem cell in bone marrow, which forms blood cells. **B1** unipotent: can become one type only, for example the cells that give rise to new cardiomyocytes in heart muscle. [4]
- B2** **B1** advantage: no embryo is used, so the ethical objection to ending the development of a blastocyst does not apply. **B1** advantage: the cells can be made from the patient's own tissue, so they carry the patient's own antigens and the risk of rejection is much lower. **B1** limitation: reprogramming succeeds in only a small proportion of the cells treated, and methods that insert the genes using a virus increase the risk of tumours. **B1** limitation: induced pluripotent cells have not been shown to be equivalent to embryonic cells, which are still used as the standard for comparison. [4]
- B3** **B1** all body cells are derived by mitosis from the same zygote, so they contain the same genes. **B1** cells differentiate by transcribing some genes and not others, rather than by losing genes. **A1** in a neurone the insulin gene is not transcribed, so no mRNA and no insulin is produced from it, although the gene is present and intact. [3]
- B4** **B1** bone marrow cells are multipotent and can form only blood cells, whereas embryonic cells are pluripotent and can form any cell type of the body. **B1** bone marrow cells can be taken from the patient themselves so carry the patient's own antigens and are far less likely to be rejected, whereas embryonic cells come from another individual and may be rejected. **B1** obtaining bone marrow cells does not end the development of an embryo, whereas obtaining embryonic cells does, so the two raise different ethical objections. [3]
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- B5** **B1** any cells that have not differentiated may continue to divide after transplant and form a tumour. **B1** the cells carry antigens from another individual, so they may be rejected by the patient's immune system unless immunosuppressant drugs are given. **B1** it is difficult to control differentiation so that only the required cell type is produced, and difficult to make the cells connect correctly with existing tissue. [3]
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SECTION C · Long, 6 marks or more

- C1** **B1** for: embryonic stem cells are pluripotent, so a far wider range of tissues can be produced from them than from adult or cord blood cells. **B1** for: they divide in culture apparently without limit, so one cell line can supply large numbers of cells, and they offer treatment for conditions with no present cure. **B1** against: obtaining them ends the development of a blastocyst, which some hold to be a human individual from fertilisation, so that no benefit to a patient can justify it. **B1** against: the cells come from another individual and may be rejected, and undifferentiated cells remaining in a transplant may form tumours. **B1** alternatives: adult and umbilical cord blood cells raise no such objection but are multipotent, and induced pluripotent cells offer pluripotency from the patient's own tissue without using an embryo. **A1** a judgement is stated and supported by the points made above it; credit either conclusion provided the reasoning leads to it. [6]
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