

2023 Bi H2 Q3

Section: DNA and the Genome

Topic: Cellular Differentiation

Question Summary

The question investigates the use of stem cells in research, including their properties, ethical issues, and how cytokines affect stem-cell growth in culture.

Worked Solution

(a)(i) One other research use of stem cells

Stem cells can be used to test new drugs or study how particular genes control differentiation.

(a)(ii) Property of embryonic stem cells making them useful for research

Embryonic stem cells are pluripotent, meaning they can differentiate into all cell types of the body. This allows researchers to study specialisation and model developmental processes.

(a)(iii) Ethical reason for using embryonic stem cells

Embryonic stem cells can come from spare embryos from IVF that would otherwise be destroyed, so using them for research can be seen as a way to benefit medical science rather than waste

potential life.

(b)(i) Two differences in cell count between the cultures

From the table:

- The culture with cytokines shows a much higher cell count at every time point.
- By day 10, cells in medium only have almost stopped growing (and declined), whereas cells with cytokines show continued rapid growth.

(b)(ii) Cell count in a 0.01 cm³ sample (with cytokines, day 10)

Cell concentration = $8200 \times 1000 = 8.2 \times 10^6$ cells per cm³

In 0.01 cm³: $8.2 \times 10^6 \times 0.01 = 8.2 \times 10^4 = 82\,000$ cells

■ Answer: 82 000 cells

(b)(iii) Evidence that the cell count was a viable cell count

The count decreases in the medium-only flask by day 10, showing that dead cells were not included in the total. A viable count measures only living cells.

Final Answers

- (a)(i) Drug testing / Gene-control studies
- (a)(ii) Pluripotent — can form all cell types
- (a)(iii) Spare IVF embryos used for beneficial research
- (b)(i) Cytokine culture = greater and continued growth

■ (b)(ii) 82 000 cells

■ (b)(iii) Dead cells excluded → viable count

Revision Tips

- Totipotent → Pluripotent → Multipotent — know the differences.
- Cytokines are signalling molecules controlling growth and differentiation.
- Viable count = live cells only; total count = live + dead.
- Ethics in stem-cell use involve balancing medical benefit vs potential life.
- Practice interpreting data tables for growth patterns.

