Questions

Q1.

Explain why some cells are not able to become other cell types.

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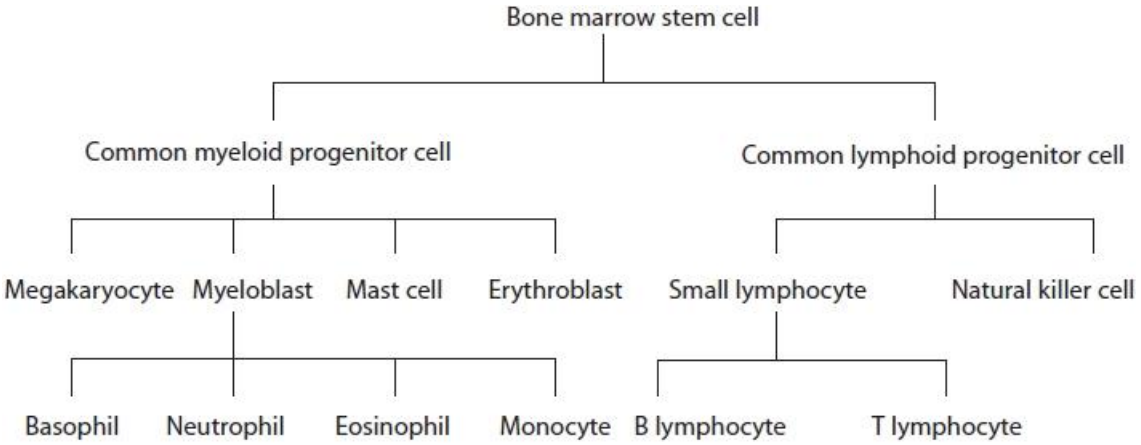
(Total for question = 2 marks)

Q2.

The diagram shows some stages in the production of blood cells from bone marrow stem cells.



Explain how a bone marrow stem cell differentiates into either a common myeloid progenitor cell or a common lymphoid progenitor cell.

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(Total for question = 4 marks)

Q3.

Scientists are developing ways of using stem cells to replace heart cells that have been damaged as a result of heart disease.

Both embryonic stem cells and induced pluripotent stem cells (iPS cells) can be used to create new heart cells.

Compare and contrast the properties and uses of embryonic stem cells with those of iPS cells.

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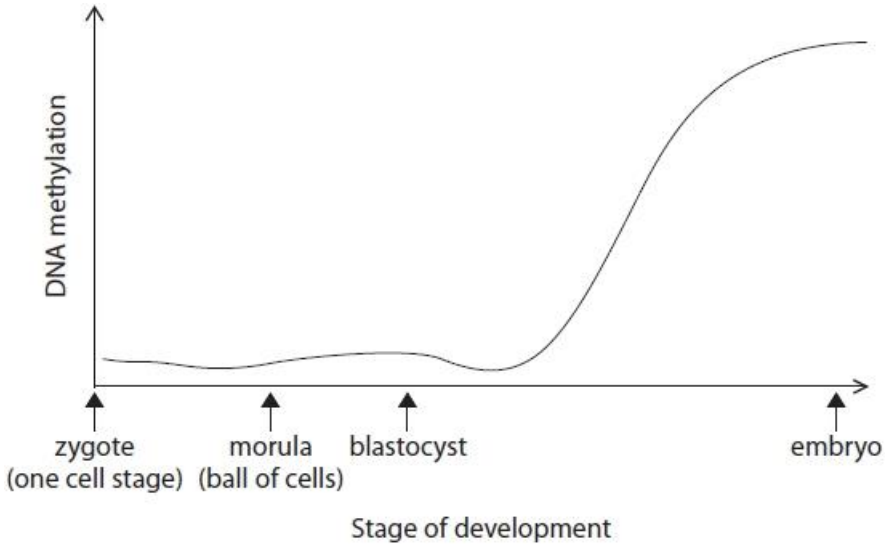
(Total for question = 5 marks)

Q4.

Epigenetic modifications are involved in the development of an embryo.

The graph shows the changes in DNA methylation during the development of an embryo from a zygote.



(i) State the meaning of the term DNA methylation.

(1)

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(ii) Describe the differences between totipotent, pluripotent and multipotent stem cells during the development of an embryo.

(3)

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(iii) Analyse the graph to explain why DNA methylation is involved in the development of an embryo.

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(Total for question = 6 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • because they are (fully) differentiated cells (1) • therefore genes needed (for other cell types) are (permanently) {switched off / silenced} (1) • therefore proteins needed by other cell types cannot be produced (1)	ACCEPT specialised ACCEPT not able to express certain genes	

Q2.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • by epigenetic modification (1) • for example by {DNA methylation / histone methylation / histone acetylation} (1) • {house-keeping genes / genes needed in both cell types} remain switched on (1) • genes needed in {common lymphoid progenitor / lymphoid} cells become (permanently) switched off (1) • causing {proteins / named protein} to be made that are specific to the {cell type / named cell} (1)	**ACCEPT** descriptions / post-transcriptional modification transcription of genes switched on / no transcription of genes switched off **ACCEPT** converse **ACCEPT** converse credit a named example of a gene which may be switched {on / off} e.g. gene coding for cytokines in T lymphocytes **NB** genes become switched on or off = 1 mark, if no other marks awarded	(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to five of the following, including at least one similarity or one difference : Similarities: • both have the potential to divide indefinitely **(1)** • both have the potential to differentiate into a number of cell types **(1)** Differences: • iPS cells were {adult cells / named example of adult cell} but embryonic stem cells are cells taken from the {morula / inner cell mass} **(1)** • iPS have a {gene / named gene} added but embryonic cells do not **(1)** • there are {no / less / different} ethical issues surrounding the use of iPS cells **(1)** • iPS cells can form adult cells whereas embryonic cells form younger cells **(1)** • iPS cells will produce patient-matched cells but embryonic stem cells will be antigenic **(1)**	**NB** do not piece together **Accept** have no Hayflick limit **Accept** to specialise e.g. fibroblasts, keratinocytes, kidney epithelium, blood cells **Accept** blastomeres / early embryo (up to 14 days) e.g. Oct4, Sox2, cMyc, KIf4 **Accept** there will be rejection issues using embryonic stem cells but not using iPS cells	**(5)**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	{methyl group / CH_3} added to a {base (cytosine or adenine) / cytosine / adenine / CpG site}	DO NOT ACCEPT between cytosine and guanine ACCEPT A for adenine, C for cytosine, G for guanine	

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • {zygote / morula} are totipotent stem cells as they give rise to all cell types (1) • {blastocyst / inner cell mass} contains pluripotent cells that give rise to the cells of the embryo (and not the extra embryonic tissue) / most cell types (1) • cells in the developing embryo are multipotent as they become only some cell types (1)	ACCEPT references to early and late stages of development if clear from description which stages are being referred to ACCEPT cleavage cells ACCEPT {trophoblastic cells / cells around the outside of the blastocyst} as they become extra embryonic tissue N.B. If correct description given for 2 or more types of stem cell but no reference to embryo, award 1 mark	

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • level of DNA methylation increases after the blastocyst stage} (1) • because genes {switched off / silenced / inactivated / cannot be transcribed / cannot be expressed} (1) • causing cells to become {specialised / differentiated} (1)		