Question Number	Answer	Additional guidance	Mark
1(a)	1. reference to stem cells being {totipotent / pluripotent} ; 2. can specialise or differentiate / can give rise to {differentiated / specialised} cells ; 3. idea that these can replace damaged cells (in spinal cord of Dachshund) / new nervous tissue can be formed / eq ; 4. capable of continuous division / no Hayflick limit ;	1. IGNORE unspecialised 2. IGNORE stem cells 'turn into' or 'become' 3. ACCEPT new nerve cells	**(2)**

Question Number	Answer	Additional guidance	Mark
1(b)	1. cells genetically identical / same genotype / eq ; 2. no rejection / avoids immune response / eq ; 3. idea of no disease transmission ;	IGNORE tumours, cancer 1. ACCEPT reference to same tissue type or same antigens – NOT the same DNA 2. OT **reduced** risk of rejection ACCEPT idea of no need for immunosuppressant drugs 3. ACCEPT – reduced risk of infection	**(2)**

Question Number	Answer	Additional guidance	Mark
1(c)(i)	1. reference to placebo OR idea of being used as a control ; 2. to compare with stem cell treatment / eq ;	1. GNORE placebo effect	**(2)**

Question Number	Answer	Additional guidance	Mark
1(c)(ii)	1. to remove bias / eq 2. idea of making it a double blind trial ;		**(1)**

Question Number	Answer	Mark
2(a)(i)	C – pluripotency ;	**(1)**

Question Number	Answer	Additional guidance	Mark
2(a)(ii)	1. idea of appropriate stimulus e.g. chemical, hormone ; 2. idea of activation of some genes ; 3. only the activated genes are transcribed / mRNA made only at active genes / eq ; 4. mRNA translated (on ribosomes) ; 5. protein made / eq ; 6. which {determines / eq} cell {structure / function} / permanently modifies cell / eq ; 7. reference to cell differentiation ;		**(4)**

Question Number	Answer	Additional guidance	Mark
2(b)	1. idea of genetically identical cells (to patient) ; 2. no risk of rejection / eq ; 3. no need to take immunosuppressant drugs / eq ; 4. less risk of infection / eq ;	2. OT less likely	**(2)**

Question Number	Answer	Additional guidance	Mark
2(c)	1. no destruction of embryos / eq ; 2. embryo has potential to become a human life / eq ; 3. {religious / ethical } objections / eq ;		**(2)**

Question Number	Answer	Additional guidance	Mark
3 (a)(i)	1. An ethical comment ; 2. Idea that no embryo used (as somatic cells are body cells) ; 3. Limited supply of embryos /eq ; 4. iPS cells can be used in the same individual that provided the somatic cells ; 5. no immune response with iPS cells ;	All converse as appropriate 5. ACCEPT no rejection of cells/tissues/construct	**(2)**

Question Number	Answer	Additional guidance	Mark
3 (a)(ii)	1. Binds to another substance e.g. forming a transcription initiation complex, deactivating inhibitors ; 2. Bind to promoter region(s) (on DNA) ; 3. So no genes switched off / eq ; 4. Ref to RNA polymerase activity ; 5. (m)RNA production ; 6. {protein / eq} produced; 7. That allow cells to divide / undifferentiate / unspecialise ;		**(4)**

Question Number	Answer	Additional guidance	Mark
3(b)	1. Idea of same source of somatic cells used ; 2. Example of measuring outcome offered e.g. percentage conversion to iPS, amount of mRNA or protein product made ; 3. Use same time (for study) / eq ; 4. Run at same temperature / eq ; 5. Run at { same / optimum } pH ;	3 ACCEPT as time taken to produce iPS	**(3)**

Question Number	Answer	Mark
4 (a)	1. C ; Any **two** of the following 2. all genes (potentially) active / as no genes {switched off / deactivated} / {cell A / cell B} has genes switched off / eq ; 3. idea that therefore it can {give rise to/differentiate to become} all cell (types) ; 4. differentiation has occurred in cell {A / B} / eq ;	**(3)**

Question Number	Answer	Mark
4 (b)(i)	1. {undifferentiated / unspecialised} cell ; 2. some genes {deactivated / switched off} ; 3. idea that it can give rise to most specialised cells / eq ; 4. but not totipotent stem cells / extra embryonic cells / eq ;	**(2)**

Question Number	Answer	Mark
4 (b)(ii)	1. fertilised egg allowed to {grow for a few days/ divide several times / eq} ; 2. reference to a {blastocyst/ blastula / hollow ball of cells / eq} ; 3. cells in inner cell mass are {pluripotent / harvested} ; 4. procedure for extraction of cells / eq ; 5. ref to source of fertilised egg e.g. spare embryo after IVF ;	**(3)**

Question Number	Answer	Mark
***5(a) QW**	(QWC – Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. *undifferentiated* cell / eq ; 2. that can give rise to other {types of cell / eq }; 3. idea that no limit to division ; 4. correct reference to {*totipotent* / *pluripotent* /eq} ;	**max (2)**

Question Number	Answer	Mark
5(b)	1. cord blood /umbilical cord / placenta ; 2. {fertilised egg / zygote / eq} / blastocyst / (early) embryo ; 3. detail of site within blastocyst 4. bone marrow / eq ; 5. {brain / connective / skin / liver} cells / eq ; 6. addition of adult nucleus to enucleated egg cell ;	**max (3)**

Question Number	Answer	Mark
5(c)(i)	1. decide on max age of embryo allowed for research / eq ; 2. idea of setting or considering {ethical / legal} aspects / judging what is acceptable / follow a code of practice ; 3. example of what {is / is not} acceptable ; 4. checking that source of stem cells is acceptable / eq ; 5. stopping of cloning (of humans) / eq ; 6. appropriate reference to unnecessary repeating of research / eq ;	**max (2)**

Question Number	Answer	Mark
5 (c)(ii)	**people involved in embryo research:** 1. idea of being able to (fully) understand the science / recognise what is possible {benefits / risks / eq} / judge in an informed manner ; **people not involved in embryo research:** 2. idea of giving a {balanced /alternative / wider / named} view ;	**(2)**