Questions

Q1.

Hypoxia is an inadequate supply of oxygen to tissues and cells that restricts their function.

The body responds to hypoxia by releasing hypoxia-inducible transcription factors (HIF).

Investigations have shown that one effect of HIF is an increase in the rate of glycolysis in the affected cells.

(i) Explain how HIF could result in an increase in the rate of glycolysis.

(2)

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(ii) Explain why cells need to respond to hypoxia with an increase in the rate of glycolysis.

(4)

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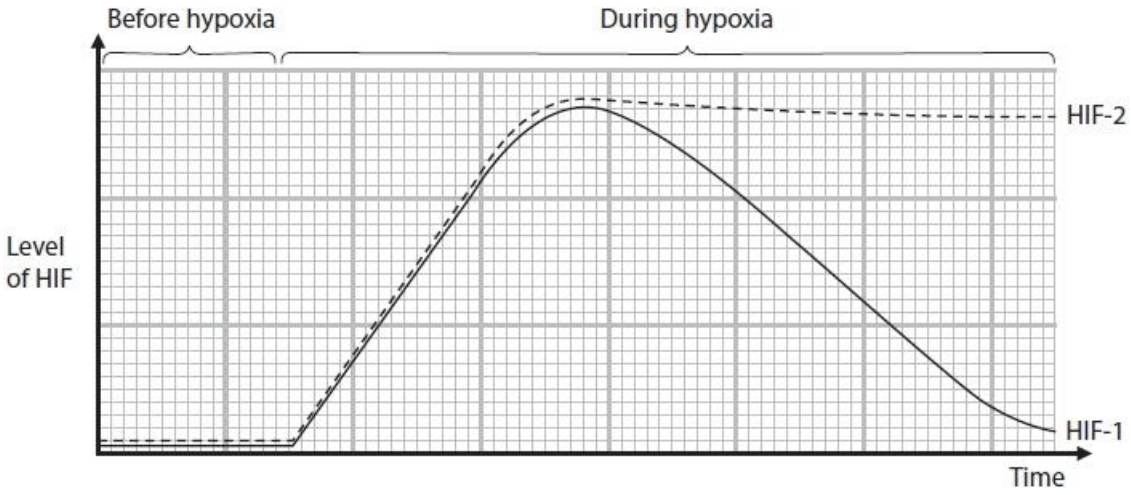
(iii) The graph shows the changes in levels of two HIFs, HIF-1 and HIF-2, before and during hypoxia.



Compare and contrast the changes in the levels of HIF-1 and HIF-2 during hypoxia.

(2)

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(iv) Explain the changes in levels of HIF-1 and HIF-2 during hypoxia.

(2)

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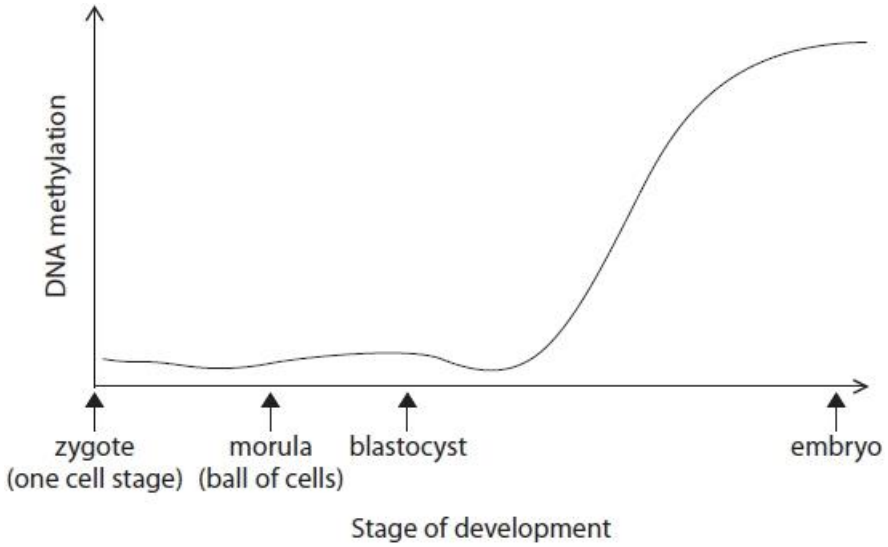
(Total for question = 10 marks)

Q2.

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.

(2)

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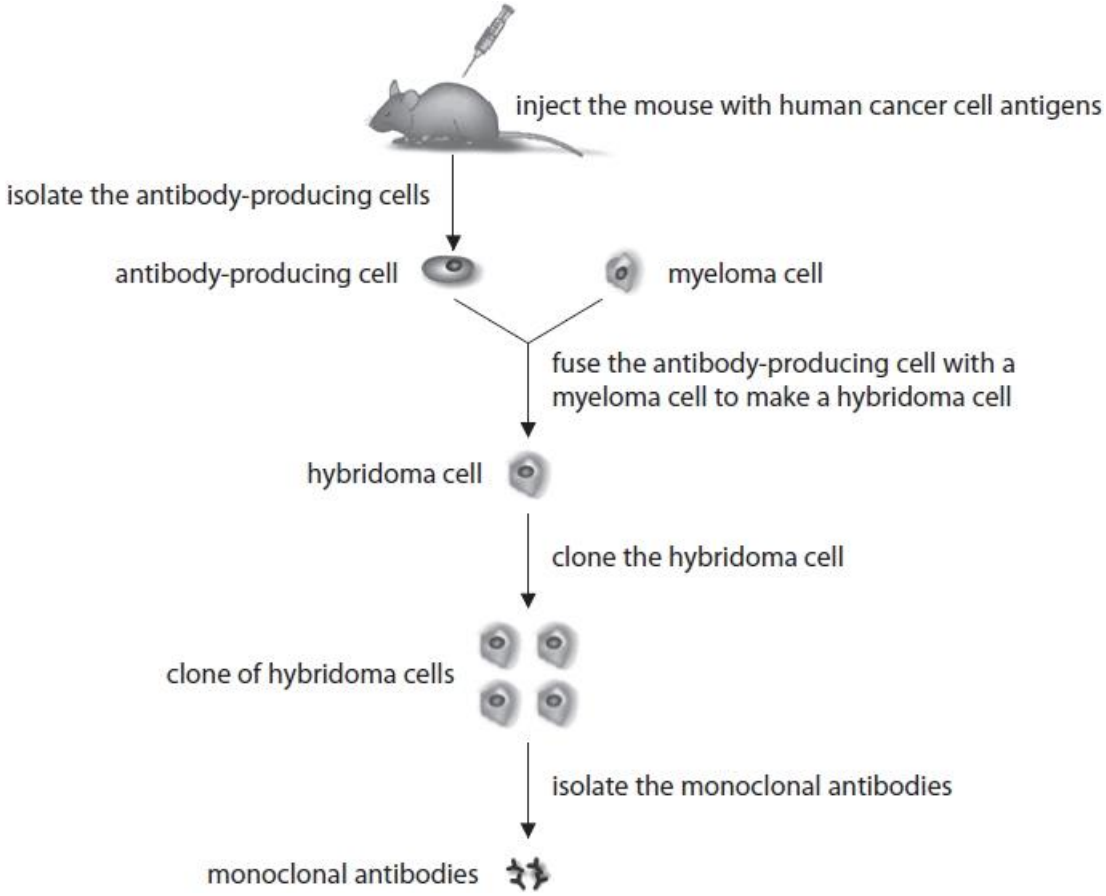
(Total for question = 6 marks)

Q3.

Monoclonal antibodies can be made against a wide range of different antigens. They are used in research and medicine.

Monoclonal antibodies are made by fusing an antibody-producing cell with a myeloma cell.

The diagram shows some of the steps involved in making monoclonal antibodies against human cancer cell antigens.



Epigenetic modification is involved in the formation of the antibody-producing cells.

Describe epigenetic modification.

(3)

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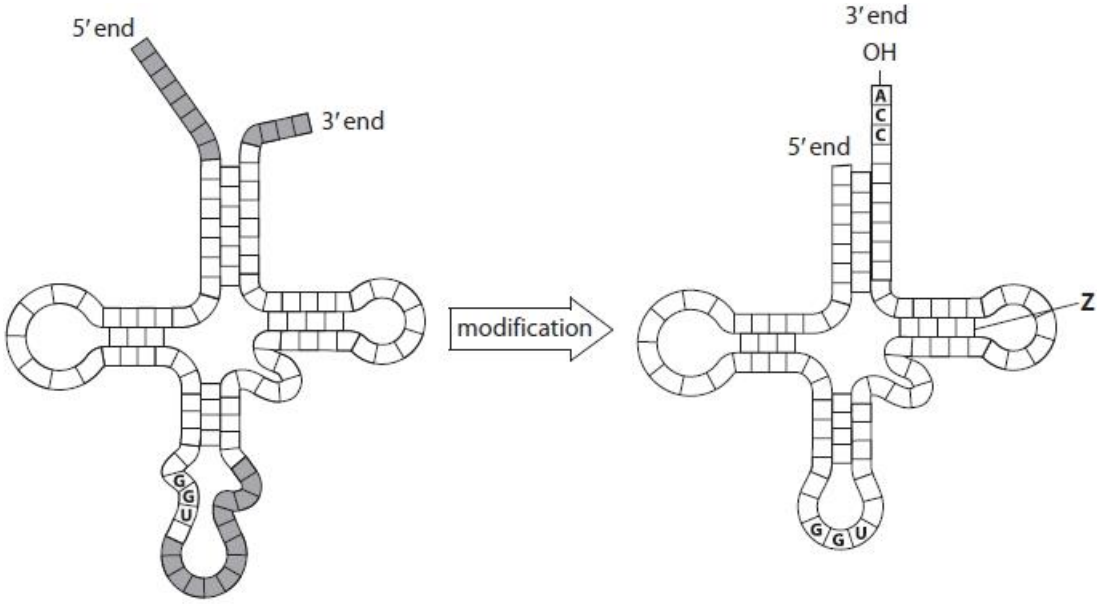
(Total for question = 3 marks)

Q4.

A molecule of tRNA is made from a precursor molecule that is modified. Modification includes splicing, trimming and attachment of new nucleotides.

The diagram shows a precursor molecule for a tRNA specific for the amino acid proline, and a tRNA molecule specific for the amino acid proline. Some of the bases are shown in each diagram.



Describe how this precursor molecule is modified to produce a tRNA molecule specific for the amino acid proline.

(3)

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(Total for question = 3 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to two of the following: • because HIF can switch on gene (expression) (1) • bind to a promotor region / stimulate transcription / stimulate protein synthesis} (1) • for {enzymes / proteins} involved in glycolysis (1)	**ACCEPT** increased gene expression **ACCEPT** increase rate of transcription **IGNORE** enzymes **ACCEPT** named {enzyme / protein} involved in glycolysis e.g. enzyme that makes NAD **IGNORE** NAD otherwise	(2) EXP
Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • (because if conditions are hypoxic) there is not much oxygen available to act as a terminal electron acceptor (1) • therefore the electron transport chain will not operate (1) • therefore ATP production by oxidative phosphorylation will be reduced (1)	**ACCEPT** no oxygen **IGNORE** numbers of ATP molecules produced	(4) EXP
	• ATP is produced (directly / SLP) during glycolysis (during these anaerobic conditions) (1)		
Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • both HIF-1 and HIF-2 increase (during hypoxia) (1) • levels of HIF-2 remain high (after a small decrease) but levels of HIF-1 fall (1)	**DO NOT PIECE TOGETHER** **IGNORE** any explanations given	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iv)	An explanation that makes reference to two of the following: • HIF-1 and HIF-2 switch on different genes (1) • {products / transcription of genes} resulting from the presence of both HIF-1 and HIF-2 are needed in the early stages of hypoxia (1) • {products / transcription of gene} resulting from the presence of HIF-2 are needed {for longer periods of hypoxia / to sustain glycolysis} (1)	**ACCEPT** bind to different promotor regions **ACCEPT** converse for HIF-1	(2) EXP

Q2.

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)		

Q3.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • changes that affect gene {expression / activation} **(1)**	**Do not accept** altering the DNA / base sequence / genetic code	
	• credit an example of epigenetic modification **(1)**	e.g. DNA methylation, histone {modification / methylation / acetylation} / chromatin remodelling / non-coding RNA / transcription factors	
	• involved in {differentiation / change in function / change in proteins synthesised } **(1)**	**Accept** when a B cell becomes a plasma cell	**(3)**

Q4.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • removal of the {shaded nucleotides / introns} (1) • attachment of ACC (and OH) (1) • joining with phosphodiester bonds (1)	**ACCEPT** shaded {parts / areas} **ACCEPT** adding {acceptor stem / amino acid binding site}	**(3)**