Questions

Q1.

Acetylcholinesterase is an enzyme involved in regulating the transmission of nerve impulses across some synapses.

Acetylcholinesterase is found on the cell surface membranes of neurones and red blood cells.

These acetylcholinesterase molecules have different primary structures.

In humans, a single gene codes for acetylcholinesterase.

(i) Explain how a single gene can give rise to acetylcholinesterase molecules with different primary structures.

(2)

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(ii) Explain how the acetylcholinesterase gene can be expressed in some tissues but not others.

(3)

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(Total for question = 5 marks)

Q2.

The internal conditions within the body are maintained by homeostatic mechanisms. The regulation of blood glucose involves homeostatic mechanisms.

Beta cells in the pancreas produce insulin when there is an increase in glucose levels in the blood.

Transcription factors are involved in the activation of the insulin gene.

Explain how transcription factors could activate insulin gene expression in beta cells.

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(Total for question = 3 marks)

Q3.

Extracellular enzymes are produced by specialised cells.

Explain how groups of cells can produce the same enzyme.

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(Total for question = 3 marks)

Q4.

Some fish live in very cold parts of the sea where ice can form.

Many of these fish produce anti-freeze proteins, which help to stop ice forming inside the fish.

Some fish produce another anti-freeze protein, called AFP II.

The tissues of these fish were tested for the presence of AFP II and the mRNA coding for AFP II.

The results are shown in the table.

Molecule	Present in
AFP II protein	all tissues
AFP II mRNA	liver tissue only

Explain the distribution of the AFP II protein and AFP II mRNA.

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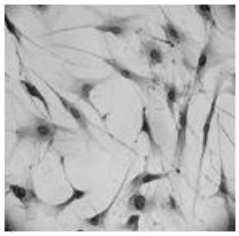
(Total for question = 4 marks)

Q5.

In humans, different types of stem cell are found in the bone marrow.

The photograph shows some mesenchymal stem cells from bone marrow.



Mesenchymal stem cells can differentiate to give rise to a variety of cell types, including bone cells, cartilage cells, muscle cells and fat cells.

The skeletal system consists of bone tissue, muscle tissue and cartilage tissue.

(i) Describe how a tissue differs in structure from a system.

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(ii) Describe how mesenchymal stem cells can give rise to different types of cell.

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(Total for question = 6 marks)

Q6.

Stem cells can be used to repair damaged organs.

Part of the eye contains stem cells. These cells can be used to repair damaged corneas in the eye.

(i) Explain why stem cells from the heart cannot be used to grow cells to repair the cornea.

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(ii) Explain why chemicals from the eye are needed to produce corneal cells from a suitable source of stem cells.

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(Total for question = 7 marks)

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to two of the following: • (pre-)mRNA splicing / post-transcriptional modification (1) • different exons removed (1) • (therefore) producing different {sequences of amino acids / mRNA sequences} (1)	ALLOW the exons can be joined in different sequences ALLOW (the acetylcholinesterase) gene ismade up from several exons and introns IGNORE producing different primary structure	Choose an item. (2)
Question number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to three of the following: • {hormones / signal molecules / chemical signals} bind toreceptors found only in some {tissues / cells} (1) • regulating a {transcription factor / repressor molecules}(1) • {transcription factor / repressor molecule} binds to thepromotor region of the (acetylcholinesterase) gene (1) • therefore switching {on / off} transcription (1)	ALLOW epigenetic changes occur in some tissues ALLOW only act on some {tissues / cells} ALLOW {allowing / preventing} binding of RNA polymerase	Choose an item. (3)

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Q2.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • interaction between transcription factors and promoter (region on gene) • RNA polymerase binds (to promoter region) (1) • { transcription /mRNA produced } (for insulin gene)	 ALLOW 'regulatory' instead of 'promoter' or reference to transcription initiation complex ALLOW transcription initiation complex binds (to promoter region) if RNA polymerase described as part of the complex	**(3)**

Q3.

Question Number	Answer	Additional Guidance	Mark
	An explanation which makes reference to three of the following: • genes can be activated or deactivated (1) • (these cells) receive the same stimulus (1) • (all of these cells) have the gene for the enzyme { activated / switched on } (1) • resulting in production of mRNA for the enzyme (1)	 ALLOW switched on or off	**(3)**

Q4.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • (AFP II) { gene / allele } { activated only in liver cells / deactivated in cells other than liver cells } (1) • transcription (of AFP II) occurs only in liver cells (1) • { translation / protein synthesis } (of AFP II) takes place only in liver cells (1) • the protein is { secreted from liver cells / transported around the body } (1) • (presence of protein in all tissues) prevents { freezing / ice } in all parts of the body (1)	ALLOW "switched on/off" This deactivation could be due to DNA methylation / histone modification Ref to liver cells required only once if context / chain of argument is clear.	(4)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to the following: • tissue contains one type of cell **(1)** • a system contains (many) {different tissues /organs} **(1)**	ALLOW similar cells	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following: • different stimuli activate different genes **(1)** • genes activated are transcribed / mRNA produced from active genes **(1)** • mRNA translated to produce proteins **(1)** • proteins determine {structure / function} of cells **(1)** • different {genes activated / proteins produced} result in different types of cell being produced **(1)**	ALLOW switch on	**(4)**

Q6.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that makes reference to the following: • cells are not totipotent (1) • therefore some genes have already been activated and deactivated (1) • therefore, will not be able to specialize into cornea cells (1)	ALLOW cells are only pluripotent ALLOW some genes have already been switched on or off ALLOW will only be able to become a specific selecton of cells	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • chemicals cause some genes (related to the cornea) to be {activated/switched on} (1) • these genes are transcribed producing specific mRNA (1) • specific mRNA is translated into specific proteins (1) • these proteins cause the cell to develop into a corneal cell (1)	Allow reference to genes being deactivated/switched off	**(4)**