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BIOLOGY

THE CONTROL OF GENE EXPRESSION

Level & Board	AQA (A-LEVEL)
TOPIC:	STEM CELLS
PAPER TYPE:	QUESTION PAPER - 1
TOTAL QUESTIONS	6
TOTAL MARKS	37

Stem Cells - 1

1.

Malignant malignancies comprise the group known as myelodysplastic syndromes (MDS). The bone marrow does not generate healthy blood cells in MDS patients.

One treatment for MDS is hematopoietic stem cell transplantation (HSCT). With HSCT, a non-MDS patient's bone marrow is used to supply stem cells to the patient. The patient's defective bone marrow is eliminated prior to the initiation of treatment.

(a) HSCT is a successful MDS treatment for certain individuals.

Describe how. **(3)**

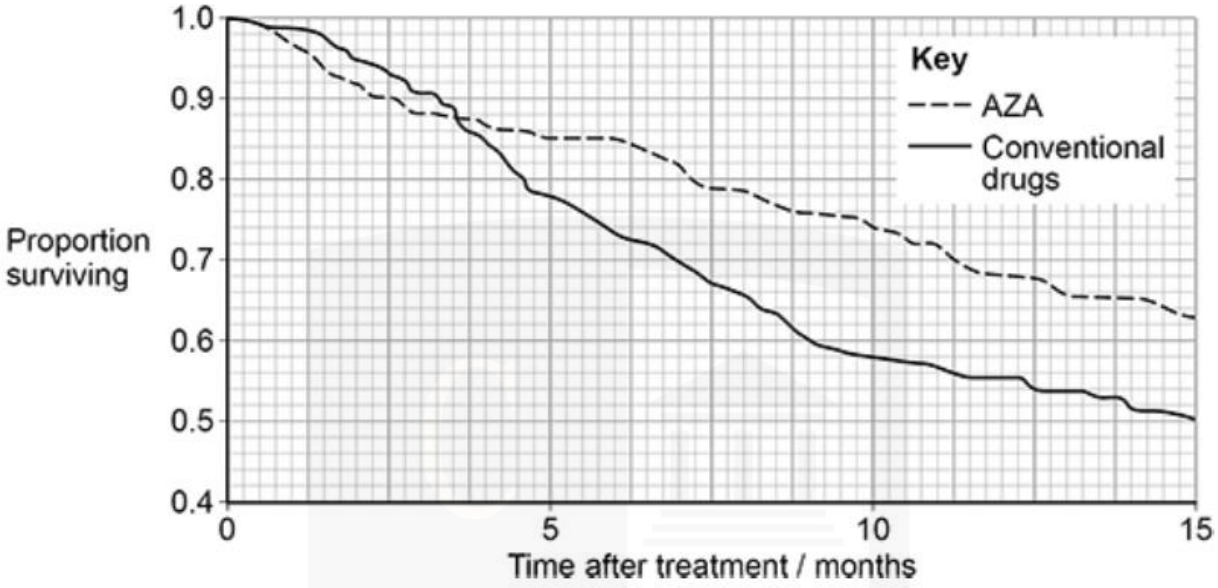
(b) Tumor suppressor gene epigenetic modifications may lead to MDS development. The medication AZA has lessened the consequences of MDS in several patients. AZA is a DNA methyltransferase inhibitor. These enzymes modify cytosine bases by adding methyl groups.

Indicate and describe how AZA may help some patients have a lessened MDS impact. **(3)**

2.

Scientists looked into how well AZA worked for MDS patients. A total of 360 patients were randomly assigned, one to one, to receive AZA or standard medication (control).

The scientists' findings are depicted in the image below.



(a) Conventional medication was used to treat the control group of patients. Give two explanations for this. **(2)**

(b) Compute the difference in the number of patients who survive at 10 months after therapy with AZA compared with conventional treatments using the information provided and the above figure. **(2)**

3.

An inherited condition known as Alport syndrome (AS) affects the kidney glomeruli in both men and women. High levels of protein in the urine are present in affected people.

Researchers looked on treating AS in mice by using transplanted stem cells.

The researchers organized four groups for experimentation.

The 40 wild type* mice in Group A

Group B: 40 AS mice

Group C: 40 AS mice that were given AS mice's stem cells

Group D: 40 AS animals given wild-type mouse's stem cells

*Mice without AS symptoms are known as wild type mice.

The amount of protein in the urine was assessed by the scientists after 20 weeks using a scale from 0 (lowest quantity) to +++++ (highest quantity).

The table below displays the scientists' findings.

Group	Maximum quantity of protein in urine at 20 weeks	Percentage of mice with this quantity of protein
A	0	100
B	+++++	97.5
C	+++++	100
D	++	68

(a) Analyze the potential of stem cell therapy for AS in humans using the information provided. **(4)**

(b) To learn more about the post-transplant development of the transplanted stem cells, the scientists conducted additional research.

• The researchers gave wild-type male mice's stem cells to AS female mice.

• Following 20 weeks, they discovered a notable reduction in the amount of protein in the urine of these female mice.

• They looked at the female mice's glomerulus cells. Y chromosomes might be found in some of these cells.

Describe how proteinuria is lessened by the donated stem cells. **(2)**

4.

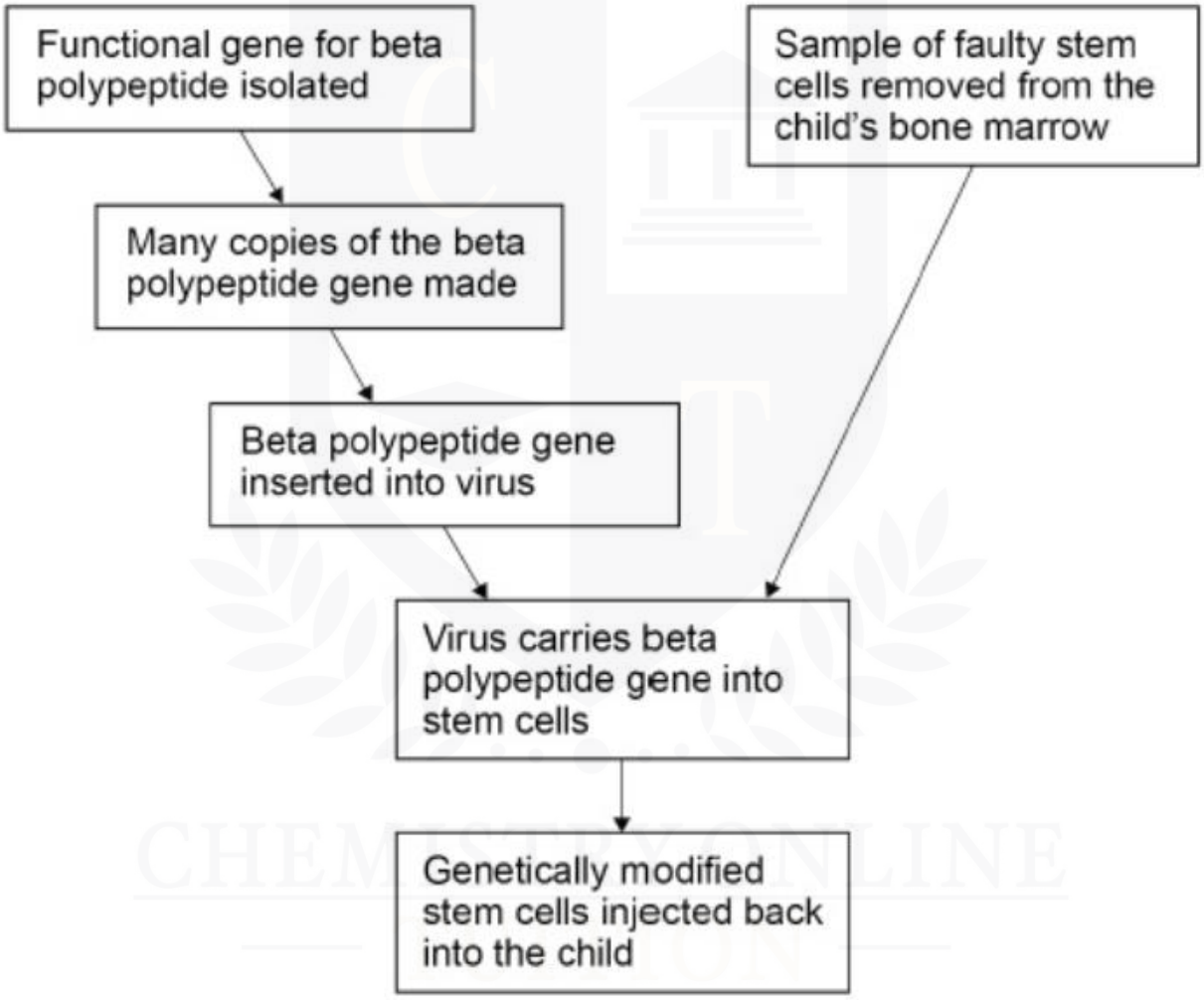
A class of hereditary illnesses is known as sickle cell disease (SCD). Red blood cells in SCD patients have a sickle form to them. One kind of SCD can result from a mutation in a single base substitution. The beta polypeptide chains in hemoglobin undergo structural alteration as a result of this mutation.

A long-term therapy for sickle cell disease (SCD) is hematopoietic stem cell transplantation (HSCT). With HSCT, a non-SCD patient's bone marrow is used to supply stem cells to the patient. Frequently, the donor is the patient's sibling or brother. The patient must have their defective bone marrow cells eliminated prior to the initiation of treatment.

(a) Make use of this knowledge to describe how HSCT is a successful long-term SCD treatment. **(4)**

Gene therapy is a novel long-term treatment for sickle cell disease (SCD).

Some of the phases of this treatment for a child with SCD are depicted in the diagram.



(b) According to some scientists, this form of gene therapy will be a longer-term, more successful treatment for sickle cell disease than hemodialysis. Make use of all the data offered to assess this conclusion. **(3)**

5.

(a) What is the difference between embryonic and adult stem cells? **(2)**

(b) Where do stem cells come from? **(2)**

(c) What are induced pluripotent stem (iPS) cells? **(2)**

6.

(a) What are the differences between adult stem cells and embryonic stem cells? **(3)**

(b) Why not use adult stem cells instead of using human embryonic stem cells in research? **(2)**

(c) Do iPS cells eliminate the need for embryonic stem cells? **(3)**

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