

AQA – The control of gene expression – A2 Biology

1. June/2021/Paper_2/No.5

0 5 . 1

Neonatal diabetes is a disease that affects newly born children. The disease is caused by a change in the amino acid sequence of insulin.

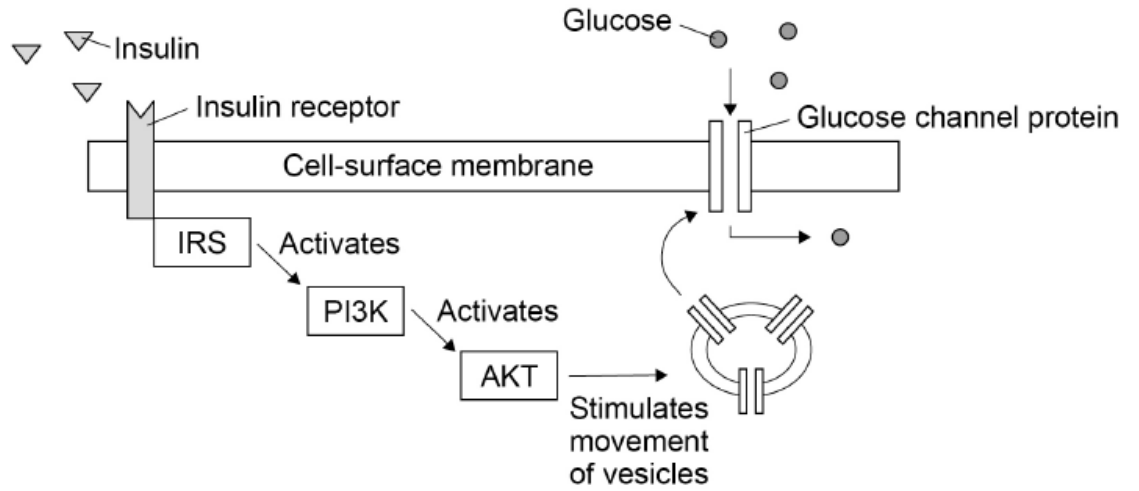
This change prevents insulin binding to its receptor. Explain why this change prevents insulin binding to its receptor.

[2 marks]

Phosphoinositide 3-kinase (PI3K) is an enzyme in several metabolic processes.

Figure 5 shows the role of PI3K in the control of blood glucose concentration.

Figure 5



0 5 . 2 A decrease in the activity of PI3K can cause type II diabetes.

Use **Figure 5** to explain why.

[3 marks]

0 5 . 3

Using your knowledge of the kidney, explain why glucose is found in the urine of a person with untreated diabetes.

[3 marks]

2. June/2021/Paper_2/No.6

0 6

Myelodysplastic syndromes (MDS) are a group of malignant cancers. In MDS, the bone marrow does not produce healthy blood cells.

Haematopoietic stem cell transplantation (HSCT) is one treatment for MDS. In HSCT, the patient receives stem cells from the bone marrow of a person who does not have MDS. Before the treatment starts, the patient's faulty bone marrow is destroyed.

0 6 . 1

For some patients, HSCT is an effective treatment for MDS.

Explain how.

[3 marks]

0 6 . 2

MDS can develop from epigenetic changes to tumour suppressor genes. In some patients, the drug AZA has reduced the effects of MDS. AZA is an inhibitor of DNA methyltransferases. These enzymes add methyl groups to cytosine bases.

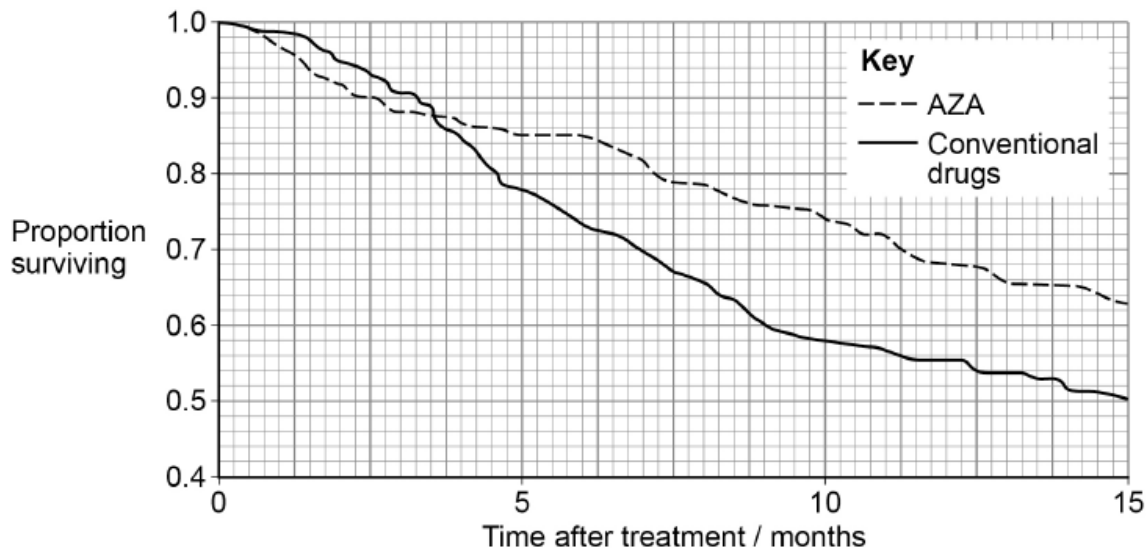
Suggest and explain how AZA can reduce the effects of MDS in some patients.

[3 marks]

Scientists investigated the effectiveness of AZA in patients with MDS. A total of 360 patients were randomised in the ratio of 1:1 to receive AZA or conventional drugs (control).

Figure 6 shows the scientists' results.

Figure 6



0 6 . 3

The control patients were treated with conventional drugs.

Give two reasons why.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____

0 6 . 4

Use Figure 6 and the information provided to calculate the difference in the number of patients surviving at 10 months after treatment with AZA compared with conventional drugs.

[2 marks]

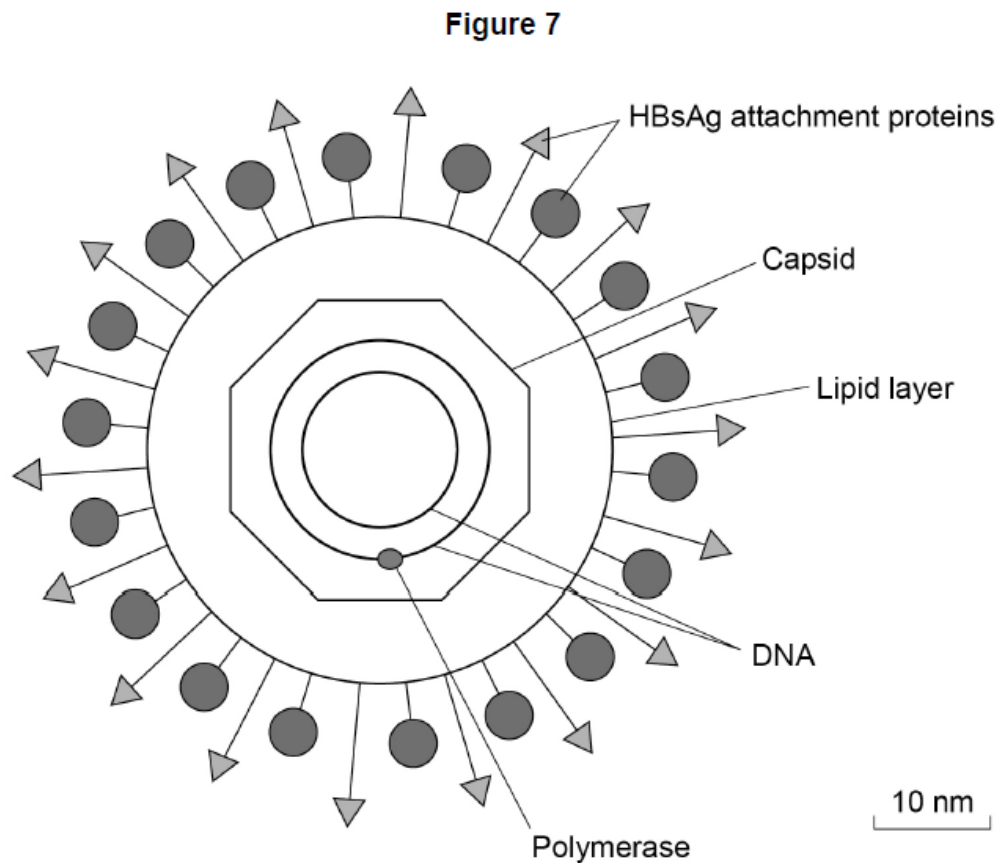
Answer _____

3. June/2021/Paper_2/No.7

0 7

Hepatitis B is a life-threatening liver infection caused by the hepatitis B virus (HBV).

Figure 7 shows the structure of HBV.



0 7 . 1

HBV infects a liver cell. The liver cell is $25\mu\text{m}$ in diameter.

Use **Figure 7** to calculate how many times larger in diameter this cell is than HBV.
You should use the lipid layer to measure the diameter of HBV.

[2 marks]

Answer _____ times larger

Scientists investigated the effectiveness of two types of RNA interference (RNAi) molecules on reducing HBV replication. These molecules were:

- short hairpin RNA (shRNA)
- long hairpin RNA (lhRNA).

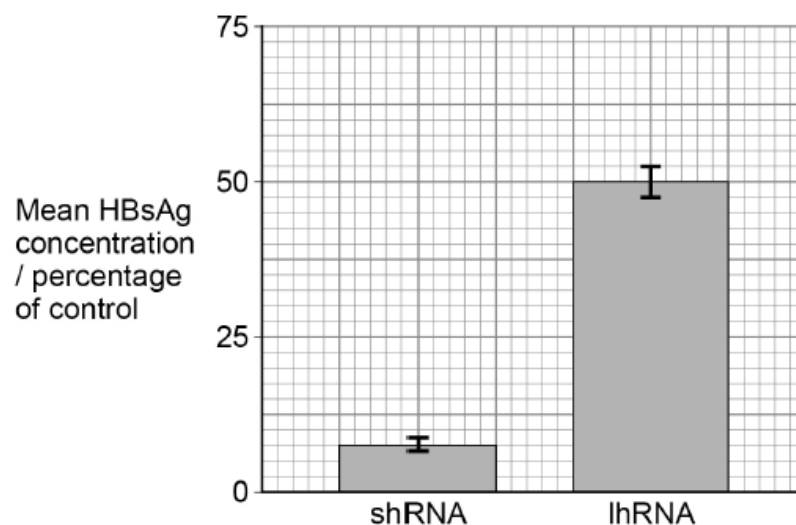
The scientists infected mouse liver cells with HBV and transferred either shRNA or lhRNA into these cells. Then they determined the concentration of the attachment proteins, HBsAg, in these cells.

The concentration of HBsAg is a measure of HBV replication.

Figure 8 shows the scientists' results.

The error bars represent ± 2 standard deviations from the mean, which includes over 95% of the data.

Figure 8



07.2

One method of transferring RNAi molecules into cells involves combining these molecules with a lipid. Suggest why this increases uptake of RNAi molecules into cells.

[1 mark]

0	7	.	3
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Using all the information provided, evaluate the use of the two types of RNAi in treating hepatitis B in humans.

Do not refer in your answer to how RNAi reduces HBV replication.

[5 marks]
