Regulation of Transcription and Translation

Question Paper

Level	A Level
Subject	Biology
Exam Board	AQA
Module	3.8 The Control of Gene Expression (A-Level only)
Topic	3.8.2 Gene Expression
Sub-Topic	3.8.2.2 Regulation of Transcription and Translation
Booklet	Question Paper

Time Allowed: 57 minutes

Score: /49

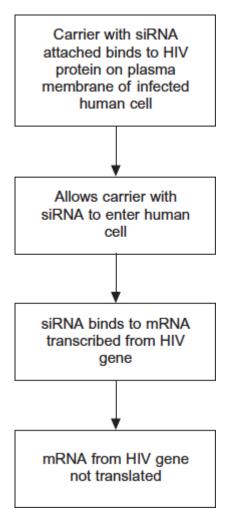
Percentage: /100

Grade Boundaries:

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Q1. Human immunodeficiency virus (HIV) particles have a specific protein on their surface. This protein binds to a receptor on the plasma membrane of a human cell and allows HIV to enter. This HIV protein is found on the surface of human cells after they have become infected with HIV.

Scientists made siRNA to inhibit expression of a specific HIV gene inside a human cell. They attached this siRNA to a carrier molecule. The flow chart shows what happens when this carrier molecule reaches a human cell infected with HIV.



(a)	When siRNA binds to mRNA, name the complementary base pairs holding the siRNA and mRNA together. One of the bases is named for you.			
	with			
	Adeninewith	(1)		

(b) This siRNA would **only** affect gene expression in cells infected with HIV.

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	Suggest two reasons why.		
	1		
	2		
			(4)
			(- /
(c)	The carrier molecule on its own may be able to prevent the infection of cells	s by HIV.	
	Explain how.		
			(2)
		(Total 7 mark	

Q2.Figure 1 shows part of a gene that is being transcribed.

Figure 1

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	Pro	moter region of gene Enzyme X	
	T		7
(a)	Nar	ne enzyme X .	
			(1)
(b)	(i)	Oestrogen is a hormone that affects transcription. It forms a complex with a receptor in the cytoplasm of target cells. Explain how an activated oestrogen receptor affects the target cell.	(2)
	(ii)	Oestrogen only affects target cells. Explain why oestrogen does not affect other cells in the body.	
			(1)

(c) Some breast tumours are stimulated to grow by oestrogen. Tamoxifen is used to treat these breast tumours. In the liver, tamoxifen is converted into an active substance called endoxifen. **Figure 2** shows a molecule of oestrogen and a molecule of endoxifen.

Figure 2

Oestrogen Endoxifen

Jse Figure 2 to suggest now endoxifen reduces the growth rate of these bi umours.	reast
	(2) (Total 6 marks)

Q3. Scientists found a correlation between prostate cancer and exposure to cadmium ions.

The scientists investigated the effects of cadmium ions on cells from a human prostate gland.

They grew a culture of these cells in liquid growth medium and removed samples at intervals.

For each sample they measured

- · how much DNA was not methylated,
- the activity of the enzyme methyltransferase.

Methyltransferase is an enzyme that adds methyl groups to some of the bases in DNA. The addition of a methyl group is called methylation.

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(a)	The	scientists set up	another cul	ture as a contr	ol.			
		cribe how the sciestigation.	entists would	d have set up a	a control	experiment for this	5	
								(2)
(b)	Figi	ures 1 and 2 sho	w the scient	tists' results.				
		Figure 1				Figure 2		
	(i)	DNA that was not methylated / percentage of control value The scientists of Suggest why.	60- 40- 20- 0 2	4 6 8 Time exposed to admium/weeks	—× 10 percentaç	Methyltransferase activity / percentage of control value	100 * 50 - 0 0	2 4 6 Time exposed cadmium/wee
								(1)
	(ii)	affected the me	thylation of	DNA.	·	oosure to cadmiur	n ions	
			•••••		•••••		ı	(1)

(c)

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(iii)	Use information from Figure 2 to suggest what caused the change to the DNA shown in Figure 1 .	
		(1)
	tate gland cells contain a tumour suppressor gene called p16 . In the investigation, the scientists also measured the amount of p16 protein uced.	
Figu	re 3 shows their results.	
	Figure 3	
	Amount of p16 80-protein produced/percentage of control value 40-20-0 2 4 6 8 10 Time exposed to cadmium/weeks	
meth	scientists found that the promoter DNA of the p16 gene had become ylated. The promoter is the sequence of bases where the enzyme polymerase binds to a DNA molecule.	
	ain how methylation of the promoter sequence of the p16 gene could cause the ges shown in Figure 3 .	
(Extra	a space)	
		(2)

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(d	Each week of the investigation, the scientists took samples of the cadmium-treated prostate cells from the laboratory cultures. They injected these cells into mice and monitored the mice for the growth of tumours.
	It was only the samples taken in the tenth week that caused tumours to begin to grow in the mice.
	Use information from Figures 1, 2 and 3 to suggest why.
	(Extra space)
	(Total 11 mark
Q4.Ess	av
Y	ou should write your essay in continuous prose.
Y	our essay will be marked for its scientific accuracy.
	will also be marked for your selection of relevant material from different parts of the pecification and for the quality of your written communication.
TI	ne maximum number of marks that can be awarded is

16

Scientific

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Breadth of knowledge 3
Relevance 3
Quality of written communication 3

Write an essay on the following topic:

Using DNA in science and technology

(Total 25 marks)