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Phone: +442081445350

[www.chemistryonlinetuition.com](http://www.chemistryonlinetuition.com)

Email: [asherrana@chemistryonlinetuition.com](mailto:asherrana@chemistryonlinetuition.com)

# BIOLOGY

## THE CONTROL OF GENE EXPRESSION

Level & Board	AQA (A-LEVEL)
TOPIC:	EPIGENETICS AND RNA INTERFERENCE
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	4
TOTAL MARKS	28

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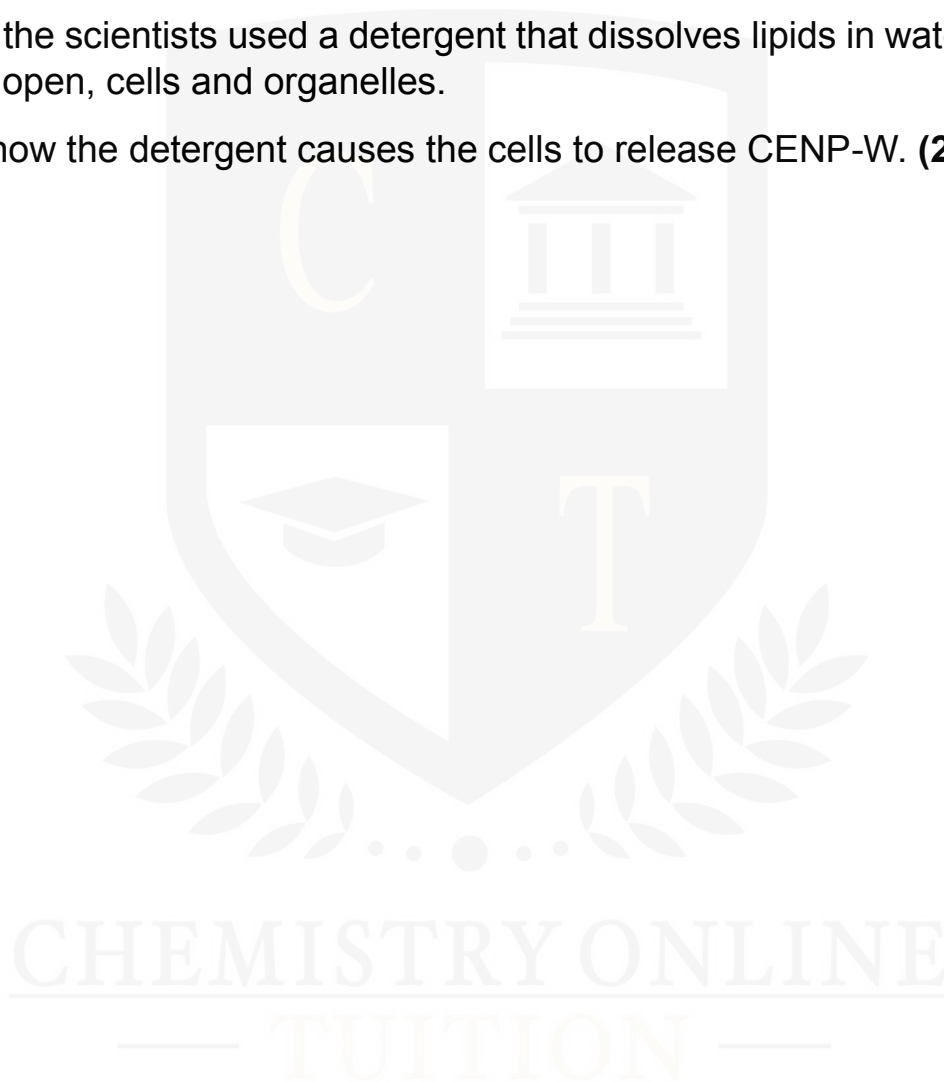
## Epigenetics and RNA interference - 2

1.

Researchers looked into how a protein known as CENP-W functions during mitosis. They used ultracentrifugation and cell fractionation in their procedure.

**(a)** First, the scientists used a detergent that dissolves lipids in water to lyse, or break open, cells and organelles.

Explain how the detergent causes the cells to release CENP-W. **(2)**



**(b)** Describe how CENP-W is separated from other molecules by ultracentrifugation. **(2)**

**(c)** During mitosis, CENP-W contributes to the development of spindle fibers. Tubulin molecules are the building blocks of spindle fibers.

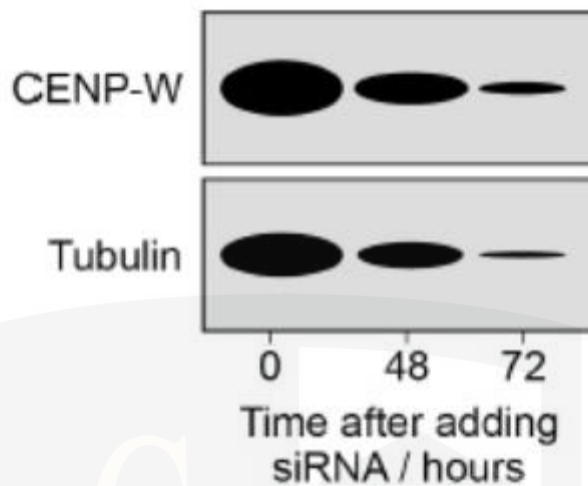
The researchers used small interfering RNA (siRNA) to cells in a culture.

The CENP-W gene's expression is RNA-interfering (siRNA).

Cell samples were collected by the scientists 0, 48, and 72 hours after the siRNA was added. After that, they separated CENP-W and tubulin from these samples using gel electrophoresis.

The electrophoresis findings are displayed in the diagram. Each band's size corresponds to the quantity of tubulin or CENP-W that is present.

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Explain how the siRNA led to these outcomes. (3)

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**2.**

**(a)** Explain the meaning of epigenetics. **(2)**



**(b)** In eukaryotes, several transcriptional factors that go from the cytoplasm into the nucleus can either stimulate or inhibit the transcription of target genes.

Transcription can be initiated by control factors such as oestrogen, methyl groups, and acetyl groups.

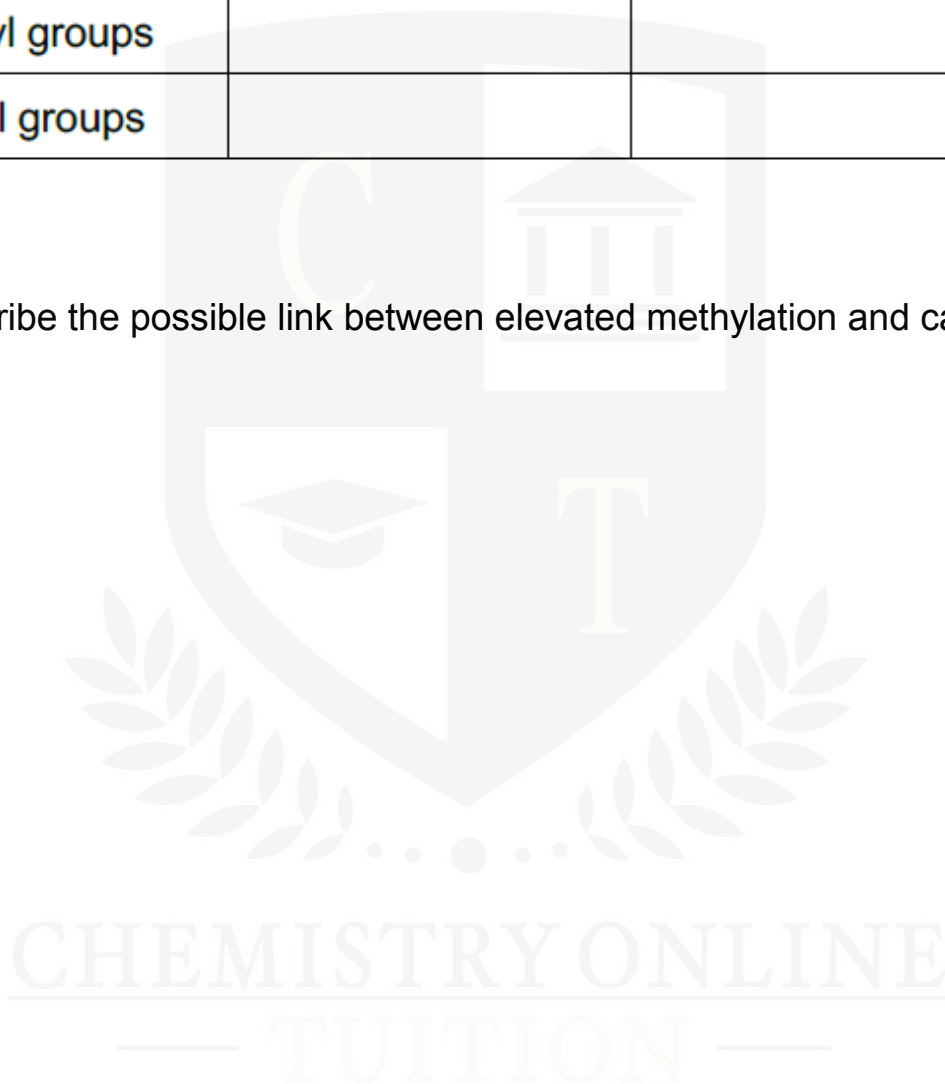
Fill in the table to display these control factors' properties.

Check the box (✓), If the control factor displays the feature. **(2)**

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	Feature	
Control factor	Binds with DNA	Binds with protein
Oestrogen		
Methyl groups		
Acetyl groups		

(c) Describe the possible link between elevated methylation and cancer. (3)

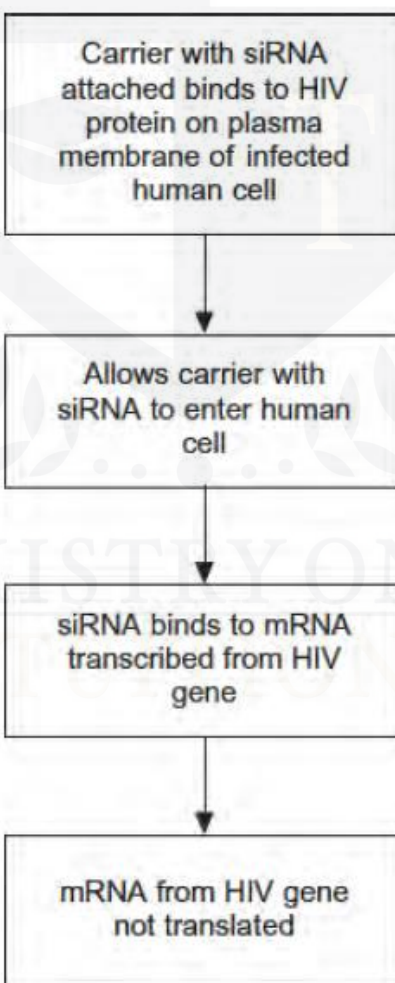


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**3.**

A particular protein is present on the surface of HIV (human immunodeficiency virus) particles. HIV can enter a human cell when this protein attaches to a receptor on the plasma membrane. Following an HIV infection, human cells carry this HIV protein on their surface.

Researchers created siRNA to prevent the production of a particular HIV gene in a human cell. This siRNA was joined to a carrier molecule by them. What transpires when this carrier molecule comes into contact with an HIV-infected human cell is depicted in the flow chart.



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**(a)** Identify the complementary base pairs that hold siRNA and mRNA together when they bind to each other. You have a base named after you.

**(2)**



**(b)** Only HIV-infected cells' gene expression would be impacted by this siRNA.

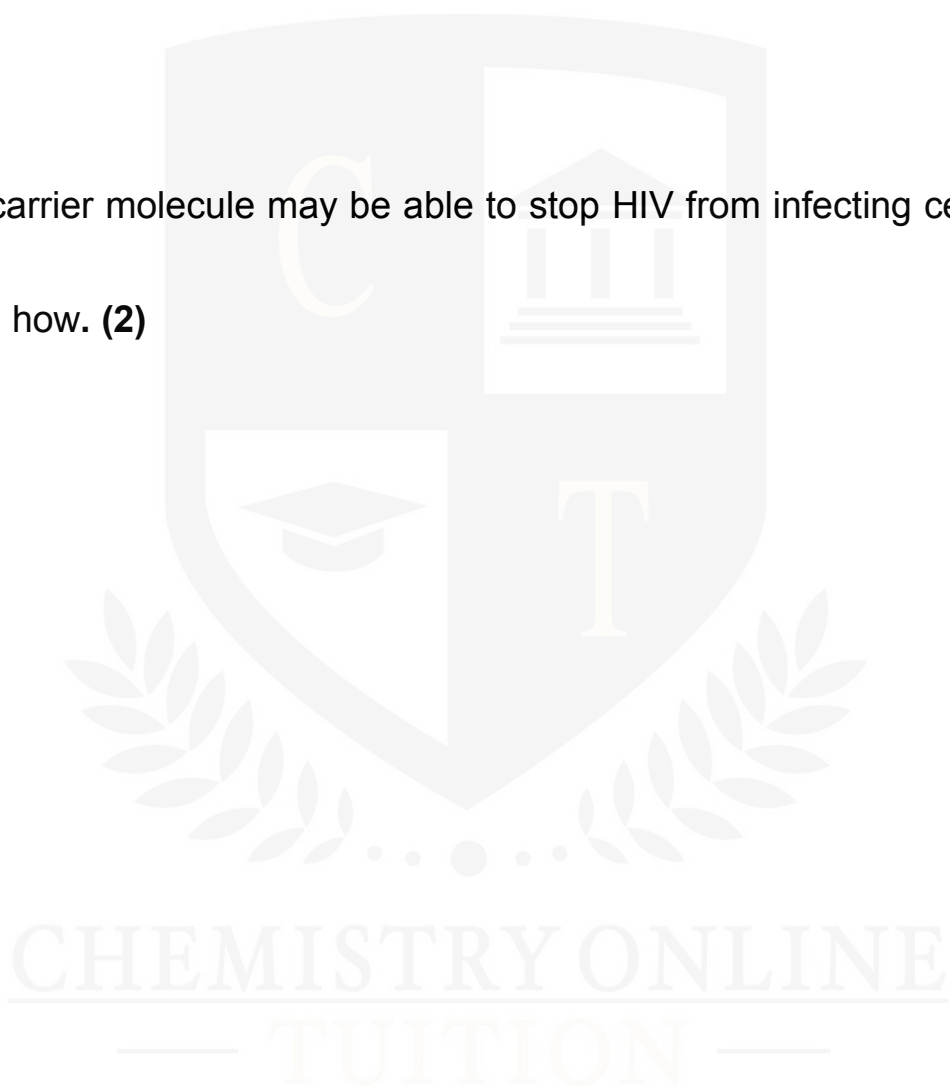
Give two explanations for this. **(2)**

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(c) The carrier molecule may be able to stop HIV from infecting cells on its own.

Describe how. (2)

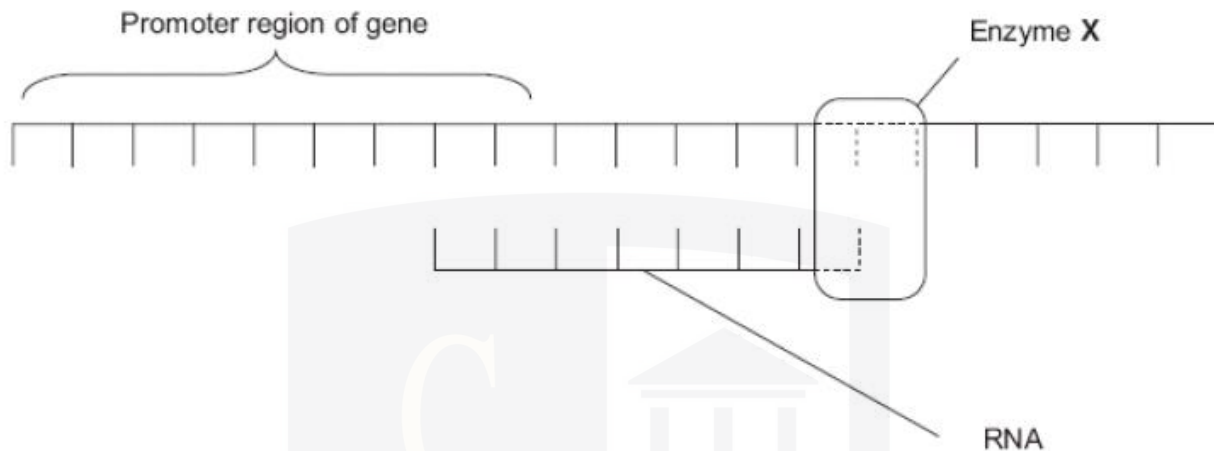


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**4.**

A portion of a gene that is transcribed is seen in Figure 1.

**Figure 1.**



**(a)** Give a name of enzyme X. **(2)**

**(b)** One hormone that influences transcription is oestrogen. In the cytoplasm of the target cells, it combines with a receptor to form a complex. Describe the effects on the target cell of an active oestrogen receptor. **(2)**

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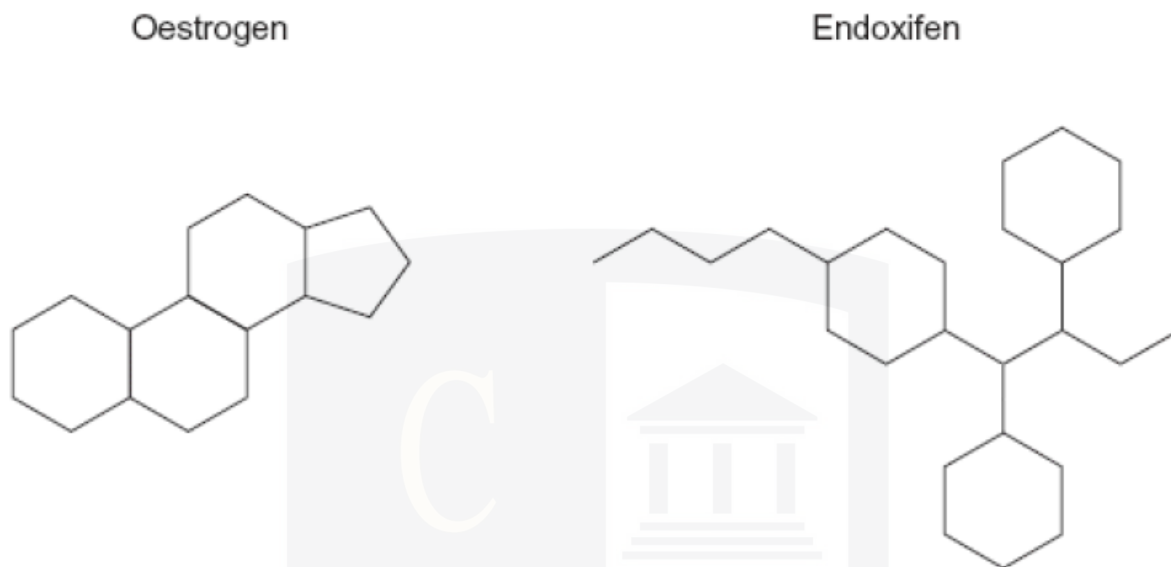
**(c)** Only target cells are impacted by estrogen. Justify the lack of effects of oestrogen on other bodily cells. **(2)**



Estrogen stimulates the growth of some breast tumors. Treatment for these breast tumors involves tamoxifen. Tamoxifen is changed into the active ingredient endoxifen in the liver. Two molecules of oestrogen and endoxifen are depicted in Figure 2.

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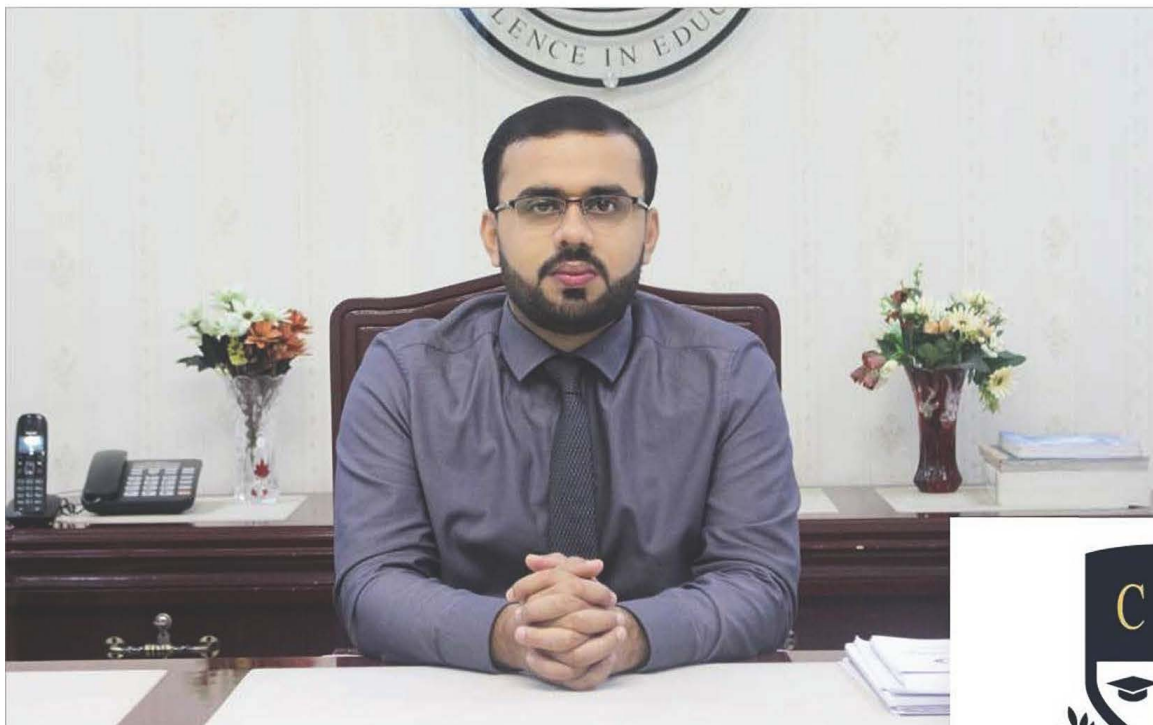
**Figure 2**



Explain how endoxifen slows the growth of these breast tumors using Figure 2. (2)

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**DR. ASHAR RANA**



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Phone: +442081445350  
www.chemistryonlinetuition.com  
Email: asherrana@chemistryonlinetuition.com

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## CONTACT INFORMATION FOR CHEMISTRY ONLINE TUITION

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: [www.chemistryonlinetuition.com](http://www.chemistryonlinetuition.com)
- Email: [asherrana@chemistryonlinetuition.com](mailto:asherrana@chemistryonlinetuition.com)
- Address: 210-Old Brompton Road, London SW5 OBS, UK