



ANSWER BOOK

Control of gene expression: which genes a cell reads

Gene regulation, genomics and biotechnology · Unit B17

AQA 3.8.2.1, 3.8.2.2 · OCR A 6.1.1 · Edexcel A Topic 3 · CAIE 16.2

5 questions · 16 marks

NAVY EDITION

SECTION A · Short, 1 to 2 marks

- A1** **B1** heavy methylation of the promoter reduces or prevents transcription of that gene. **B1** decreased acetylation also reduces transcription, because the histones regain positive charge and the chromatin condenses. [2]
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SECTION B · Standard, 3 to 5 marks

- B1** **B1** the regulatory gene *lacI* is transcribed steadily whatever else is happening, and its product is the *lac* repressor, which binds to the operator. **B1** with the repressor on the operator, RNA polymerase cannot move on from the promoter, so the structural genes are transcribed only at a very low background rate. **B1** lactose binds to the repressor's other binding site and changes the protein's tertiary structure, so the site that fitted the operator no longer fits it. **B1** the repressor leaves the operator, so RNA polymerase transcribes *lacZ*, *lacY* and *lacA* as one mRNA and the enzymes are made. [4]
- B2** **B1** oestrogen is a steroid and therefore lipid-soluble. **B1** it diffuses straight through the phospholipid bilayer without a channel or a carrier, so it reaches the inside of the cell and then of the nucleus. **B1** there it binds an oestrogen receptor, changing the receptor's tertiary structure and exposing its DNA-binding site, so the complex binds the oestrogen response element and transcription of the target gene increases. **B1** insulin is a peptide and is not lipid-soluble, so it binds a receptor on the outside of the membrane and its message is carried inwards by a second messenger instead. [4]
- B3** **B1** double-stranded RNA in the cytoplasm is cut into fragments about twenty-one nucleotides long, and one strand of each fragment is loaded into a protein complex. **B1** the complex uses that single strand as a search template and pairs with any mRNA whose bases are complementary to it. **B1** the mRNA is cut and broken down, so it is never translated and no polypeptide is made, even though transcription of the gene did happen. [3]
- B4** **B1** oestrogen can no longer bind, because the drug is occupying its binding site. **B1** the receptor's tertiary structure is therefore not altered, so no hormone-receptor complex able to bind the oestrogen response element forms and transcription of that gene is not increased. **B1** only cells that make the receptor can respond to oestrogen at all, and breast tissue makes it while liver tissue does not, so there is little for the drug to interfere with in the liver. [3]
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