Oxford Cambridge and RSA

A Level Biology B

H422/01 Fundamentals of biology

Question Set 19

1. (a) CRISPR is an adaptive system in bacteria that protects against invading viruses by destroying viral DNA upon entry into cells.

CRISPR is an acronym for **c**lustered **r**egularly **i**nterspaced **s**hort **p**alindromic **r**epeats.

Define the term palindrome in the context of DNA.

[1]

(b) (i) The actions of CRISPR are mediated by an enzyme-RNA complex. The enzyme, Cas9, is attached to a guide RNA molecule, as shown in Fig. 35.

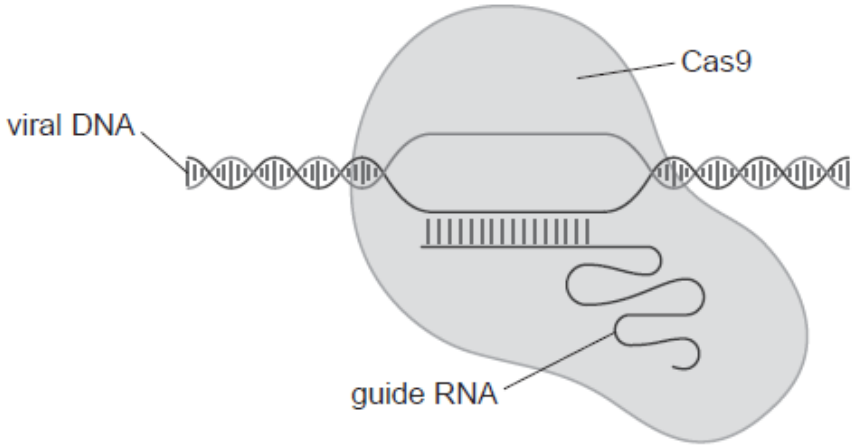

Fig. 35

The guide RNA molecule is complementary to the viral DNA molecule. Upon binding of the guide RNA to viral DNA, Cas9 cuts straight through both strands of the DNA at a precise position.The gene encoded by the DNA is inactivated. This prevents the virus from replicating inside the bacterial cell.

Cas9 is an endonuclease enzyme because it cuts within a nucleotide sequence.

Name another type of bacterial endonuclease enzyme.

[1]

(ii) State **one** similarity and **one** difference between Cas9 and the type of enzyme in **(b)(i)**.

[2]

(c) CRISPR has been adapted into a laboratory tool for genetic modification in eukaryotic cells. Using purified Cas9 protein and artificially-synthesised guide RNA molecules, scientists can target genes of interest.

In eukaryotic cells, DNA breaks induced by Cas9 are repaired by the cell's own (imperfect) DNA repair mechanisms. This leads to the generation of mutations at the site of the DNA break, and the gene function is lost.

RNA interference (RNAi) is another laboratory tool that scientists can use to target genes of interest.

Using the information provided, and your knowledge of RNAi, discuss the advantages **and** disadvantages of CRISPR **and** RNAi for the study of gene function. **[4]**

(d) Using the most appropriate word(s), complete the sentences below about the production of mature mRNA.

A molecule of pre-mRNA contains sequences that code for amino acids, known as..... , and sequences that are non-coding, known as ..... . The process of ..... removes non-coding regions and joins coding regions to produce a molecule of mature mRNA. In this way, a gene may code for several different proteins.

[3]

Total Marks for Question Set 19: 11