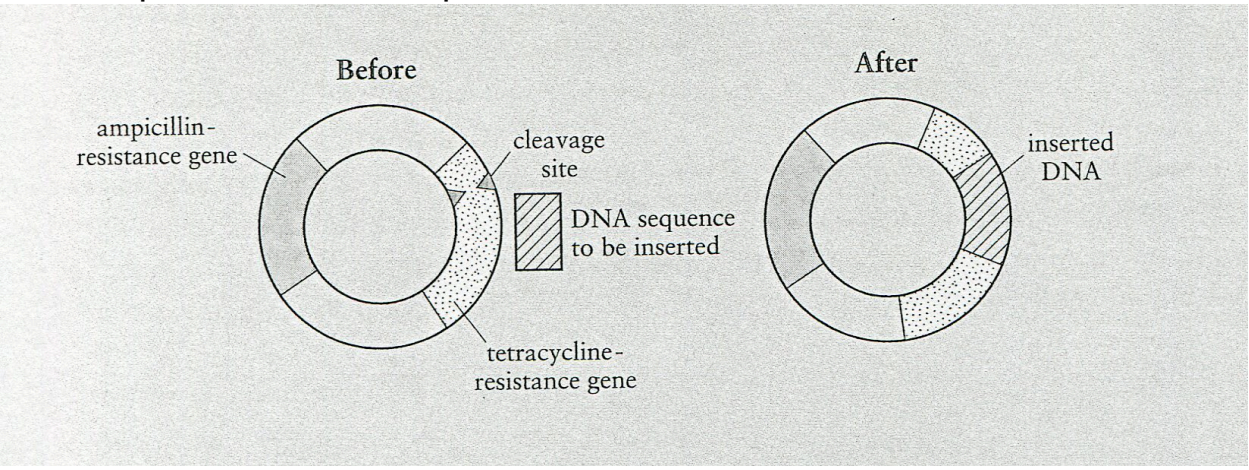
1.
The diagram below shows a bacterial plasmid before and after a required DNA sequence has been spliced into it.



(a) Briefly describe the part played by enzymes in this process.

Only a small percentage of plasmids accept the foreign DNA. Additionally, only a small percentage of bacteria take up a plasmid of any kind. A genetic engineer wants to know which bacterial cells contain plasmids with the required DNA sequence before cloning them. This is done by growing colonies on suitable media.

First, all the bacteria are spread onto a medium containing ampicillin, an antibiotic tetracycline, which allows only bacteria with an intact resistance gene to grow.

(b) Explain why bacteria are unsuitable for cloning if:

(i) They fail to grow on a medium containing ampicillin.

(ii) They can grow on a medium containing both ampicillin and tetracycline.

(c) Explain why bacteria which grow on a medium containing ampicillin but do not grow on tetracycline are kept for cloning.

2.

A bacterial mRNA with a length of 360 nucleotides in length codes for a protein of:

A roughly 360 amino acids
B roughly 1080 amino acids
C exactly 120 amino acids
D less than 120 amino acids

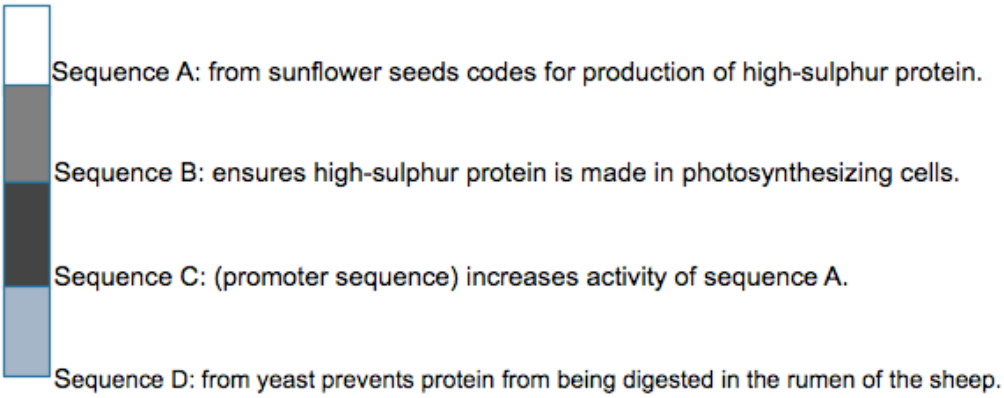
(a) Explain your answer.

(b) Would your answer change if it were a eukaryotic mRNA prior to processing?

(c) Would the protein size differ between the prokaryote and eukaryote? Why or Why Not?

3.

Australian scientists have recently produced genetically engineered clover containing a protein high in sulphur-containing amino acids. As proteins in wool are also rich in these amino acids, it is thought that feeling sheep on this new strain of clover will produce an increase in the yield of wool. A length of DNA was prepared from the sequences shown in the diagram for insertion into the clover.



(a) Describe how each of the following enzymes might be used in preparing this sequence of DNA.

(i) Ligase

(ii) Restriction enzyme

(b) Briefly explain why it is necessary to:

(i) Ensure that the protein is made in photosynthesizing cells;

(ii) Prevent protein from being digested in the rumen of the sheep.

4.
Restriction endonucleases occur naturally in bacteria and cut DNA between specific base sequences.

(a) Suggest how the presence of restriction endonucleases may help to protect bacteria from viruses.

(b) Many different restriction endonucleases have been purified and are widely used in generic engineering.

Suggest why:

(i) Incubating DNA with particular restriction endonuclease cuts the DNA into fragments of different lengths;

(ii) Restriction endonucleases that produce staggered cuts are more useful in genetic engineering than those that do not .

5.

Bacteria play central biological roles.

(a) Bacteria may act as

- producers
- parasites
- mutualistic symbionts
- decomposers

Select THREE of the ecological roles above. For each one you choose, **describe** how bacteria carry out the role and **discuss** its ecological importance.

(b) **Explain** how bacteria can be altered to make genetically engineered products.