

1. Some of the stages in the genetic engineering of the bacteria *E. coli* to produce human growth hormones, HGH, are listed below.

- 1 A plasmid is cut with **enzyme 1** so the gene for HGH can be inserted.
- 2 A DNA copy of the messenger RNA for HGH is made using **enzyme 2**.
- 3 Many copies of the gene for HGH are made using PCR and **enzyme 3**.
- 4 The gene and plasmid are attached to each other using **enzyme 4**.

Select the row from **Table 20.1** to correctly identify enzymes 1, 2, 3 and 4.

Answer	Enzyme 1	Enzyme 2	Enzyme 3	Enzyme 4
A	DNA Ligase	DNA Polymerase	Reverse Transcriptase	Restriction Enzyme
B	Reverse Transcriptase	Restriction Enzyme	DNA Polymerase	DNA Ligase
C	Restriction Enzyme	Reverse Transcriptase	DNA Polymerase	DNA Ligase
D	DNA Ligase	Reverse Transcriptase	Restriction Enzyme	DNA Polymerase

Table 20.1

Your answer

[1]

2. The polymerase chain reaction (PCR) is used to produce multiple copies of a desired DNA sequence.

A DNA sequence encoding a gene was amplified from a single copy.

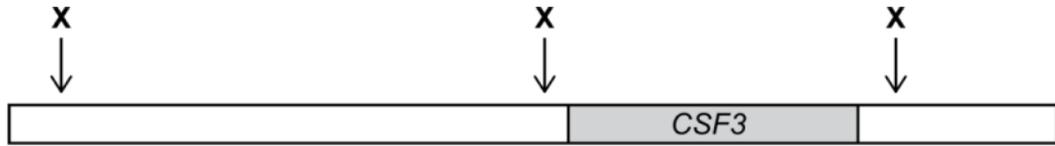
Which of the options, A to D, would be the theoretical number of copies of the gene after 12 cycles of heating and cooling?

- A 13
- B 24
- C 144
- D 4096

Your answer

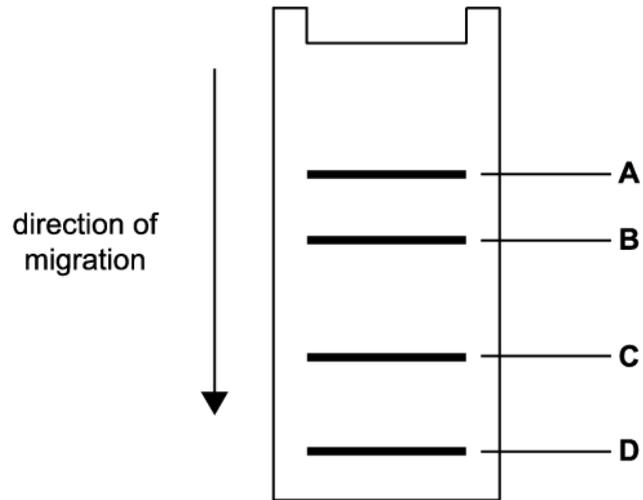
[1]

3. The diagram below represents an **isolated** length of DNA containing the gene, *CSF3*.



- *EcoRI* is a restriction enzyme that recognises specific sequences, labelled X, within the DNA.
- The DNA was cut at every point X with *EcoRI*, and the fragments separated by gel electrophoresis.

The result is shown below.



Which of the DNA bands, A to D, contains the gene, *CSF3*?

Your answer

[1]

4. RNA interference can be carried out by a type of non-coding RNA molecule known as microRNA.

Some microRNA molecules are tumour suppressors.

Which of the options, A to D, is an action of a tumour suppressor microRNA molecule?

- A degradation of a messenger RNA transcript encoding Myc
- B degradation of a messenger RNA transcript encoding p53
- C inhibition of translation from a messenger RNA transcript encoding Myc
- D inhibition of translation from a messenger RNA transcript encoding p53

Your answer

[1]

5. A gene mutation causes part of a DNA sequence to change from TAC to TAA.

TAA is a stop codon.

Which of the statements, A to D, is a correct explanation of why the stop codon may not affect translation of the mRNA sequence?

- A TAA also codes for an amino acid
- B TAA stops transcription, not translation
- C the mutation in the mRNA sequence may be repaired
- D the stop codon may not be present in the mature mRNA sequence

Your answer

[1]

6. Scientists can identify an unknown species as follows:

- extract DNA from tissue, e.g. skin or hair
- amplify a length of DNA, known as a barcode, using the polymerase chain reaction (PCR)
- read the base sequence of the DNA.

The strip below represents a length of extracted DNA before PCR. Lines 1 to 4 represent primers.

**Key:**

white = same DNA sequence in all species

black = variable DNA sequence between species



Which of the options, **A** to **D**, gives the pair of primers that could be used to amplify DNA from all species?

- A 1 and 3
- B 1 and 4
- C 2 and 3
- D 2 and 4

Your answer

[1]

7. Which of the statements, A to D, is true of single nucleotide polymorphisms (SNPs)?

- A All SNPs have four possible variations.
- B Genetic recombination can generate a SNP.
- C SNPs can influence banding patterns on a DNA fingerprint.
- D SNPs occur in exons only.

Your answer

[1]

8. The polymerase chain reaction (PCR) involves a repeating sequence of temperature changes.

Which of the options, A to D, occurs at a temperature of 72 °C?

- A annealing of primers
- B detachment of primers
- C polymerisation of free nucleotides
- D separation of DNA strands

Your answer

[1]

**END OF QUESTION PAPER**

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			C	1	
			Total	1	
2			D	1	
			Total	1	
3			B	1	
			Total	1	
4			C ✓	1	
			Total	1	
5			D ✓	1	<p><b>Examiner's Comments</b>            This question was assessing whether candidates understood that not all the DNA sequence is transcribed into mature mRNA. The most common incorrect response was that repair of the mRNA took place.</p>
			Total	1	
6			A ✓	1	<p><b>Examiner's Comments</b>            Candidates scored highly on this question, most correctly identifying the pair of primers that could be used to amplify DNA from all species.</p>
			Total	1	
7			B	1	<p><b>Examiner's Comments</b>            Many candidates confused SNPs with VNTRs and hence selected option C.</p>
			Total	1	
8			C	1	
			Total	1	