

Question 22 (Answer: C)

- The protein has $220\,000/110 = 2000$ amino acids.
- Three bases code for each, so the coding mRNA is about $2000 \times 3 = 6000$ bases.
- The gene is 130 000 base pairs, so roughly $130\,000 - 6000 = 124\,000$ of them are introns.

Question 25 (Answer: D)

- Use the table to translate the original sequence, then the mutated one.
- Compare the two amino acid sequences to see which triplet changed.
- The type of mutation follows from whether the reading frame shifted or a single base was swapped.

Question 25 (Answer: B)

- Three bases give $4^3 = 64$ possible triplets for only 20 amino acids.
- Most amino acids are coded for by more than one triplet – the code is degenerate.
- The spare triplets are not useless: three of them are stop signals.

Question 26 (Answer: D)

- The primary transcript contains both exons and introns.
- The introns are cut out and the exons are joined together.
- Removing material makes the molecule shorter, so mRNA is shorter than the primary transcript.

Question 27 (Answer: C)

- In a prokaryote there is no nucleus, so transcription and translation happen together in the cytoplasm.
- Prokaryotic ribosomes are 70S, not 80S.
- An anticodon is complementary to the codon, so read the first mRNA codon and pair each base.

Question 26 (Answer: B)

- The primary transcript has introns removed to leave the exons, giving mRNA.
- Transcription copies the *template* strand, but translation reads mRNA, not DNA – so A is wrong.
- Exons are kept, not removed, and it is tRNA that carries anticodons, not codons.

Question 27 (Answer: A)

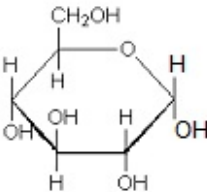
- Use the table to read the original sequence as triplets and translate it.
- Then translate the new amino acid sequence back into triplets.
- Comparing the two shows which single base changed and where.

Question 23 (Answer: **D**)

- An anticodon is complementary to the mRNA codon, and mRNA is itself complementary to the template DNA strand.
- So the anticodon matches the *coding* strand, except that U replaces T – statement 1 is wrong.
- There are more anticodons than amino acids because the code is degenerate, so statement 2 is wrong too.

Question 24 (Answer: **A**)

- The primary transcript contains both exons and introns.
- Splicing removes the introns.
- What is left, the mRNA, contains exons only.

3(a)	any three from: different sequence of, (DNA) nucleotides / bases ; R RNA nucleotides code for / result in, different, polypeptides / proteins ; A result in different sequences of amino acids A LCT, codes for / AW, lactase / enzyme, <u>and</u>, MCM6, codes for a different protein / involved in regulation have different numbers of, introns / exons ; different, lengths / number of nucleotides / number of bases ; <i>context is DNA</i> AVP ; e.g. one may be continually expressed, the other switched on and off MCM6 associated with different regulatory sequences
3(b)	statement showing relationship between transcribed strand and primary transcript ; e.g. (transcribed strand is the) DNA (strand) / template (strand), used to form the primary transcript primary transcript is RNA (molecule first) formed from transcription of transcribed strand primary transcript is a complementary copy of the transcribed strand (but uracil replaces thymine) statement showing relationship between primary transcript and mRNA ; e.g. primary transcript undergoes, gene / RNA, splicing, to form mRNA primary transcript undergoes modification to produce mRNA mRNA formed by removal of introns from primary transcript mRNA formed only from exons of primary transcript <i>one mark for a response that has correct ideas but does not show a direct relationship</i>
3(c)	base substitution / substitution (mutation) ; I missense
3(d)	 <i>all correct for one mark – if deciding to leave out the H, then this must be for <u>all</u> C1 to C5 hydrogens – leaving out only the C5 H is zero marks</i>

3(e)(i)	<i>any two from:</i> <i>idea of</i> can, detect increase in / distinguish between, the intensity of colour (as products form) ; can obtain quantitative results (for coloured product of ONPG) ; A can provide numerical, values / readings / results / measurements R if stated that the results are wavelengths <i>ref. to</i> not subjective / AW ; <i>idea of</i> not by-eye judgments / difficulty in describing different colour shades can obtain <u>accurate results / readings / values</u> ; A <i>idea of</i> greater accuracy in obtaining results <i>vague references to accuracy should be considered for ideas linked to 'not subjective'</i> can construct numerical graphs of results to compare curves of each (lactase) concentration ; AW AVP ; e.g. more sensitive to small colour changes at the beginning of the experiment not able to see initial reaction proceeding by eye <i>ref. to</i> use of a (prepared) calibration, curve / graph (to compare rates / product concentrations)
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3(e)(ii)	<i>any four from:</i> <i>accept activity for percentage of maximum activity</i> 1 immobilised (overall) greater, productivity / yield / hydrolysis (of lactose in milk) ; I activity 2 (process / immobilised) more tolerant to, temperature / pH, <u>fluctuations / changes</u> ; AW A <i>idea that</i> can be used in <u>processes</u> covering a wide range of, temperature / pH 3 detail immobilised vs free lactase from Fig. 3.2 ; e.g. (at temperatures) above optimum / higher than 38 / 39 °C, (immobilised) has a higher activity AW above optimum / higher than 38 / 39 °C, (partial / extent of) denaturation (for immobilised) is less at each temperature AW A higher than 40 °C <i>if accompanying context is correct</i> R if optimum stated as 35 °C 4 data from Fig. 3.2 to support ; <i>any one comparison (units only for temperature required)</i> 5 detail immobilised vs free lactase from Fig. 3.3 ; e.g. higher activity at all pHs except pH 6.5 and pH 7.0 higher activity, below pH 6.5 / above pH 7.0 free not active at pH 5.5 but immobilised active, at all pHs / for a wider pH range 6 data From Fig. 3.3 to support ; 7 AVP ;; e.g. can use a lower temperature / cheaper, for same quantity of product 8 more, heat stable / thermostable / stable at high temperatures I longer shelf-life R thermostatic better in <u>alkaline</u> pHs
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