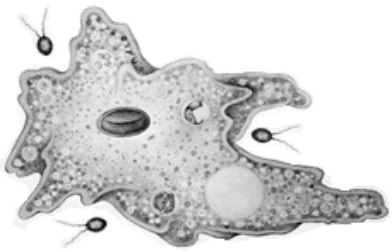


Q1: If genetic information were encoded in the living structure of cells, rather than in the nucleotide sequences within DNA molecules, Griffith's studies on the transformation in bacteria ..

□ A. would have produced exactly the same result

□ B. would not have worked at all □ no idea

□ C. would have identified proteins as the genetic material

Explain (below) why the <u>correct</u> answer is correct

Q2. In his studies, Griffith found that S-strain (smooth + virulent) bacteria grown in culture very occasionally gave rise to R-strain (rough + avirulent) bacteria (a change from S → R).
Can you predict the relative frequency of a R → S mutation rate?

□ A. The same as the S → R rate □ B. Much higher than the S → R rate

□ C. Much lower than the S → R rate □ D. impossible to say □ no idea

Explain the logic of your answer

Q3: A mutation occurs that leads to higher mutation rates in actively dividing cells, but which has no obvious effect on DNA in non-dividing cells. You would be justified in assuming that the original mutation inactivated ...

□ A. DNA-dependent DNA polymerase

□ B. DNA polymerase's proof-reading activity

□ C. DNA-dependent, RNA polymerase (primase)

□ D. the repair of mutations due to the demethylation of C's □ no idea

Explain the logic behind your answer:

Q4: PICK THE <u>WRONG</u> ANSWER: Which of the following statements is correct about DNA replication?

□ A. DNA synthesis of the daughter strand always proceeds from 5′ to 3′ □ no idea

□ B. DNA synthesis of the daughter strand always proceeds from 3′ to 5′

□ C. DNA synthesis can occur in either direction depending on which strand is to be replicated

Explain the logic behind your answer (Hint: Draw a picture with labels and arrows indicating synthesis directionality for full credit) ...

Q5: The YUM gene is normally expressed <u>only</u> in the skin cells of an organism. In your studies, you discover a mutant allele that leads to the expression of the normal YUM gene product in all cells of the organism. Which is the most plausible explanation?

□ A. the mutation is in the regulatory region of the YUM gene □ no idea

□ B. the mutation is within the coding region of the YUM gene

□ C. the mutation alters DNA synthesis, leading to defect in primer synthesis

Explain the logic behind your answer

Q6: As the percentage of GC in a double-stranded DNA molecule increases, what would you be completely and totally confident will occur?

□ A. The rate of DNA synthesis will increase □ no idea

□ B. The mutation rate will increase

□ C. The separation of two strands of the DNA molecule, due to thermal motion, will increase

□ D. The percentage of A in the DNA would decrease

Explain the logic behind your answer

Q7: A mutation occurs that leads to very high numbers of single stranded breaks in the replicated strands of a double-stranded DNA molecule, but with no obvious effects on the parental strands. A plausible model for this effect would be to assume that the mutation inactivated ...

□ A. the proof-reading activity associated with DNA polymerase

□ B. the DNA ligase

□ C. DNA-dependent, DNA polymerase

□ D. topoisomerase I □ no idea

Explain the logic behind your answer:

Q8: Which is correct? the binding of a transcription factor to DNA …

□ A. has no effect on the direction of transcription □ no idea

□ B. determines exactly where translation begins

□ C. determines where in the cell the encoded polypeptide will end up

□ D. determines which strand will be used to generate an RNA

□ E. determines when and where RNA primers are synthesized

Explain what will happen to the transcript (RNA) made if you were able to remove, rotated 180°, and reinsert back into to DNA the transcription factor's binding site (a diagram could be useful).

Q9: Consider a cell. Which of the following processes are absolutely required to produce a functional transcription factor?

□ A. DNA replication □ no idea

□ B. transcription

□ C. translation

□ D. both transcription and translation

Explain the logic of your answer.

Q10: A protein has a short half-life, meaning that ….

□ A. it is rapidly synthesized □ no idea

□ B. it is rarely synthesized

□ C. the mRNA that directs its synthesis is unstable

□ D. it is rapidly degraded after it has been synthesized

Explain the logic of your answer.

Q11: You are asked to genetically engineer an organism so that it now incorporates a new type of amino acid (not one of the normally used set of amino acids). Which molecule or molecular complex would you NOT need to change?

□ A. one of the genes encoding a tRNA □ no idea
□ B. the genes that encode the ribosome
□ C. the gene that encodes the enzyme that adds the new amino acid to the tRNA
□ D. the genes encoding the enzymes involved in synthesizing the new amino acid (assuming that it is not normally made by the organism)

Explain the logic of your answer.

Q12: We discussed a type of mutation that allows a stop codon to be read as an amino acid. Such a mutation would occur in a gene that encodes a …

□ A. ribosomal RNA □ no idea
□ B. messenger RNA
□ C. transfer RNA
□ D. a gene's regulatory region

Explain the logic of your answer (and why the other choices are wrong).

Q13: The time between the synthesis and degradation of particular RNA or protein is noisy (stochastic), like radioactive decay, because …

□ A.it depends upon random collisions between molecules □ no idea
□ B. it is determined by the molecule's structure
□ C. it is based on radioactive decay
□ D. it can be regulated by other factors

Explain the logic of your answer.

Q14: You isolate total <u>tRNA</u> from a cell and analyze its base composition (i.e. the ratio of the various nucleotides). This ratio will be …

□ A. A = U □ no idea
□ B. A = G
□ C. the same as the bulk composition of the cell's DNA (but with Us instead of Ts)
□ D. impossible to know based on the information supplied

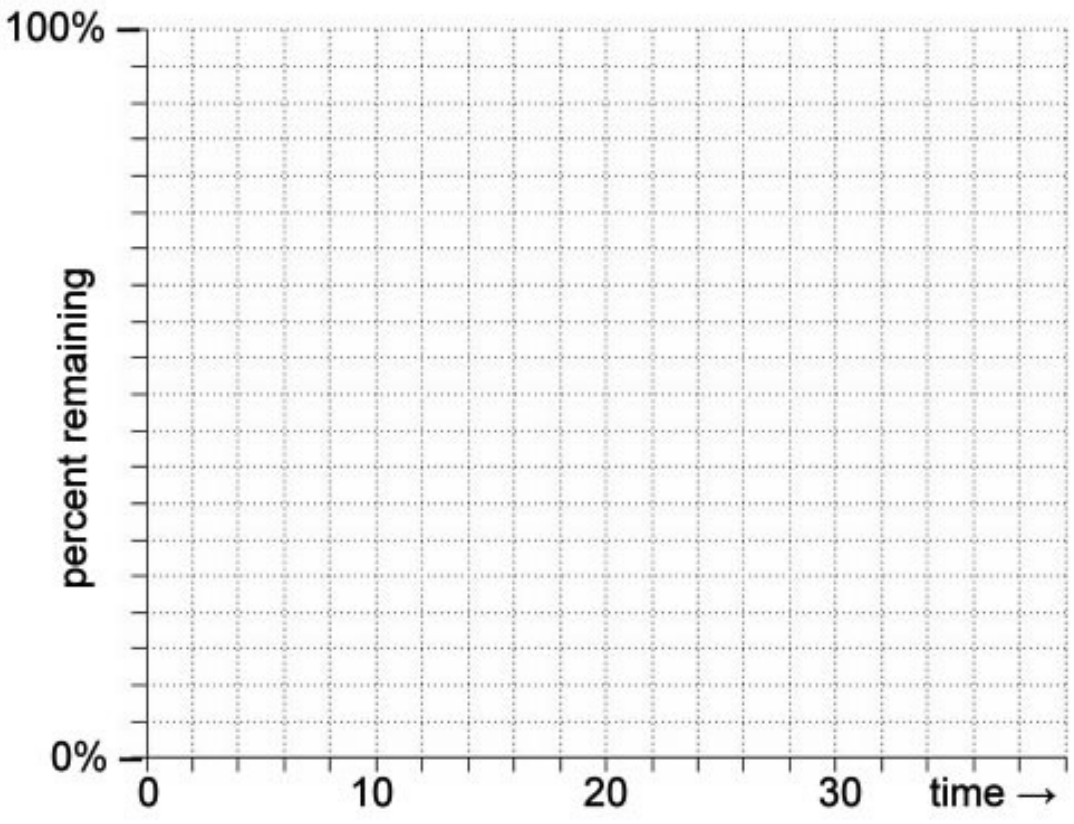
Explain the logic of your answer.

Q15: A mis-sense mutation can alter a polypeptide's 3D folding because ...

□ A. a different amino acid is inserted at the site of the mutation □ no idea
□ B. the polypeptide's synthesis stops prematurely
□ C. any change at any position of a polypeptide will lead to misfolding
□ D. it will alter the rate at which mRNA is synthesized

Explain the logic of your answer.

Q16: You are studying a particular polypeptide; it has a half-life of 10 minutes. The cell contains 300,000 copies of this polypeptide. At time 0 the synthesis of polypeptide stops completely.



Using a solid line draw a graph that represents the amount of polypeptide that remains as a function of time.

How will your graph will change if there are only 10 copies of this polypeptide in the cell □ no idea

How might a cell could benefit from making a protein with a short half life?

Q17: For an organism to be able to survive a mutation that creates a non-sense suppressor, which <u>must</u> be true?

□ A. the mutated gene must be relatively unimportant □ no idea

□ B. the original mutation (the mutation that is suppressed) must be in a non-coding region

□ C. there must be multiple genes encoding specific tRNAs

□ D. the mutation must alter the region of the tRNA that determines which amino acid is attached to the tRNA

Explain the logic of your answer.

Q18: A non-sense mutation will <u>always</u> …

□ A. lead to the production of a longer polypeptide □ no idea

□ B. lead to the production of a shorter polypeptide

□ C. lead to the production of a dysfunctional polypeptide

□ D. generally have no effect on polypeptide function

Explain how the position of a non-sense mutation would be likely to influence polypeptide activity.

Q19: You are studying the XUP gene of the speckled trout (a eukaryote). The XUP gene encodes a negatively acting transcription factor. You identify a mutation in the XUP gene and you find that the mutant Xup protein is secreted from the cell. Which is the most likely effect on the expression of genes whose transcription is directly regulated by the Xup protein?

□ A. no effect, since it normally acts negatively □ no idea
□ B. their expression would increase
□ C. their expression would decrease
□ D. the expression of all genes would increase

Explain the logic of your answer.

Q20: A polypeptide passes through a membrane once, and only once. Which is the most likely to be the case for the region of the polypeptide that that passes through the membrane? In will form …

□ A. an unstructured polypeptide with both hydrophobic and hydrophilic R-groups □ no idea
□ B. a β-sheet like structure with hydrophilic R-groups
□ C. an α-helix with hydrophobic R groups
□ D. it is impossible to make a plausible model based on the information given

Explain the logic of your answer.

Q21: Draw and label: How could a membrane channel protein be generated using a single polypeptide? □ no idea

Q22: If you were trying to devise a simple system that could recognize unfolded (denatured) proteins in the cytoplasm of a cell, you might look for …

□ A. acidic amino acid residues within the interior of the molecule □ no idea
□ B. non-peptide bonds on the surface
□ C. a net positive surface charge
□ D. multiple hydrophobic R groups on the surface

Explain the logic of your answer and describe what is likely to happen if the unfolded protein is not refolded correctly.

Q23: A protein kinase phosphorylates a normally cytoplasmic protein; the phosphorylated form of the protein is found in the nucleus. Which of the following most likely explains the observation?

□ A. phosphorylation inactivates a nuclear localization sequence □ no idea
□ B. phosphorylation activates a signal sequence
□ C. phosphorylation activates a nuclear localization sequence
□ D. phosphorylation activates a nuclear export sequence

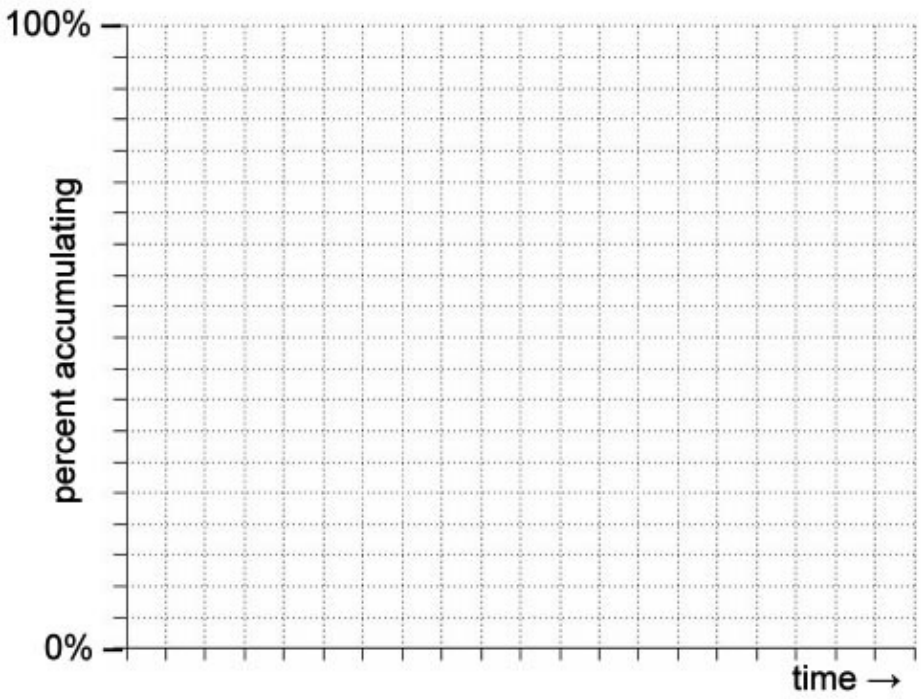
Explain the logic of your answer.

Q24: In a bacterium the expression of the CHL gene is regulated by the transcription factor ZIP.

Expression of the ZIP gene depends on another transcription factor, ZNG.

The ZNG gene is always expressed, but the ZNG protein is active only when the allosteric effector molecule ZOUP is present.

At time = 0 we add enough ZOUP to the culture to activate all of the ZNG protein present. Draw a graph of the accumulation of the CHL polypeptide as a function of time after the addition of ZOUP.



□ no idea

Describe the assumptions you made in drawing your graph.

Q25: Some genes are transcribed but not translated; pick the type of RNA that is both transcribed and translated.

□ A. mRNAs
□ B. rRNAs
□ C. tRNAs
□ D. depends on the gene
□ no idea

Explain the logic of your answer (include why are the wrong choices wrong).

Q26: How is regulation by an allosteric effector different from regulation by proteolytic cleavage? Allosteric regulation is …

□ A. irreversible
□ B. reversible
□ C. always positive
□ D. always negative
□ no idea

Explain the logic of your answer.

Q27: A mutation occurs that replaces an mRNA's normal start codon with a stop codon. Draw and explain what can happen ….