EE-526 Introduction to Bioengineering

Example Exam

Lecture 2 Cell Biology

Q. Which of the following is involved in chromosome segregation during cell division? (**1 pt**)

a. Microtubules
b. Microfilaments
c. Intermediate filaments

A:

Q. Which part of the eukaryotic cell is involved in ribosomal RNA synthesis? (**1 pt**)

a. Nucleolus
b. Endoplasmic reticulum
c. Golgi apparatus
d. Mitochondria
e. Chloroplast

A:

Q. Which part of the eukaryotic cell is involved in lipid synthesis and detoxification processes? (**1 pt**)

a. Rough endoplasmic reticulum
b. Smooth endoplasmic reticulum
c. Golgi apparatus
d. Mitochondria
e. Chloroplast

A:

Q. Which parts of the eukaryotic cell are involved in energy processing? Select all the appropriate answers. (**3 pts**)

a. Glogi apparatus
b. Chloroplast
c. Lysosomes
d. Ribosomes
e. Mitochondria

A:

Q. What kind of molecules can pass through the cell membrane? Select all the appropriate answers. (**3 pts**)

a. Polar molecules
b. Non-polar molecules
c. Large molecules
d. Small molecules

A:

Q. Which transport uses ATP? (**1 pt**)

a. Simple diffusion
b. Primary active transport
c. Facilitated Diffusion
d. Secondary active transport

A:

Lecture 3 DNA and RNA

Q. What are the structural differences between RNA and DNA? (**4 pts**)
A:

Q. How many genes does a human have? (**1 pt**)

a. About 200
b. About 2,000
c. About 20,000
d. About 200,000
e. About 2,000,000

A:

Q. What is the synthesis direction of DNA polymerases? (**1 pt**)

a. 5’ to 3’
b. 3’ to 5’

A:

Lecture 4 Proteins

Q. A _____(peptide/disulfide/acetylene/ethylene) bond links two consecutive amino acids in a protein chain. (**1 pt**)
A:

Q. Alphafold is a deep learning method that is revolutionising protein engineering by: (**1 pt**)

a. Predicting protein structure
b. Suggesting proteins for transcribing selected DNA
c. Designing DNA for robust protein synthesis
d. Designing fluorescent markers for proteins

A:

Lecture 5 Biochemistry

Q. What are the key ingredients required to start translation during protein synthesis? (**1 pt**)

a. DNA, mRNA, tRNA
b. mRNA, Ribosome, Amino acids
c. mRNA, Ribosome, Initiator
d. mRNA, DNA polymerase, Ribosome

A:

Lecture 6-7 Thermodynamics

$$K_d = \frac{[A][B]}{[AB]} = \frac{k_{off}}{k_{on}} = K_a^{-1}$$

$$Y_B = \frac{[A]}{K_d + [A]} \approx \frac{[A]_{total}}{K_d + [A]_{total}} \text{ if } [B]_{total} << K_d \text{ or } [A]_{total} >> [B]_{total}$$

$$\frac{1}{K_d} - \frac{Y_B}{K_d} = \frac{Y_B}{[A]}$$

$$[AB] = [AB]_0 * e^{-k_{off}t}$$

$$t_{1/2} = \frac{ln(2)}{k_{off}}$$

$$[AB] = \frac{[A][B]_0}{[A] + K_d}(1 - e^{-(k_{on}[A] + k_{off})t})$$

All formulas will be provided.
Questions will be similar in difficulty to the problem set on this topic.

Lecture 8 Techniques and Methods I

Q. What is the ideal temperature for medium-term storage (~1-3 years) of a glycerol stock of bacteria? (**1 pt**)

a. 4°C
b. 20°C
c. -20°C

d. -80°C

A:

Lecture 9 Techniques and Methods II

Q. Which enzyme is essential for the PCR process? (**1 pt**)

a. Protease
b. RNA Polymerase
c. DNA Polymerase
d. Ligase

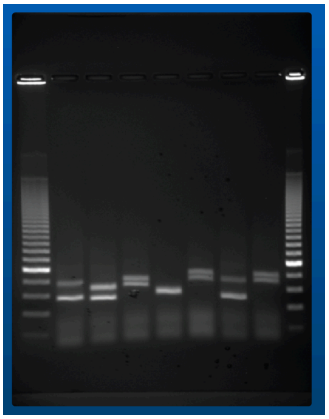
A:

Q. Why is PCR an important tool in molecular biology? (**1 pt**)

a. It sequences the entire genome.
b. It helps in the direct observation of proteins.
c. It aids in the conversion of RNA to DNA.
d. It allows for the rapid amplification of specific DNA sequences.

A:

Q. The picture below shows the result of the agarose gel of 7 PCR reactions in which you tested different primer pairs to find the most optimal pair. Which PCR reaction achieved the best result? (**2 pts**)



A: 4th reaction from the left. Because this is the only reaction that produced a single product band.

Q. How can initial target DNA template concentration be determined in digital PCR? (**2 pts**)

1. _____

A:

Lecture 10-12 Advanced Topics

Q. Which of the following microfluidic techniques offers the highest throughput? (**1 pt**)

a. Valve-based microfluidics
b. Droplet microfluidics
c. Digital microfluidics
d. Paper-based microfluidics

A:

Q. What is achieved by including both an analog and a digital detection mechanism on a single microfluidic device? (**1 pt**)

a. Increased throughput
b. Increased dynamic range
c. Higher limit of detection
d. Improved device robustness

A:

Q. Name at least 3 application areas for organ-on-a-chip and organoid technologies. (**3 pts**)

1. _____
2. _____
3. _____

A: