Sample Quiz

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Student Information

Please fill in your name and student ID below, this is important!

Name:

ID:

Exam Information

This is a sample exam.

Question 1 **[2 points]** ***Select <u>one</u> answer***

According to the Beer-Lambert law, which factor does NOT directly affect the absorbance of a solution?

(a) ☐ The concentration of the absorbing species.

(b) ☐ The path length of the light through the solution.

(c) ☐ The molar absorptivity (extinction coefficient).

(d) ☐ The temperature of the solution.

(e) ☐ The wavelength of light used.

Question 2 **[2 points]** ***Select <u>one</u> answer***

What is the Hill coefficient (n_H) for a protein that exhibits perfect non-cooperative binding?

(a) ☐ $n_H > 1$

(b) ☐ $n_H = 1$

(c) ☐ $n_H < 1$

(d) ☐ $n_H = 0$

(e) ☐ n_H is undefined for non-cooperative binding.

Question 3 **[2 points]** ***Select <u>one</u> answer***

Which statement correctly describes the relationship between Gibbs free energy change (ΔG) and spontaneity of a reaction?

(a) ☐ A reaction is spontaneous only when $\Delta G > 0$.

(b) ☐ A reaction is spontaneous when $\Delta G < 0$.

(c) ☐ A reaction is at equilibrium when $\Delta G < 0$.

(d) ☐ A reaction is never spontaneous when $\Delta G = 0$.

(e) ☐ The sign of ΔG is unrelated to spontaneity.

Question 4 **[2 points]** ***Select <u>one</u> answer***

In competitive inhibition, how does the inhibitor affect the kinetic parameters of an enzyme-catalyzed reaction?

(a) ☐ Both K_M and V_{max} increase.

(b) ☐ K_M increases while V_{max} remains unchanged.

(c) ☐ K_M remains unchanged while V_{max} decreases.

(d) ☐ Both K_M and V_{max} decrease.

Question 5 **[2 points]** ***Select <u>one</u> answer***

In a redox reaction, electrons spontaneously flow from:

(a) ☐ A species with a more positive reduction potential to one with a more negative reduction potential.

(b) ☐ A species with a more negative reduction potential to one with a more positive reduction potential.

(c) ☐ The oxidizing agent to the reducing agent.

(d) ☐ A species at higher pH to one at lower pH.

Question 6 **[2 points]** ***Select <u>one</u> answer***

Under standard biochemical conditions (pH 7, 25°C, 1 mM Mg^{2+}), what is the approximate standard free energy change ($\Delta G^{\circ\prime}$) for ATP hydrolysis to ADP and inorganic phosphate?

(a) ☐ +30.5 kJ/mol

(b) ☐ −30.5 kJ/mol

(c) ☐ +7.3 kJ/mol

(d) ☐ −7.3 kJ/mol

(e) ☐ 0 kJ/mol

Question 7 **[2 points]** ***Select <u>one</u> answer***

Which statement best describes facilitated diffusion across a biological membrane?

(a) ☐ It requires ATP hydrolysis to transport molecules against their concentration gradient.

(b) ☐ It involves passive transport through protein channels or carriers along the concentration gradient.

(c) ☐ It only transports ions, not larger molecules.

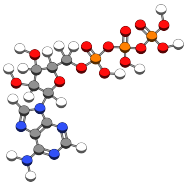
(d) ☐ It creates a concentration gradient across the membrane.

(e) ☐ It is independent of membrane proteins.

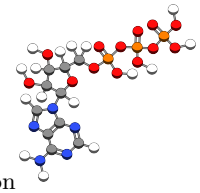
Question 8 [2 points]

Select <u>one</u> answer

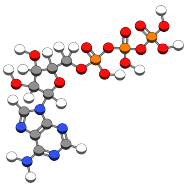
Which of the shown molecules (a, b, c, or d) is the correct representation of a cool molecule?



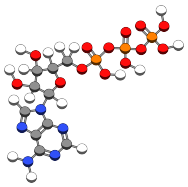
(a) Molecule (a) this caption has a cool equation $E = mc^2$



(b) Molecule (b)



(c) Molecule (c)



(d) Molecule (d)

Figure: Options

(a) ☐ Choice (a)

(b) ☐ Choice (b)

(c) ☐ Choice (c)

(d) ☐ Choice (d)

Question 9 **[2 points]** ***Select <u>one</u> answer***

At a pH equal to a protein's isoelectric point (pI), what is the net charge of the protein?

(a) ☐ The protein has a net positive charge.

(b) ☐ The protein has a net negative charge.

(c) ☐ The protein has a net charge of zero.

(d) ☐ The protein's charge cannot be determined without knowing its amino acid sequence.

(e) ☐ The protein is fully denatured.

Question 10 [2 points]

Select <u>one</u> answer

Which factor would increase the melting temperature (T_m) of a DNA double helix?

(a) ☐ Higher AT content compared to GC content.

(b) ☐ Shorter DNA fragment length.

(c) ☐ Higher GC content compared to AT content.

(d) ☐ Lower salt concentration in the solution.

(e) ☐ Lower pH of the solution.

(f) ☐ Presence of denaturing agents like formamide.

Question 11 [2 points]

Select <u>all</u> correct answers

What is the correct description of the molecule shown in the image?

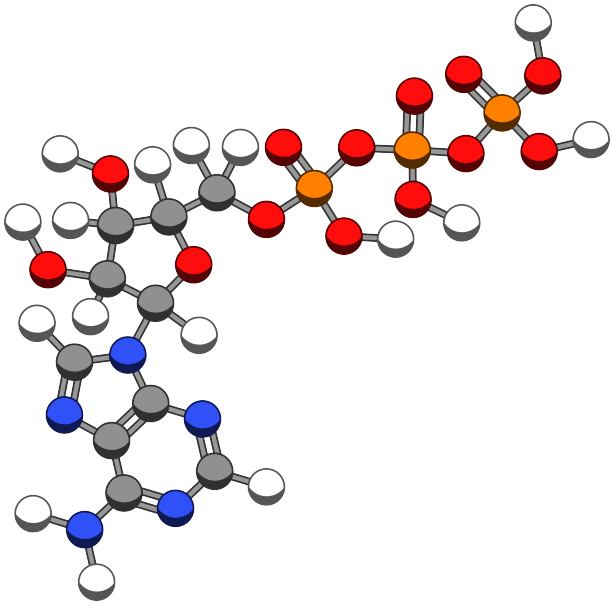


Figure: Image showing a weird molecule.

(a) ☐ It is a water molecule (H2O).

(b) ☐ It is unstable and does not exist in nature.

(c) ☐ It will be a stable organic compound.

Question 12 [2 points]

Select <u>one</u> answer

According to the van't Hoff equation, how does the equilibrium constant K change with temperature for an exothermic reaction?

(a) ☐ K increases with increasing temperature.

(b) ☐ K decreases with increasing temperature.

(c) ☐ K remains constant regardless of temperature.

(d) ☐ K first increases then decreases with temperature.

(e) ☐ The relationship depends on the pressure.

Question 13 [2 points]

Select <u>one</u> answer

According to the Michaelis-Menten model, which of the following statements correctly describes the meaning of the parameter K_M?

(a) ☐ It is the turnover number of the enzyme s^{-1}.

(b) ☐ It equals the substrate concentration at which the reaction rate is half of V_{max}.

(c) ☐ It represents the rate constant for the formation of the enzyme-substrate complex.

(d) ☐ It is always identical to the dissociation constant of the enzyme-substrate complex, with a unit of concentration (e.g., M). This means something very complicated, which makes thiis sentence very long and therefore it is less likely that you will choose it by mistake and allows me to have an option that is spanning multiple lines.

Question 14 [2 points]

Select <u>one</u> answer

What is the primary distinction between a cofactor and a coenzyme?

(a) ☐ Cofactors are organic molecules, while coenzymes are inorganic ions.

(b) ☐ Cofactors are inorganic ions or small molecules, while coenzymes are organic molecules often derived from vitamins.

(c) ☐ Cofactors permanently bind to enzymes, while coenzymes transiently associate.

(d) ☐ There is no distinction; the terms are interchangeable.

(e) ☐ Cofactors increase enzyme activity, while coenzymes decrease it.

Question 15 **[2 points]** ***Select <u>one</u> answer***

What does a smaller dissociation constant (K_d) indicate about a ligand-protein interaction?

(a) ☐ Weaker binding affinity between the ligand and protein.

(b) ☐ Higher binding affinity between the ligand and protein.

(c) ☐ Faster association rate of ligand binding.

(d) ☐ Slower dissociation rate of ligand binding.

(e) ☐ The ligand concentration at half-saturation.

Question 16 **[2 points]** ***Select <u>one</u> answer***

During the light reactions of photosynthesis, what is the primary role of photosystem II (PSII)?

(a) ☐ To reduce $NADP^+$ to NADPH.

(b) ☐ To synthesize ATP through chemiosmosis.

(c) ☐ To oxidize water molecules and release oxygen.

(d) ☐ To fix carbon dioxide into organic molecules.

(e) ☐ To transport electrons directly to photosystem I.

Question 17 **[2 points]** ***Select <u>one</u> answer***

According to the Henderson-Hasselbalch equation, at what pH is a buffer most effective?

(a) ☐ When pH equals $pK_a \pm 2$.

(b) ☐ When pH equals $pK_a \pm 1$.

(c) ☐ When pH is far from pK_a.

(d) ☐ When pH equals exactly pK_a.

(e) ☐ Buffers are equally effective at all pH values.

Question 18 **[2 points]** ***Select <u>one</u> answer***

Which of the following agents would most effectively denature a protein by disrupting hydrophobic interactions?

(a) ☐ High concentrations of urea or guanidinium chloride.

(b) ☐ Low pH (< 3).

(c) ☐ High temperature (> 80°C).

(d) ☐ Detergents such as sodium dodecyl sulfate (SDS).

(e) ☐ Oxidizing agents.

Question 19 **[2 points]** ***Select <u>one</u> answer***

For a first-order reaction, what is the relationship between the rate constant k and the half-life $t_{1/2}$?

(a) ☐ $t_{1/2} = \frac{1}{k}$

(b) ☐ $t_{1/2} = \frac{\ln 2}{k}$

(c) ☐ $t_{1/2} = \frac{k}{\ln 2}$

(d) ☐ $t_{1/2} = k \cdot \ln 2$

(e) ☐ $t_{1/2} = 2k$

Question 20 **[2 points]** ***Select <u>one</u> answer***

What type of interaction primarily stabilizes the α-helix secondary structure in proteins?

(a) ☐ Disulfide bonds between cysteine residues.

(b) ☐ Hydrogen bonds between carbonyl oxygen and amide hydrogen of the backbone.

(c) ☐ Ionic interactions between charged side chains.

(d) ☐ Van der Waals forces between hydrophobic side chains.