Practice Qs for the topics that will be tested on Midterm 1

This document contains some questions that you can practice on. The questions are grouped by topic along with the learning objectives associated with each of the topics. The types of questions are divided into three groups:

1. Study questions: these are questions on your direct knowledge of the topics, so essentially 'drills' on the basics – practice to make sure you get the fundamentals. Work with these questions first to build up your skills.
2. Exam-type multiple choice questions (MCQs): these are the types of questions you are likely to see on the exam – various levels of application of the fundamental knowledge and skills for each topic area.
3. Open response questions (ORQs): a few examples at the end to give you an idea of the kinds of short answer questions you will see on the exams.

BIOL 112 Learning Center (WESB 200) is a great place to work on these problems either on your own or in groups. TAs and Peer Tutors will be there at their scheduled times to help out (see Learning center schedule on Connect). We encourage you to use this resource.

In addition, during the week of Sept. 22nd (23rd to 26th), there will be tutorial sessions, called "Targeted Tutorials" being run by TAs in WESB room 238 (directly across from the Learning Center room (WESB 200). TAs will go over some specific questions from the practice question sets, and membrane transport worksheets. Schedule of the Targeted Tutorials is also posted on Connect in the Exam-Related folder.

Topic: Introduction to cells

Your learning objectives are:

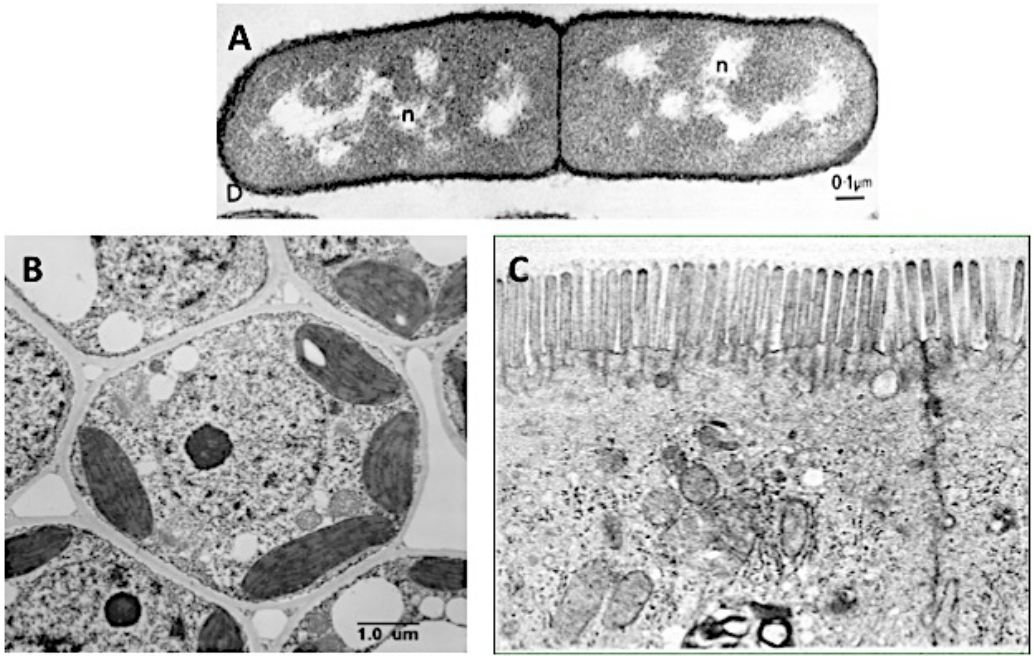
- List and evaluate the key requirements (properties/features) for self-replication.
- Summarize the cell theory and explain how that applies to where cells come from.
- Discuss diversity in cell size, structures; cells as organisms *versus* cells in organisms; unicellular versus multicellular.
- Discuss the fundamental principles of chemistry and physics dictating cellular processes, and energy transformations involved.
- List the three domains that comprise the tree of life.
- Compare and contrast bacterial and eukaryotic cells.
- Discuss the factors contributing to the limitation of cell size (solute concentration, transport, diffusion)

Here are some big picture STUDY questions:

1. What are the key features that define "what is a cell?"
2. What is the function of the plasma membrane?
3. What is the purpose of some cells having internal membranes?
4. What are the three domains on the tree of life?
5. What are the differences between bacterial cells and eukaryotic cells?
6. What is the main chemical form of energy stored inside the cell?

Exam type questions:

1. Examine the micrographs of cells shown and answer the questions below.



a) Explain how each cell is addressing cell size-related limitations for dilution, diffusion and surface area to volume ratio.

b) The image above shows bacterial, plant and human cell types. What are some differences between these types of cells? What characteristics could you use to distinguish between them?

Topic: Macromolecules contributing to cell structure and function

Your learning objectives are:

- List the four major macromolecules in cells.
- For each of the macromolecules, LIST the monomers, types of covalent bonds linking the monomers together, the directionality of the macromolecules, and the reason for the directionality.

Here are some big picture STUDY questions:

1. What are the four main types of biologically important macromolecules? What is the general role of each type? What are the monomers ("building blocks") of each of these macromolecules?
2. What is the general structure of the monomer (building block) of proteins? Describe and draw this structure.
3. What are the names of the termini (ends) of a protein chain?
4. What is the general structure of the monomer (building block) of nucleic acids? Describe and draw this general structure. What are the differences between the DNA monomer and the RNA monomer?
5. Look at Figure 2.18. Predict the types of non-covalent interactions that nucleic acid monomers can participate in.

6. What are the names of the termini (ends) of a nucleic acid?
7. What is the general structure of the monomer (building block) of complex carbohydrates?
8. Look at Figure 2.23. Predict the types of non-covalent interactions that carbohydrate monomers can participate in.
9. What are the names of the termini (ends) of a carbohydrate?
10. What type of lipids are found in cell membranes?
11. What is the general structure of the monomer (building block) of phospholipid?
12. Look at Figure 2.28. Predict the types of non-covalent interactions that phospholipids can participate in.
13. By convention how is the directionality of a DNA molecule expressed?
14. What is the directionality observed in a polypeptide?

Here are some exam type questions:

1. Fill in the blanks: Macromolecular structures are assembled in this order: _____ are joined together by _____ bonds to form biological _____, which associate with each other by _____ bonds, forming larger structures.

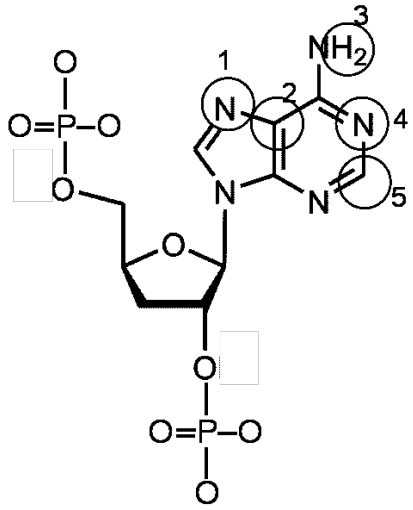
    a. Monomers, covalent, polymers, noncovalent
    b. Polymers, covalent, monomers, noncovalent
    c. Monomers, noncovalent, polymers, covalent
    d. Polymers, noncovalent, monomers, covalent

2. Conditions of low pH (which means that the hydrogen ion (H^+) concentration is increased) will affect amino acids and proteins. For some amino acids, side chains that were negatively charged at neutral pH may become neutral and for other amino acids side chains that were neutral may become positively charged. These effects might contribute to altering the tertiary and quaternary structures of a protein by which of the following mechanisms?

    1. Breaking of peptide bonds.
    2. Changing the ionic interactions.
    3. Making new Induced Dipole-Induced Dipole interactions
    4. Changing the amino acid sequence.
    5. Causing charge repulsion.

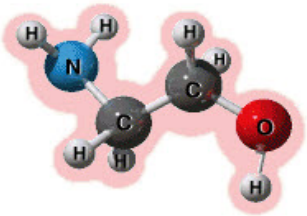
    a. All 5 probably contribute.
    b. 1, 2, 3, 4 probably contribute.
    c. 2 and 5 probably contribute.
    d. 3 and 4 probably contribute.
    e. 1, 3 and 4 probably contribute.

3. In this picture showing one of the nitrogenous bases in DNA, Which of the circled atoms could make hydrogen bonds with water?



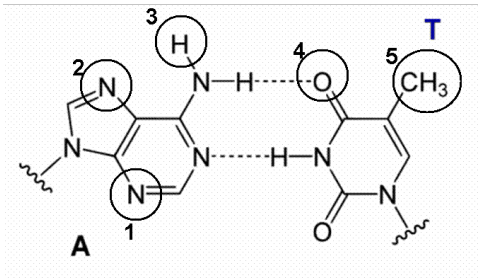
A. All 5
B. 1, 2, 3 only
C. 1, 3, 5 only
D. 1, 3, 4 only
E. 3, 4 only

4. How many atoms in the pictured molecule can form H-bonds with water molecules?



A. 7
B. 3
C. 2
D. 5
E. 8

5. Below is a diagram showing two molecules that are H-bonded to each other. An isoleucine in the primary structure of a protein was shown to interact with these molecules. Using just this information, which one of the circled atoms/groups shown on the molecules below is likely to have an induced-dipole – induced-dipole interaction with the isoleucine?



A. group 1

B. group 2

C. group 3

D. group 4

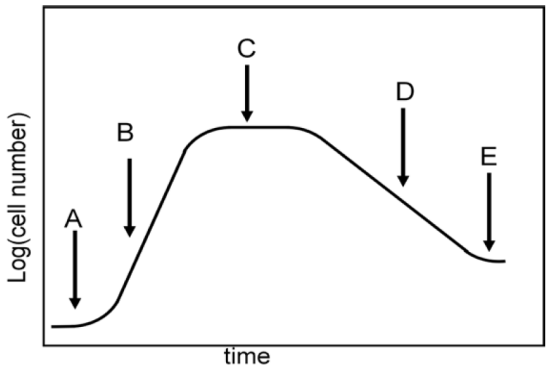
E. group 5

Topic: Bacterial growth in batch culture

Your learning objectives are:

- Describe what is meant by growth in a unicellular organism.
- Identify the four phases of population growth in a batch culture and in the associated growth curve graph - lag phase, exponential phase, stationary phase, death phase.
- Compare and Contrast lag phase, exponential phase, stationary phase, and death phase in terms of population growth rate, cell composition, and cell survival.
- Predict the changes in cell growth in response to changes in environmental conditions.
- Predict plausible reasons for an observe pattern of the growth curve.

Exam type questions:



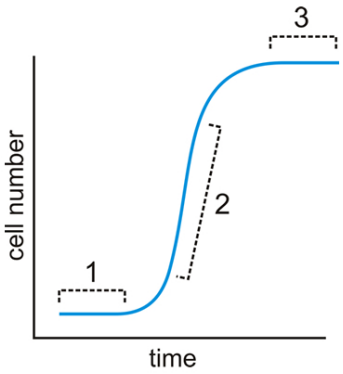
1. In the figure above, cells were added just before the time marked by arrow A. Match the letter(s) on the growth curve with each of the following:

i. Cells are in lag phase
ii. Cells are in stationary phase
iii. Cells not dividing but adapting to new growth (nutrient) conditions:
iv. All cells are dividing
v. Essential nutrients have become limiting
vi. Essential nutrients have become depleted (mostly gone)
vii. Toxic waste products are beginning to accumulate:
viii. Lethal levels of waste products have accumulated
ix. Rate of cell death exceeds rate of cell division:

2. Which growth phase has the largest increase in cell numbers per unit of time?
    a. Lag phase
    b. Exponential phase (log phase)
    c. Stationary phase
    d. Death phase

3. The growth curve represents the growth of some bacteria using only glucose as their source of energy. Imagine that the experiment is repeated with HALF as much glucose as in the experiment shown in the diagram (all other conditions are the same).

What changes in regions 1, 2, or 3 of the growth curve would you expect to observe?



a. Region 1 would not last so long and region 2 would be steeper;
b. Region 3 wouldn't change in its general trend.
c. Region 1 would not last so long; regions 2 and 3 wouldn't change.
d. Region 2 would be longer, but have the same slope; region 3 would be at a higher level; region 1 would be the same.
e. Region 1 would disappear; 2 would be longer and steeper; 3 would be at a higher level.
f. Region 2 would be steeper; regions 1 and 3 wouldn't change.

Topic: Membrane Structure and membrane Assembly

Learning Objectives:

- **Describe** the Fluid Mosaic model of the biological membrane structure.
- **Review** the electronegativity of O, N, C, S, P, H atoms.
- **Identify** whether a molecule or group on a molecule is polar/nonpolar, neutral/charged, hydrophobic/hydrophilic/amphipathic.
- **Predict** the types of interactions that can form between the various types of functional groups on molecules.
- **List** the types of non-covalent bonds involved in macromolecular assemblies.
- **Relate** the general properties of membranes to the properties of membrane phospholipids.
- **Explain** the amphipathic nature of phospholipids.
- **Predict** the structures that will form when phospholipids are mixed with water and provide a rationale.
- **Discuss** spontaneous assembly of lipid bilayers using the language of thermodynamic system stability, including the role of enthalpy and entropy in driving the process (reaction) to occur.

Study questions:

1. Why do phospholipids spontaneously assemble into specific lipid structures? Look at Figure 5.3, why does each of these structures form? What determines whether a miscelle, bilayer or liposome forms?
2. What are the different components that make up a phospholipid?
3. What is the fluid mosaic model of membrane structure? Why is it called this?
4. Explain, in your own words, why the formation of a phospholipid bilayer in an aqueous solution is a spontaneous process using the terms delta G, entropy, hydrophobic effect and non-covalent interactions.

Exam type questions:

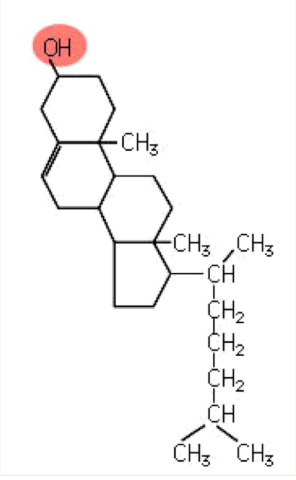
1. What is the most important factor explaining the spontaneous assembly of phospholipids into a bilayer in an aqueous solution?

a. Increased entropy of water, and thereby the stability of the system
b. Increased entropy of lipids, and thereby the enthalpy of the system
c. Formation of ionic bonds between the phospholipids, and thereby increased ΔH
d. Stabilization of permanent dipole-induced dipole interactions
e. Increased Induced dipole induced dipole interactions between the phospholipid head groups
f. Many non-covalent interactions between the hydrocarbon tails of the phospholipids

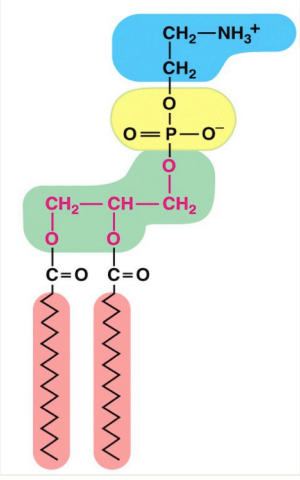
2. Based on the structures shown, which of these lipids can form bilayers on their own?

a. A only
b. B only
c. Both
d. Neither

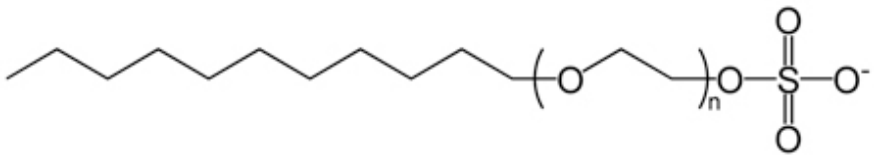
Lipid A



Lipid B



3. The structure below is for sodium dodecyl sulfate (SDS), a commonly used laboratory detergent. Which statements may be true regarding the structure of SDS? and the observed behaviour listed for SDS below?



    1. Many SDS molecules in solution will form a micelle due to the hydrophobic tails and the hydrophilic head.
    2. The negatively charged oxygen atom would be exposed on the hydrophilic surface of the membrane.
    3. The amphipathic nature of this molecule can result in SDS inserting into the cell membrane.
    4. The nonpolar portion of SDS can form Induced Dipole-Induced Dipole interactions with the hydrocarbon chains of the phospholipids.
        i. 1, 2, 3
        ii. 1, 3, 4
        iii. 1 and 2 only
        iv. 3 and 4 only
        v. All statements are true.

4. Why are phospholipids well suited to be the main structural components of membranes?
    1. They are completely insoluble in water.
    2. They can self assemble into a bilayer
    3. They form a structure in which the hydrophobic portion faces outward.
    4. They are made from atoms that are commonly available in foods.
    5. They form a single sheet in water.
    6. They form a selectively permeable structure.
        a. 1, 4 and 6
        b. 2, 3 and 5
        c. 3 and 5
        d. 2 and 6
        e. 1 and 6

Topic: Membrane Transport, Diffusion, Osmosis & osmotic pressure

Learning Objectives:

- Discuss selective permeability of biological membranes and structural features that contribute to the selective permeability.
- Distinguish between the process of diffusion and osmosis.
- List some strategies that cells use to deal with the consequences of osmotic pressure build up as a result of the selective permeability of membranes.
- Predict the membrane permeability of various types of molecules based on size and charge.
- Distinguish between the different types of membrane transports (simple diffusion, facilitated diffusion and active transport, in terms of concentration dependence, protein transporters, and energy requirements.
- Compare and contrast the transport proteins, carriers versus channels.
- Discuss the diversity in cell wall structures.

Study questions:

1. What are the different types of passive transport across cell membranes? What are the similarities and differences of each type?

2. What is the definition of diffusion, how does this relate to the different types of passive transport?

3. Look at Figure 5.9. Describe what the green solute particles are doing in each flask. Are they static, or are they moving? If so in what direction?

4. What is osmosis? How is this the same or different from other types of passive transport?

5. Look at Figure 5.11. Compare this figure to Figure 5.9, what is different in this scenario?

6. Look at Figure 5.14, explain why the red blood cell changes shape? Relative to the shown solute concentration, what is the water concentration inside the cell? Outside the cell?

7. How does active transport compare to passive transport?

8. What is an electrochemical gradient?

9. Compare the active transport that is shown in Figure 5.12 and 5.13? What are the similarities and differences?

Exam-type questions:

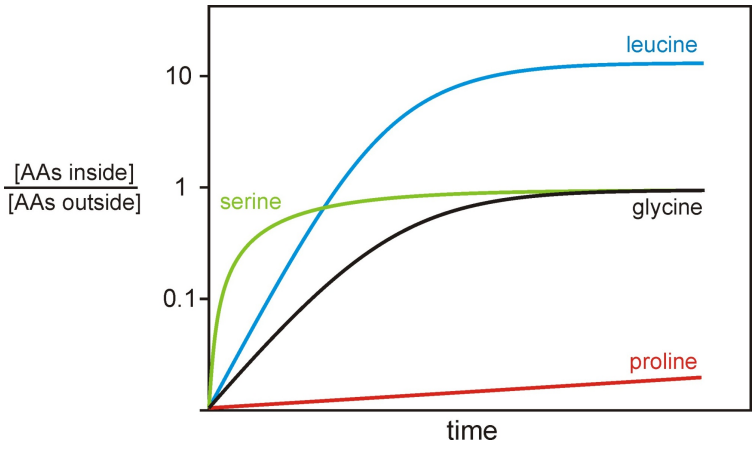
1. **Which of the following statements is true about passive diffusion?**
    a. Passive diffusion operates independently of concentration.
    b. Passive diffusion phenomena can never reach equilibrium.
    c. Passive diffusion requires no expenditure of cellular energy.
    d. Passive diffusion moves molecules into a cell, but not out of the cell.
    e. Passive diffusion does not occur in cells that possess a cell wall.

2. You are hiking in the woods, and you fall and end up with a particularly nasty, dirty wound. Unfortunately, you have forgotten your first aid kit, but you seem to recall that packing a large amount of sugar into the wound might help to prevent a bacterial infection by killing the bacteria. What is the most reasonable explanation for this?
    a. The sugar will give your skin cells energy to kill the bacteria.
    b. The sugar will make it difficult for the invading bacteria to diffuse into the wound.
    c. The sugar inhibits bacterial growth by inducing dehydration.
    d. The sugar kills the bacteria by cell rupture due to excess water.
    e. The sugar kills the bacteria by cutting off its air supply.

3. If the transport of a particular solute from a cell to the outside always requires energy, then which of the following is always true?
    1. The concentration of the solute must be higher inside the cell than outside it.
    2. A transport protein is involved in the movement of the molecules.
    3. The concentration of the solute must be lower inside the cell than outside the cell and a transport protein is involved.
    4. The lipid bilayer is permeable to the solute.

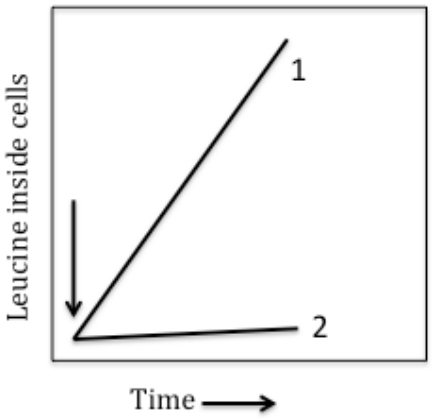
    a. 1 and 2
    b. 2 and 3
    c. 1 only
    d. 2 only
    e. 3 only

4. The figure below shows the uptake of 4 amino acids into cells. Given these data and your knowledge of relative permeability of lipid bilayers to different kinds of molecules, which of the following conclusions are correct?



    a. Leucine gets in by active transport; serine, glycine and proline get in by passive transport.
    b. Serine and leucine get in by active transport; glycine and proline get in by facilitated diffusion.
    c. Leucine gets in by active transport; serine, glycine and proline get in by facilitated diffusion
    d. All four amino acids get in by facilitated diffusion
    e. Leucine, serine, and glycine get in by active transport; proline gets in by facilitated diffusion

5. The figure shows two experiments of the uptake of leucine into the bacterium *E.coli*. Leucine was added at the arrow. The two curves show the uptake at two different temperatures, 35^{o} for curve 1, and 15^{o}C for curve 2.

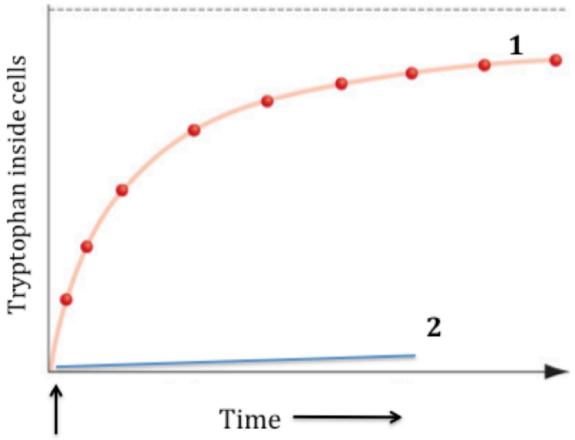


From the data, which of the conclusions can you make for sure?

1. The transport mechanism is active transport.
2. The transport mechanism is facilitated diffusion.
3. The transport mechanism is passive diffusion.
4. The cytoplasmic membrane is more permeable to leucine at the lower temperature.
5. The cytoplasmic membrane is more permeable to leucine at the higher temperature.

a. Only conclusions 1 &4 can be made.
b. Only conclusions 1 &5 can be made.
c. Only conclusions 3 & 4 can be made.
d. Only conclusions 2 & 5 can be made.
e. Only conclusion 4 can be made.
f. Only conclusion 5 can be made.
g. Only conclusion 3 can be made**.**

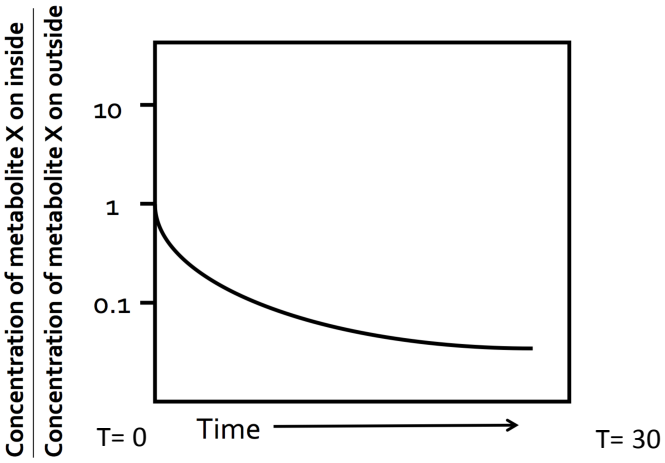
6. The figure shows data from two experiments of the uptake of the amino acid tryptophan in *E.coli* cells. At the arrow in the graph, a solution containing tryptophan was added to the media. For experiment 1, tryptophan alone was added. For experiment 2, tryptophan + KCN (potassium cyanide, a known ATP synthesis inhibitor) were added. Which of the following is the most likely explanation for the differences observed in the two uptake curves?



a. KCN binds to the phosphate groups on the phospholipids in the cytoplasmic membrane, reducing the permeability as shown in curve 2
b. Tryptophan is taken up by facilitated diffusion in curve 1 and by active transport in curve 2 with ATP providing the energy for uptake.
c. Tryptophan is taken up by active transport in curve 1 and no uptake in Curve 2 without available ATP.
d. KCN binds to tryptophan making it too big to diffuse through the membrane (curve 2).

7. A protein named PGP can be found in the membrane of kidney cells. PGP is known to be a membrane transporter of Metabolite X – but you don't know what type of transporter it is. To investigate this, kidney cells were placed in growth media containing Metabolite X, and the concentration of this metabolite was measured over time inside and outside the cells over a period of 30 minutes.

   From the following graph, interpret the data by answering the following questions**.**



   a. Using the letter X to represent metabolite X, draw the relative concentrations of the metabolite at the initial time and later time:

At T = 0

Inside	**Outside**

T = 30 minutes

Inside	**Outside**

   b. Based on the data, what type of transporter is PGP?

Topic: Proteins and Enzymes

Your learning objectives are:

- List the various roles of proteins in cellular activities.
- Draw the generic structure of an amino acid and identify the key functional groups.
- Recognize a peptide bond between amino acyl residues in a polypeptide (be able to circle it on a structure).
- Classify amino acids on the basis of the hydrophilic/ hydrophobic properties of their side chains (R-groups).
- Distinguish between primary, secondary and tertiary structure of polypeptides and the molecular interactions (non-covalent bonds/interactions) that give rise to them.
- Predict the location of different types of amino acids within a protein's folded structure based on their R-group features.
- Define protein denaturation, and predict the effects of protein denaturation on structure and function.
- Predict the effects of changing amino acids on protein structure and function.
- List the factors contributing to correct protein folding.
- Describe in general terms how enzymes can increase reaction rates.
- Contrast the progress curve of an enzyme catalyzed reaction and that of an uncatalyzed reaction.
- Compare competitive, non-competitive, allosteric enzyme inhibitions as a way of regulating enzyme activity.
- List the factors that can affect enzyme activity.

Study questions:

1. Look at figure 4.2. Based on the structures, what is the strongest type of non-covalent bond that the polar amino acid side chains can participate in with each other? (The table on Connect "Chemical bonds for biology" may be helpful here.)

a. Ionic bonds
b. Ion – Permanent-dipole
c. Permanent-dipole – Permanent-dipole
d. Permanent-dipole – Induced-dipole
e. Induced-dipole – Induced-dipole

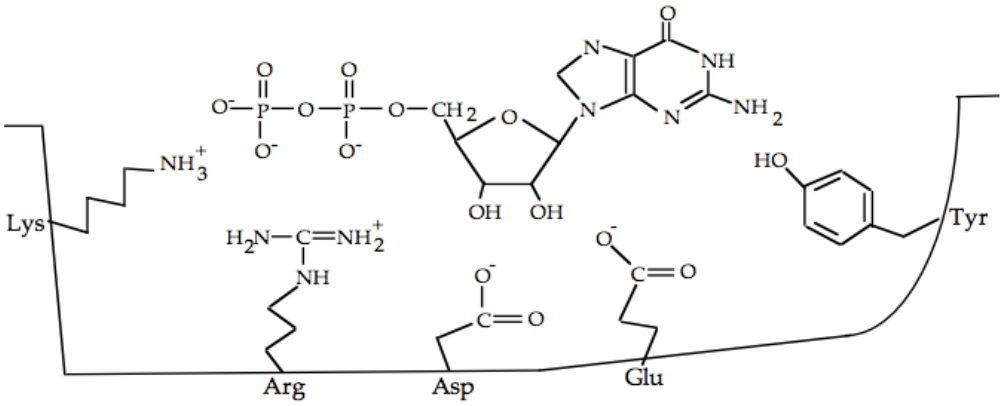
2. Look at figure 4.3. What is the best description of this figure?

a. Peptide bonds are formed by the carboxyl group of both amino acids being covalently linked by sharing electrons.
b. Peptide bonds are formed by the carboxyl group of one amino acid being covalently linked to the amino group of another amino acid.
c. Peptide bonds are formed by the carbon attached to R-group being covalently linked to the next R-group.
d. Peptide bonds are formed by the central carbon atom in an amino acid being covalently linked to 4 groups.
e. Peptide bonds are formed by a nitrogen and a carbon within one amino acid being covalently linked.

3. Look at figure 4.6 and 4.7. Which statement(s) are true about protein secondary structure? (Choose any/all that apply)

1. They form as a result of repetitive H-bonds between two carbonyl groups of the peptide bond
2. They form as a result of repetitive H-bonds between the carbonyl oxygen of one amino acyl residue and the hydrogen on the amide group of another.
3. They form as a result of repetitive H-bonds between the peptide bond groups and the adjacent R-groups.
4. They form as a result of repetitive H-bonds between R-groups
5. One type is an α – helix
6. One type is a β-pleated sheet

4. In biology, non-covalent bonds are very important in stabilizing specific interactions between molecules. For example, the figure below shows a nucleotide interacting with a protein's amino acid side chains. The amino acids are labeled with their three-letter codes.



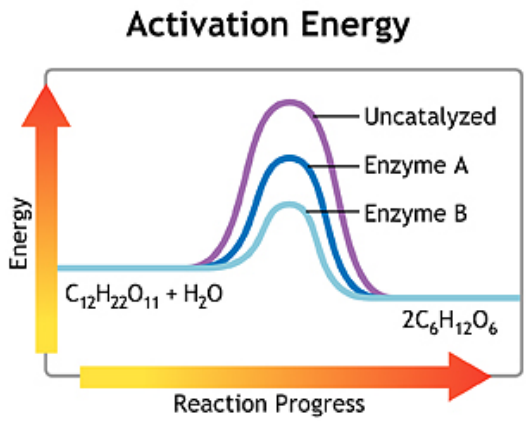
For each pair given below, draw (using dashed lines) the strongest type of non-covalent bond on the diagram. (If there is a 'tie' choose the closest interaction.)

a. The interaction between the side chain of Lys, and the phosphate group of the nucleotide. What type of non-covalent interaction is this?
b. The interaction between the side chain of Glu, and the ribose group of the nucleotide. What type of non-covalent interaction is this?
c. The interaction between the side chain of Tyr and the base of the nucleotide. What type of non-covalent interaction is this?

5. Tertiary structures of proteins results from which of the following interactions? (Choose any/all that apply)

1. Non-covalent interactions between the backbone and the R-groups
2. Non-covalent interactions between the R-groups
3. Covalent bonds between the backbone and S-containing R-groups
4. Covalent bonds between two S-containing R-groups

6. The graph presents three activation energy profiles for a chemical reaction (the hydrolysis of sucrose): an uncatalyzed reaction, and the same reaction catalyzed by two different enzymes.



Rank these by reaction rate, as measured by the rate of product formation per unit time, from lowest reaction rate to highest reaction rate.

1. Uncatalyzed reaction
2. Reaction catalyzed by Enzyme A
3. Reaction catalyzed by Enzyme B

7. Refer to the graph in question 5. What is the difference between the reaction's free energy in the different curves?

a. The uncatalyzed reaction has the largest free energy change
b. The reaction catalyzed by enzyme B has the largest free energy change
c. They all have the same free energy change, and it is a spontaneous reaction (*)
d. They all have the same free energy change, and it is a non-spontaneous reaction

8. Refer to Figure 6.15. Where on the enzyme is peroxide (the substrate in this case) binding the enzyme?

a. Catalase
b. The active site
c. The binding site
d. The enzyme-substrate interface

9. Refer to figure 6.16, and look at the folded enzyme. If the yellow bound substrate is a non-polar molecule, what type of amino acids (shown in purple) are likely interacting with it in the folded enzyme? (Figure 4.2 may help with this question – consider the types of non-covalent bonds that can happen between the substrate and the amino acid side chains.)

a. Basic
b. Acidic
c. Polar
d. Hydrophobic
e. Special

Exam Type Questions:

1. Conditions of low pH (which means that the hydrogen ion (H^+) concentration is increased) will affect amino acids and proteins. For some amino acids, side chains that were negatively charged at neutral pH may become neutral and for other amino acids side chains that were neutral may become positively charged. These effects might contribute to altering the tertiary and quaternary structures of a protein by which of the following mechanisms?

    1. Breaking of peptide bonds.
    2. Changing the ionic interactions.
    3. Making new Induced Dipole-Induced Dipole (van der Waals) interactions
    4. Changing the amino acid sequence.
    5. Causing charge repulsion.

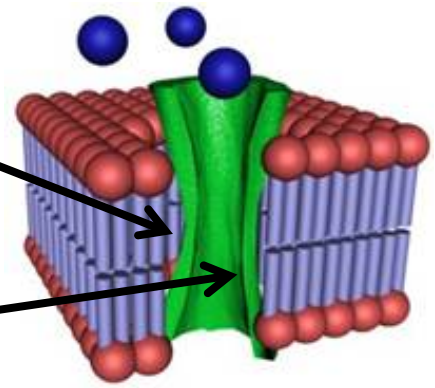
    a. All 5 probably contribute.
    b. 1, 2, 3, 4 probably contribute.
    c. 2 and 5 probably contribute.
    d. 3 and 4 probably contribute.
    e. 1, 3 and 4 probably contribute.

2. You are given the amino acid sequence of a protein. All 20 of the common amino acids are present in the protein. Which statements are most likely to be correct when considering the final conformation this protein will assume?
    1. H bonds between the atoms of the amino acid R groups will help stabilize the 3^o structure.
    2. An alpha helix will form within the protein.
    3. In the 3^o structure a disulphide (S-S) bond will form between 2 cysteine residues, which will stabilize the 2^o structure.
    4. 2^o structures form as a result of repetitive H-bonds between the backbone groups of the polypeptide.
    5. The 1^o structure will determine if a beta pleated sheet will form.

    A. 2, 4 and 5 only
    B. 1, 3 and 5 only
    C. 2 and 3 only
    D. 1, 4 and 5 only
    E. 3 and 5 only

3. Imagine that leucine is in the hydrophobic region of a particular protein. By mutation, one of the other amino acids is substituted in place of that leucine. Which substitution would have the least effect? *(See the chart of amino acids in your textbook – amino acid structures will be provided on exam)*.
    a. Asparagine
    b. Valine
    c. Aspartic acid
    d. Glutamic acid
    e. Lysine

4. The green structure in the picture shown represents an outer membrane protein called a porin found in some bacteria. Porins are water channels that allow the transport of small ions or charged molecules.



A. The R-groups of the amino acids lining the outer surface of the porin spanning the lipid bilayer and making contact with the lipid tails, are likely to be:

a. mainly polar and charged R groups.
b. an equal mix of charged and uncharged R groups.
c. mainly non-polar R groups.

B. **The R-groups of the amino acids lining the inner surface of the porin water channel are likely to be:**
a. mainly charged R groups.
b. an equal mix of charged and uncharged R groups.
c. mainly polar R groups.

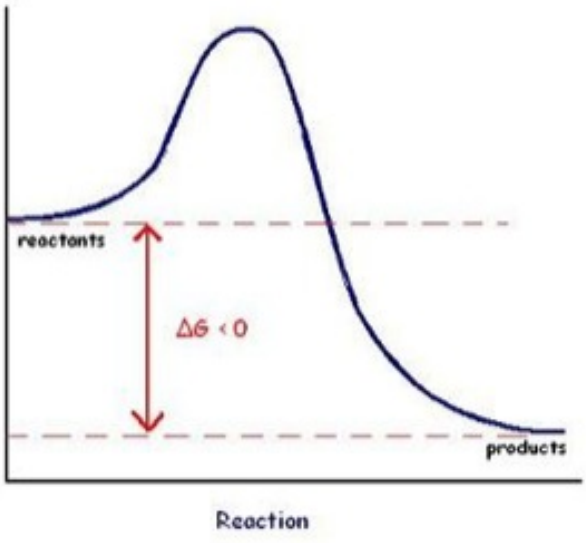
5. Which statement is true, regarding this reaction?

A + B → C Delta G > 0

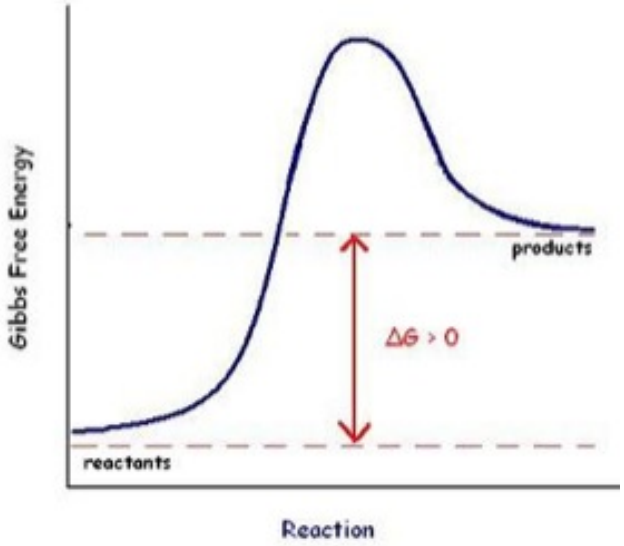
a. The reaction rate can be sped up by an enzyme only in the forward direction
b. The reaction rate can be sped up by an enzyme only in the backward direction.
c. The reaction rate can be sped up by an enzyme in either direction.

6. The two reaction curves shown below both represent two different un-catalyzed reactions. On each, draw the curve for the enzyme catalyzed (fast) reaction.

Reaction 1:



Reaction 2:



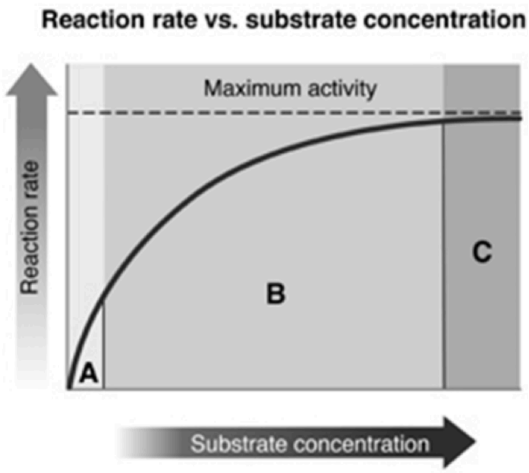
For each curve, is the reaction spontaneous or non-spontaneous? Explain

7. What is a transition state in an enzyme-catalyzed reaction?
    a. An interaction between reactants with high kinetic energy, due to high temperature.
    b. The complex formed as covalent bonds are being broken and re-formed during the reaction.
    c. The place where an allosteric regulatory molecule binds to an enzyme.
    d. The shape adopted by an enzyme that has an inhibitory molecule bound at its active site.
    e. The state that has the most stable delta G value compared to the reactants and products.

8. How does the presence of an enzyme affect whether a reaction is spontaneous or not?
    a. It makes the reaction more spontaneous
    b. It makes the reaction less spontaneous
    c. It increases the reaction free energy change
    d. It decreases the reaction free energy change
    e. None of the above

9. Look at the graph on the right, of reaction rate versus substrate concentration for an enzyme.

   In which region (A, B, or C) is the enzyme saturated with substrate?

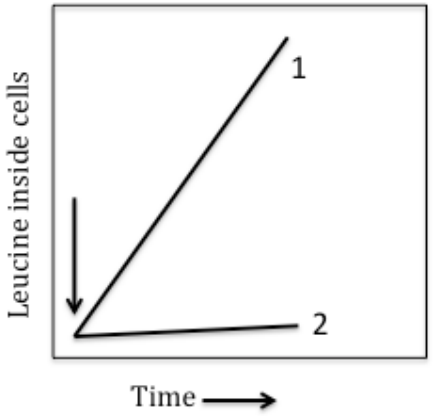


10. Enzymes work by _____.
    a. increasing the potential energy difference between reactant and product.
    b. decreasing the potential energy difference between reactant and product.
    c. decreasing the overall delta G of the reaction.
    d. decreasing activation energy.
    e. increasing the stability of the products.

11. A(n) _____ inhibitor has a structure similar to the substrate of an enzyme, where as a(n) _____ inhibitor does not need to have a structure similar to the substrate.
    a. competitive; reversible
    b. competitive; non-competitive
    c. non-competitive; irreversible
    d. reversible; irreversible
    e. non-competitive; competitive

Examples of Open Response Qs

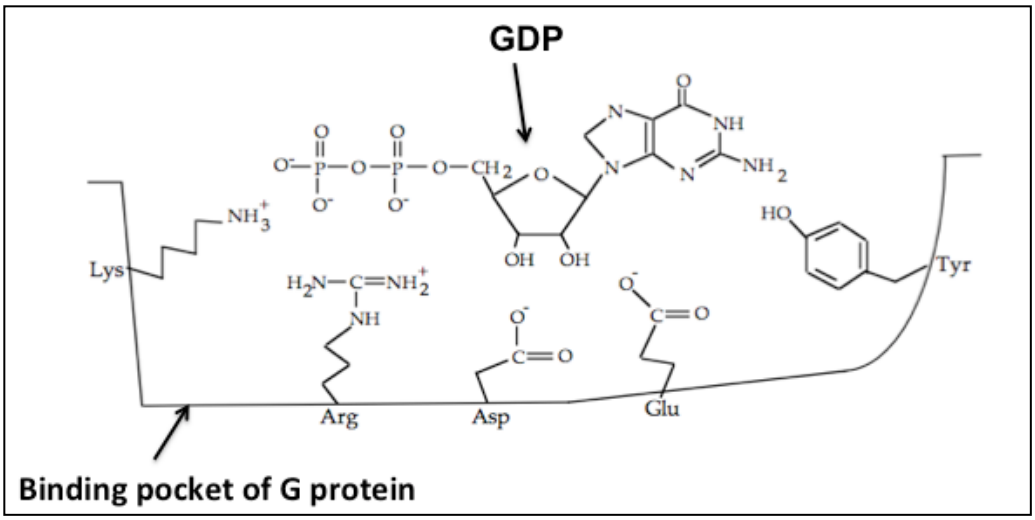
1. The figure below shows two experiments of the uptake of leucine into the bacterium *E.coli* measured using the method described in the lectures. Leucine was added at the arrow. The two curves show the uptake at two different temperatures, 35° for curve 1, and 15°C for curve 2.



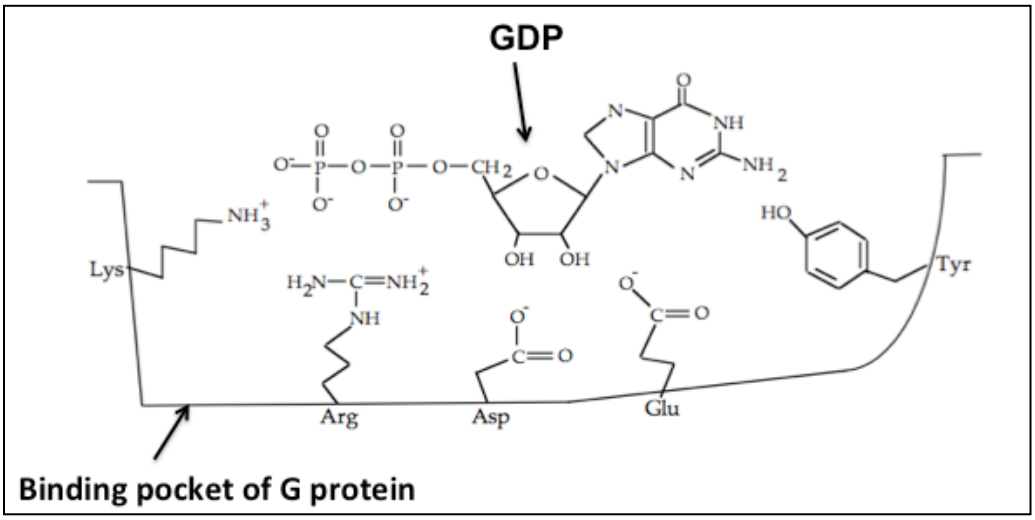
   a. What do the data show?

   b. What inference can you draw from the data shown?

Q2 – Q3. The figure below shows GDP in the binding pocket of a G protein.



Q2. Name the most likely interaction that could occur between the side-chain of Lysine (Lys) in the binding pocket with the phosphate group of GDP?



Q3. You make single amino acid changes in the GDP-binding pocket of the G protein and examine their effects on the binding of GDP. Consider the nature (e.g. charge, polarity, hydrophilicity, hydrophobicity) of the amino acid side chains and give the **most likely** reason **why** each of the amino acid change has the stated effect.

Consider each amino acid change independently.

i. Arg is changed to a Lys, resulting in a G protein that still binds GDP.

ii. Lys is changed to a Glu, resulting in a G protein that cannot bind GDP.