

NAME (PRINT): _____ SIGNATURE: _____
Student #: _____

BIOLOGY 112 – PRACTICE Questions for the Midterm exam
Summer 2013

Time allowed: (actual midterm will be 90 min)

There are 33 multiple choice questions plus graph paper, scantron copy and an amino acid table.
[Actual midterm approximately 30 - 35 questions]
The multiple choice questions are worth 1 mark each.

READ THIS!

FAILURE TO FOLLOW INSTRUCTIONS CAN DELAY THE GRADING OF YOUR EXAM

A. SCANTRON SHEET.

- **LAST NAME, FIRST NAME [PENCIL]**
Completely, fill in the bubbles for your **LAST** name (family name) then **FIRST** name.
- **ID NUMBER [PENCIL]**
This is your 8 digit student number. Other student information (e.g., phone number) is **NOT** required.
- **NAME _____*signature*_____ [IN INK]**
Sign the computer answer sheet on line in the middle of the form.
- Record all multiple choice responses **IN PENCIL** on the computer answer sheet, **NOT** on the question paper. All multiple choice questions have **ONE BEST** answer and are worth one point. **NOTE THAT SOME QUESTIONS HAVE ONLY 4 POSSIBLE ANSWERS.**
- Students **MUST** record their multiple choice responses onto their computer sheet during the time allowed for the exam. **NO** writing will be permitted after the time allowed for the exam has expired. **NO** appeals will be considered.

B. RETURN OF THE EXAM COMPONENTS – QUESTION PAPER AND SCANTRON

The question paper **MUST** be returned with the answer sheets. Answer sheets without a question paper will **NOT** be graded. In this regard, students are **STRONGLY CAUTIONED** to guard against theft of their question paper by other students. **NO** appeal relating to loss of a question paper by theft will be considered.

C. STUDENT QUESTIONS

The invigilators will **NOT** answer any clarifying questions during the exam. Students must interpret and answer each question on their own. Only questions about typographical or other errors will be answered.

D. FACULTY OF SCIENCE RULES GOVERNING FORMAL EXAMINATIONS

- #1. Each candidate must be prepared to produce, upon request, a Library/AMS card for identification.
- #2. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions.
- #3. No candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination.
- #4. Candidates suspected of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action:
 - Having at the place of writing any books, papers or memoranda, calculators, computers, audio or video devices or other memory aid devices, other than those authorized by the examiners.
 - Speaking or communicating with other candidates.
 - Purposely exposing written papers to the view of other candidates. The plea of accident or forgetfulness shall not be received.
- #5. Candidates must not destroy or mutilate any examination material; must hand in all examination papers; and must not take any examination material from the examination room without permission of the invigilator.

E. EXAM DISRUPTION POLICY FOR THE MIDTERM EXAM

In the event of an exam disruption and students must leave the exam room, the following policies apply:

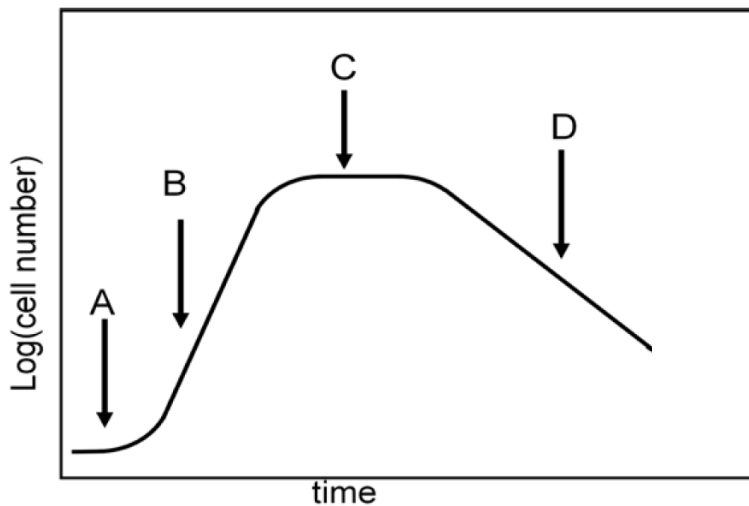
- #1. The testing of Midterm content is POSTPONED to the Final examination period and the % weighting for the Midterm Exam as stated in the General Course Information is combined with the Final Exam.
- #2. Procedure for exiting the exam room.
 - Pick up your question paper and answer sheet. (Make sure they are signed)
 - As you exit the room, give your exam papers to the instructor.
 - Any student failing to produce an exam paper will be asked to wait until all students have exited.
 - Do not return to the exam room.
- #3. Students **MUST** wait outside the exam room until the disruption has been resolved.
- #4. Students are **RESPONSIBLE** for the return of their exam question and answer papers. Any student failing to do so will receive a grade of “0” for the midterm. Students are **STRONGLY CAUTIONED** to guard against theft of their question paper by other students. **NO** appeal relating to loss of a question paper by theft will be considered.

1. 100 bacterial cells are on leaf in the forest. They go through five doublings (five generations). After the fifth doubling, an amoeba comes along and eats $\frac{3}{4}$ of all the cells that are present (only $\frac{1}{4}$ th of them are left) and then it wanders off. The remaining cells double three times. How many cells are there at the end?

- A. 100
- B. 800
- C. 3200
- D. 6400
- E. 128 000

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

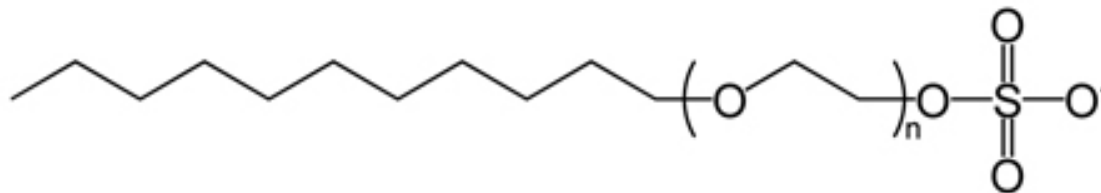
- A. The maximization of entropy
- B. Formation of ionic bonds between the phospholipids
- C. Stabilization of polar dipole-induced dipole interactions
- D. Induced dipole induced dipole interactions between the phospholipid head groups
- E. Covalent bonds in the hydrocarbon tails of the phospholipids



3. In the figure above, cells were added just before the time marked by arrow A. Select the letter (s) on the portion(s) of the growth curve where:

- i. No cell division is happening: A
- ii. Nutrients become limiting: C and D
- iii. Toxic waste products are being made and secreted: B, C and D
- iv. Rate of cell death exceeds rate of cell division: D

4. The chemical structure below is for sodium lauryl sulfate (SDS) a commonly used laboratory detergent. Which statements are true regarding the structure of SDS and the observed behavior of SDS given in each statement.



1. The long hydrophobic tail can insert between the phospholipids of the membrane destroying the integrity of the membrane.
2. The negatively charged oxygen atom would be exposed on the hydrophilic surface of the membrane.
3. The amphipathic nature of this molecule results 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.
5. When SDS is added to water a micelle will form.

- A. 1, 2, 3 and 4 only
- B. 1, 3, 4 and 5 only
- C. 1, 2 and 3 only
- D. 3, 4 and 5 only
- E. All statements are true.

5. 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 lipid 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 only
- B. 2, 3 and 5 only
- C. 3 and 5 only
- D. 2 and 6 only
- E. 1 and 6 only

6. 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.

7. If the transport of molecules of a particular solute from inside a cell across the cell membrane to the outside always requires energy, then which of the following is true?

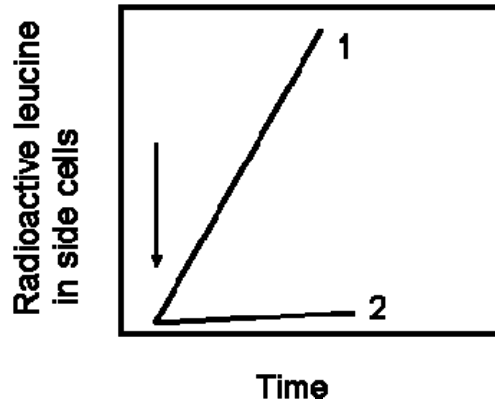
- 1. The concentration of the solute must be higher inside the cell than outside it.
- 2. A transport protein is involved in the movement of the molecules.
- 3. The concentration of the solute must be lower inside the cell than outside the cell and a transport protein is involved.
- 4. The lipid bilayer is permeable to the solute.

- A. 1 and 2 only
- B. 2 and 3 only
- C. 1 only
- D. 2 only
- E. 3 only

8. You are hiking in the woods and you suffer 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 kill the bacteria by dehydration.
- B. The sugar will cut off the air supply to the invading bacteria.
- C. The sugar will make it difficult for the invading bacteria to diffuse.
- D. The sugar will give you skin cells energy to kill the bacteria.
- E. All of the above are good rationales.

9. 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.

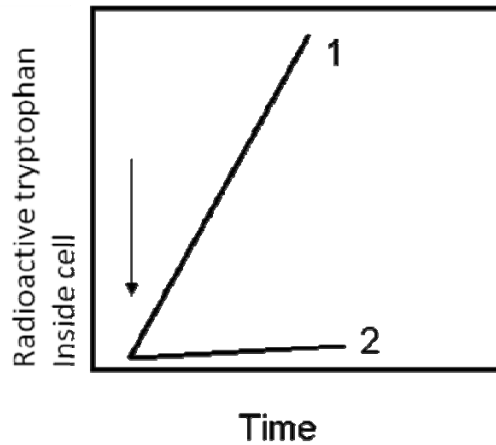


From this data which of the conclusions can you make?

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 low temperature.
 5. The cell growth rate decreased at low temperature.
- A. Only the conclusion 1 can be made.
 B. Only conclusion 4 can be made.
 C. Only conclusion 5 can be made.
 D. None of the conclusions.
 E. All of the conclusions.

10. Which of the following is a reasonable reason why low temperature tends to reduce the growth rate of a prokaryotic cell?

- A. It hardens the peptidoglycan of the cell such that the cell cannot grow larger.
- B. It decreases the relative amount of nutrients in the environment such that the cell is not capable of further growth.
- C. The phospholipid bi-layer "stiffens" and prevent the ability of permeases to change shape and transport required nutrients.
- D. The acquisition of nutrients such as glucose by passive diffusion is too slow to support rapid growth.
- E. The cell needs to expend energy to keep warm reducing the energy needed for biosynthesis.



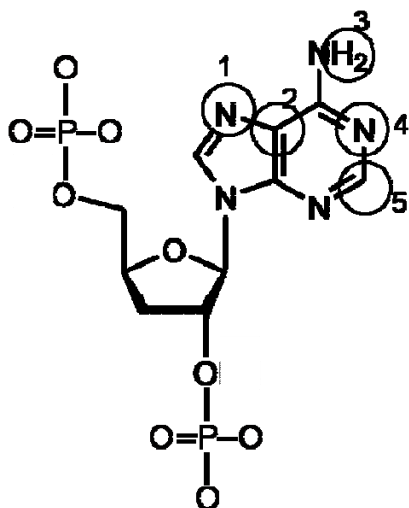
11. The figure above shows two experiments of the uptake of the amino acid tryptophan (radioactive and added at the arrow) into the bacterium *E.coli* measured using the method described in the lectures. For curve 1, radioactive tryptophan alone was added. For curve 2, the cells had been incubated with KCN (potassium cyanide) for 3 minutes before testing. KCN blocks ATP synthesis, and by 3 min after KCN treatment, ATP levels in the cells are very low. Which of the following is the most likely explanation of the differences between the two curves?

- A. KCN binds to the phosphate groups on the phospholipids in the cytoplasmic membrane, reducing the permeability
- B. Tryptophan is taken up by facilitated diffusion and this is the expected pattern.
- C. Tryptophan is taken up by an active transport system, and this is the expected pattern.
- D. KCN binds to tryptophan making it too big to diffuse through the membrane.

12. If the tertiary structure of an enzyme is changed, which one of the following would be true?

- A. Its substrate may not fit properly in the active site.
- B. It will be missing one of its polypeptides.
- C. The helical coil will be stretched out.
- D. The product of the reaction will be a different molecule.
- E. Its substrate will bond covalently with the wrong part of the molecule.

13. Here is a picture of one of the bases in DNA (this is deoxyadenosine). 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

14. 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 quaternary and tertiary structures of a protein by which of the following mechanisms?

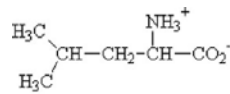
1. Breaking of peptide bonds.
2. Eliminating ionic bonds.
3. Making new Induced Dipole-Induced Dipole (van der Waals) interactions
4. Changing the amino acid sequence.
5. Causing charge repulsion.

- A. All 5 probably contribute.
- B. Only 1-4 probably contribute.
- C. Only 2 and 5 probably contribute.
- D. Only 1, 3, 4 probably contribute.
- E. Only 2 and 4 probably contribute.

15. Sterols in the eukaryotic membrane accomplish which of the following?

- A. They act as permeases for essential nutrients such as 'fats'.
- B. They buffer the lipid tails keeping the ion concentration correct
- C. They allow water passage because they have OH groups
- D. They reduce membrane permeability
- E. They facilitate the uptake of ions such as Na⁺

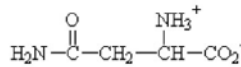
16. The structures of 5 amino acids are shown below. Imagine that a particular leucine is in a hydrophobic region of a protein and by mutation, one of the other amino acids is substituted for that leucine. Which substitution would have the least effect?



L-leucine

leu

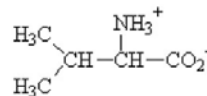
2001 A.M. Helmenstein
Licensed to AbouZ, Inc.



L-asparagine

asn

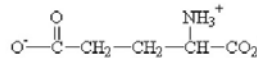
2001 A.M. Helmenstein
Licensed to AbouZ, Inc.



L-valine

val

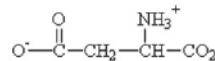
2001 A.M. Helmenstein
Licensed to AbouZ, Inc.



L-glutamic acid

glu

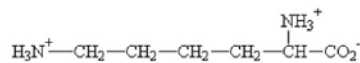
2001 A.M. Helmenstein
Licensed to AbouZ, Inc.



L-aspartic acid

asp

2001 A.M. Helmenstein
Licensed to AbouZ, Inc.



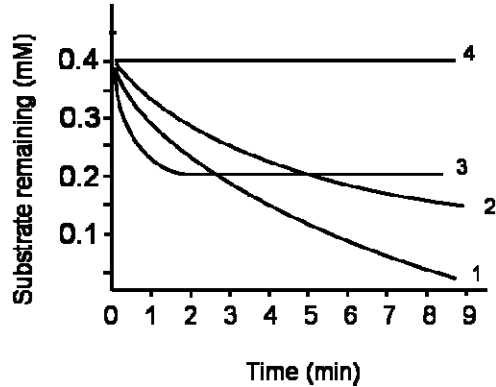
L-lysine

lys

2001 A.M. Helmenstein
Licensed to AbouZ, Inc.

- A. Asparagine
- B. Valine
- C. Aspartic acid
- D. Glutamic acid
- E. Lysine

17. An enzymatic experiment was conducted at 4 different temperatures. The following graph shows the amount of substrate remaining each minute after the enzyme was added to the substrate. Based on your knowledge of enzymes and effect of temperature on enzymatic activity, rank the trials 1, 2, 3, 4 from the lowest temperature to the highest temperature (assume identical pH with identical substrate and enzyme concentrations initially for all three trials).

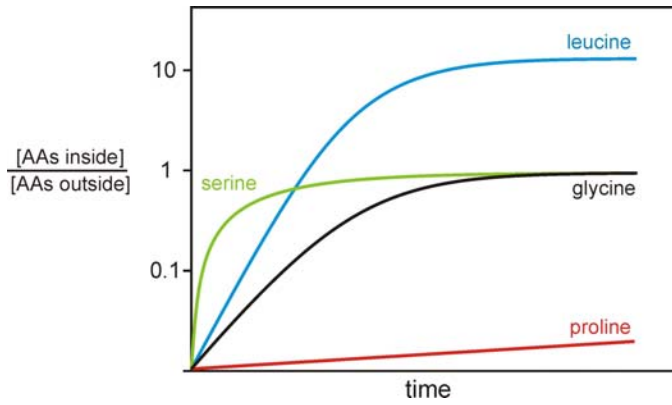


- A. 1 < 2 < 3 < 4
- B. 4 < 1 < 3 < 2
- C. 3 < 4 < 2 < 1
- D. 2 < 4 < 3 < 1
- E. 4 < 2 < 1 < 3

18. 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 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° structure.
2. An alpha helix will always form within the protein.
3. In the 3° structure a disulphide (S-S) bond will form between 2 cysteine residues, which will stabilize the 2° structure.
4. This protein will always form a 4° structure.
5. The 1° 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 and 5 only
- E. 3 and 5 Only

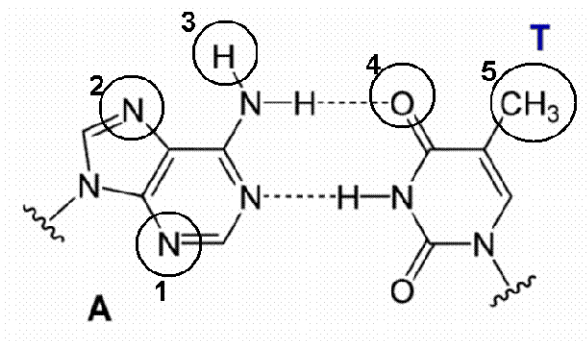


19. The figure above shows the uptake of 4 amino acids into cells measured using the method described in the lectures. Given these data and your knowledge of relative permeability of lipid bilayers to different kinds of molecules, which of the following conclusions are correct?

- A. Leucine gets in by active transport; serine, glycine and proline get in by passive diffusion
- 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

20. 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



21. Which one of the following statements about enzymes is false?

- A. Enzymes allow reactions to occur that would otherwise be non-spontaneous
- B. An enzyme is very specific in terms of which substrates it can bind to.
- C. The maximum speed of an enzyme-catalyzed reaction (V_{max}) is independent how well the enzyme binds its substrate.
- D. An enzyme lowers the activation energy of a chemical reaction.
- E. A and C

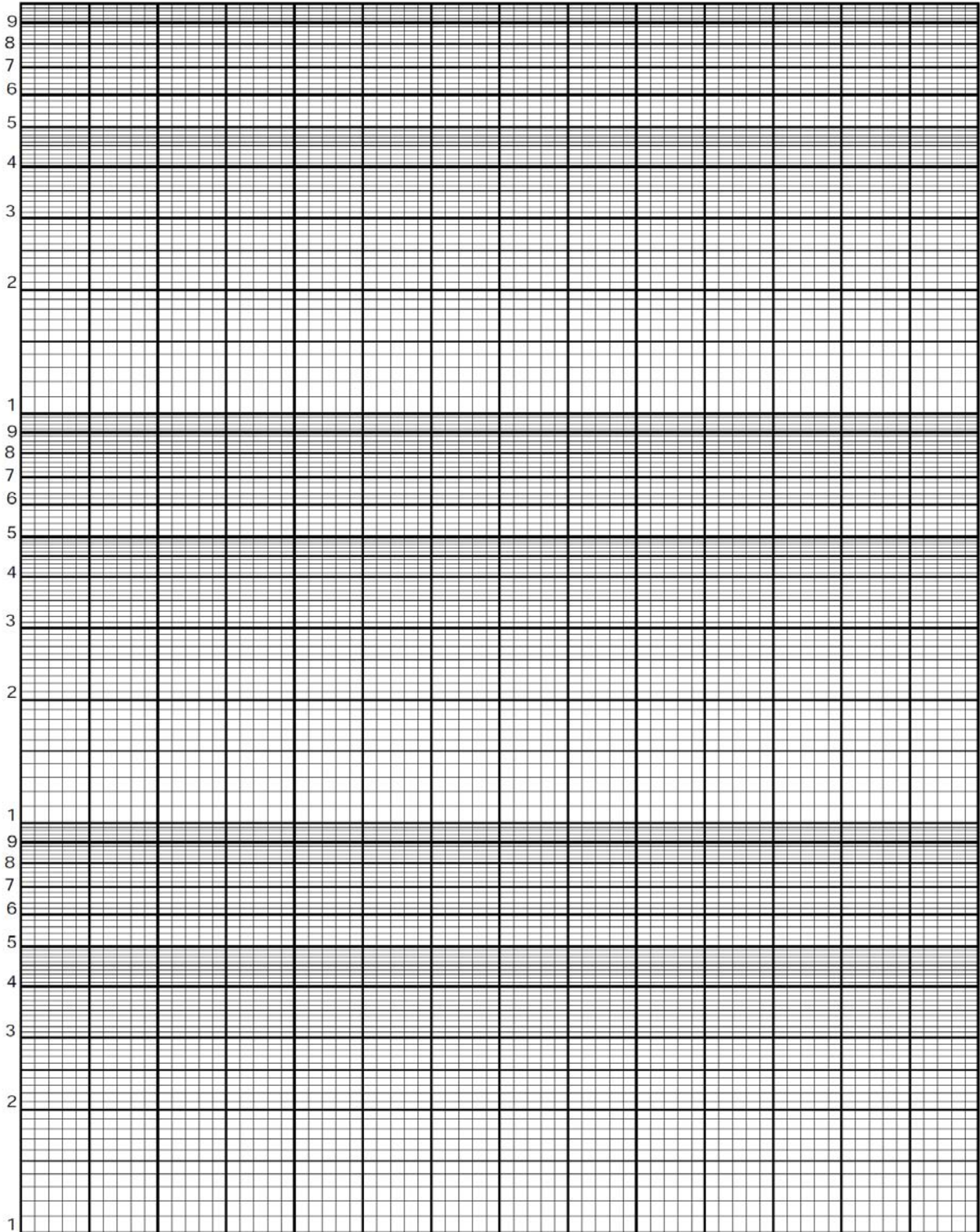
22. A microbiologist wants to examine the growth patterns of two different types of bacteria in the laboratory. She grows bacteria type A and type B separately in flasks starting with the same number of cells and at various time intervals determines the number of bacteria.

She plans on taking samples every 10 minutes but as she is doing other experiments she loses track of time and takes some samples at different intervals. The following growth data was obtained. **This is an exercise only and you will not need to draw a graph on the midterm exam**

Time of growth (min)	Bacterial Type A (# of cells)	Bacteria Type B (# of cells)
0	120	120
10	125	140
20	142	199
40	157	266
60	330	533
70	642	646
85	1307	1155
103	2544	1282
150	6129	1331
200	1.1×10^4	1400
220	1.67×10^4	1386
243	1.77×10^4	1306
277	1.83×10^4	1375

Based on the data above, which of the following conclusions would be true for these bacterial cells. You may want to plot the curve on the semi-log paper provided.

1. Type A bacteria has a higher growth rate than type B.
 2. Type B bacteria double approximately every 30 minutes.
 3. There is a lag phase for both bacterial types.
 4. Only type B bacteria enter into stationary phase.
 5. Type A bacteria double 3 times as fast as type B bacteria.
- A. 1 and 3
 - B. 2 and 5
 - C. 2, 3 and 4
 - D. 1, 2 and 5



23. Information storage and transfer are the critical functions of nucleic acids. What characteristic of the sugar phosphodiester backbone contributes to the information storage ability of DNA?

- 1) It has high energy bonds allowing for catalytic interactions.
 - 2) The ionic properties cause the molecule to be readily water soluble.
 - 3) Hydrophobic interactions between the bases stabilize the double stranded helix.
 - 4) It is asymmetric so that the strands have a specific orientation.
- A. All of the above.
B. 2 only.
C. 1, 2 and 3.
D. 1 and 3.
E. 4 only.

24. Choose the *BEST* answer that explains how the two strands of DNA are held together.

- A. The sugar-phosphate backbone holds DNA together.
B. Only H-bonds between complementary bases of the two strands hold DNA together.
C. The strands are twisted around each other and can't get apart and this fact holds DNA together.
D. Stacking interactions between neighboring bases of the same strands and H-bonds between complementary bases of the two strands that hold DNA together.
E. The combination of H-bonds between complementary bases holds the two strands of DNA together.

25. Suppose an enzyme carries out the following reaction:



**A+B is converted by an enzyme to an intermediate called C.
C is then converted to two products D and E by the same enzyme.**

If you add a surplus of C to a mixture containing substrates A, B and the enzyme, what do you expect will happen?

- A. Not much, the enzyme binds A and B as substrates and it still would.
B. Not much, the enzyme acts as a catalyst so adding C has little effect.
C. Conversion of A and B to C would be affected while C would be converted to D and E.
D. The conversion of A and B to D and E would speed up.
E. It would depend on the temperature so it's hard to say.

26. Some RNA molecules in cells can act like enzymes because they can catalyze chemical reactions. DNA is usually thought to not do this. What might be the reason for this difference?

- A. The 3' OH group is probably very chemically reactive.
- B. Single strand regions on RNA have more exposed chemical groups.
- C. DNA molecules are chemically more stable and so are less likely to stimulate reactions.
- D. RNA molecules are usually shorter and therefore more active.
- E. A cell contains more RNAs than DNAs giving more chances of a catalytic molecule.

27. You have found that a particular protein binds to a specific sequence of bases in the DNA of a bacterial cell. There are six possible sequences for this binding site.

The sequences where it binds are:

Position	1	2	3	4	5	6
	T	A	G	T	C	A
	A	A	G	A	C	A
	T	T	A	A	G	A
	T	G	T	C	A	T
	C	T	G	A	A	C
	T	A	A	T	C	A
	T	C	G	G	C	A
	T	T	T	A	C	A

Which of the following is the consensus base in position 4?

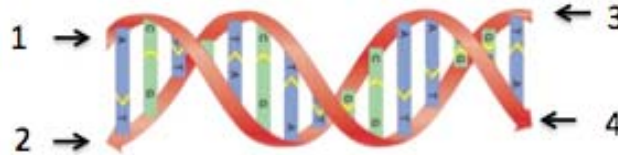
- A. A
- B. G
- C. C
- D. T
- E. There is no consensus.

28. In a bacterium, 14% of the DNA nucleotides were found to be Thymine. What proportions of the other bases would you expect to be present in this particular DNA?

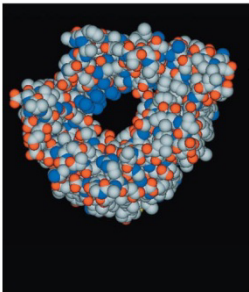
- A. 14% A, 0% C, 36% G
- B. 14% A, 36% C, 14% U
- C. 14% A, 36% C, 36% G
- D. 28% A, 36% C, 0% G
- E. Cannot be determined.

29. The picture below represents two strands of a complementary double stranded DNA. The ends are numbered. If the end numbered “1” represents the 5' end of the strand, which of the following describes the end numbered “4”?

[Biological Science Fig 4.7]



- A. The 5' end of the other strand.
 B. The 3' end of the other strand.
 C. The 5' end of the same strand.
 D. The 3' end of the same strand.
 E. It cannot be determined from this picture.
30. The picture below represents the tertiary structure of an outer membrane porin protein from Gram negative bacteria.
 [Biological Science Fig. 3.10 (b)]



← The outer surface of the porin that spans the lipid bilayer is likely to have:

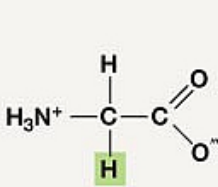
- A. many non-polar R groups (side chains) on the amino acids
 B. many positively charged R groups (side chains) on the amino acids.
 C. many negatively charged R groups (side chains) on the amino acids.
 D. many polar but uncharged R groups (side chains) on the amino acids.
31. The inner opening of the porin protein in question #25 would best be described as:
- A. An alpha helix.
 B. A beta pleated sheet
 C. A permease.
 D. A water filled channel

32. The porin in question #25 would most likely allow the diffusion of:

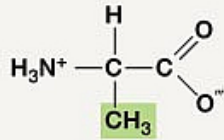
- A. Small hydrophobic molecules.
- B. Small charged molecules.
- C. Small hydrophilic molecules.
- D. Large uncharged molecules.

33. Some RNA molecules in cells can act like enzymes because they can catalyze chemical reactions. DNA is usually thought to not do this. What is the *BEST* reason for this difference?

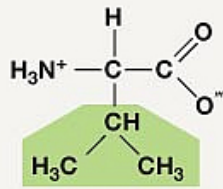
- A. The 2' OH groups on single stranded regions of RNA molecules are more exposed.
- B. The 3' OH group is probably very chemically reactive.
- C. DNA molecules are chemically more stable and so are less likely to stimulate reactions.
- D. RNA molecules are usually shorter and therefore more active.
- E. A cell contains more RNAs than DNAs giving more chances of a catalytic molecule.



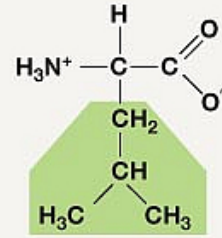
Glycine (G)
Gly



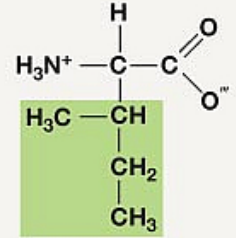
Alanine (A)
Ala



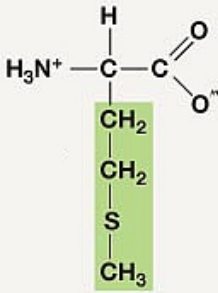
Valine (V)
Val



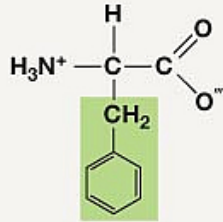
Leucine (L)
Leu



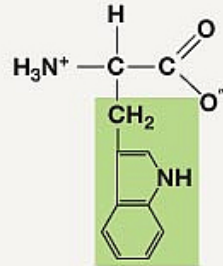
Isoleucine (I)
Ile



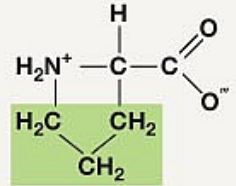
Methionine (M)
Met



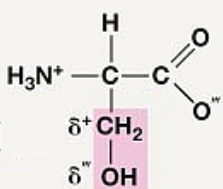
Phenylalanine (F)
Phe



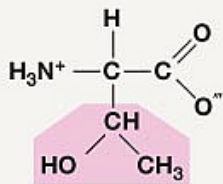
Tryptophan (W)
Trp



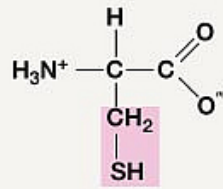
Proline (P)
Pro



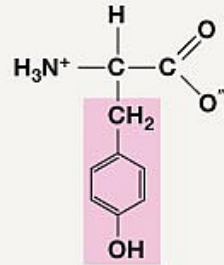
Serine (S)
Ser



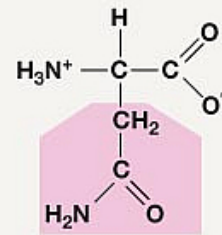
Threonine (T)
Thr



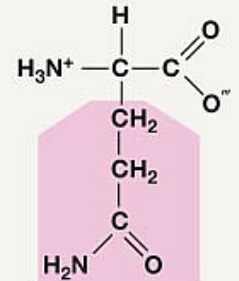
Cysteine (C)
Cys



Tyrosine (Y)
Tyr

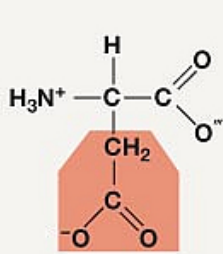


Asparagine (N)
Asn

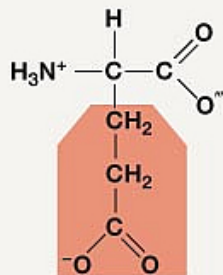


Glutamine (Q)
Gln

Negatively Charged

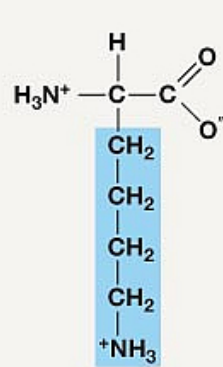


Aspartate (D)
Asp

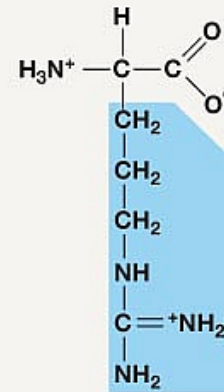


Glutamate (E)
Glu

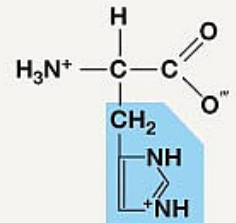
Positively Charged



Lysine (K)
Lys



Arginine (R)
Arg



Histidine (H)
His