BIOL 4374/BCHS 4313
Cell Biology
Exam #1
September 30, 2002

SS#_____ Name_____

This exam is worth a total of 100 points. The number of points each question is worth is shown in parentheses. Good luck!

1. (3) The codons 5' ACA 3', 5' ACU 3' and 5' ACC 3' can all be read by the anticodon:
   a) 5' IGU 3'
   b) 5' GGU 3' answer: a
   c) 5' UGI 3'
   d) 5' UGU 3'
   e) 5' IGC 3'

2. (3) In the mRNA below, bracket the start codon and the stop codon and indicate how many amino acids the protein would encode.

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                  1   2   3   4   5   6   7   8   9
5' CGAUCACCCACCAUGGUACAUCUACAUACAUUACAGGACUGACAUGUAAUAG 3'
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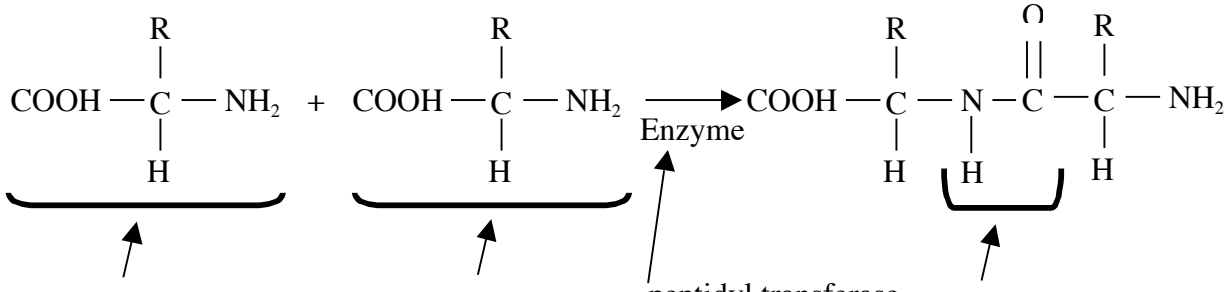
3. (2) An amino acid is bound to its appropriate tRNA by the enzyme

   ___aminoacyl-tRNA synthetase_____.

4. (2) Label the indicated parts of the reaction below:



___amino acid #1___ __amino acid #2__ _peptidyl transferase_ __peptide bond___

5. (5) Match the translation factors with their functions.

___c____	EFTu	a) Binds 5' mRNA cap, unwinds mRNA and scans mRNA for start codon
___d____	EIF2	b) Brings the large ribosomal subunit into the initiation complex
___e____	RFs	c) Brings ternary complexes to the A site of the ribosome
___a____	EIF4	d) Brings the first ternary complex to the P site of the small subunit
___b____	EIF5	e) Recognize stop codons and terminate translation

6. (4) Of the five amino acid sequences below, the most hydrophobic one is __c__ and the most charged one is ___e__.

a) Lys Val His Glu Gln Gly Ile Ala Pro Asp Ala Glu Met Asn Cys
b) Phe Ala Arg Leu Ser cys Lys Ala Glu Gln Pro Trp Tyr Leu Asp
c) Try Trp Phe Ala Leu Ile Val Pro Gly Ser Met Asn Leu Thr Ile
d) Cys Asn Pro His Gly Gly Leu Thr Gln Cys Ser Ser Pro Gly Asn
e) Asp Lys Gln Gly Asp Arg Arg Thr His Gln Glu Asp Arg Lys Lys

7. (2) As proteins are translated, the chaperone ___hsp70__ binds to them and assists them to ___fold properly___.

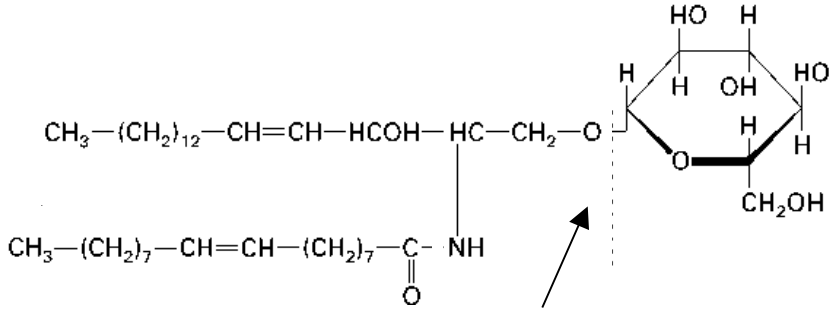
8. (2) When a protein has been ubiquitinated, it is destined to be ___degraded__ in the __proteasome__.

9. (4) **Describe** two parameters that affect an enzymes rate of product formation.
1. Affinity for its substrate (K_m)
2. Maximum velocity of the reaction at saturating substrate concentration (V_{max})
3. Temperature
4. Substrate concentration

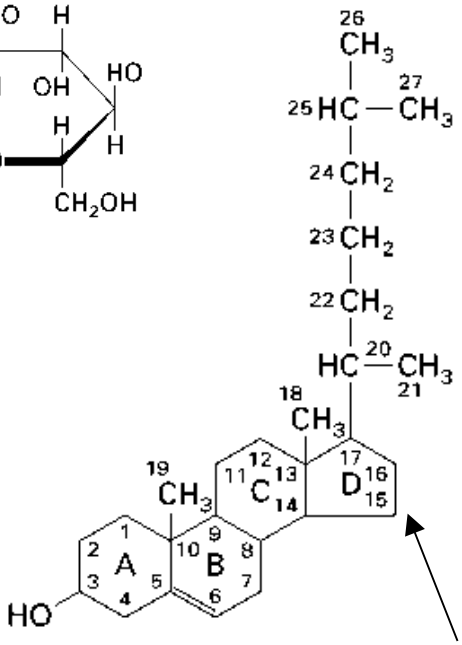
10. (2) Describe what happens to cAMP-dependent protein kinase when cAMP levels go from low to high.

At low cAMP concentration, two regulatory subunits are bound to two catalytic subunits and the complex is inactive. As camp concentration rises, two cAMP molecules bind to the regulatory subunits, causing the release of the catalytic subunits, thereby activating the catalytic subunits.

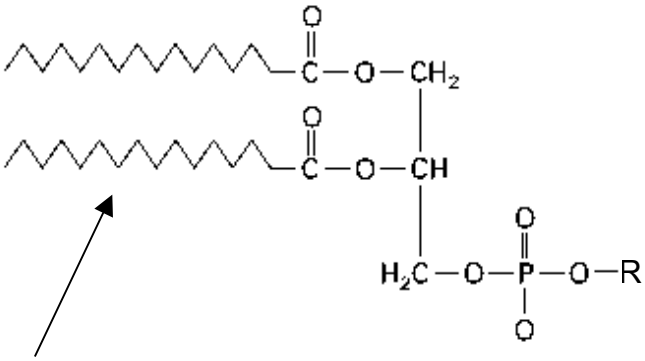
11. (3) Name the three molecules shown below.



___glycolipid or glucocerebroside_____



___cholesterol_____



_____phospholipid____

12. (3) State whether the following would make a membrane more fluid, less fluid or have no affect on fluidity.

Saturated fatty acids ____less fluid_____

Long fatty acids ____less fluid_____

Low temperature ____less fluid_____

13. (4) Describe a FRAP experiment and what property of membranes it demonstrates.

1. Label cell surface molecule with a fluorescent tag.
2. Bleach the fluorescence on a small area on the cell surface using light.
3. Wait for a certain amount of time and determine whether fluorescence in the bleached are recovers.
4. Recovery of fluorescence shows that the membrane is fluid because the molecules can move back into the bleached area.

14. (3) Match the organelle with the statement that best describes its function.

___f___	ER	a) Oxidizes fatty acids and toxic hydrophobic molecules
___a___	peroxysomes	b) where all translation initiates
___b___	cytoplasm	c) surrounded by a double membrane
___e___	vacuoles	d) where proteins are modified before export
___c___	nucleus	e) used for storage of ions, water and nutrients
___d___	Golgi apparatus	f) where fatty acids and phospholipids are synthesized

15. (3) A new life form was recently discovered in a deep thermal vent that has an unusual cellular ionic composition (shown below) and a membrane potential of –41mV. Which ion accounts for the membrane potential in this organism? Show your work.

Ion concentrations Mem. Pot.=0.059 log [ion] outside/[ion] inside

Inside cell	Outside cell	answer: Na^+
500mM Cl^-	25mM Cl^-	Mem. Pot. for Cl^-: 76 mV
250mM Na^+	50mM Na^+	Mem. Pot. for Na^+: -41 mV
50mM K^+	500mM K^+	Mem. Pot. for K^+: 59 mV
0.05mM Ca^{+2}	15mM Ca^{+2}	Mem. Pot. for Ca^{+2}: 73 mV

16. (4) In a typical mammalian cell, the resting membrane potential of ___-70 mV____ is

determined mainly by permeability of ____K^+___ ions

17. (5) Describe the mechanism of Ca^{+2} ATPase function in the sarcoplasmic reticulum. Be sure to include the following in your answer: Concentration of Ca^{+2}, Ca^{+2} binding site affinity, what ATP does, where Ca^{+2} goes and how the ATPase is returned to its initial state.

1. Calcium is at a higher concentration in the SR and outside the cell compared to the cytoplasm.
2. High affinity calcium binding sites on the Ca^{+2} ATPase are on the cytoplasmic side, and calcium readily binds to these sites.
3. ATP is used to phosphorylate the Ca^{+2} ATPase, which causes a conformational change that moves calcium to the SR side of the Ca^{+2} ATPase at low affinity calcium binding sites.
4. Calcium is released into the SR from the low affinity sites.
5. The Ca^{+2} ATPase is dephosphorylated to return it to its original conformation.

18. (3) List three principal differences between passive transport through a membrane and facilitated transport through a membrane using a uniporter.

1. Faster
2. Specific (only moves a single molecule)
3. Occurs only at specific sites where there are transporters

19. (2) The Na^+/K^+ ATPase functions to: answer: d

a) Move $3K^+$ ions out of the cell and $2Na^+$ ions in to the cell.
b) Move $2K^+$ ions out of the cell and $3Na^+$ ions in to the cell.
c) Move $2Na^+$ ions out of the cell and $3K^+$ ions in to the cell.
d) Move $3Na^+$ ions out of the cell and $2K^+$ ions in to the cell.

20. (2) What type of transporter moves glucose into the cell against its concentration gradient?

a) glucose uniport answer: d
b) Na^+ - glucose antiport
c) K^+ - glucose symport
d) Na^+ - glucose symport
e) K^+ - glucose antiport

21. (4) In ___systemic____ capillaries, red blood cells convert CO_2 to bicarbonate using the enzyme ___carbonic anhydrase____. The AE1 protein then transports one bicarbonate molecule to the _blood stream/outside the cell_ in exchange for a _____Cl^-_____ ion.

22. (4) List the four basic nutritional requirements for growth of animal cells.

1. Carbon source
2. Vitamins
3. Essential amino acids
4. Serum (growth factors and hormones)
5. Salts

23. (5) What are the components of HAT media and are these components useful for selecting hybrid cells.

1. HAT media: Hypoxanthine, Aminopterin, Thymidine
2. Aminopterin blocks de novo purine and TMP synthesis, forces cell to use salvage pathway
3. Hypoxanthine provides substrate for purine salvage
4. Thymidine provides substrate for thymidylate salvage
5. Hybrid TK- and HGPRT- cells will survive on HAT medium because one copy of the TK and HGPRT are normal, but TK- and HGPRT cells will die since they will turn Thymidine and Hypoxanthine to toxic compounds, respectively.

24. (2) Animal viruses are classified based on what two parameters?

1. The type of genome (ssDNA, dsDNA, ssRNA, dsRNA)
2. How the genome generates transcripts that can be translated.

25. (2) In fission yeast, MPF is comprised of the cdc 2 _cyclin dependent kinase__ and the cdc13 __cyclin___.

26. (4) Describe how MPF triggers its own destruction by the end of M phase.

1. MPF phosphorylates APC
2. APC is activated by MPF phosphorylation
3. APC promotes ubiquitination of cyclin b within MPF
4. Ubiquitinated cyclin b is destroyed in the proteasome, thus inactivating MPF.

27. (2) Phosphorylation of the Tyr-15 on MPF of fission yeast:

a) inhibits MPF activity — answer: a
b) is carried out by Cdc25 protein
c) is removed by CAK protein
d) is required along with Thr-161 for MPF activity

28. (2) APC triggers chromosome segregation by degrading ___anaphase inhibitor___, which then inactivates ____cohesin_____ proteins that hold metaphase chromosomes together.

29. (2) In budding yeast, cyclins 1 and 2 (cln1/2) function to:

a) trigger spindle formation — answer: b
b) inhibit APC and lead to the destruction of SicI
c) trigger DNA sythesis
d) activates transcription of enzymes needed for DNA synthesis in G_1
e) triggers nuclear division

30. (2) In mammals, __mitogens__ are no longer required for cell cycle progression after the restriction point late in G_1.

31. (2) In mammals, E2F functions to: — answer: a

a) Activate E2F, cyclin E and Cdk2 mRNA synthesis
b) Inhibit both cyclin E mRNA sythnesis and Rb phosphorylation
c) Activate both cyclin D and Cdk4/6 mRNA synthesis and Rb phosphorylation
d) Activate cyclin E and Cdk2 mRNA synthesis and inhibit Rb phosphorylation
e) Activate cyclin E and Cdk2 mRNA synthesis and inhibit E2F mRNA synthesis

32. (4) DNA damage initially leads to the stabilization of ___p53_____, which activates the transcription of p21 CIP, and accumulating levels of p21 CIP protein then arrest the cell cycle by inhibiting _cyclin dependent kinase__ activity.

33. (4) In the absence of _trophic or cytokine_ factors, apoptosis is triggered when _Bad_ binds to Bcl proteins and allows bax to form channels and let __ions_ flow into the mitochondria. In response, the mitochondria then release cytochrome C, which binds to __Apaf1___, thereby activating caspase effector proteins.