

MCDB/CHEM 103/203 Final Examination, March 19, 2012

Print Your Name as Registered in this Course on the Line Below:

(Exams Lacking Names or with Illegible and Incomplete Names will not be Graded)

Absent, illegible or otherwise unclear responses will be considered wrong responses. Carefully circle answers to multiple-choice questions and legibly write answers to questions requiring written responses. Return all pages for credit.

1) Which of the below organelles, components, or structures are absent from prokaryotes? (4 pts)

- a) nucleus
- b) endoplasmic reticulum
- c) plasma membrane
- d) a and b
- e) none of the above

2) What does a chloroplast do? (4 pts)

3) How many different eggs and sperm are needed to generate fraternal (dizygotic) twins? (4 pts)

4) Which below are features of the scientific method? (4 pts)

- a) evidence-based reasoning and logic
- b) opinion-based belief and faith
- c) conclusions can be appealed and overturned by authority
- d) skepticism is unacceptable and suppressed
- e) all of the above

5) Which macromolecules of all cells are not encoded by the genome? (4 pts)

6) (True or False) All enzymes are proteins. (3 pts)

7) Which is incorrect? (4 pts)

- a) ribosomes bind both mRNAs and tRNAs during translation
- b) most cellular RNAs do not encode proteins
- c) lipids must be obtained in humans from both diet and cellular biosynthesis
- d) glycans are made from nine essential monosaccharides present in the diet
- e) DNA is transcribed into RNA before intron splicing occurs

8) The unusual amino acids selenocysteine and pyrrolysine are not found in the standard genetic code that determines the 20 amino acids of proteins. How are they encoded? (4 pts)

9) In water, which are the three possible packing forms of lipids having either one or two fatty acid tails? (4 pts)

- a) planar monolayer, spherical monolayer, and spherical bilayer
- b) spherical monolayer, cubical monolayer, planar bilayer
- c) spherical monolayer, planar bilayer, spherical bilayer
- d) cubical monolayer, cubical bilayer, planar bilayer
- e) spherical monolayer, planar monolayer, cubical bilayer

10) The leaflets of biological membranes are often asymmetric. What about them is asymmetric? (4 pts)

11) In membrane transport, under what condition would the rate of molecular transport by simple diffusion be higher than by protein/transporter-mediated (saturable) diffusion? (4 pts)

- a) whenever the concentration of the transported molecule is above the K_m of the transporter
- b) whenever the rate of transporter-mediated transport is above $\frac{1}{2}$ of its V_{max}
- c) when the transporter is saturated and the rate of simple diffusion is greater than V_{max}
- d) it never happens
- e) simple diffusion always has a higher rate of molecular transport

12) What must the potassium channel exclude from its pore in order to selectively transport the larger potassium ion instead of the smaller sodium ion? (4 pts)

13) Which type of cellular glycan consists only of a simple disaccharide repeat? (4 pts)

- a) glycosaminoglycans of proteoglycans
- b) hyaluronan
- c) N-glycans
- d) glycans of glycolipids
- e) glycans of GPI-anchors

14) What is a major distinguishing feature of vertebrate N-glycans compared to the N-glycans of lower organisms including yeast? (4 pts)

15) (True or False) Some proteins are synthesized in the nucleus before they are transported to the cytosol. (4 pts)

16) Which two organelles have double membranes? (4 pts)

- b) nucleus and Golgi
- a) endoplasmic reticulum and lysosomes
- c) Golgi and peroxisomes
- d) lysosomes and endosomes
- e) mitochondria and nucleus

17) Which of the following is incorrect? (4 pts)

- a) ATP is made in both the mitochondria and the cytosol.
- b) The electron transport chain is coupled to ATP synthesis by the proton gradient and ATP synthase.
- c) The majority of mitochondrial proteins are synthesized in mitochondria.
- d) a and c
- e) None of the above

18) What are the four main functions of the Golgi apparatus? (4 pts)

19) Name two of the three pathways/processes that can lead to lysosomal degradation? (4 pts)

20) Which statement below is incorrect about kinases and phosphatases? (4 pts)

- a) Kinases can activate proteins
- b) Phosphatases can activate proteins
- c) Phosphatases phosphorylate proteins
- d) Proteins can be phosphorylated at serines, tyrosines, and threonines
- e) None of the above

21) Which of the choices below is correct about phosphatidylinositol (PI) and phosphoinositides (PIPs)? (4 pts)

- a) They are major components of cellular lipids
- b) They are primarily found among the outer leaflet of the plasma membrane
- c) They are glycolipids that can act as membrane and organelle localization signals
- d) a and c
- e) None of the above

22) Which of the following is correct? (4 pts)

- a) Both PI and PIPs are phospholipids
- b) PIPs are phosphorylated PI at positions 3, 4, and/or 5
- c) Different PI/PIP kinases and phosphatases have different subcellular compartmental localizations
- d) All of the above
- e) None of the above

23) (True or False) PIPs, like PIP_2 , can be cleaved by phospholipases to generate signaling molecules. (4 pts)

24) What are the three mechanisms of intracellular transport? (6 pts)

25) (True or False) All gated and transmembrane transport is non-vesicular. (4 pts)

26) Proteins that are transported into organelles originate from which cellular locations? (4 pts)

- a) nucleus and endoplasmic reticulum
- b) endoplasmic reticulum and cytosol
- c) cytosol and Golgi
- d) a and b
- e) All of the above

27) What is different about protein structures transported by co-translational and post-translational mechanisms? (4 pts)

28) (True or False) Both signal sequences and signal patches can be involved in co-translational transport. (4 pts)

29) (Yes or No) Consider a large protein (>60kDa) with a single nuclear transport signal. Can that signal be sufficient but not necessary for nuclear transport? (4 pts)

30) If you fuse an endoplasmic reticulum signal sequence to the N-terminus of a nuclear protein, where would this fusion protein be targeted? (4 pts)

- a) endoplasmic reticulum
- b) nucleus
- c) both endoplasmic reticulum and nucleus
- d) remain in the cytosol
- e) None of the above

31) How can phosphorylation and de-phosphorylation control trafficking between the nucleus and cytosol? Use the NF-AT protein as an example. (4 pts)

32) Which is incorrect about GTPases? (4 pts)

- a) GTPases bind and hydrolyze GTP
- b) GTP hydrolysis is a single step
- c) GDP to GTP exchange is a two step process
- d) GDP dissociation is typically faster than GTP association
- e) None of the above

33) In order for the Ran GTPase to participate in bi-directional transport between the nucleus and cytosol, what additional molecules besides GTP, GDP, and the nuclear pore complex are needed?

(6 pts)

34) (True or False) Protein translocation into mitochondria can occur either by diffusion or protein-mediated translocation. (4 pts)

35) Which is correct? (4 pts)

- a) peroxisome protein translocation is post-translational
- b) peroxisomal proteins are translocated in the folded state
- c) chaperones can aid in both protein folding and unfolding
- d) all of the above
- e) none of the above

36) Vesicular transport can be divided into four steps. What are they? (4 pts)

37) Which statement is incorrect about vesicular transport between the endoplasmic reticulum and Golgi? (4 pts)

- a) COPI vesicles transport cargo primarily to the endoplasmic reticulum
- b) COPII vesicles transport cargo primarily from the endoplasmic reticulum to the Golgi
- c) The VTC is formed by homotypic membrane fusion between ER-derived transport carriers.
- d) coat proteins are used to identify and bind target membranes.
- e) none of the above

38) What controls the disassembly of a COPII coat? (4 pts)

39) Which statement is incorrect regarding vesicle transport processes? (4 pts)

- a) SNARES assist in vesicle formation
- b) Rab GTPases participate in the specificity of membrane targeting
- c) SNARES participate in the specificity of membrane targeting
- d) ATP is needed for the recycling of SNARES
- e) none of the above

40) (True or False) The vesicular tubular structure is an intermediate compartment for protein transport between the nucleus and the endoplasmic reticulum. (4 pts)

41) In order to keep resident proteins localized to a particular compartment or organelle, two types of mechanisms are used by the cell. What are these two mechanisms and what do they do? (4 pts)

42) The KDEL receptor controls protein retention in the endoplasmic reticulum. Which of the following statements in a-d is incorrect? (4 pts)

- a) the KDEL receptor must have a Golgi retention signal
- b) the KDEL receptor must have an endoplasmic reticulum export signal
- c) the KDEL receptor must have a Golgi to endoplasmic reticulum transport signal
- d) the KDEL receptor must bind cargo preferentially in the endoplasmic reticulum
- e) all of the statements in a-d are correct

43) What are the two models of transport within the Golgi? (4 pts)

44) Which is not one of the major sorting pathways/destinations from the trans Golgi network (TGN)? (4 pts)

- a) lysosome
- b) plasma membrane
- c) endoplasmic reticulum
- d) secretory vesicle
- e) b and d

45) What does the mannose-6-phosphate modification do? (4 pts)

46) If protein phosphorylation by kinase activity does not occur in the Golgi apparatus, then how does the mannose residue in N-glycans obtain a phosphate group at the 6th carbon position to become the mannose-6-phosphate signal? (4 pts)

47) Which of the following is correct? (4 pts)

- a) lysosomal sorting is dependent upon pH
- b) proteins are targeted to lysosomes by signal sequences
- c) unlike most transport machinery, the M6P receptor is not recycled
- d) a and b
- e) none of the above

48) What would happen to acid hydrolases in patients with Inclusion-cell (I-cell) disease? (4 pts)

49) (True or False) Transport from the trans Golgi network (TGN) to the plasma membrane is always constitutive and part of the default pathway. (4 pts)

50) What is often the fate of endocytic cargo (such as the EGF/EGFR) that becomes sequestered in internal vesicles of a multi-vesicular body (MVB)? (4 pts)

51) Which of the below are not endocytosis pathways in mammals? (4 pts)

- a) phagocytosis
- b) clathrin-mediated endocytosis
- c) macropinocytosis
- d) microtubular endocytosis
- e) caveolin-mediated endocytosis

52) (True or False) If you use a G-actin mutant unable to hydrolyze ATP for the *in vitro* F-actin assembly experiment, there would be no polarity present on the two ends of F-actin filaments. (4 pts)

53) Which type of proteins do proteasomes degrade? (4 pts)

- a) misfolded membrane proteins
- b) misfolded cytosolic proteins
- c) ubiquitinated proteins
- d) folded cytosolic proteins
- e) all of the above

54) After the polymerization of F-actin filaments has reached the steady state in a solution containing actin monomer, what would happen if the solution is diluted by 10-fold?

Assume that the critical concentration (C_c) of the + (plus) ends of the F-actin filaments is one third of that of the – (minus) ends. (4 pts)

- a) The preassembled F-actin filaments will start to depolymerize from both ends
- b) Actin monomers will be polymerized at both ends
- c) No effects on the preassembled F-actin
- d) The – end of F-actin will disassemble and the + end will remain the same
- e) The – end of F-actin will disassemble and the + end will grow

55) In most cells, the concentration of total actin monomer is about 100 μM and the critical concentration is about 1 μM . Based on these observations, one may mistakenly assume that the condition always favors polymerization *in vivo*. How do you explain this apparent paradox? (4 pts)

56) (True or False) Although microtubules are linked to the microtubule organizing center (MTOC), they typically nucleate at the + end located near the plasma membrane. (4 pts)

57) List the five basic mechanisms / types of cell signaling. (5 pts)

58) Which of the following is incorrect? (4 pts)

- a) cells can respond differently to the same molecule at the same concentration
- b) cells can respond differently to different concentrations of the same molecule
- c) enzymes may be positively or negatively regulated by their products
- d) Negative feedback in protein phosphorylation and dephosphorylation can generate signal oscillation
- e) the *src* oncogene in the Rous sarcoma virus is an exact duplicate of the cellular *src* gene found in the host organism

59) List the five phases in the cell cycle, and each of the four phases of cell division. In which phase of the cell cycle does cell division occur?
(10 pts)

60) What is different about the products of meiosis and mitosis? (4 pts)