

THE UNIVERSITY OF WESTERN ONTARIO  
DEPARTMENT OF BIOLOGY

Cell Biology 282b FINAL EXAM

Time: 9:00am-12:00noon

April 21<sup>st</sup>, 2005

INSTRUCTIONS

1. NO QUESTIONS can be asked of the proctors. If issues arise with specific questions, they will be dealt with at a later date.
2. Mark within the bubbles with a single or double stroke of an ordinary HB lead pencil. Marks made with a ballpoint pen or felt tip marker will NOT be detected. Do not make stray marks. Make all erasures complete.
3. Fill in the name and course blanks on the top of the SCANTRON sheet.
4. **STUDENT NUMBER:** Print the digits of your student number in the squares provided. Mark the corresponding bubble in the column below each printed digit.
5. **SECTION:**  
Fill in your course section (001 or 002) on the SCANTRON sheet.
6. **CODE:**  
Leave this area blank on the SCANTRON sheet.
7. Mark the one best choice from the alternatives provided for each question.
8. There are 60 questions in this test. Check your paper to ensure all questions are present. It is your responsibility to transfer all answers from the examination paper to the SCANTRON sheet **WITHIN THE THREE HOUR** time period.
9. THE SCANTRON sheet **MUST** be handed in at the end of the examination. You may keep the question booklet.
10. Wrong answers WILL NOT be deducted from your score.
11. There is only ONE correct answer for each question.

**\*\*NOTE\*\***

When filling in the Scantron answer sheet, failure to properly include and "bubble in" your student number will result in a loss of 5% from your exam grade.

1) With respect to intermediate filaments, which of the following is true?

- a) Keratin proteins are acidic or basic.
- b) Lamin A, B and C are epithelial-specific.
- ☒ c) Lamin A is epithelial specific.
- d) Lamin A is mesenchyme specific.
- e) Neurofilament (NF) L, M and H form trimers.

2) If an epithelial cell changes and becomes a mesenchymal cell, which of the following events does NOT occur?

- ☒ a) It will break its hemidesmosome connections.
- b) It will undergo anoikis.
- c) It will change its expression of intermediate filament proteins.
- d) It will become migratory.
- ? ☐ e) It will break its desmosome connections.

3) You are an expert on cell cycle regulation and have a sea urchin cell free system. In this nuclei-free system you have discovered that the activity of MPF follows a repeated up/down rhythmic cycle. This rhythm is abolished, however, when cyclin mRNA is translated and not replaced. You think you have a way to upset the rhythm by using an mRNA encoding a cyclin that has no destruction box. What would happen to the cell cycle if you added this mRNA to your sea urchin cell free system?

- ☒ a) The cycle would go up and down, but there would be no activation of MPF.
- b) The cycle would go up, level out and remain at this point.
- c) The continuous up/down cycle would be fully rescued.
- d) The cycle would go up and down once then stop and remain at this point.
- e) Nothing, the cycle would not start.

4) Epinephrine (adrenalin) secreted from the adrenals instructs recipient liver cells to break down glycogen into glucose – the flight or fight response. One of the first steps in the glycogen metabolic pathway is the elevation in cAMP levels that activate protein kinase A (PKA). PKA in turn post-translationally modifies glycogen phosphorylase kinase via \_\_\_\_\_, which then activates glycogen phosphorylase, leading to the breakdown of glycogen.

- a) glycosylation
- b) sulfation
- c) hydroxylation
- d) ubiquitination
- ☒ e) phosphorylation

5) Which of the following statements is TRUE when an epithelial cell continues to sit on a basement membrane?

- a) Vimentin is found in the adherens junctions.
- b) Vimentin supports the inside of the nuclear membrane.
- c) The cell undergoes apoptosis.
- d) Keratin supports the plasma membranes.
- ☒ e) The cell undergoes amorphosis.

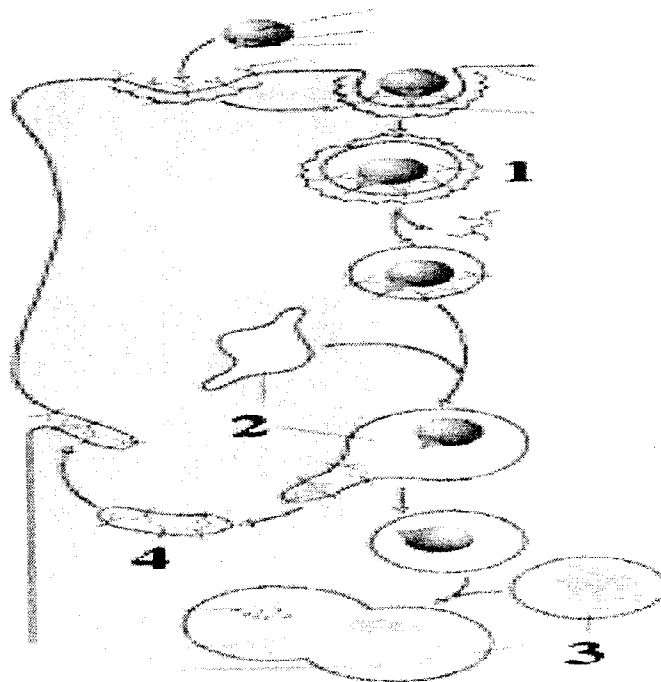
6) Which of the following is FALSE with respect to the fatty acids commonly found in animal membranes?

- a) Saturated fatty acids have more van der Waal's forces than unsaturated fatty acids.
- b) With respect to their tail lengths, myristic, palmitic and stearic are listed with increasing length (with myristic being the shortest).
- c) With respect to their melting points, myristic, palmitic and stearic are listed with decreasing melting points (with myristic being the highest).
- d) With respect to their melting points oleic, linoleic and arachidonic are listed with decreasing melting points (with oleic being the highest).
- e) Fatty acids rarely have trans double bonds.

7) Which of the following can readily pass through a lipid bi-layer?

- a) glucose
- b)  $\text{Na}^+$
- c)  $\text{HCN}$
- d) ATP
- e) none of the above

8) In the following diagram clathrin forms the coat around the internalized vesicle, seen at 1. At 2, the coat is lost and eventually the pH in the CURL will \_\_\_\_\_. This change in pH is essential to target the internalized protein to the \_\_\_\_\_ seen at 3. Finally, at 4, the cell recycles the \_\_\_\_\_ where it can be used again.



- a) decrease; nucleus; destruction box
- b) increase; trans-Golgi; phospholipid
- c) decrease; RER; KDEL receptor
- d) increase; cis-Golgi; ubiquitin
- e) decrease; lysosome; LDL receptor

9) Many toxins work by inactivating a protein or protein complex needed for day-to-day biological functions. How many of the following are responsible for causing ADP-ribosylation?

*Escherichia coli*; *Vibrio cholera*; *Clostridium botulinum*; *Ricis communis*; *Amanita phalloides*

- a) 1      **b) 2**      c) 3      d) 4      e) 5

10) PIP<sub>2</sub> levels in a cell are high. PIP<sub>2</sub> binds to, and inhibits profilin. PI-4 kinase is then added into the cell to alter phosphoinositide ratios. How will the addition of PI-4 kinase alter the function of the actin cytoskeleton?

- a) Actin polymerization will increase as G-actin is released.  
b) Actin will not bind to myosin even in the presence of Ca<sup>2+</sup>.  
c) Actin polymerization will be inhibited, as profilin is unavailable.  
**d) G-actin will breakdown into its constituent  $\alpha$  and  $\beta$  subunits.**  
e) Calcium will flood into the cytoplasm and cause apoptosis.

11) In a hypothetical situation a molecule exists that suddenly changes its partition coefficient, such that its new partition coefficient is much higher. As a result this molecule:

- a) can diffuse from an area of low concentration to an area of high concentration.  
b) can be pumped at a much faster rate across the membrane by its specific pump.  
c) will become concentrated in the lysosome.  
**d) can diffuse more readily across a biomembrane along its concentration gradient.**  
e) will result in an electrical potential forming across the cell membrane.

12) Ligands that activate MAPK pathways do so through the activation and/or inhibition of many protein intermediates. One of these intermediates is the protein called SOS, which functions in:

- a) keeping Raf in the inactive state.  
b) serving as the receptor of the ligand.  
**c) hydrolyzing GTP-GDP.**  
d) binding SH2 domains on Grb2.  
e) none of the above.

13) You are faced with a real cell biology puzzle as the mouse model system you are working on displays problems with smooth muscle relaxation of its blood vessels. To begin with, you test the ability of its endothelial cells to respond to acetylcholine, and they respond in the appropriate manner, IP<sub>3</sub> is released and you detect the almost immediate increase in Ca<sup>2+</sup> in the cytosol. Western blot analysis indicates that calmodulin levels are also normal. Perplexed, you decide to add cGMP to its smooth muscle cells, and they respond by activating PKG and they vasodilate. Given this information you come to the conclusion that the problem is:

- a) in the NO synthase.**  
b) in GTP levels in endothelial cells.  
c) in the NO receptor.  
d) in two of the above.  
e) in none of the above.



14) The improper preparation of many plants can have disastrous consequences to those who eat them. That was the case in the Philippines earlier this year when several children died after eating improperly cooked cassava root. In this case the acid that was released directly blocked the production of an ion used by the:

- a) ABC superfamily.
- b) A-class pumps.
- c) F-class pumps.
- ☒ d)  $\text{Na}^+/\text{K}^+$  ATPase.
- e) voltage gated  $\text{Na}^+$  channels.

15) Under normal conditions, apoptosis occurs in:

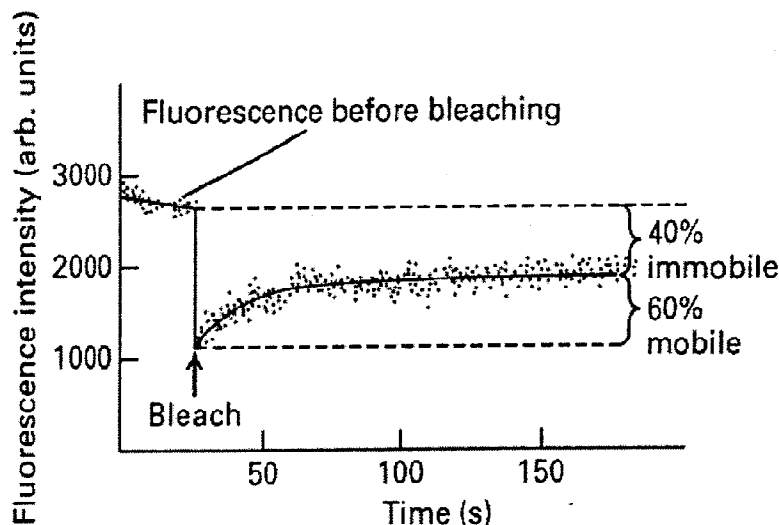
- a) cases where epithelial cells detach from basement membrane and extracellular matrix.
- ☒ b) cases where the cytoskeleton is severely disrupted.
- c) cases where Bcl-2 is activated and prevents the release of cytochrome C.
- d) cases where NO levels are too high.
- e) none of the above.

16) AMPPNP is a non-hydrolysable form of ATP. What would be the effect on sarcomere contraction if at the rigor stage all of the muscle cell's ATP was replaced with AMPPNP (assume all other channels and molecules work properly)?

- ☒ a) The myosin head would release, but not bind actin again.
- b) The sarcomere will remain in the rigor state.
- c) The myosin will release from the actin, bind again, and complete its power stroke.
- d) The F-actin will depolymerize.
- e) The A-band of the sarcomere would shorten.

17) The graph below demonstrates that:

- a) there is no link between the plasma membrane and the cytoskeleton
- b) integral membrane proteins do not diffuse laterally in the plasma membrane.
- ☒ c) 60% of the tubulin in the plasma membrane is mobile
- d) 40% of the tubulin in the plasma membrane is mobile
- e) bleached membrane components are replaced by neighbouring non-bleached fluorescent components



18) Which is typical of ALL membrane proteins?

- 9.7
- ~~a)~~ They rarely contribute to the function of the membrane.
  - ~~b)~~ They have transmembrane domains.
  - ~~c)~~ They are symmetric.
  - ~~d)~~ They have N-terminal signals.
  - ☒ e) They are involved in numerous protein-protein interactions.

19) The dynactin heterocomplex:

- 7
- ~~a)~~ cannot bind membranes.
  - b) is composed of 3 proteins and a phosphate group.
  - ☒ c) transports cargo along the nerve axon towards the nerve body.
  - d) utilizes heavy, intermediate and light chains that are all ATPases.
  - e) associates with GPCRs.

20) ApoB is an abundant protein in our body, yet blocking the polypeptide's entrance into the bloodstream would have frightful consequences. If an individual's cells were unable to \_\_\_\_\_ it would severely hinder his/her's ability to make a secretable form of ApoB and thus they would likely suffer from hypercholesterolemia, heart attacks and strokes.

- 7
- a) synthesize SRP
  - b) raise the pH in the CURL
  - c) hydrolyze ampholytes
  - d) methylate MPF
  - ☒ e) target clathrin to a proteasome

21) Alcohol containing high levels of sweetgrass or Buffalo grass may appeal to the palate of some, but is dangerous because of the coumarin present in the plant. In this regard, the problem lies in the fact that the chemical specifically works in:

- ✓
- a) blocking the synthesis of new mRNA.
  - b) activating the transition of G to F-actin.
  - ☒ c) preventing the reduction of a co-factor required to phosphorylate clotting factors.
  - d) cleaving a docking complex required for neurotransmission.
  - e) none of the above.

22) Tetrodotoxin directly affects which of the following cellular process?

- 7
- a) anaphase A
  - b) metaphase
  - ~~c)~~ filopodia extension
  - ~~d)~~ sarcomere contraction
  - ☒ e) mRNA transcription

23) Which is NOT part of the ECM?

- 7
- ~~a)~~ collagen
  - b) MMPs
  - c) fibronectin
  - ☒ d)  $\beta$ -catenin
  - e) proteoglycans

24) Which is NOT a phosphoglyceride?

- a) PE
- b) PC
- ☒ c) SM
- d) PI
- e) PT

25) The generation and maintenance of a resting membrane potential requires all of the following EXCEPT:

- ☒ a) a very permeable membrane.
- b) active pumping of ions.
- c) ion-specific membrane pores.
- d) ATP.
- e) a closed cellular compartment.

26) All of these are exoplasmic, except the:

- ☒ a) ER lumen.
- b) interior of lysosome.
- c) intermembrane space of mitochondria.
- d) ECM.
- ☐ e) internal face of plasma membrane.

27) You are studying the poisoning effects caused by the Death Cap Mushroom, and you plan to use a number of cell biological techniques along with fibroblast cells that are easily grown in culture and proliferate in response to FGF. First off, you use fluorescent microscopy with an actin monoclonal antibody and notice that \_\_\_\_\_.

Secondly, microarray analysis shows that c-fos mRNA levels are \_\_\_\_\_ those cells grown in the absence of the mushroom toxin. Given this information, pick the best answers to complete the sentences above.

- a) most of the actin is in the globular form; higher than in
- ☒ b) there is significantly more filamentous actin; lower than in
- ☐ c) there are no differences in the actin forms; higher than in
- d) most of the actin is in the globular form; lower than in
- e) most of the actin is in the filamentous form; identical to

28) You have received a tissue sample from an individual who displays all the symptoms of Botox poisoning. Unfortunately, you are given a deadline and can only perform one scientific test to see if your diagnosis is correct. Which one of the following would be the most informative to support your claim that the person had in fact been poisoned by Botox?

- a) IEF to measure the lectin component of the toxin
- ☒ b) SDS-PAGE and Western blot analysis to measure SNARE proteins
- c) Two-Hybrid analysis to measure cyclin/cdk interactions
- d) Northern blot analysis to measure p53 levels
- e) Southern blot analysis to measure profilin mutations

29) Which of the following is not possible with respect to integral membrane proteins?

- ☐ a) They have a hydrophilic cytosolic domain.
- ☒ b) Their transmembrane domain may have  $\beta$ -barrels spanning 3-4nm of the membrane.
- ☐ c) They have a hydrophobic transmembrane domain.
- ☐ d) Their transmembrane domain may have an  $\alpha$ -helix of 20-25 amino acids.
- ☐ e) They have a hydrophilic exoplasmic domain.

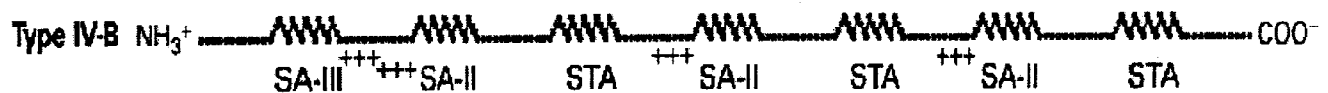
30) The fatty acid composition of a membrane cannot affect the membrane's:

- ☒ a) translation
- ☐ b) curvature
- ☐ c) melting point
- ☐ d) membrane function
- ☐ e) thickness

31) Which is true with respect to lipid linked membrane proteins?

- ☒ a) Acylation of Gly occurs on the exoplasmic side.
- ☐ b) Prenylation of Cys occurs on the exoplasmic side.
- ☒ c) Glycosylphosphatidylinositol links occur on the exoplasmic side.
- ☒ d) Acylation of Cys occurs on the cytosolic side.
- ☒ e) Prenylation of Gly occurs on the cytosolic side.

32) Given the information in the diagram below, the illustrated protein:

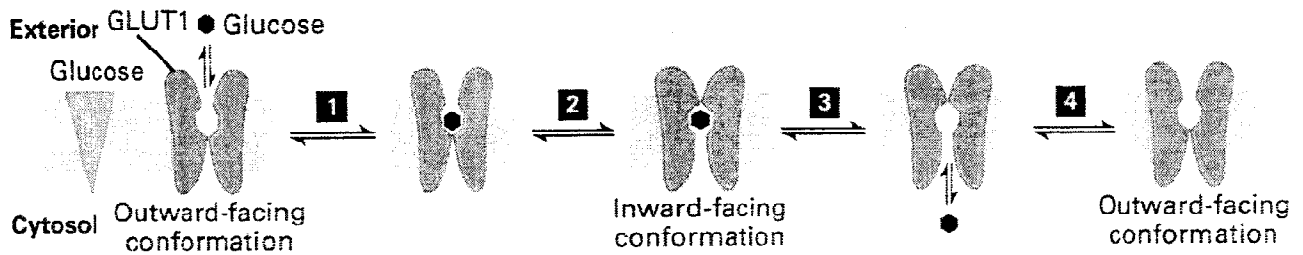


- ☒ a) has a cytosolic  $\text{NH}_3$  end.
- ☐ b) has 3 complete cytosolic loops.
- ☐ c) will be secreted.
- ☐ d) has 8 transmembrane domains.
- ☐ e) has 4 complete loops in the lumen.

33) Epithelial cells are connected by gap junctions. In a hypothetical case, a mutation occurs such that glucose can selectively and readily pass through these gap junctions from cell to cell. Assuming that the  $\text{Na}^+/\text{K}^+$  ATPase,  $\text{Na}^+$ /glucose symporter and the GLUT 2 channel are working properly, what effect would this gap junction mutation have on the level of glucose in the cytosol of these mutant epithelial cells?

- ☐ a) More glucose is pumped in by the basal  $\text{Na}^+$ /glucose symporter.
- ☐ b) Glucose accumulates in the lumen of the gut.
- ☒ c) Glucose accumulates in the cytosol as gap junctions with the basal lamina bring blood glucose into the cytosol.
- ☐ d) Glucose levels are relatively similar in all the epithelial cells.
- ☐ e) There is less glucose in the cytosol as cellular metabolism increases.

34) In the following diagram:



- a) an ABC type pump moves glucose into the cytosol.
- b) a uniporter moves glucose from an area of low to high concentration.
- ☒ c) a uniporter pumps glucose from an area of high to low concentration.
- d) facilitated transport is occurring.
- e) transport is occurring that is non-saturable.

35) A group of epithelial cells that contain circumferential belts constrict at their apical (top) surface during early development to help form the central nervous system. How would the treatment of these cells with vincristine affect this constriction?

- a) The cells dissociate.
- b) The cells constrict normally.
- c) The cells constrict basally (at their bottom).
- ☒ d) The cells do not constrict.
- e) The cells begin to migrate.

36) The cytoskeleton plays a crucial role during the cell cycle and mitosis, and is therefore the target of chemotherapeutic cancer drugs that selectively act on rapidly growing cells like those seen in many cancers. Taxol, originally isolated from the bark of the Pacific Yew tree acts on the same protein as the plant alkaloids vinblastine and vincristine, and although its mode of action is different than that of these alkaloids, the effects are similar. If you applied taxol to rapidly dividing liver cancer cells it would act in:

- a) initiating the formation of the cleavage furrow.
- b) interfering with lamin phosphorylation and breakdown.
- ☒ c) disrupting spindle dynamics.
- d) blocking RNA polymerase II.
- e) none of the above.

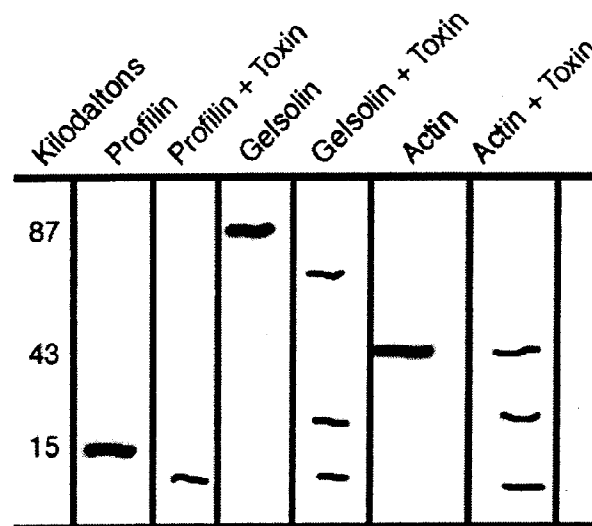
37) Proteasome degradation is one mechanism used by cells to process and destroy proteins. This targeted degradation, however, requires a signature on that protein. Which one of the following is a requirement in the proteasome degradation process?

- a) The carboxylation of glutamate.
- ☒ b) The ubiquitin ligation to lysine.
- c) The disulfide bond formation between cysteines.
- d) The hydroxylation of proline.
- e) All of the above.

38) Which is not a characteristic of a biomembrane?

- a) asymmetric
- b) fluid
- ✓ c) polar
- d) a closed compartment
- e) semi-permeable

39) Drs. Damjanovski and Kelly have submitted a grant for funding whereby they plan to test the effects of toxins on various cytoskeletal proteins. Using a cell free system with all the components needed for translation,  $S^{35}$  methionine, and mRNAs specific for profilin, actin and gelsolin, Dr. Kelly translates these mRNAs in the presence of a toxin and wants Dr. Damjanovski to use SDS-PAGE to analyze the products. The products are electrophoresed alongside control samples of mRNAs translated without the toxin. Dr. Kelly does not, however, tell Dr. Damjanovski what toxin he used, and when the gel is run and exposed to X-ray film, the autoradiogram looks like this:



Based on the toxins that were discussed in class, the one responsible for the data above is:

- a) botox.
- b) TTX.
- ✓ c) ricin.
- d)  $\alpha$ -amanitin.
- e) phalloidin.

40) The phenotype of the *kit* mouse shows characteristics of a human genetic syndrome described in the 1940's by a Dutch eye doctor named Petrus Waardenburg. Later, evidence would indicate that there are at least 4 genes that may be mutated in humans. The one, however, mutated in the *kit* mouse encodes:

- a) tyrosinase.
- ✓ b) mitf.
- c) MAPKK.
- d) receptor tyrosine kinase.
- e) stem cell factor.

41) Specialized cell junctions such as desmosomes and hemidesmosomes require:

- X
- a) MTOCs.
  - ☒ b) intermediate filaments.
  - c) microfilaments.
  - d) microtubules.
  - ☒ e) integrins.

42) Topogenic sequences in proteins are located in all of these locations EXCEPT:

- X
- ☒ a) near the-C terminal end.
  - b) at the N-terminal end.
  - c) where carbohydrate is attached.
  - ☒ d) at multiple sites within one protein.
  - e) near the N-terminal end.

43) People with the human genetic disease called adrenoleukodystrophy are unable to break down long chain fatty acids because the gene encoding a membrane protein is unable to transport an oxidizing enzyme into peroxisomes. This was the disease the little boy had in the movie *Lorenzo's Oil*. The disease shows up in mid-childhood, when severe neurological disorders appear, and is followed by death a few years later.

As a cell biologist you have evidence that in certain rare cases the mutation results in Aspartic acid being substituted for by Proline, causing the protein to fold improperly. Your task is to select the proper technique a hospital lab would need in order to screen a population of individuals for this rare disease. The best method to detect this mutated peroxisome membrane protein is:

- ?
- a) electron microscopy.
  - b) autoradiography.
  - c) isoelectric focusing.
  - ☒ d) gel filtration chromatography.
  - e) equilibrium density gradient centrifugation.

44) Resolution for a Phase Contrast Microscope is defined as being equal to:

- ✓
- a)  $\frac{0.61\alpha}{n \cos \lambda}$
  - b)  $\frac{0.61\lambda}{\alpha}$
  - c)  $\frac{0.61\alpha}{\sin \alpha}$
  - ☒ d)  $\frac{0.61\lambda}{n \sin \alpha}$
  - e)  $\frac{0.61 \cos \alpha}{n \arctan \lambda}$

45) The lamins:

- X
- ☒ a) are a component of the nuclear envelope. *membrane*
  - b) are destroyed by the cdc25 kinase.
  - c) are composed of collagen fibers.
  - d) are proteins that attach chromatids to the mitotic spindle.
  - e) are proteins of the extracellular matrix that bind fibronectin.

46) One August I spent the entire day at the beach and carelessly forgot to wear sun block. That night my skin was red hot and very uncomfortable to the touch. My friend, on the other hand, had put on sun block and now is going out partying. As a scientist you convince me to give you a sample of skin because you want to see if my friend's skin cells contain protein(s) that differ from my own. The protein of particular interest to you is p53, which serves as a transcription factor. Using \_\_\_\_\_, you would expect to find \_\_\_\_\_ p53 protein in my sun burnt skin cells that particular night because p53 transcribes the p21 gene, producing a protein that would \_\_\_\_\_ MPF.

**Pick the correct combination of answers to complete the sentence above.**

- a) differential centrifugation; no difference in levels of; degrade
- b) FACS; less; activate
- ☒ c) SDS-PAGE; more; inhibit
- d) equilibrium-density gradient centrifugation; more; activate
- e) electron microscopy; less; inhibit

47) Failure to add mannose-6-phosphate residues to glycoproteins results in:

- ☒ a) an ER disease.
- b) a Golgi disease.
- c) a nuclear disease.
- d) a lysosomal disease.
- e) none of the above.



48) I found this living in my lab and had to take a picture of it. How many of the following would I need and/or be required to generate this micrograph?

primary electrons; phosphorescent screen; heavy metals; fluorochromes; UV-light;  
secondary electrons; X-ray film; monoclonal antibodies; electromagnetic lenses

- a) 1
- b) 2
- ☒ c) 3
- d) 4
- e) 5



49) Which one of the following does not directly affect muscle contraction?

- a) malfunctioning  $\text{Na}^+/\text{K}^+$  pumps
- b) coumarin
- ☒ c) tetrodotoxin
- d) botox
- e) malfunctioning voltage gated channels

50) Which of the following is TRUE?

- ☒ a) Sterate has a higher melting temp than oleate.
- ☒ b) C28:2 fatty acids are common in human cells.
- c) Phosphoglycerides have a three carbon Lysol 3-phosphate scaffold.
- d) Cholesterol is hydrophilic.
- e) A micelle is bi-layered.

51) Individuals suffering from B-cell (Non-Hodgkin's) lymphoma may have a poor prognosis if these cells proliferate and make their way to other organs. There are many possibilities as to why these cells are not subject to the normal rules governing cell growth, but as the name implies there are definitely problems in their ability to undergo apoptosis. From what was discussed in class, a reason to explain why Bcl-2 is active in B-cell lymphomas is because:

- ☒ a) a mutation in the coding sequence prevents Bad from binding to Bcl-2 under any condition.
- b) AKT kinase cannot be activated in these cells.
- c) PI3-kinase directly phosphorylates procaspase 3.
- d) PIP2 cannot be cleaved into IP3 and DAG.
- ~~e) Bax dimerizes with itself.~~

52) DNA microarray analysis shows that the cdc2 gene product is turned on during certain times in the cell cycle, but you are suspicious that the gene product does not act alone. To address this, you used the gene as bait in a yeast two-hybrid screen and you are successful, as you have identified a binding partner. You have the "fish" from the screen sequenced and it turns out to encode:

- ☒ a) p34.
- ☒ b) cyclin.
- c) weel.
- d) ubiquitin.
- e) none of the above.

53) Apoptosis is known to result in the cleavage of various components of the cytoskeleton. Which of the following directly disrupts cytoskeletal function?

- a) Tetrodotoxin poisoning.
- b) Binding of Bad to 14-3-3.
- c) Caspase-3 activation.
- ☒ d) Cyt c localization in the intermembrane space of the mitochondria.
- e)  $\text{Ca}^{2+}$  localization in the intermembrane space of the mitochondria.

54) You suspect that a young patient that has come to see you is suffering from whooping cough. The symptoms are obvious, but to make sure before administering antibiotics, you suggest one test. You have an antibody to the toxin from the bacteria that causes whooping cough, and you have taken a sample from the infected area and are growing the person's lung cells to see if they are infected with *B. pertussis*. Using non-denaturing PAGE followed by a Western blot, you find that the pertussis toxin is there and it is bound to:

- a) the 28s component of the large ribosomal subunit
- b) the prostaglandin receptor
- c) a G-alpha subunit
- d) adenylyl cyclase
- e) the translocon

55) Once stimulated, Phospholipase C (PLC) is responsible for activating many events. How many of the following are the result of PLC activation, and/or serve to activate PLC?

synthesizes PIP2 from IP3 and DAG; requires cAMP to function; catalyzes the breakdown of cGMP to 5'GMP; binds NO; stimulated by tyrosine kinases; is targeted by the ricin RTA polypeptide

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

56) Which is true of a typical biomembrane?

- a) It contains a hydrophilic core.
- b) The biomembrane has an exoplasmic and cytosolic face.
- c) It is composed of one type of lipid molecule.
- d) Lipid tails in the biomembrane are attached to each other through covalent bonds.
- e) All lipid molecules in the biomembrane are typically immobile.

57) The phenomenon in cell biology referred to as the "Kiss of Death" applies to:

- a) actin binding to capping proteins.
- b) mannose 6-phosphate binding lysosomal hydrolases.
- c) lectins binding voltage-gated ion channels.
- d) RTK receptors binding KDEL-containing chaperones.
- e) none of the above.

→ ubiquitin

58) Dr. Hyde, a world-renowned pharmacologist, found a toxin produced by a toad that cleaves kinesin into two, non-functional fragments. Luckily for humans, this toxin does not cross the plasma membrane. When the chemical structure was reported, a malicious scientist found a way to couple it to apoB. What happens when this chimeric protein is injected into the bloodstream?

- a) It enters the cell by phagocytosis, and stops anterograde movement of cargo on microtubules.
- b) It enters the cell by facilitated transport, and accelerates retrograde movement of ribosomes on microfilaments.
- ☒ c) It enters the cell by receptor-mediated endocytosis, and accelerates anterograde movement of cargo on microtubules.
- d) Two of the above.
- e) None of the above.

59) The jellyfish protein aequorin reacts and gives off visible light when it binds calcium ions. If cells were injected with aequorin into the cytosol which one of the following, when present, would directly or indirectly cause aequorin to give off a flash of light?

- a) DAG
- b) Thymosin
- c) Latrunculin B
- d) Cytochalasin
- ☒ e) IP<sub>3</sub>

60) Ouabain is a poisonous glycoside extracted from the seeds of certain African trees. It is used as a heart stimulant, and by some African peoples as a dart poison because it acts specifically on Na<sup>+</sup>/K<sup>+</sup> ATPase. When epithelial cells grown in culture are treated with ouabain, how many of the following would specifically be affected?

maintenance of the resting membrane potential; action potentials; actin polymerization; gap junction communication; mitosis

- a) 0
- b) 1
- ☒ c) 2
- d) 3
- e) 4