

THE UNIVERSITY OF WESTERN ONTARIO
DEPARTMENT OF BIOLOGY

Cell Biology 282b Midterm 2

Time: 1:00-2:30 pm

March 13th, 2005

INSTRUCTIONS

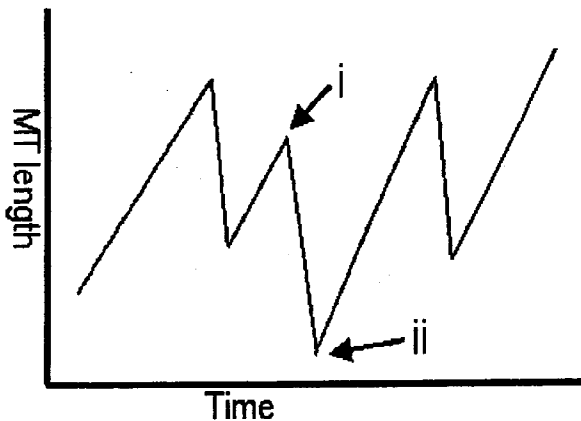
1. Mark within the bubbles with a single or double stroke of an ordinary HB lead pencil. Marks made with a ballpoint pen or felt tip marker will NOT be detected. Do not make stray marks. Make all erasures complete.
2. Fill in the name and course blanks on the top of the SCANTRON sheet.
3. **STUDENT NUMBER:** Print the digits of your student number in the squares provided. Mark the corresponding bubble in the column below each printed digit.
4. **SECTION:**
Fill in your course section (001 or 002) on the SCANTRON sheet.
5. **CODE:**
Leave this area blank on the SCANTRON sheet.
6. Mark the one best choice from the alternatives provided for each question.
7. There are 35 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 90 minute time period.
8. NO QUESTIONS can be asked of the proctors. If issues arise with specific questions, they will be dealt with at a later date.
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.

$$\frac{16}{35} = 45.7\%$$

1. Below is a graph showing the length of a single microtubule over time.



What events would have occurred at time points **i** and **ii**, respectively?

- A. Profilin stores were depleted and then replenished.
- B. The temperature decreased and then increased.
- C. α and β monomers disassociated and then re-associated.
- ☒ D. Kinase activity resulted in phosphorylation, while phosphatase activity resulted in de-phosphorylation.
- E. Retrograde transport switched to anterograde transport.

2. Which of the following would you NOT expect to find when viewing a moving cell?

- A. lamellipodia
- ☒ B. fillapodia
- C. stress fibers
- D. membrane ruffles
- E. none of the above

3. The depolarization of the plasma membrane by a nerve impulse causes a muscle cell to

- A. close its SR calcium channels.
- B. relax its contraction.
- ☒ C. open its SR calcium channels.
- D. form T-tubules.
- E. pump calcium out of the SR.

4. A single cell is migrating along an extracellular matrix (ECM). Which of the following proteins would you typically associate with a migrating cell and its ECM? The proteins listed are in no particular order.

- ☒ A. cadherin, laminin, actin
- B. desmoglein, actin, myosin
- C. lamin, occludin, integrin
- D. fibronectin, integrin, actin
- E. fibronectin, peripherin, actin

5. Using a sliding filament assay you can determine that:

- A. myosin II moves at $0.04 \mu\text{m/s}$. ✗
- ☒ B. myosin is a (+) end directed motor.
- C. myosin V moves at $0.04 \mu\text{m/s}$.
- D. myosin I moves at $4.5 \mu\text{m/s}$. ✗
- E. two of the above.

6. Microtubule associated proteins do NOT:

- A. stabilize microtubules. ✓
- B. contain a microtubule binding domain. ✓
- C. bundle microtubules. ✓
- ☒ D. contain a basic projection domain. *more acidic proj domain!*
- E. have variable length projection domains.

7. If you add cytochalasin to cultured mammalian cells that have just entered interphase what is most likely to happen?

- ☒ A. The cells continue mitosis and arrest at cytokinesis. ?
- B. The cells cannot align the chromosomes during metaphase.
- C. The cells complete the cell cycle normally. ?
- D. The cells arrest at mitotic anaphase.
- E. The cells cannot replicate their DNA.

8. A fictional disease results in the sudden loss of ALL calcium channel function in muscle cells just as the sarcomere was at its shortest length. What would the consequences of such a loss be on muscle contraction?

- A. Normal contractions occur as magnesium can be used instead. ✗
- B. Normal contractions occur as the cells can still utilize ATP. ✗
- ☒ C. Muscle cells would contract and would not stop contracting. ✗ *mal contr!*
- D. Muscle cells would not contract as actin and myosin would not interact. ?
- E. Muscle cells would not contract as their gap junctions do not function.

9. With regards to the sarcomere, which statement is CORRECT?

- A. CapZ stabilizes myosin.
- B. Synemin stabilizes the Z-disk.
- ☒ C. Tropomodulin movement is due to its binding of Ca^{2+} . ✗ *+ troponin binds!*
- ☒ D. Rho caps actin. ✗
- E. Tropomyosin coats the myosin heads. ?

10. What is the key difference between intermediate filaments on the one hand, and microfilaments and microtubules on the other?

- A. Only intermediate filaments stabilize cell structure.
- ☒ B. Intermediate filaments do not have polarity.
- C. Intermediate filaments are thinner than the other filaments.
- D. Intermediate filaments are hollow tubes.
- E. Only intermediate filaments can support membranes.

11. During mitosis, ____ end microtubule motors lengthen the spindle after ____ microtubule motors align it. The asters are then pulled to the cell membrane primarily by ____ microtubule motors.

A. (+);(-);(+);

B. (-);(+);(-);

C. (+);(-);(-);

☒ D. (-);(+);(+);

E. none of the above

+ = lengthen
- = align
- = pull

12. You have injected a large amount of thymosin into a migrating fibroblast. What is the most likely scenario?

A. The cell changes direction and migrates with the injection site as its leading edge.

☒ B. The cell increases migration speed in its original direction as more G-actin becomes available for polymerization at the leading edge.

C. The cell slows down and the F-actin content of the cell increases as thymosin prevents de-polymerization.

D. The treatment has no effect.

E. The cell no longer migrates as F-actin filaments depolymerize.

13. To determine actin polarity one can "decorate" the actin with ____ . This is a fragment of myosin, which is a ____ end directed motor.

A. S2 myosin; (-)

☒ B. S1 myosin; (+)

C. LMM; (+)

☒ D. LMM; (-)

E. none of the above

14. 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 colchicine 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.

15. A cell migrating *in vitro* is experimentally treated such that it cannot produce or utilize keratin. As a result, this cell will:

A. stop migrating because it cannot form focal adhesions.

B. continue migrating normally unaffected by the treatment.

C. stop migrating because it cannot form hemidesmosomes.

☒ D. adhere tighter to the substrate and lie flat because it cannot form stress fibers.

E. proliferate indefinitely as it cannot form desmosomes between cells.

16. Phalloidin is labelled with a fluorescent dye and added to cells to stain and visualize cytoskeletal structures. Which one of the following would be stained and made visible by fluorescent phalloidin?

- 2 X
- ☒ A. mitotic apparatus.
 - ☐ B. adherens junctions.
 - ☐ C. nuclear lamina.
 - ☐ D. mitochondria.
 - ☐ E. centrosomes.

17. Which of the following occurs during the extravasation of leukocytes?

- 2 X
- ☐ A. Endothelial cells migrate in response to microtubule polymerization.
 - ☐ B. Integrins bind to cadherins to form hemidesmosomes.
 - ☒ C. PAF binds to the PAF receptor.
 - ☐ D. Leukocytes express cell-surface N-CAMs.
 - ☒ E. Endothelial cells respond to inflammatory signals and secrete spectrin on their surface.

18. Which statement is INCORRECT?

- /
- ☐ A. Tight junctions are composed of occludin and claudin. *
 - ☐ B. NCAMs are Ca^{2+} independent Ig superfamily CAMs. *
 - ☒ C. Cadherins are heterodimers of alpha and gamma subunits. ?
 - ☐ D. Selectins bind carbohydrates. *
 - ☐ E. Keratin fibers are associated with integrins in hemidesmosomes. ?

19. The cytoskeleton plays NO DIRECT role in:

- ✓
- ☐ A. Muscle cell contraction.
 - ☐ B. Nerve cell stability and function.
 - ☐ C. Cytokinesis.
 - ☒ D. Transcription.
 - ☐ E. Exocytosis.

20. Which treatment does NOT affect/disrupt cilia beating and function?

- ✓
- ☒ A. Degradation of nexin. *
 - ☐ B. Severing of the axoneme at the basal body. *
 - ☒ C. Removal of all dynein. *
 - ☒ D. Depolymerization of the B-microtubules. *
 - ☒ E. All of the above treatments would affect cilia function.

21. Which of the following would NOT be affected by the addition of taxol?

- ✓ 43
- ☒ A. Ciliary beating.
 - ☐ B. Chromosome movement and positioning during metaphase.
 - ☐ C. Chromosome separation during Anaphase A.
 - ☐ D. Microtubule depolymerization in cold temperatures.
 - ☐ E. Dynamic instability.

22. Which of the following is CORRECT?

- ☒ A. An actin network is found inside the nucleus supporting the nuclear membrane.
☐ B. Actin networks are often cross-linked by plectin. *x*
☐ C. Actin networks cannot be linked to transmembrane proteins.
☐ D. Actin networks can be regulated by cdc42, Rac and Rho.
☐ E. Actin networks allow aster positioning during interphase.

23. Which of the following statements is CORRECT?

- ☐ A. Amoebae, and other migrating cells, localize Mg^{2+} to their trailing tail edge.
☐ B. Intermediate filament assembly causes the extension of filopodia.
☐ C. The formation of cell extensions, like filopodia, flagella, and lamellipodia is the first step in the cell migration sequence.
☒ D. Focal adhesion attachment to a substrate prevents cell migration.
☒ E. Extension of the plasma membrane occurs at the leading edge of migrating cells.

24. With regards to cilia AND flagella, which statement is INCORRECT?

- ☐ A. Cilia and flagella contain axonemal structures.
☒ B. In cilia and flagella, dynein arms "walk" to the (+) end of the microtubule.
☒ C. In cilia and flagella, microtubule sliding does not occur in the basal body.
☐ D. Cilia and flagella contain a 9+2 arrangement of microtubules.
☐ E. Cilia and flagella are membrane bound.

25. Which statement is INCORRECT?

- ☐ A. Cadherins mediate Ca^{2+} dependent homophilic cell adhesion.
☐ B. NCAMs have polysialic acid addition sites.
☐ C. Actin binds to RGD sequences on integrin.
☒ D. Adherens junctions contain cadherins. *x*
☐ E. Gap junctions form channels.

26. You have injected a large amount of cofilin into a fibroblast cell that is attached to a surface, but not migrating. Which of the following is the most likely outcome?

- ☐ A. The fibroblast migrates as F-actin stress fibers and associated focal contacts disintegrate.
☐ B. Stress fibers contract and the fibroblast binds tighter to the surface.
☐ C. The F-actin content of the fibroblast dramatically increases as cofilin binds to the plus ends of F-actin and prevents de-polymerization.
☐ D. The treatment has no effect on the fibroblast.
☒ E. The fibroblast detaches easily from the substrate as the disruption of actin filaments weakens the adhesive interactions.

27. Which event REQUIRES active microtubule depolymerization?

- ☒ A. Mitosis.
☐ B. Cilia beating.
☐ C. Axonal transport.
☐ D. Sacromere contraction.
☐ E. Microvilli formation.

28. Assuming that the role of each protein fragment remained the same as in its original protein, what would be the consequences on cargo trafficking by a kinesin molecule if you replaced its light chains with a dynactin heterocomplex?

- X
- A. Cargo recognized by the kinesin heads would be trafficked to the minus end of the microfilament.
 - B. Cargo recognized by the dynactin complex would be trafficked to the plus end of the microfilament.
 - C. The kinesin heavy chains will migrate towards the plus end of the microtubule, regardless of its cargo.
 - ☒ D. The kinesin heavy chains will neither recognize the correct cargo, nor will they migrate in the correct direction.
 - E. Cargo recognized by the dynactin complex would undergo retrograde axonal transport.
- L light chain = +ve
wt heavy + 18
dynactin = - end
wt heavy
wt heavy + 19

29. During actin polymerization, which of the following is CORRECT?

- ✓
- A. Nucleation increases the time needed to reach steady state. X
 - B. Gelsolin coats the myosin thick filament within the sarcomere. X
 - ☒ C. The flexibility of F-actin allows for polymerization close to membranes.
 - D. Profilin binds actin away from thymosin to inhibit polymerization. X
 - E. Both A and D.

30. Which is NOT a cellular adhesion molecule?

- O X
- A. Desmoglein.
 - ☒ B. Selectin.
 - C. Integrin.
 - D. Proteoglycan.
 - E. NCAM.

31. Which statement is INCORRECT?

- ✓
- ☒ A. Microtubule bundles support microvilli. → micro filament bundles of actin do.
 - B. Studies using nerve axons have revealed much about kinesin's functions.
 - C. Dynein drives the rhythmic beating of cilia.
 - D. Polymerization and depolymerization of the cytoskeletal elements can both push and pull cellular components and organelles.
 - E. Microfilament bundles support filopodia.

32. Cells growing *in vitro* are injected with an antibody that inhibits the function of all lamin proteins. What observation would you expect to see with respect to the injected cells?

- X D
- A. Cell surface integrin α and β subunits do not dimerize.
 - B. Cells that were migrating switch their adhesive properties, and instead use their cell surface integrins to bind with cadherin.
 - C. NF-L, NF-M and MF-H replace the lamin network in all cells.
 - D. The cells lose their nuclear structure and shape.
 - ☒ E. Cells that were migrating cease migration since focal adhesions are not made.

33. Which of the following statements is TRUE with regards to a migrating mesenchymal cell?

- A. Vimentin is found in adherens junctions.
- B. Vimentin supports the inside of the nuclear membrane. ✓?
- C. Actin is bound to hemidesmosomes.
- D. Keratin is bound to adherens junctions.
- ☒ E. Actin polymerization is associated with membrane ruffling at the leading edge.

34. You add a microfilament fragment that is decorated with S1 myosin to a pool of reagents that contain all that is needed for actin polymerization. The reagent mix also contains a number of unknown actin binding proteins. After a long period of time, you note that polymerization occurs only at the end of the decorated microfilament towards which arrowheads are pointing. Which of these possibilities would result in this observation?

- B X
- A. The (-) end and (+) end both polymerized.
 - B. CapZ is present.
 - ☒ C. Troponin is present.
 - D. The (+) end polymerized faster than the (-) end.
 - E. The (-) and (+) ends have different Cc's.

35. You have manipulated two non-adhesive cell culture lines, so that line A expresses P-cadherin, while line B expresses N-cadherin. You mix A cells and B cells, and incubate them in the presence of an antibody that blocks the activity of N-cadherin. What is the likely outcome from this cell mixture?

- D X
- A. A and B cells remain mixed.
 - B. A and B cells sort out, and A and B cells form separate clusters.
 - C. Both A and B cells disperse.
 - D. A and B cells sort out, where A cells cluster and B cells disperse.
 - ☒ E. None of the above.
- Handwritten note:* A and B cells sort out, where A cells cluster and B cells disperse.