KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MOLECULAR AND CELL BIOLOGY

SBC 116: CYTOSKELETON 1

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DATE: WEDNESDAY 28TH MARCH 2012 TIME: 4.30 P.M. – 6.30 P.M.

INSTRUCTIONS

Section A: Answer all questions. Each question is 1 mark. Total marks = 20.

1. A linear chain of protein subunits joined end to end which associate laterally with other chains to form microtubule cytoskeletal component are referred to as --------
2. The property of sudden conversion from growth to shrinkage and vice cersa in a microtubule filament is referred to as---------
3. The end of a microtubule at which addition of monomers occurs most readily and is also the first growing end is ------
4. The process by which a polymeric microtubule filament is maintained at a constant length by addition of protein subunits at one end and loss of subunits at the other is called----
5. Centrally located organelle of animal cells that is the primary microtubule organizing centre and acts as the spindle pole during mitosis is called---------
6. Protein assembly containing a special form of tubulin along with other proteins that is an efficient necleator of microtubule growth is referred to as ----------
7. A member of the family of motor proteins that move along microtubules by walking towards the minus end are referred to as ------

8. Bundle of microtubules and associated proteins that forms the core of a cilium or flagellum in a eukaryotic cell and is responsible for their movement is referred to as --
9. Higher plant cells nucleate microtubules at sites distributed around the ----------
10. In humans, hereditary defects in ciliary dyneins causes ----------

Multiple choice questions. One correct answer.

11. Which of the following is true about bacteria flagella?

A).They contain microtubules.

B).Are long rigid helical filaments made up of repeating subunits of flagellin protein.

C). They rotate with a whip like motion driven by dyneins.

D). They emanate from the centrosome.

12. At metaphase, three classes of dynamic microtubules are -----

A). Kenetochore, Astarala nd bipolar.

B). Metaphase, interphase and cytokinesis.

C). Interpolar, astral and kenetochore.

D). Astral, centrosome and mitotic.

13. -------is involved in centrosome reorientation.

A). Rho family protein CDC42.

B). Centriole.

C). Microtubules.

D). GTP.

14. Old components from the axon terminals are carried cack to the cell for degradation by --- A). Cytoplasmic kinesin

B) Cytoplasmic dynein.

C). Synpases.

D). Kinesin-13.

15. Which of the following is not true about axonemal dyneins?

A). Have 2 or 3 motor domains heads.

B). Are involved in the sliding movement of microtubules that drives the beating of cilia.

C) Some are heterodimers and others heterotrimers.

D). They sometimes function as monomers and move membrane enclosed organelles.

16. Microtubules are nucleated at their -----end.

A) Minus

B). Plus

C). Centrosome

D). Nucleus αβ end.

17. ------represent a family of GTP binding proteins which form heterooligomeric complexes which polymerize to form a new type of non-polar filament.

A). centriole

B). Aβ tubulin

C). Septins

D). Protofilament.

18. In fluorescence microscope studies, fluorescently labeled proteins are synthesized within a cell as------

A).A fusion protein containing GFP

B). Intracellular domains

C). Enzymes.

D). Heterodimers of the repective building blocks of the filament.

19. Which of the following is not true about microtubules.

A). In a microtubule, lateral and longitudinal interactions between the tubulin subunits are responsible for maintaining the tubular form.

B). Longitudinal contacts between the ends of adjacent subunits link the subunits head to tail into a linear protofilament.

C). Within each protofilament, the dimeric subunits repeat every 25 nm.

D). Through lateral interactions, protofilaments associate side by side into a sheet or cylinder.

20. Which of the following is false.

A). The number of monomers that add microtubule polymer per second will be proportional to the concentration of the free sububits.

B). The number of monomers that leaves the polymer end at a constant rate depend on concentrationof free subunits.

C). At critical concentration, the rate of subunit addition equals the rate of subunit loss.

D). All the choices are correct.

Section B: Answer all questions (Total marks = 30)

1. A). The structural polarity of all microtubules is such that α- tubulin is exposed at one end and β-tubulin is exposed at the opposite end. State if this statement is true or false and justify your answer (3 marks)

B). The role of GTP hydrolysis in microtubule serve to weaken the bonds in the polymer and thereby promote depolymerization. State if this statement is true or false and justify your answer (2 marks)

2. A). Explain why it is much easier to add tubulin to existing microtubules than to start a new microtubule from the scratch (2 ½ marks).

B). In most animal cells, minus end directed microtubules motors deliver their cargo to the periphery of the cell, whereas plus end directed microtubule motors deliver their cargo to the interior of the cell. State if this statement is true or false and justify your answer. (2 ½ marks) marks).

3. You are intrested in monitoring the dynamics of the cytoskeleton. Name and briefly describe the technique of choice (5 marks).
4. Outline the stages of microtubule assembly (5 marks).
5. Describe the structure of MAPs stabilizing proteins (5 marks).
6. Using specific examples, distinguish stable from unstable microtubules (5 marks).

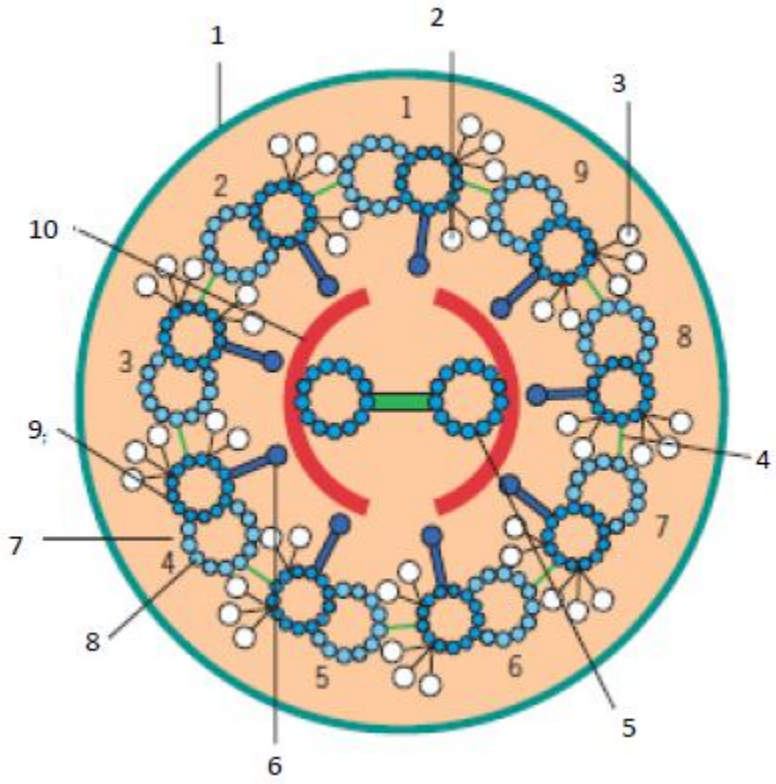
Section C: Answer any two questions. Total marks = 20.

1. Dynamic instability causes microtubules to either grow or to shrink rapidly. Consider an individual microtubule in its shrinking phase.
   A) What must happen at the end of the microtubule in order for it to stop shrinking and start growing ? (3 marks).
   B) How would an increase in the tubulin concentration affect this switch from shrinking to growing? (3 marks).
   C) What would happen if GDP, but not GTP were present in the solution? (2 marks).
   D) What would happen if the solution contained an analogue of GTP that would not be hydrolyzed? (2 marks).

2. The drugs taxol, extracted from the bark of yew trees and colchicine an alkaloid from autum crocis have opposite effects. Taxol binds tightly to microtubules and stabilize them. When added to cells, it causes much of the free tubulin to assemble into microtubules. In contrast, colchicine prevents microtubule formation. Taxol and colchicine are equally toxic to dividing cells and both are used as anticancer drugs. Based on your knowledge of microtubule dynamics, explain why these drugs are toxic to dividing cells despite their opposite modes of action (5 marks)

B. The orientation of the αβ-tubulin dimer in a microtubule can be determined in several ways. GTP-coated beads for example are found to bind exclusively at the plus end of microtubules. By contrast, gold beads coated with antibodies specific for a peptide of α-tubulin bind exclusively at the minus end. How do these observations define the orientation of the αβ-tubulin dimer in the microtubule? Which subunit, α or β is at which end? Expalin how you arrived at your answer (5 marks).

3. The figure below shows a cross section through a flagellum. Label the parts labelled 1-10 (5 marks)



B). Assembly and stability of microtubules are temperature dependent. With an illustration, explain this reality (5 marks).