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MCB130 midterm exam

1) The exam has 6 pages (not including this page). Check that you have all 6 pages

2) Please write your name and SID on the top of each page. The pages will be separated for grading

3) Restrict your answer to the space provided. If you run out of space for some reason, continue on the back of the same page, NOT on the next page. The pages may be separated for grading

4) Please write clearly and legibly. The grader has to be able to read your answer without your assistance!

Good Luck!

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TOTAL	**/90**

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1(a) (6 points) You add radioactively-labeled insulin to liver cells that have 30,000 insulin receptors per cell. The K_d of the interaction between insulin and its receptor is 10^{-8}M. On the axes provided, draw a single curve that shows how the binding of radioactive insulin to the cells would change (as directly measured in your experiment) with increasing concentrations of radioactive insulin. Remember to label the axes.

1(b)(4 points) A pharmaceutical company has developed a new drug Diabcure that competes with insulin for binding to its receptor. The K_d for the interaction between Diabcure and the insulin receptor is 10^{-11}M. You repeat the binding experiment but this time you always mix the radioactive insulin with an equal concentration of Diabcure. Draw on the same axes, the expected binding of radioactive insulin in the presence of Diabcure (label this '+ Diabcure') .

2 (6 points) Are the following statements about the insulin receptor True or False
(a) (2 points) The insulin receptor has 7 transmembrane domains

(b) (2 points) The insulin receptor dimerizes upon ligand binding

(c) (2 points) The insulin receptor has enzymatic activity

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3)(6 points) A newly developed drug called Niagra enters cells and blocks the interaction of Ca^{2+} with calmodulin. What would be the effect of Niagra on the following (increase, decrease or unchanged)?

a) (2 points) Activation of the Ca^{2+}/calmodulin-dependent protein kinase (CaM-kinase)

b) (2 points) The generation of diacylglycerol (DAG)

c) (2 points) The activity of the pump that pumps Ca^{2+} out of cells

4) (9 points) In an experiment with purified proteins, radioactively labeled GTP is bound to Ras. RasGAP is added to the reaction. After a period of incubation you measure the radioactivity that remains bound to Ras. Would it increase, decrease or be unchanged if:

a) (3 points) The γ-phosphate group of GTP is radioactively labeled

b) (3 points) The α-phosphate group of GTP is radioactively labeled

c) (3 points) Both the α– and γ– phosphate groups of GTP are radioactively labeled

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5) (6 points) When you add the drug rapamycin to cells, what would happen to the following? Answer only whether they would increase, decrease, or stay unchanged.

a) (2 points) Translation of mRNA

b) (2 points) Phosphorylation of Akt(PKB) by Tor

c) (2 points) The percentage of Rheb that is GTP-bound

6) (8 points) Explain how dimerization of the EGF receptor results in the recruitment of Grb2.

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7) (9 points) Regarding MAP kinase (write one sentence for each answer)

a) (3 points) How does MAP kinase dimerization affect its localization?

b) (3 points) How does MEK activate MAP kinase?

c) (3 points) Why is there very little amplification in the MAP-kinase activation pathway that responds to mating pheromone in yeast?

8) (10 points) Are the following statements about the cell cycle 'True' or 'False'?

a) (2 points) Variations in cyclin-cdk activity through the cell cycle are primarily due to changes in cdk levels

b) (2 points) cdk-activating kinase (CAK) is itself a cyclin-dependent kinase

c) (2 points) In yeast cells, the SCF complex binds to and degrades the inhibitor Sic1 to enable entry into S-phase

d) (2 points) The metaphase to anaphase transition is triggered by the degradation of separase

e) (2 points) Cdc14, a key regulator of exit from mitosis, is a protein kinase

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9) (6 points) In the cell fusion experiment where a cell in G2 was fused to a cell in S-phase, what happened to the G2 nucleus in the heterokaryon? Explain the molecular basis of this observation.

10) (6 points) DNA damage results in phosphorylation of the p53 protein. How does this lead to cell-cycle arrest?

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11) (6 points). Are the following statements about apoptosis True or False?

a) (2 points) Cells swell and burst open during apoptosis

b) (2 points) Caspase 8 binds directly to the Fas trimer

c) (2 points) In the C. elegans cell death pathway, the Ced-9 gene directly activates Ced-3 without involvement of the mitochondria

12) (8 points) In the lecture on G1 control, I told the class that each student should try to solve the following problem: Arthur Pardee showed that either phosphate deprivation or amino-acid starvation caused a cell-cycle arrest at exactly the same point in G1 (the restriction point). Outline the principles of a simple experiment that could test whether this is the case (i.e. test whether the two mechanisms of arrest stop the cell cycle at the same or different places in G1). (Hint: All you need to measure is radioactive thymidine incorporation to determine whether DNA synthesis has occurred). Hopefully you have thought about this question over the last couple of weeks and know the answer.