Name: ________________________________

Bio130, Final Examination, May 2001

Match the regulator in the left hand column with one of the enzymes on the right. Indicate whether the regulator increases or decreases the activity of the enzyme. Each regulator can be used once. (1 point for each correct answer)

<table>
<thead>
<tr>
<th>Regulator</th>
<th>Enzyme</th>
<th>Increase or Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. calcium</td>
<td>e. 1. glycogen phosphorylase</td>
<td>decrease</td>
</tr>
<tr>
<td>b. NADPH</td>
<td>a. 2. CDK6</td>
<td>increase</td>
</tr>
<tr>
<td>c. cyclic AMP</td>
<td>b. 3. phosphofructokinase-1</td>
<td>increase</td>
</tr>
<tr>
<td>d. malonyl CoA</td>
<td>c. 4. carnitine acyl transferase I</td>
<td>decrease</td>
</tr>
<tr>
<td>e. glucose</td>
<td>f. 5. glucose-6-phosphate dehydrogenase</td>
<td>decrease</td>
</tr>
<tr>
<td>f. insulin</td>
<td>g. 6. skeletal muscle phosphorylase kinase</td>
<td>increase</td>
</tr>
<tr>
<td>g. cyclin D</td>
<td>h. 7. protein kinase A</td>
<td>increase</td>
</tr>
<tr>
<td>h. fructose 2,6 bisphosphate</td>
<td>8. a receptor tyrosine kinase</td>
<td>increase</td>
</tr>
</tbody>
</table>

*True or False* (1 point each)

9. **F** All catalysts are proteins.

10. **T** Vitamins that function as cofactors for enzymes are sometimes themselves metabolized.

11. **T** The lower the $K_m$, the higher the velocity of the reaction at a substrate concentration that gives a rate below the $V_{max}$.

12. **F** Competitive inhibition by an allosteric regulator will affect the $V_{max}$ but not the $K_m$.

13. **F** The $V_{max}$ for an enzyme is reached at a substrate concentration equal to the $K_m$. 
Bio130, Final Examination, May 2001

Match the substrates in the left hand column with their respective enzymes. Each substrate can be used once, more than once or not at all. (1 point for each correct answer)

a. AMP (adenosine monophosphate)  
   b. lactate dehydrogenase
b. pyruvate  
   e. Epidermal Growth Factor receptor
   f. JAK2 (a tyrosine kinase)
c. glycogen synthase  
   g. transducin
d. UDP-glucose  
   h. phosphorylase kinase
e. phospholipase C  
   i. adenylyl cyclase (credit to all)
f. STAT5 (a transcription factor)
   j. pyruvate dehydrogenase
g. GTP (guanosine triphosphate)  
   k. glycogen synthase
h. glycogen phosphorylase  
   l. fatty acid synthase
i. cyclic GMP  
   m. Gsα
j. malonyl CoA

You are performing a laboratory experiment in which the biochemical physiology of two rats will be compared. One will be in a fed state at the time of sacrifice. The other will have been fasted for 24 hours. Indicate whether the following observations will be seen in the fed or in the fasted rat (relative to its experimental opposite). (1 point each)

24. fed  
   High serum insulin concentration.
25. fasted  
   Activated hormone-sensitive lipase in fat cells.
26. fed  
   Activated acetyl CoA carboxylase in liver.
27. fed  
   Activated glycogen synthase in skeletal muscle.
28. fasted  
   Activated fructose 2,6 bisphosphatase in liver.
29. fed  
   Low serum ketone body concentrations.
30. fed  
   High liver malonyl CoA concentrations.
31. Which of the following are more reduced? (Circle the correct answers; 2 points each)

\[
\begin{align*}
\text{NADP}^+ \quad \text{or} \quad \text{NADPH} \\
\text{H-C=O} \\
\text{H-C-OH} \\
\text{H}_2\text{-C-O-P}
\end{align*}
\]
\[
\begin{align*}
\text{glyceraldehyde 3-phosphate} \\
\text{H-C-O-P} \\
\text{H-C-OH} \\
\text{H}_2\text{-C-O-P}
\end{align*}
\]

32. The activity of cyclin-dependent kinases (CDKs) is regulated by:

a. Cyclin content.
b. CKI (cyclin-dependent kinase inhibitor) content.
c. CDK phosphorylation status.
d. All of the above.

33. The retinoblastoma gene product, Rb:

a. Is a transcription factor.
b. Is a substrate for phosphorylation by specific CDKs.
c. Regulates progression from G2 to M.
d. All of the above.

34. A cell has the following options when it exits the cell cycle (ceases proliferation):

a. It can die.
b. It can permanently lose its ability to proliferate.
c. It can rest, then re-enter the cell cycle.
d. All of the above.
Bio130, Final Examination, May 2001

35. b The Ras proto-oncogene:
   a. Is an enzyme that can catalyze a phosphorylation (kinase) reaction.
   b. Is a G-protein.
   c. Is an adaptor protein that is involved in activation of glycogen synthesis.
   d. All of the above.

36. c Insulin promotes or activates:
   a. Gluconeogenesis in liver.
   b. The translocation of glucose transporters to the surface of neurons.
   c. Fatty acid synthesis in liver.
   d. All of the above.

37. d Which of the following might represent an effective target for cancer therapy?
   a. The MAP kinases, ERK1 and ERK2.
   b. Amino acid transporters.
   c. Receptor tyrosine kinases.
   d. All of the above.

Match each item in the left hand column with a function in the right hand column. Use each item on the left one time. (2 points each)

a. Mitochondrial F0/F1 ATPase 38. f Regulation of fatty acid oxidation
b. Hexose monophosphate shunt 39. e Catalytic modification of G-proteins
   c. Rhodopsin 40. b Required for fatty acid synthesis
   d. IRS-1 41. a ATP synthesis
e. Cholera toxin 42. c Light Reception
f. Carnitine acyl transferase I 43. l Glycogen breakdown
g. Protein phosphatase 1 44. d Required for insulin activation of glycogenesis
h. Debrancher enzyme 45. g Coupling of the insulin receptor with downstream events

\[\text{shouldn't there }\text{be reversed}\]
Bio130, Final Examination, May 2001

True or False (1 point each)

46. ___ F ___ Cholesterol is broken down by adipocytes to acetate.

47. ___ T ___ HDL is generally inversely related to triglyceride concentrations.

48. ___ T ___ The LDL receptor (apoB, E receptor) is located in both liver and peripheral cells and mediates uptake of approximately 80% of serum LDL in normal individuals.

49. ___ F ___ Chylomicrons are converted to LDL by the action of lipoprotein lipase.

50. ___ T ___ Saturated fat diets are associated with elevated cholesterol levels.

Match the following enzymes with their functions. There is one match for each enzyme. (1 point each)

51. ___ D ___ HMG CoA Reductase  a. Hydrolysis of triglycerides in VLDL and chylomicrons

52. ___ A ___ Lipoprotein lipase  b. Intracellular esterification of cholesterol

53. ___ B ___ Acyl cholesterol acyl transferase  c. Hydrolysis of triglyceride and phospholipid in IDL and HDL.

54. ___ E ___ Lecithin cholesterol acyl transferase  d. Synthesis of cholesterol

55. ___ C ___ Hepatic lipase  e. Esterification of HDL associated cholesterol in the circulation
Bio130, Final Examination, May 2001

Multiple choice. Indicate the single best answer. (2 points each)

56. D Which of the following is/are characteristic of lipoproteins?
   A. Micellar structure with a core of cholesteryl ester and triglyceride and a surface of phospholipid, free cholesterol and protein
   B. Increased protein content with increased density
   C. Composition and size constantly in flux
   D. All of the above

57. B Which is/are not a “second messenger” function of cellular cholesterol?
   A. Increased degradation of HMG CoA reductase
   B. Decreased activity of hepatic lipase
   C. Decreased synthesis of LDL receptors
   D. All of the above

58. D Which of the following is/are associated with the metabolic syndrome?
   A. Increased abdominal fat
   B. Hypertriglyceridemia
   C. Insulin resistance
   D. All of the above

59. C Which of the following is not associated with increased lipoprotein lipase activity?
   A. Increased HDL
   B. Decreased triglycerides
   C. Apo C-II deficiency
   D. Exercise

60. A Which of the following is not true of chylomicrons.
   A. Is a substrate for lecithin cholesterol acyl transferase
   B. Picks up Apo C and apo E proteins from HDL in the lymph and peripheral circulation
   C. Transports dietary fat
   D. Is taken up by the liver via the apoE or remnant receptor.
Multiple choice, 3 points each. Choose the single best answer.

61. **E** In the biosynthesis of steroid hormones:
   A. Androgens and estrogens, but not glucocorticoids and mineralocorticoids, are synthesized from cholesterol.
   B. Cytochrome P-450 linked enzymatic reactions are key steps in estrogen, but not androgen, biosynthesis.
   C. Mitochondria that are in steroidogenic cells contain at least one key enzyme in the synthesis of cortisol, but not estradiol.
   D. All of the above.
   E. None of the above.

62. **D** In male pseudohermaphroditism caused by complete androgen insensitivity:
   A. Both the Mullerian and Wolffian ducts fully differentiate during fetal development.
   B. The Mullerian ducts regress and the Wolffian ducts fully differentiate during fetal development.
   C. The Mullerian ducts fully differentiate and the Wolffian ducts regress during fetal development.
   D. Both the Mullerian and Wolffian ducts regress during fetal development.
   E. None of the above.

63. **E** In male pseudohermaphroditism caused by 5α-reductase deficiency:
   A. There is not sufficient testosterone produced during fetal development to fully masculinize the external genitalia.
   B. There is not sufficient testosterone produced during fetal development to stimulate Wolffian duct growth and differentiation.
   C. There is not sufficient Mullerian inhibiting hormone produced during fetal development to stimulate Mullerian duct regression.
   D. All of the above.
   E. None of the above.
Bio130, Final Examination, May 2001

64. C. Which of the following statements are true?
   A. Estradiol, the most biologically active natural estrogen, is an 18 carbon neutral steroid.
   B. Testosterone, the most biologically active natural androgen, is a 19 carbon neutral steroid.
   C. The receptor for thyroid hormone is a member of the gene family that includes steroid receptors.
   D. All of the above.
   E. None of the above.

65. In the picture of the inactive steroid hormone receptor complex shown below, there are three locations marked by letters (A, B and C). Match each letter to the one name on the list that best describes its location. (1 point for each correct answer)

   ___ N-terminal transcription activating domain
   ___ DNA binding domain
   ___ Plasma transport protein
   ___ Hormone response element
   ___ Hormone binding domain
   ___ Heat shock protein