Name____________________
Page-1

Chemistry 786
Final Exam
March 16, 1998

- Print you name on all sheets of the exam.
- Show all work. Partial credit cannot be given without evidence of work. No credit will be given for incorrect answers without work.
- Do work in the space provided. If additional space is needed, use the opposite side of the page and make note of your additional work in the given space.
- The exam is worth 150 points total. Questions 1-16 are worth 5 points each. Questions 17-23 are worth 10 points each.

For questions 1-9, write or draw out the reaction for the named enzyme. Include names or structures of principal reactant and product and name any cofactors required for the reaction.

1. phosphofructokinase-1

fructose 6-phosphate+ ATP → fructose 1,6-bisphosphate + ADP

2. aldolase

fructose-1,6-bisphosphate → glyceraldehyde-3-phosphate + dihydroxyacetone phosphate

3. glyceraldehyde-3-phosphate dehydrogenase

glyceraldehyde 3 phosphate + P_i + NAD^+ → 1,3-bisphosphoglycerate + NADH

4. isocitrate dehydrogenase

isocitrate + NAD^+ → α-ketoglutarate + NADH + CO_2

5. malate synthase

glyoxate + acetyl-CoA → L-malate + CoASH

6. ribose-5-phosphate isomerase

ribulose-5-phosphate → ribose-5-phosphate

7. HMG-CoA lyase

HMG-CoA → acetoacetate + acetyl-CoA

8. CTP:phosphatidate cytidyl transferase

phosphatidate + CTP → CDP-diacylglycerol + PP_i

9. carbamoyl phosphate synthetase I

$NH_3 + HCO_3^- + 2\ ATP$ → carbamoyl phosphate + 2 ADP + P_i

10. The standard reduction potential for cytochrome c is +0.254 V while the standard reduction potential for pyruvate/lactate is -0.18 V. Calculate the standard free energy change ($\Delta G^{0\prime}$) for the reaction below:

$$2\ \text{cyt}\ c^{red} + \text{pyruvate} + 2H^+ \rightarrow 2\ \text{cyt}\ c^{ox} + \text{lactate}$$

ΔE = -0.18 - (+0.254) = -0.434 V

$\Delta G = -n\mathscr{F}\Delta E$ = -(2)(96480J/V·mol)(-0.434 V) = +83.7 kJ/mol

11. The free energy change (ΔG) for the conversion of PEP to pyruvate is -16.7 kJ/mol. The standard free energy change ($\Delta G^{0\prime}$) for this same reaction is -31.4 kJ/mol. What is the ratio of PEP to pyruvate that exists for this difference in free energies to occur (assume standard concentration for all other species)?

$\Delta G = \Delta G^{0\prime}$ + RT ln(pyruvate/PEP)

-16.7 kJ/mol = -31.4 kJ/mol + (0.008315 kJ/mol)(298 K) ln (pyruvate/PEP)

ln (pyruvate/PEP) = 5.9

(pyruvate/PEP) = 377

12. Describe, briefly, the role of the Cu_B/Fe_B complex in Complex IV of the mitochondondrial electron transport pathway.

-reduces O_2 to form H_2O
-binds O_2 throughout the transfer of 4 electrons to prevent the release of radical oxygen species

13. Calculate the number of ATP equivalents that can be derived from a saturated 6 carbon length fatty acyl-CoA.

3 beta oxidations → 3 acetyl CoA + 2 NADH + 2 $FADH_2$
(3 x 10 ATP) + (2 x 2.5 ATP) + (2 x 1.5 ATP) = 38 ATP

14. Name the metabolic intermediate that is generated from the degradation from the following amino acids:

i.	cysteine	pyruvate
ii.	aspartate	oxaloacetate
iii.	alanine	pyruvate
iv.	proline	glutamate/α-ketoglutarate

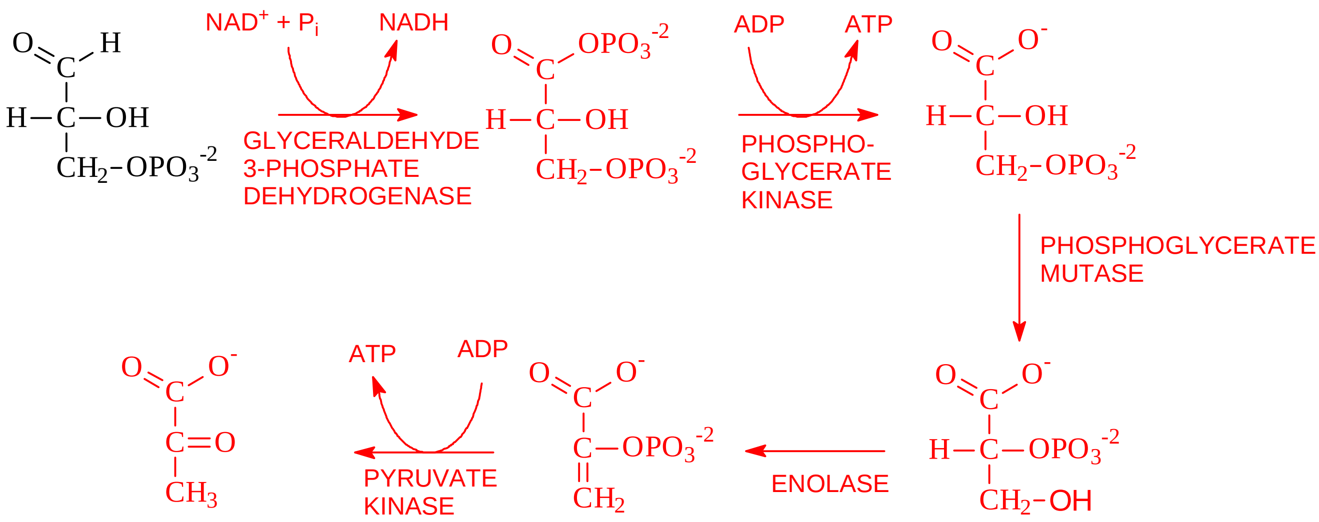
15. Describe, briefly, the role of carnitine in the degradation of fatty acids.

Carnitine reacts with acyl-CoA to form acyl-carnitine. Acyl carnitine is then transported into the matrix where it is reconverted to acyl-CoA and free carnitine. Once in the matrix, acyl-CoA is degraded by β-oxidation

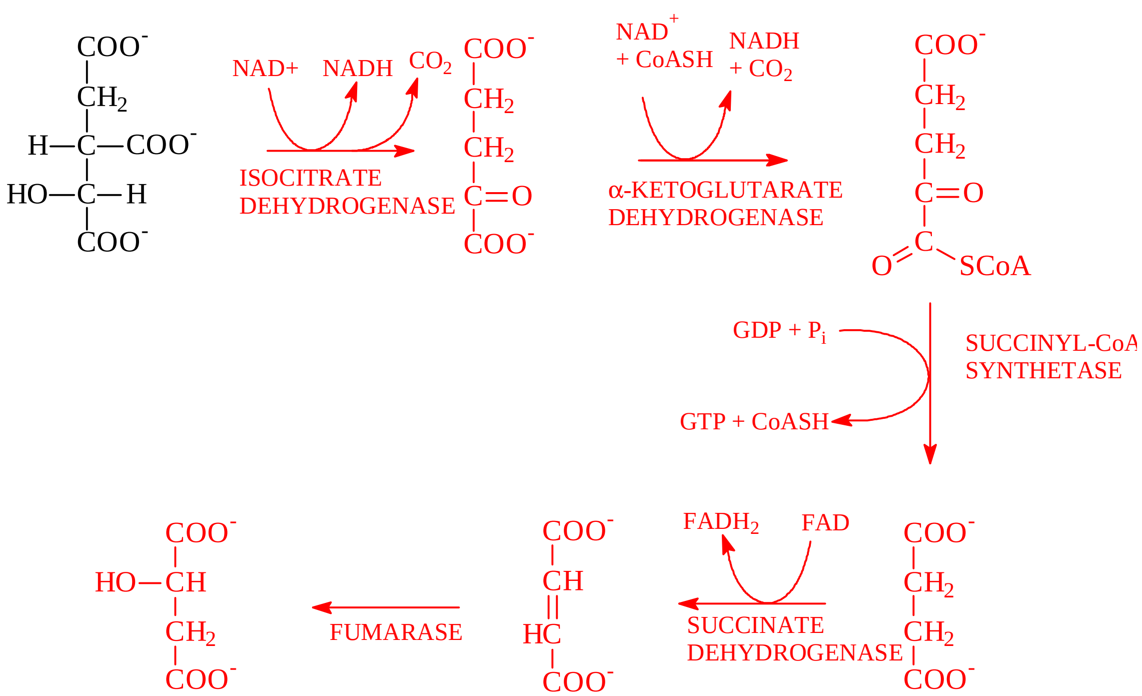
16. For the following metabolic intermediates and modulators, determine whether an elevation in the named species would eventually result in an activation of glycogen storage or an activation of glycogen breakdown.

i.	Ca^{2+}	activates breakdown
ii.	AMP	activates breakdown
iii.	epinephrine	activates breakdown
iv.	citrate	activates storage
v.	ATP	activates storage

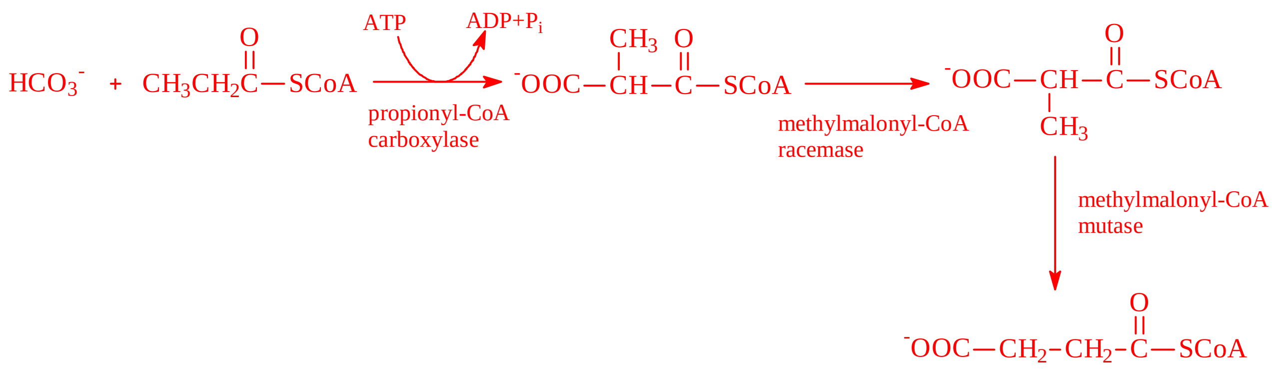
17. Starting with the structure below, draw out the remaining glycolysis reactions, with structures, leading to the formation of pyruvate. Include cofactors and enzymes.



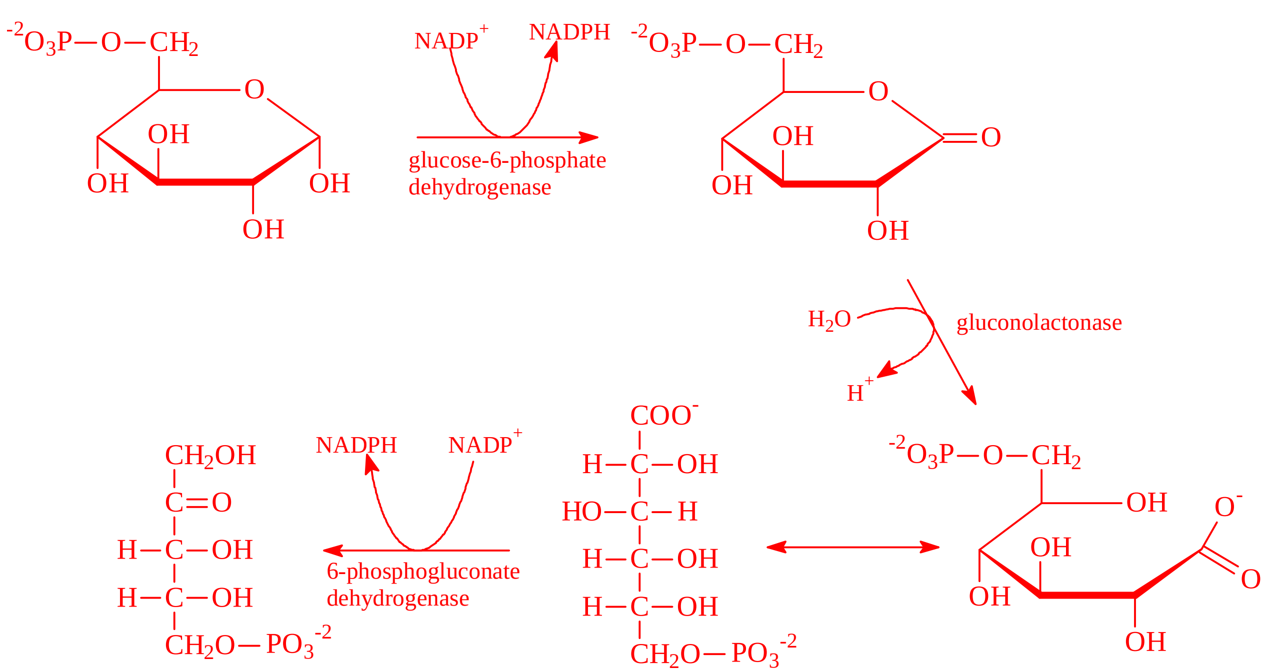
18. Starting with isocitrate, shown below, draw out the steps, including structures, leading to the formation of malate, either by the citric acid cycle or by the glyoxylate cycle. Include cofactors and enzymes.



19. Starting with propionyl-CoA, draw out the reactions, including structures, for degradation of odd-numbered fatty acids leading to the formation of succinyl-CoA. Include cofactors and enzymes.

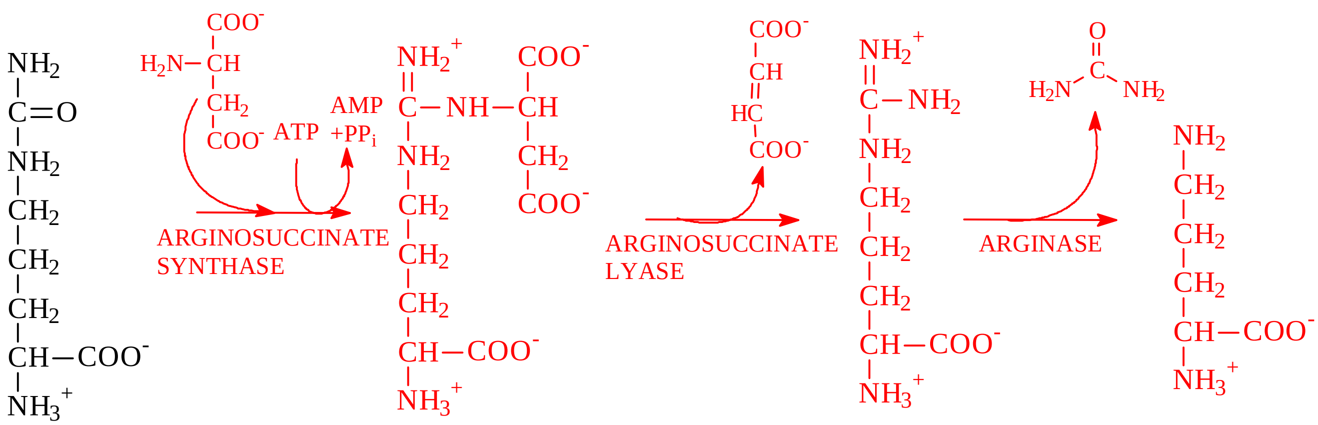


20. Starting with glucose-6-phosphate, draw out the steps, including structures, leading to the formation of ribulose-5-phosphate via the pentose phosphate pathway. Include cofactors and enzymes

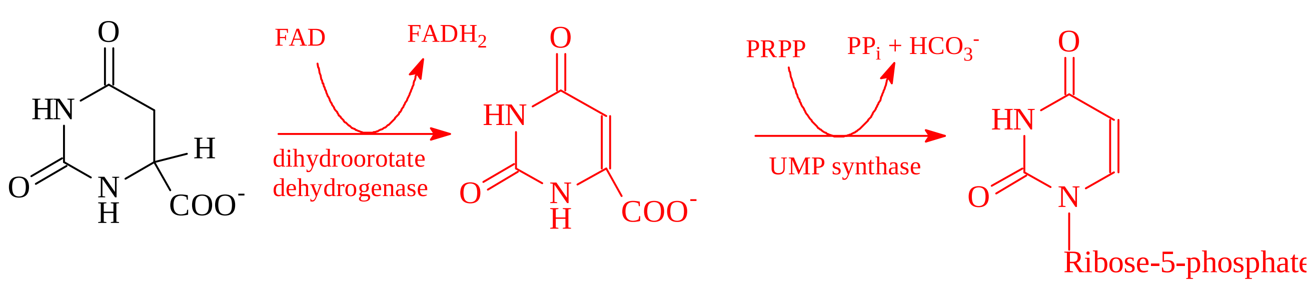


Name___________________

21. Starting with citrulline, shown below, draw out the steps of the urea cycle, including structures, leading to the formation of ornithine. Include cofactors and enzymes.



22. Starting with dihydroorotate, shown below, draw out the steps leading to the formation of UMP. Include cofactors and enzymes



Name____________________

23. Starting with adenine, draw out the steps leading to the formation of uric acid.