1. Complete the following table in as much detail as time and space permit.

<table>
<thead>
<tr>
<th>Pathway feature</th>
<th>Glycolysis</th>
<th>TCA cycle</th>
<th>Gluconeogenesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main function(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of enzymes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endproduct(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As much detail as time and space permits...
2. Show how the action of glucagon causes NET degradation of glycogen in the liver and subsequent increase in the concentration of blood glucose. (Show effects on glycogen synthesis and degradation). Be sure to indicate the target tissue for glucagon.

(4)
a. binding of glucagon and its consequences

(12)
b. action of second messenger
c. fate of end-product of glycogen breakdown

i) in liver

ii) in skeletal muscle

3. Electron transport systems are tightly coupled to several enzymes in the cell. On the diagram below, show:

(6)i) arrows indicating all enzyme-catalyzed reactions of the carbon skeleton
(6)ii) each reaction where ETS systems are attached e.g. XH---->X
(1)iii) the mitochondrial membranes in relation to intermediates of carbon skeleton

glycogen glucose

f-6-P

3-PG <------> _____ -------> a-glycerol P DHAP
PEPpyr
pyr
acetyl CoA OAA
citratemalate
isocitratefumarate
aKG succinate
succ.CoA

(2)
iv) Describe the phenomenon of oxygen debt

4. Write the reactions which are rate-limiting in the following pathways. (show structures are for substrates but not structures for cofactors)
ex. Glucose-6-P + NADP -----> Glucuronic-6-P + NADP:H (you would show ONLY structures for bold, underlined)
glycolysis

---------
5. Show, in detail, all the steps in the oxidation of a keto glutarate to succinyl-CoA including the regeneration of all cofactors. Only the structures of a keto glutarate, succinyl and the reactive portion of thiamin are required.

6. Describe, in detail, the regulation of each of the following enzymes.

- pyruvate dehydrogenase
- isocitrate dehydrogenase
7.a. Diagram the Electron Transport System found in mitochondria attached to malate DHase. Show the cofactors and the proteins to which they are bound.

7.b Explain how ATP is formed using the energy from Electron Transport System.