Problems to solve;

1. The [ATP]/[ADP] ratio varies during metabolic processes, however it is usually Kept high. For ATP hydrolysis reaction (ATP→ ADP + P_i) & using the bioenergetics equations you've taken in my lectures, please plot ΔG against lnX where X is the mass-reaction ratio (concentration of products over reactants) at 25°C & pH 7 for the concentrations of ATP, ADP, and P_i in the following table. ΔG° for the reaction is –30.5 kJ / mol. According the plot generated, please provide a logical explanation for the high ratio of [ATP]/[ADP] in metabolism.

Material	Concentration (mM)				
ATP	5.0	3.0	1.0	0.2	5.0
ADP	0.2	2.2	4.2	5.0	25.0
P_i	10	12.1	14.1	14.9	10

2. Estimate the standard free energy for the following reaction & provide a logical explanation for your answer:

   ATP + CDP → ADP + CTP

3. Technically, it is hard to determine directly the standard free energy change for ATP hydrolysis experimentally. This is because of the minute amount of ATP remaining at equilibrium, so measurements will not be accurate. It is calculated indirectly!
   Calculate the standard free energy change of ATP hydrolysis provided the following information:
   Glucose 6-phosphate + H_2O → glucose + P_i K°eq = 270
   ATP + glucose → ADP + glucose 6-phosphate K°eq = 890

4. As we studied before; metabolic pathways are either catabolic or anabolic. Nevertheless, there is a third type present in metabolism; it is called Amphibolic Pathway. These Amphibolic pathways can serve either in energy-yielding catabolic or in energy requiring (anabolic) biosynthetic processes; depending on the cellular circumstances. Based on this, do you consider the TCA cycle one of these pathways? Defend your answer

5. There are many cases of human disease in which one or another enzyme activity is lacking due to genetic mutation. However, cases in which individuals lack one of the enzymes of the citric acid cycle are extremely rare. Why?

6. All the dehydrogenases of glycolysis and the citric acid cycle use NAD^+ as electron acceptor except succinate dehydrogenase, which uses covalently bound FAD. Suggest why FAD is a more appropriate electron acceptor than NAD^+ in the dehydrogenation of succinate.
   (E° for NAD^+/NADH = -0.32 V)
   (E° for FAD/$FADH_2$ in succinate dehydrogenase = 0.050 V)
   (E° for fumarate/succinate = 0.031)