Worksheet [illegible]: Thermodynamics of Glycolysis

Consider reaction A below:

Glyceraldehyde 3-phosphate + Pi + NAD^+ ⟶ 1,3-Bisphosphoglycerate + NADH + H^+

$\Delta G^{\circ\prime}$ = [illegible] kJ/mole

a) Draw the structures for Glyceraldehyde 3-phosphate (G3P) and 1,3-Bisphosphoglycerate (1,3-BPG).
b) Is this an Oxidation, Reduction or both? Why?
c) Which step of glycolysis is it? What is the name of the enzyme that catalyzes this reaction?
d) Is this reaction endergonic or exergonic under standard conditions? Why or why not?
e) In the cytosol we have the following concentrations: [G3P] = [illegible], [NAD^+] = [illegible], [NADH] = [illegible], [Pi] = [illegible]. In order for this reaction to occur in the cell what would [1,3BPG] have to be?
f) Is your result from (e) the minimum or maximum concentration needed for the glycolytic reaction? How much 1,3-BPG would you need for the reaction to be part of gluconeogenesis?
g) What is gluconeogenesis?
h) Write out the reaction B that follows reaction A in glycolysis. Draw the structures of the metabolites. What is the name of the enzyme? Is it an oxidation, reduction, both?
i) This reaction is much more favorable with $\Delta G^{\circ\prime}$ = -20 kJ/mole. What would Q have to be in order for this reaction to proceed in the forward direction?
j) What is Q under the conditions in the cell if [glycerate 3-phosphate] = [illegible], [ADP] = [illegible], [ATP] = [illegible] and [1,3BPG] = from (e)? Will the reaction occur with the concentration of 1,3-BPG obtained in (e)?
k) How many moles of ATP (for each mole of glucose) does this step in glycolysis produce?
l) Steps 6 and 7 in glycolysis constitute an energy coupling process. What is the common intermediate? Why is it coupled?
m) What is the combined $\Delta G^{\circ\prime}$? Write the NET equation and the NET mass action ratio (Q) for steps 6 and 7.
n) What is NET ΔG for the combined reaction? What is the advantage of that value?