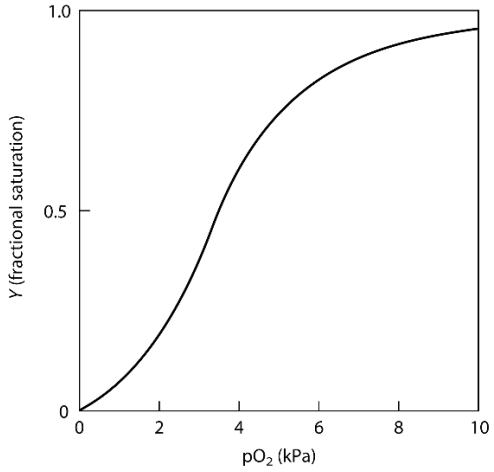
Name:_____ Student ID:_____
CHEM 161 PAL Fall 2026

Worksheet 11: Hemoglobin

1. For each ligand of hemoglobin below, write the location of its binding site:
    a. 2,3-bisphosphoglycerate (BPG):_____
    b. Oxygen: _____
    c. Carbon dioxide: _____
    d. H^+: _____

2. Why is cooperative binding necessary for O_2 transport across the body? In your explanation mention the differences in O_2 partial pressures in the lungs vs. the tissues and changes in hemoglobin saturation.

3. The graph below shows the oxygen-binding curve for adult human hemoglobin. For each of the following physiological conditions or locations, indicate whether the curve would shift to the right, shift to the left, or show no change. Then, explain your reasoning, describing:
    - How the condition affects hemoglobin's structure (T-state vs. R-state) in detail including changes in ligand binding, structure, salt bridges, etc.
    - How it influences oxygen affinity and the dissociation constant (K_d).



a. Increase in the concentration of CO_2

b. Increase in $[H^+]$

c. Decrease in the concentration of O_2

d. Decrease in the concentration of CO_2

e. Decrease in $[H^+]$

f. Increase in 2,3-BPG

g. Hemoglobin is fetal hemoglobin

h. Hemoglobin is in the lungs

i. Hemoglobin is in the muscles

j. A person moves from a low altitude to a higher altitude