1. (3 points) Show the minimum spanning tree of the following graph.

2. (2 points) What is the amortized asymptotic running time of MST-Kruskal on graph $G = (V, E)$ using the disjoint sets data structure with union by rank and path compression?

3. (2 points) What is the amortized asymptotic running time of MST-Prim on graph $G = (V, E)$ using the Fibonacci heap data structure?

4. (2 points) For which type of graphs will MST-Prim asymptotically outperform MST-Kruskal?
5. (4 points) Give the final $D$ and $II$ matrices resulting from running an all-pairs shortest path algorithm on the following graph.

![Graph Diagram]

6. (2 points) What is the asymptotic running time of the Fast-APSP algorithm for solving the all-pairs shortest path problem on graph $G = (V, E)$. Recall that Fast-APSP uses the approach of repeatedly “squaring” the weight matrix $W$.

7. (2 points) What is the asymptotic running time of the Floyd-Warshall algorithm for solving the all-pairs shortest path problem on graph $G = (V, E)$.

8. (2 points) For which type of graphs will Floyd-Warshall asymptotically outperform Fast-APSP?
9. (4 points) Show the maximum flow network and the corresponding residual network obtained after running the Edmonds-Karp algorithm on the following flow network. Also, indicate the maximum flow of your network.

![Flow Network Diagram]

10. (2 points) Suppose you have computed the maximum flow for a network, which includes a flow $f(u, v) = 10$ along edge $(u, v)$, where the capacity of that edge $c(u, v) = 10$. Then, suppose we reduce the capacity $c(u, v)$ to 5. What effect will this capacity reduction have on the maximum flow of the network?