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Name: _____

1. (1 pt.)
   - **Read all material carefully.**
   - *If in doubt whether something is allowed, ask, don't assume.*
   - You may refer to your books, papers, and notes during this test.
   - E-books may be used *subject to the restrictions* noted in class.
   - Computers are not permitted, except when used strictly as e-books.
   - Network access of any kind (cell, voice, text, data, ...) is not permitted.
   - Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
   - Use class and textbook conventions for notation, algorithmic options, etc.

   Write your name in the space provided above.

WAIT UNTIL INSTRUCTED TO CONTINUE TO REMAINING QUESTIONS.

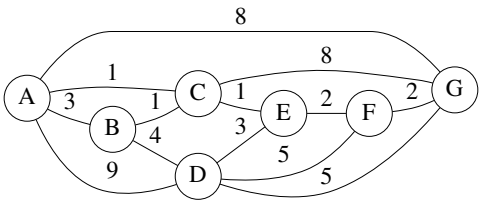
Do not write in the following table.

Q	Full	Score
1	1	
2	20	
3	24	
4	25	
total	70	

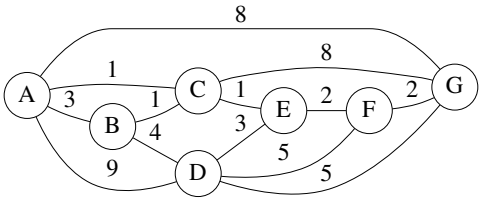
2. (20 pts.) Trace the operation of MST-Prim on the following graph using the conventions of Figure 23.5 (p. 635) of the textbook. In particular, after **each iteration** of the while loop:

   - mark **vertices belonging to the tree** using a check mark;
   - highlight **edges belonging to the tree** A using double-lines; and
   - draw an arrow pointing to the **vertex** u **that was removed from** Q **in that iteration**.

   You may abbreviate as long as the result is unambiguous.

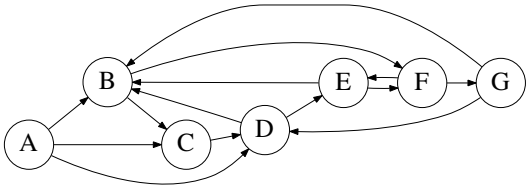


[additional space for answering the earlier question]



3. (24 pts.) Trace the operation of DFS-Visit(G, A), for the following directed graph G using the conventions of Figure 22.4 (p. 605) of the textbook. In particular:

   - Depict the state of the graph after each iteration of the for loop.
   - Annotate each vertex with its color: **W**hite, **G**ray, **B**lack.
   - Record the discovery and finishing times in the format `d/f`.
   - Highlight tree edges using double lines, and annotate **F**orward, **B**ackward, and **C**ross edges.



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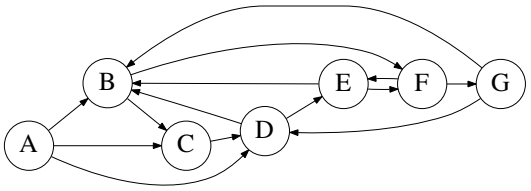
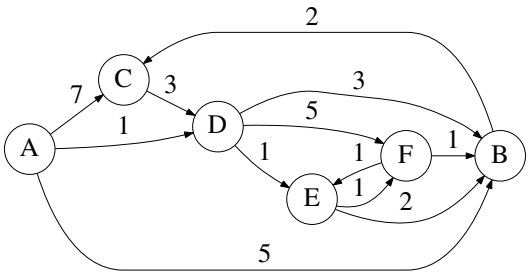
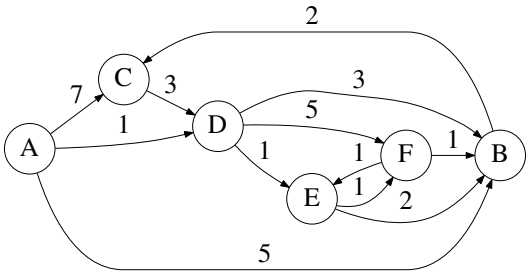


4. (25 pts.) Trace the operation of the FLOYD-WARSHALL algorithm on the following graph, using the conventions of Figure 25.4 (p. 696) of the textbook. (You may use the $\cdot$ symbol instead of ∞ within the matrices.)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