Math 1060: Chapter 3 Homework Name: _____

Score: ____ / 154 Due June 19 at 1:00pm

1. (___ / 9 points) Give precise mathematical definitions of the following terms:

   (a) Critical path:

   (b) List processing algorithm:

   (c) Chromatic number:

2. (___ / 9 points) What term from class has the following definition?

   (a) _____: An algorithm that is fast to carry out but doesn't necessarily give an optimal solution to an optimization problem.

   (b) _____: An assignment of labels to the vertices of a graph such that vertices joined by an edge get different labels.

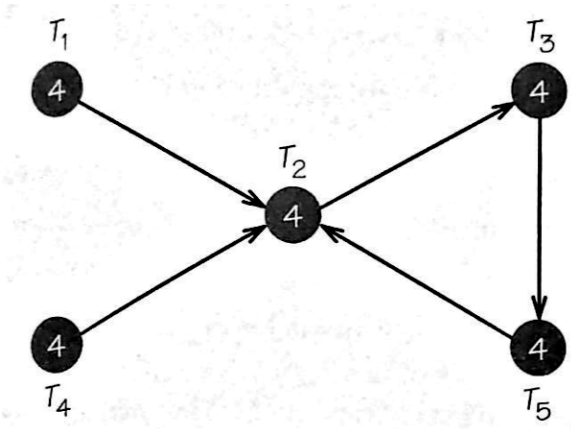
   (c) _____: The study of an algorithm from the point of view of how well it performs on the hardest problems it may be used on.

3. (___ / 3 points) The following graph cannot be an order-requirement digraph because (choose one):

   (a) No vertex has four edges that enter a particular vertex.

   (b) All tasks require the same amount of time to complete.

   (c) It has a directed circuit.

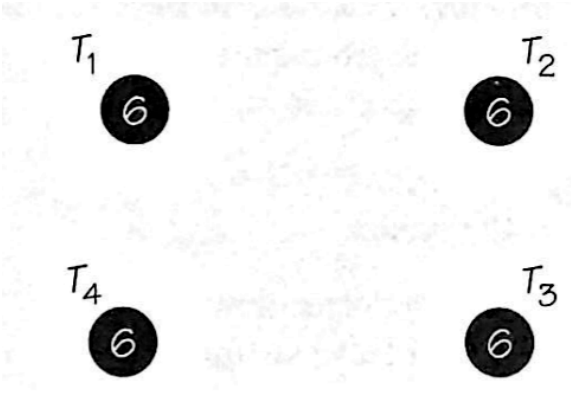


4. (___ / 3 points) Which of the following statements about the accompanying digraph is true?

   (a) This graph cannot be an order-requirement digraph because it has no (directed) edges.

   (b) This graph can be the order-requirement digraph of a scheduling problem.

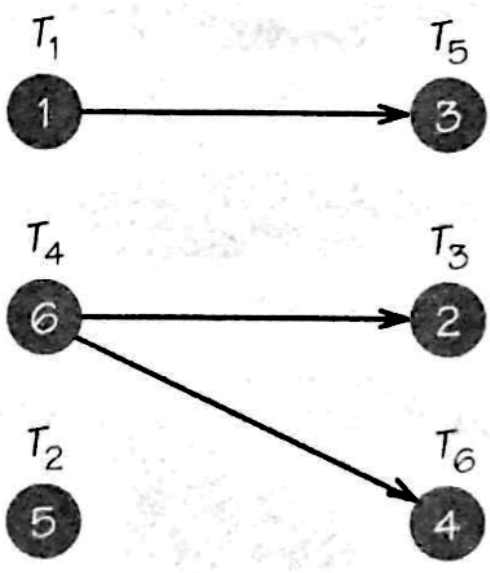
   (c) This graph cannot be an order-requirement digraph because all tasks have the same time length.



5. (___ / 10 points) You and your two housemates are planning a party this Friday night. Eight guests are expected, and you plan to serve a homemade dinner. List the tasks involved in throwing such a party, and the types of processors used. Can any of the tasks be done simultaneously?

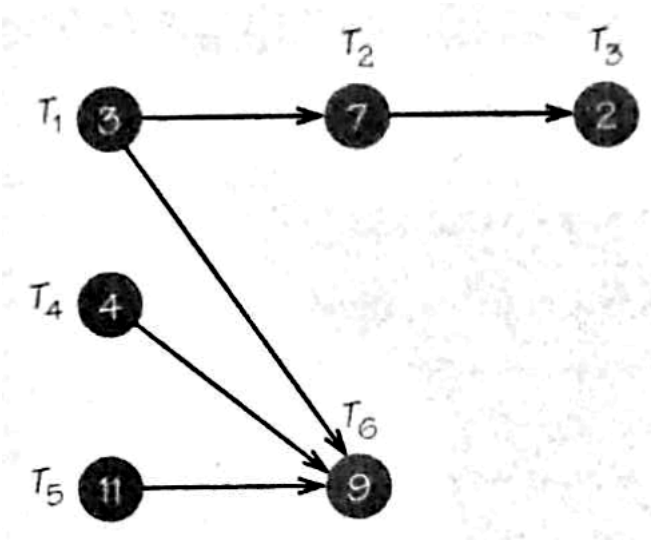
6. (___ / 15 points) Consider the following digraph.

   (a) (___ / 5 points) Schedule the jobs appearing to the right on one processor using the list processing algorithm. Use the ordering $T_1, T_2, T_3, T_4, T_5, T_6$.



   (b) (___ / 10 points) Schedule the same tasks with the same digraph and ordering using two processors instead of one.

7. (___ / 15 points) Answer the following questions about this order-requirement digraph.



(a) (___ / 4 points) What are the lengths of critical paths and which tasks are on critical paths?

(b) (___ / 4 points) Which task(s), taken one at a time, would not alter the length if the task were to increase by 1 time unit?

(c) (___ / 7 points) With two processors, can this task be scheduled to complete by time 20? If so, what list L would allow you to apply the list processing algorithm and finish by time twenty on two processors?

8. (___ / 25 points) At a large toy store, scooters arrive unassembled in boxes. To assemble a scooter, the following tasks must be performed:

Task 1 Remove parts from box.
Task 2 Attach wheels to footboard.
Task 3 Attach vertical housing.
Task 4 Attach handlebars to vertical housing.
Task 5 Put on reflector tape.
Task 6 Attach bell to handlebars.
Task 7 Attach decals.
Task 8 Attach kickstand.
Task 9 Attach safety instructions to handlebars.

(a) (___ / 5 points) Give reasonable time estimates for these tasks and construct a reasonable order-requirement digraph.

(b) (___ / 8 points) Schedule this job on two processors (humans) using the critical path algorithm. How long does the job take? Be sure to draw the completed schedule.

(c) (___ / 8 points) Schedule this job on three processors (humans) using the critical path algorithm. How long does the job take? Be sure to draw the completed schedule.

(d) (___ / 4 points) The cost of labor is \$10/hour. Is it more cost-effective to use two or three processors?

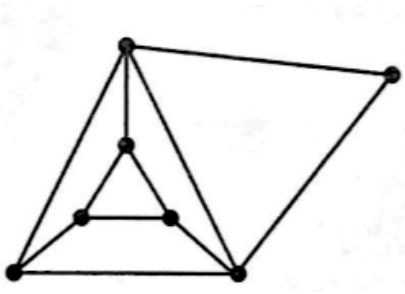
9. (___ / 15 points)

(a) (___ / 5 points) Draw a connected graph with 12 vertices and 11 edges whose vertices can be colored by two colors. What kind of graph is this?

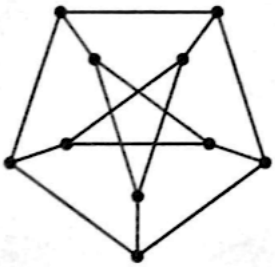
(b) (___ / 5 points) Can all trees be colored by two colors? Come up with a reason why, or an example of one that cannot be.

(c) (___ / 5 points) Add a single edge to your graph from part (a) in such a way that the resulting graph can no longer be colored with two colors.

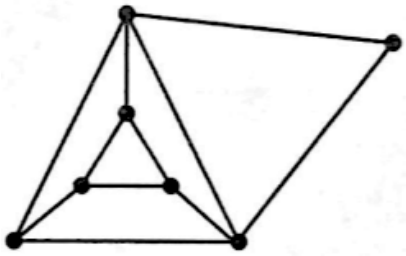
10. (___ / 24 points) For each of the following graphs, find its chromatic number.



(a)



(b)



(c)

11. (___ / 26 points) The faculty-student governing council at All State College has nine standing committees (such as Curriculum, Academic Standards, Campus Life) that are designated A, B, ... , I for convenience. The following table shows which committees have *no member in common*.

	A	B	C	D	E	F	G	H	I
A		X		X		X	X		X
B	X				X	X		X	X
C				X		X	X	X	X
D	X		X			X		X	
E		X					X	X	X
F	X	X	X	X					
G	X		X		X			X	
H		X	X	X	X		X		X
I	X	X	X		X			X	

(a) (___ / 8 points) Draw an appropriate graph to represent the information on the table.

(b) (___ / 9 points) What is the minimum number of time slots in which all the committee meetings can be scheduled?

(c) (___ / 9 points) How many rooms are needed during each time slot to accommodate the committees that are scheduled to meet at that time slot?