

Name: _____

Math 203: Contemporary Mathematics

Chapter 7 test, version (a)

Thursday, February 19, 2009

60 points

Instructions:

1. This test has 5 pages (including this one), which contain 4 questions. Please check that you have all of the pages.
 2. Do **THREE** of these four questions.
 3. Read each question carefully. If you have any questions, please ask.
 4. Answer all of the following questions clearly and completely. Justify all of your answers. Most of the points you receive will be based on the accuracy, completeness, and clarity of your responses. Use full sentences, and avoid saying things that are untrue, ambiguous, or nonsensical.
 5. You may use a calculator for this test, but you may not use a book or any notes.
 6. Give your answer to each question completely and clearly in the space provided. You may use the back of the test pages for scratch work; however, if you want this work to be considered, please make note of it in the space provided for the question.
 7. Erase or cross out work you do not wish to be graded.
 8. You have 25 minutes to complete this test. Good luck!
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DO THREE OF THE FOUR QUESTIONS ON THIS TEST.

Question 1. (20 points.) Your uncle, the famous gizmo tycoon, is giving you a tour of his gizmo factory. You ask him how gizmos are made, and he answers:

“Well, we have seven machines here in the factory. Each machine does a specific task, and they all work together to make a gizmo.

“Machine 1 is a computer; its task is to process orders from our Web site. This is important because, as you know, our customers can customize their gizmos.

“Machine 2 makes a custom faceplate based on a customer’s order. It gets the information it needs from Machine 1.

“Machine 3, over here in the corner, makes widgets. It has a large bin full of parts, as you see, and it puts them together to make a widget. It takes a long time to make a widget, because it’s a sensitive precision instrument, but fortunately widgets aren’t customized—the widget in every gizmo is exactly the same—so we don’t have to wait for an order to come in before we make a widget.

“However, the widget does need to be installed in a customized case, which is the task of Machine 4. Machine 4 receives information about the design for the case from Machine 1.

“Machine 5 is where it all comes together. This machine takes a faceplate from Machine 2 and a case (with a widget installed) from Machine 4 and bolts them together to make a gizmo.

“Machine 6, back there by the loading bay doors, is the packaging machine. It takes a finished gizmo and an instruction manual and puts them in a box to be shipped out.

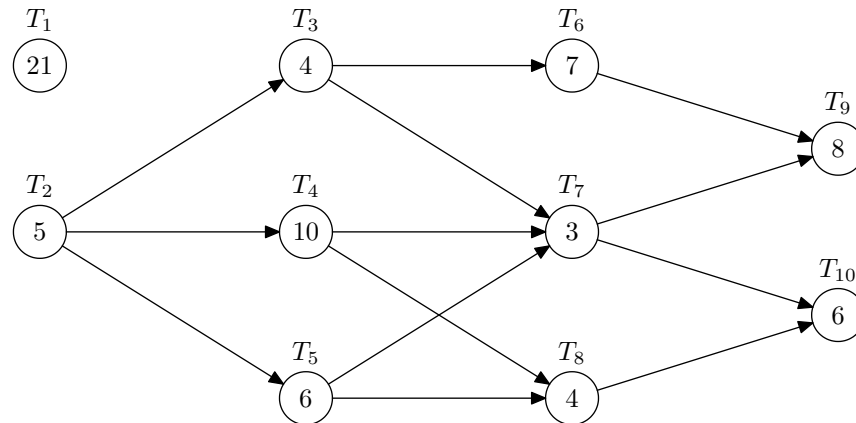
“Oh, right, the instruction manual—I almost forgot Machine 7. The task of Machine 7 is to print the instruction manuals, so that we have one ready when it comes time to put the gizmo in the box. The manuals aren’t customized, so we can print a manual whenever we want.

“Does that answer your question?”

Your uncle has described seven tasks that are needed to make a gizmo; each task is done by a particular machine. Call these seven tasks T_1 through T_7 , so that T_1 is the task done by Machine 1, T_2 is the task done by Machine 2, and so on. Draw an order-precedence digraph showing the precedence relations (order requirements) among these seven tasks. (Don’t include the times required to finish each task, because you haven’t been given that information.)

If you have time at the end, your uncle would like you to redesign the box that the gizmos are packaged in. Draw a proposal on the back of this page. Be sure to emphasize the many useful features of a gizmo. (This is not worth any points.)

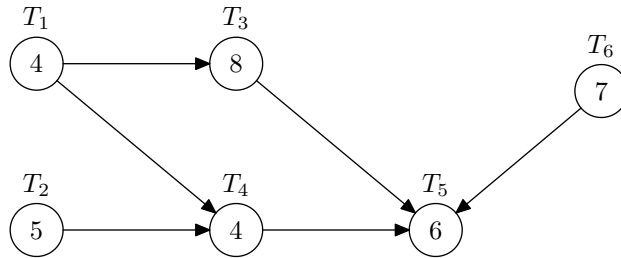
Question 2. (20 points.) Consider the following order-requirement digraph. Times are given in minutes.



(a) (12 points.) Find the critical time for the whole project. Show all of your work. (You can do this using any method you like, but I would recommend using an easy method if you know one. Feel free to use the back of this page or scratch paper if you need more space.)

(b) (8 points.) What does the critical time mean? In other words, what does your answer to part (a) tell you about this project? Explain it as clearly, as carefully, and as precisely as you can.

Question 3. (20 points.) Consider the following order-requirement digraph. Times are given in minutes.



(a) (5 points.) Construct the decreasing-time priority list for these tasks.

(b) (3 points.) At the beginning of the project, which task(s) are ready?

(c) (9 points.) Use the list-processing algorithm (the method described in Section 7.2) with your decreasing-time priority list from part (a) to make a Gantt chart for this project, assuming that there are *two* processors.

(d) (3 points.) What is the *finishing* time for the schedule you made in part (c)?

Question 4. (20 points.) The officers of six student clubs are shown below. Note that some people are officers of more than one club.

Astronomy	Ballet	Cooking	Dinosaurs	Electronics	Fencing
Alexis	Charles	Lisa	Roberto	Julie	Chad
Sally	Frannie	Paul	Sally	Matt	Lisa
Winston	Roberto	Tyler	Tyler	Roberto	Winston

These clubs would like to schedule weekly, hour-long executive meetings in the Union. The Union would like to schedule as many meetings at the same time as possible. Of course, two clubs cannot have their executive meetings simultaneously if there is someone who is an officer of both clubs.

(a) (10 points.) Draw the conflict graph for this problem. Be sure to label the vertices.

(b) (10 points.) Use graph coloring to find the smallest number of different meeting times that are required. You can color your graph above directly, but use the space below to interpret your coloring. (If you don't have colored pencils or pens, you can "color" using different patterns or different numbers representing colors.)

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“Well, we have seven machines here in the factory. Each machine does a specific task, and they all work together to make a gizmo.

“A gizmo has two main parts: a whatsit and a doodad. Machine 1 here is the whatsit machine. It makes whatsits, using this bin of parts.

“Machine 2, on your right there, takes an assembled whatsit from Machine 1 and paints it. Interestingly, we paint most whatsits bright yellow, because that color seems to sell better than the others for some reason.

“Machine 3 attaches a metal base to a painted whatsit. It’s very important that the whatsit is painted before the metal base is attached, because we don’t want to get any paint on the base.

“Speaking of which, the metal base that Machine 3 needs is produced by Machine 4 over there. Machine 4 is a big metal-stamping machine. It takes a sheet of metal from that stack and stamps out a metal base for the whatsit. At the same time, it also stamps out the metal parts that are needed to make the doodad.

“Here we have Machine 5, whose task is to assemble a doodad from the metal parts made by Machine 4.

“Machine 6 takes a whatsit (with metal base attached) from Machine 3 and an assembled doodad from Machine 5 and glues them together to make a gizmo.

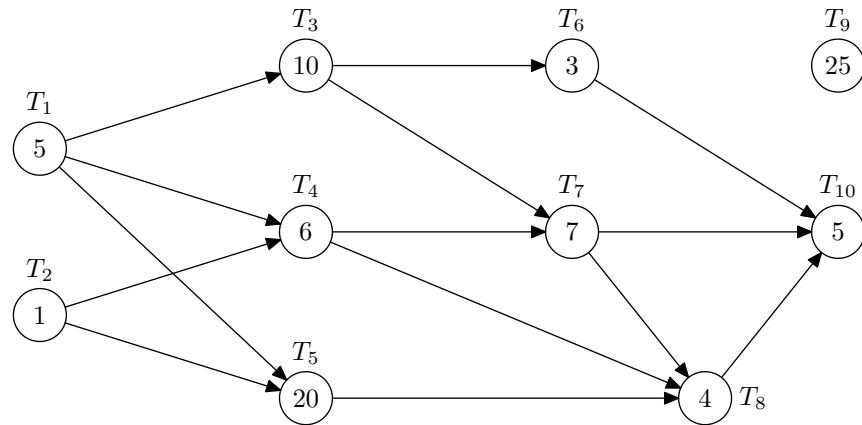
“Finally, over there by the loading bay doors, we have Machine 7, which is responsible for packaging the finished gizmo into a box so it can be shipped out.

“Does that answer your question?”

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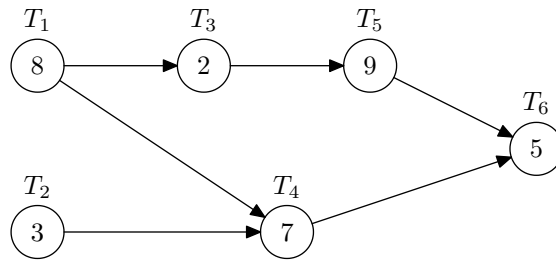
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Anime	Book	Chess	Dance	Entomology	French
Elaine	Elaine	Nate	Cheryl	Bridget	Harriet
Marcus	Peter	Peter	Nate	Cheryl	Marcus
Trevor	Wendy	Sandra	Trevor	Wendy	Oscar

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