Name:_____ Student #:_____

University of Toronto
Faculty of Applied Science and Engineering
APS112 and APS113 Engineering Strategies and Practice II

Quiz #1 February 14, 2014

This is a 50-minute closed-book quiz. No aids are permitted except for a translation-only dictionary. The quiz has a total of 18 questions. There are 14 multiple-choice questions and 4 written answer questions. There are a total of 30 marks with 14 marks for the multiple-choice questions and 16 marks for the written questions.

Your question paper, with your name and student number filled in **on each page**, must be returned with the multiple choice answer sheet slipped inside. Do not separate any pages.

Good Luck!

Written Answer Mark Breakdown

Question	Possible Marks	Marks
15	6	
16	2	
17	4	
18	4	
Total	16	

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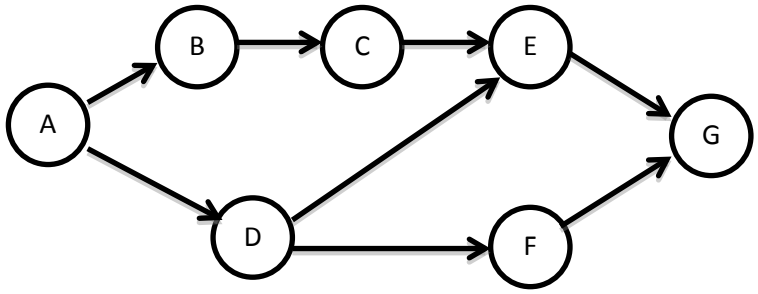
Multiple Choice Questions (1 mark each; total of 14 marks)

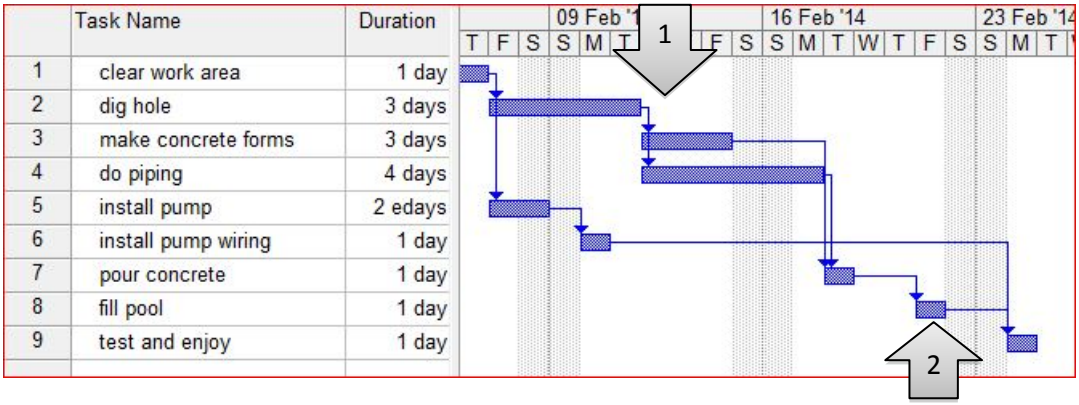
For multiple choice questions, you must use the multiple choice answer sheet provided – fill in your name and student number. Follow the directions on the sheet carefully to ensure that you receive marks for the correct answer. **You should mark only the single, most correct answer for each question.** Always mark the answer in the spot corresponding to the question number. Use a pencil. Erase any errors completely. There is no deduction for wrong answers.

1. In the following PERT diagram, if converted to a "activity on the arrow" form, we want to know if dummy tasks are required. What would be required:

a. No dummy task
b. A dummy task because of the link between A and B.
c. A dummy task because of the link between C and E.
d. A dummy task because of the link between D and E.
e. A dummy task because of the link between D and F.
f. A dummy task because of the link between E and G.



Questions 2 through 5 use the following Gantt chart for a swimming pool installation:



2. At arrow #1, task #2 takes 3 days but extends over 5 days. This could be because of (choose the most complete answer):

a. the resources doing the task are involved in other tasks of the project and leveling has meant that the task goes longer
b. that task #2 the resources involved in the task are not available weekends
c. task #2 is more difficult than was first planned so the actual time is taking longer
d. a and b are both possible
e. a, b and c are all possible

3. At arrow #2 there is a gap between tasks 8 and 9. This indicates:
   a. a lag of two days between the tasks
   b. a lead of two days between the tasks
   c. resources being unavailable for the two days
   d. slack or float time
   e. none of the above

4. The following tasks are on the critical path:
   a. 1,2,3
   b. 1,2,4
   c. 1,5,6
   d. 1,2,5
   e. none of these combinations

5. If it was found that task #8 (at arrow #2) was extended one day, but the resource person doing the task was willing to work overtime to finish on time, then the Gantt chart would show that :
   a. the project would finish one day sooner
   b. the project would finish one day later
   c. the project would finish at the same time (no change in the Gantt chart)
   d. the project would finish at the same time (with change in the Gantt chart)
   e. task #8 would start on the Thursday instead of the Friday

6. Regarding the PRPMP, which of the following is **TRUE**?
   a. Functions are verbs that indicate what the design will do.
   b. The Project Management Plan must tell the client everything the team has done.
   c. Stakeholders who are hostile to a design have no interest connected to it.
   d. The Executive Summary functions as an introduction to the report.

7. If the functional basis for the design of a door lock is “to secure mass,” an appropriate secondary function would be:
   a. To reduce break-ins
   b. To enable safety
   c. To release the lock
   d. Not to allow entry

8. You are searching for a highly specialized diamond tipped cutter for cutting granite countertops. It is not the type of thing that could be found at the local hardware store. You should:
   a. Use an industrial database like Thomas Register or Global Spec.
   b. Find a Wikipedia article on cutting wheels.
   c. Do a Google search for “diamond tip cutters”.
   d. Review the patent literature to learn about cutters.
   e. Start by brainstorming new designs for cutters before doing any homework.

9. You are working on a project to create a recreational space in a shelter for homeless women and one of the requirements is a smoking area. One of your team members, Lee, has ethical concerns about this and says, "Smoking is unhealthy. We should not contribute to a bad habit." The kind of Critical Thinking associated with the Project Requirements is shown in which of the following statements that you might make to Lee?
   a. We should put it in the design because even though smoking isn't healthy, it's not illegal and these are adults.
   b. You're right. Let's ask our Project Manager to talk to the client to get this requirement removed.
   c. We should put it in the design because we have to take the context of these women's lives into account. They are dealing with large problems.
   d. We have to put it into the design, because the client has asked for it.

10. Although the belt sander-based paper folder demonstrated in lecture worked, it was ultimately a poor design compared to a buckle folder. The most likely way for next year's class to "invent" the buckle folder (i.e. without any prior knowledge of how it really works) is:
   a. Get together in larger groups to produce more variability of ideas.
   b. Use biological analogies to spark creative ideas about folding.
   c. Attempt to mimic the manual methods as closely as possible.
   d. Start by unstructured brainstorming to obtain the widest set of possible solutions.
   e. Do a functional decomposition and focus on each part of the process independently.

11. You are an experienced design engineer and you are asked to design a new underwater stabilizing fin for a luxury yacht, a field of design you are not particularly familiar with. You want the most efficient design with the least amount of drag. Which of the following statements is FALSE:
   a. You should look for inspiration in other engineering designs – airplanes, windmills, hydrofoils, etc.
   b. You should look for inspiration in nature, such as the fin of a whale.
   c. You should employ a variety of creative thinking techniques to avoid functional fixation.
   d. You should brainstorm possible configurations before looking at reference designs in order to avoid fixation.
   e. You should start with more general references on fin design, and then build towards more specific references.

12. Design for safety is a key DFX principle. Which of the following statements is FALSE?
   a. Designing for Safety should be left to near the end of the design process, so that a full inventory of potential hazards is known.
   b. Risk depends on the severity of a hazard and the probability that it will materialize.
   c. Safety is a highly regulated field and there are often Codes and Standards to consider.
   d. Engineers can be held accountable for accidents if they did not display a reasonable standard of care in the design.
   e. Safety factors are commonly used to reduce the probability of failure.

13. The theory of inventive problem solving (TRIZ) involves:
    a. Finding appropriate biological analogies.
    b. Working in a group using a set of well defined critical questions.
    c. Using a limited set of well-defined inventive principles to solve new problems without compromises.
    d. Combining, Maximizing, and Eliminating parts of design solutions to derive new solutions.
    e. A visualization technique in which coloured markers are used to identify functionally distinct parts of a design.

14. You have just received a client problem statement, and it describes a problem of flooding in an underground parking garage owned by the client, together with a statement that the client would like you to source an appropriate pumping system to deal with this. Before you meet your client for the first time, you should:
    a. Do a detailed search for appropriate pumps to show the client that you are well prepared for the job.
    b. Do some background reading on flooding in engineered structures and the various ways to deal with this.
    c. Interview some key stakeholders including the clients and maintenance staff to get the true story about the problem.
    d. Brainstorm a set of design solutions and prepare a short report highlighting your preferred choice.

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Written Answer (marks per question as indicated on question; 16 marks total)

Write answers into the spaces provided on the question paper.

Questions 15 – 17 refer to the following client statement: The client is a business person, starting up a new factory to make plastic snow toboggans (sleds) at the minimum possible cost. In the factory, 1.5 mm thick sheets of plastic have to be heated to 150°C so that they are soft, and then formed to the shape of the toboggan (see the figure). The client asks you to design a press to allow a single production worker to do this.

15.(6 MARKS) List two objectives, two constraints and two stakeholders that would be appropriate for this design.

OBJECTIVES:

CONSTRAINTS:

STAKEHOLDERS:

16. (2 MARKS) A worker in the factory is supposed to wear safety boots with steel toes while operating the press. One day, her supervisor notices that she is wearing running shoes that do not have steel toes.

Describe one obligation of the worker and one obligation of the supervisor in a case like this. Full sentences are not required.

17. (4 MARKS) One way of forming plastic or metal sheets is to use matched steel dies that come together with the plastic in-between to form the final shape. Such presses could be very dangerous; for example, they could crush a worker's arm. You are to design a forming process that is as safe as possible.

a) Could the crush hazard be eliminated entirely? Show some evidence of structured creative thinking.

b) If the crush hazard is not eliminated, how could you guard against the hazard to protect workers?

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18.(4 MARKS) Estimation Question:

How many metric tonnes (1 tonne = 1000kg) of salt does the City of Toronto use on its roads annually? Estimate this amount using reasonable assumptions based on your personal knowledge and the information provided here. Salt has a density of ~ 2 tonnes/m^3, and the city has an area of 630 km^2. You don't have to get the exact answer, obviously, but you do have to compute a number, and show an appropriate method of making this estimation. You may earn a bonus mark if you can suggest a way of being sure that your answer is reasonable, without using any additional information.

WRITE YOUR FINAL ANSWER (in Tonnes) HERE: