

Name: _____ MARKING KEY _____

Student #: _____

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

Quiz #1 February 13, 2015

This is a 50-minute quiz. The quiz is closed book and closed notes. The quiz has a total of 22 questions, worth 30 marks.

There are 18 multiple-choice questions, worth 1 mark each. For multiple-choice questions, you must use the multiple-choice answer sheet provided. Fill in your name and student number correctly. 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. There is no penalty for wrong answers.

There are 4 short-answer questions, worth 12 marks. These must be answered in the spaces provided on the question paper. The question paper, with your name and student number filled in, must be returned with the multiple-choice answer sheet slipped inside. Do not separate any pages.

Short-Answer Mark Breakdown

Question	Possible Marks	Marks
19	3	
20	2	
21	3	
22	4	
Total	12	

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MULTIPLE-CHOICE QUESTIONS

1. In project management, a milestone is
 - a. A task with a definite end point
 - b. The conclusion of a project
 - c. A specific point in a project
 - d. A time when an external review is required
2. From a project management point of view, which of the following is a well-defined task?
 - a. Designing stop-watch app for a smartphone
 - b. Researching existing stop-watch apps
 - c. Determine the optimum human user interface for a stop-watch app
 - d. Convincing my supervisor of the merits of my idea for a smart-watch app
 - e. Writing the code and testing the functionality of a stop-watch app
3. We learned in the lectures that some of the reasons projects fail are:
1: Lack of planning. 2: Incomplete requirements. 3: Technology. 4: Lack of management

The order of most important to least important reason for failure is
 - a. 1, 2, 3, 4
 - b. 2, 3, 4, 1
 - c. 4, 2, 3, 1
 - d. 2, 1, 4, 3
 - e. 3, 1, 2, 4
4. Levelling in project management software is used to
 - a. Make sure all human resources are treated fairly where possible
 - b. Spread costs over the project to prevent periods of very high expenditure
 - c. Prevent over-allocation of resources
 - d. Maximize resource effectiveness (cost / time required)
 - e. Find underutilized or unused resources in a specific time period
5. Which of the following is needed in order to construct a critical path of a project?
 - a. A list of all activities required to complete the project (typically categorized within a work breakdown structure)
 - b. The time (duration) that each activity will take to complete
 - c. The dependencies between activities
 - d. All items are needed
6. Open questions
 - a. Are used to determine specific details
 - b. Are used to end conversations
 - c. Are used to avoid asking a lot of questions
 - d. Are used to get a lot of details from the client

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7. Bias

- a. never exists in scientific and engineering writing
- b. invalidates information and makes it unusable
- c. has to be taken into account when using information
- d. can be overcome to make you "bias-free"

8. Service environment provides

- a. one of many points of view covered in a project requirements
- b. a bird's eye view of the characteristics of a solution - e.g. waterproof
- c. a bias that has to be counterbalanced in determining solutions
- d. the "gap" that the proposed design is intended to fill

9. A complete claim

- a. has to have five paragraphs
- b. always has internal citations and a reference list
- c. is never used in engineering writing
- d. has a statement, explanation and evidence

10. An Executive Summary is

- a. a detailed introduction to your document
- b. a stand-alone document sent with the document
- c. written before the document, so it supplies an outline
- d. required to have references and a separate reference list

11. A client statement

- a. defines the functional basis of the project
- b. forms the "contract" between the client and the design team
- c. may contain bias and implied solutions
- d. creates scope creep partway through a project

12. Prior art is:

- a. the sum total of all information relevant to the design challenge at hand
- b. all patented designs for which the patent has run out
- c. any art, literature or technology from ancient history
- d. the functions, objectives and constraints of your project, before revision

<<Questions continue on next page>>

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Questions 13-15 are based on the following Case Study.

Client: Zippy Zappy Online Marketeria

Client statement: Speed and variety are our trademark but current delivery services take too much time. We would like to speed up our delivery through the use of remote control operated drones. We want to be able to deliver, in three hours, what currently takes three days. We want these to be cost efficient, saving us money in the long run, over current conventional delivery systems. We want this system to be operable anywhere in the world.

13. The functional basis for this design would be

- a. transport packages
- b. transmit information
- c. convey mass
- d. transform mass

14. This client statement has

- a. unintentional bias
- b. an implied solution
- c. a reasonable scope
- d. a complete claim

15. In your design document, you have identified the US Federal Aviation Administration as a stakeholder. Its interest is:

- a. safe drones
- b. public safety
- c. safe aviation
- d. safe urban areas

<<End of questions pertaining to the case study>>

<<Other questions continue on next page>>

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16. The Occupational Health and Safety Act in Ontario provides workers with some fundamental rights. Which of the following rights does it NOT provide:
- a. The right to know the risks associated with work.
 - b. The right to refuse unsafe work.
 - c. The right to sue the employer in the case of an accident.
 - d. The right to participate in health and safety management.
17. In designing a new automated method of packaging potatoes in five kilogram bags, an experienced design engineer should:
- a. Strive for simplicity in the basic concept of the design.
 - b. Strive for simplicity in the final implementation of the design.
 - c. Attempt to mimic the manual methods as closely as possible.
 - d. Avoid researching existing solutions until after sufficient brainstorming.
18. As an engineer takes on greater leadership in their organization and the world,
- a. she or he has to communicate with fewer and fewer people
 - b. she or he has someone else to write their communication for them
 - c. she or he has to communicate with other researchers, manufacturers, and governments
 - d. she or he gets funding automatically, without having to communicate at all

<<End of multiple-choice questions>>

<<Short-answer questions start on next page>>

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SHORT-ANSWER QUESTIONS

We are not looking for long paragraph answers. Short bullet–point answers are fine. Use the spaces provided on the question paper to write your answers.



Questions 19 & 20 refer to the following statement:

You work for a food company that will make a new energy bar with ground cashew nuts. The nuts need to be ground into smaller pieces, and for the purposes of this quiz, we will assume that no one has ever designed equipment to do this.

19. (3 MARKS) List TWO suitable objectives and ONE suitable constraint for the design.

OBJECTIVES:

Any 2 are fine: The design should be as: inexpensive, robust, low maintenance, easy to clean, reliable as possible. Other answers within this general theme may be ok. Metrics are not required in this case.

CONSTRAINT:

The design must be: safe, made from food grade materials, grind a certain mass of nuts per unit time, or cost less than a particular figure. Must be stated as an absolute threshold.

20. (2 MARKS) When designing the grinder, your boss has asked you to draw on analogies to provide ideas. Name two separate TYPES of analogy, and give an example of each relevant to the current problem.

Technical analogy: how are rocks ground in a mining operation, how are wood chips ground in a paper mill – etc.

Biomimetic analogy: How do animals grind food? With teeth obviously, but also by swallowing rocks.

Personal analogy: How do I or other humans grind nuts? With our teeth, with a nutcracker, with a knife and fork.

Any 2 of the 3 is ok.

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21. (3 MARKS) You have just invented a new process for making waxed cardboard, which is the perfect material for making pizza boxes. You are sure that you can capture 40% of the “pizza box market” with your new cardboard, and you want to test this idea in one town: Hamilton Ontario, which has a population of about 500,000. You want to make enough cardboard to supply Hamilton for six months, before you invest in a full sized factory to supply all of North America.

In the space below, estimate how many square metres of the new cardboard you should produce for your test. You must compute an actual number, and the steps used in making your estimate. MAKE SURE YOU INDICATE THE UNITS OF ALL QUANTITIES INVOLVED IN THE CALCULATION.

1 mark for simply using a series of sequential estimations. 1 mark for getting the key points and having units that cancel. 1 mark for getting a reasonable answer.

$(500000) \text{ people} \times .4 \text{ (40\% of market)} \times (0.8 \text{ of people of pizza eating age/person}) \times (2 \text{ large pizzas/person/month}) \times 1 \text{ (box/pizza)} \times 6 \text{ months} \times 1 \text{ m}^2 \text{ of cardboard/box}$

Answer ~ 2 million m^2

Up or down by a factor of 5 would be fine.

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22. (4 MARKS) You are designing a water treatment system for a small cruise ship. The system's job is to reduce the number of live bacteria in the water tanks by 99.99%.

IN THE SPACE BELOW, provide some evidence that you know how to start the solution phase of such a problem with a STRUCTURED APPROACH, and show some of your ideas for a solution.

Marking for this problem is holistic. Below are some examples of how to earn marks.
2 marks for any indication that students are not just brainstorming individual solutions
1 mark for functional decomposition
1 mark for recognizing that killing and filtering are two alternatives
1 mark for generating alternative solutions for either of these
1 mark for using any creativity technique: TRIZ, SCAMPER, Analogy, etc.
Any of the above combinations to earn total of 4 marks.

Function: Reduce live bacteria
Objectives: Cheap reliable etc.
Constraints: Effective to 99.99%

Functional decomposition:

1. Remove water from tank OR Treat in situ
2. Reduce live bacteria in the water
3. Return water

Focus on 2. Killing bacteria:

UV, Heat, Chemical (e.g. Chlorine), Gamma ray, Biological action, Mechanical shearing, Super high pressure.

Focus on alternative for 2. Remove them: centrifuge, filter medium

To make an effective system, we could combine two methods (SCAMPER) filtration + UV for example.

To come up with ways of killing bacteria, we could examine how it is done elsewhere: In hospitals, in animals or humans

To find the optimum system we could find out how water is treated in other self contained systems of comparable size: Submarines, etc.

We specify a final system – flow through UV disinfection cell of appropriate size.