

Written Answer (marks per question as indicated on question; 14 marks total)

Write answers into the spaces provided on the question paper.

Client Statement #1 (Questions 17-22)

I use a motorized wheelchair (see figure 1) to get from my car to the baseball diamond to watch my daughter's baseball games. Some of the parks where the games are played do not have paved access from the street to the diamonds. Often I have to try to cross grass and sometimes mud using my wheelchair to get to the baseball diamond. More than once I have gotten stuck in a dip in the grass or in some mud. Once I even tipped over. I need you to redesign my wheelchair to increase its motor to 300 horsepower to keep me from getting stuck. The motor must be mounted on the bottom of the chair to keep the center of mass low and keep me from tipping over. The structure of the chair will need to be strengthened to handle the additional weight of the motor and the torque it will apply when running. Titanium is stronger than steel and so you can use less of it so it will save money. Please use tricks like this to keep costs low. Try to keep the new chair from costing more than my existing chair. I want mud flaps to keep me clean if I go through a puddle, and a drink holder.



****Note from Course Coordinator to markers: These are guidelines. Consult with me if any specific issues arise that don't fit these answers.****

17. (2 mark) The functional basis for this project is: to

Verb	Noun
<ul style="list-style-type: none">• Sense, detect, indicate, identify• Support, maintain, secure, steady, hold constant• Combine, connect, join, mix, merge, bond• Separate, split, detach, parse• Store, deposit, place• Extract, remove, mine, retrieve, recover• Transport, transmit, convey, move, channel, rotate• Transform, convert, alter, modify, adapt• Control	<ul style="list-style-type: none">massenergyinformation

2 marks: Transport, convey, move mass

1.5 marks: support, transmit, channel mass

1 mark: control, transform, convert, alter, modify, adapt, place, deposit mass

0.5 marks: anything else from the table above

0 marks: Uses wheelchair or user instead of mass

Modifiers

-0.5 additional qualifier

...safety and efficiently transport the mass across the soft grassy area.

Synonyms: if the verb or noun used is not on the list, but is a close synonym you can give it a -0.5 penalty and then grade it as if it were on the table. EX. Matter instead of mass; transfer instead of transport

18. (2 marks) What is the purpose of defining the functional basis at the start of a project?
One sentence will be fine. One of the following or similar will get 2 marks.

To dissect an engineering design problem and understand it from a functional perspective.

To have an abstract / high level definition of the problem that keeps the design space open.

Helps identify the underlying functionality of the design.

Identify comparable technologies to use as analogies.

To scope the project while keeping the design space as open as possible.

To understand the client's fundamental need.

Give partial marks if they don't quite say one of these examples, but they are close.

19. (2 mark) Give one stakeholder and state their interest.

1 Mark for each (must have one stakeholder and one interest)

If multiple stakeholders are given grade the top one in the list and don't look at the others.

Daughter	– Family value; sports
Disable rights organizations	– Bettering the lives of disabled people
NGO's	– Better the lives of disabled people
	– Encourage use of public parks
Grounds caretakers	– Avoid unnecessary work
Wheelchair manufacturers	– Increase profit; diversify product line; recruit more customers
Government	– Developing productive citizens
	– Support self-sufficiency of disable
	– Encourage use of Public Park
Client / User*	- Family values; self-sufficiency; live life 'normally'; independence

*Textbook says no, but we'll give them grades.

No marks

Better wheelchair

Avoid getting stuck

Avoid tipping over

Have a drink holder

20. (3 marks) Give one primary function, one objective and one constraint for the project. They only need to give you one of each, but I gave several examples of each.

Primary Function: Support user; Move user; transport user (client will work as well)

Objective: Inexpensive; Minimize sinking into soft surfaces

Constraint: Retro fit of existing wheelchair; [wheelchair regulations]

NO: Low centre of mass; 300 hp; Use titanium; more power

21. (3 Marks) Use the Pugh method to select which of these three alternatives methods for opening a bottle of root beer best meets the following objectives (show your work):

- Minimal training
- Safe
- Inexpensive



Bottle opener



Spoon



Chainsaw

Minimal Training	S	-1	-1
Safe	S	-1	-1
Inexpensive	S	+1	-1
Sum +	0	1	0
Sum S	3	0	0
Sum -	0	-2	-3
Total	0	-1	-3

****Methodology is the important thing, not the exact ratings though the chainsaw definitely required more training, is more expensive and is much less safe.****

****If they used different notation than -1, S, +1 that is fine as long as they are still doing a pairwise comparison of the alternatives. I.E. -1, 0, +1; 1, 2, 3 are both OK. ****

The alternative that best meets the stated objectives is Bottle Opener (or Spoon) [**depends on result of correct Pugh Method**]

because though it is slightly more expensive then the spoon it is slightly safer and easier to use.

****No marks for Q. #21 if they didn't do a correct Pugh Method.****

22. (2 marks) In general explain a limitation of the Pugh method.

The Pugh method assumes an equal weighting for all objectives. The example above treats safety equally important to minimal training.