

WATERLOO **ENGINEERING**

**Senior Team Design
Competition Problem**

Spring 2011
Waterloo Engineering Competition
July 8-9

GENERAL RULES

1. All questions regarding the competition problem must be asked during the welcome and briefing session. No questions will be answered during the design and build stage.
2. Teams are not allowed to leave the DWE building unless they have submitted their prototype and presentation to competition staff.
3. All communication devices must be turned off throughout the duration of the competition. This means you may not use a cell phone camera to take pictures for the purpose of your presentation or in the shop in this competition.
4. Wireless on laptops must be turned off. Violation of this rule will result in immediate disqualification.
5. Visitors are not allowed throughout the design and build stage. Violation of this rule will result in immediate disqualification.
6. Teams may only use materials they have purchased in the shop.
7. Final prototype and presentation materials must be submitted to the submission desk prior to the end of the design and build stage. It is the team's responsibility to bring its deliverables from the design area to the submission desk.
8. Competitors may not use the blackboard when delivering presentations.
9. Keep work spaces clean. Tidy up at the end - marks will be deducted otherwise.

SCHEDULE

Friday, July 8	5:30 p.m. – 5:45 p.m.	Competitor Check-In	DWE 2536
	5:45 p.m. – 6:30 p.m.	Welcome/Briefing	DWE 2536
	6:30 p.m. – 12:30 p.m.	Design/Build	Various
	12:30 p.m. – 1:00 a.m.	Submissions/Debriefing	DWE 2536
Saturday, July 9	7:00 a.m. – 7:30 a.m.	Competitor Check In	RCH 3rd floor lobby
	7:30 a.m. – 12:05 p.m.	Presentations/Demonstrations	RCH 307
	12:05 p.m. - 12:30 p.m.	Deliberation	RCH 307
	12:30 p.m. - 1:00 p.m.	Announcement of winners	RCH 302

Volunteers will give instructions to teams on when and where to get their pizza, which will be available at some time between 8:30p.m. – 9:30p.m. Please remind the competition coordinators and volunteers of your dietary restrictions and/or allergies. Dress code for presentation and demonstration is business casual. There will be a question period after the problem is presented. No questions will be answered during the development and build stage to ensure fairness in the competition.

THEME

The theme of the Spring 2011 Senior Team Design is mountain riches.

SCENARIO

A recent rumour has spread across the province of Ontario regarding a stash of precious metals and gems located on the side of a very steep mountain, completely inaccessible on foot. You and your team, fresh out of Waterloo Engineering with your Bachelor's degrees, Iron Rings, and an accumulated student-loan debt of \$150,000 have decided you're the right people to cash in on this once in a lifetime opportunity.

You're riches-retrieving/student debt reducing contraption will be required to travel across the top of the mountain to retrieve the treasure located at various depths. Each individual piece of treasure has been given a different value depending on the ease at which it can be retrieved. Not every single piece of treasure will likely be able to be retrieved, but it's in your best interest to retrieve as much treasure as possible so as to completely pay off your student loans.

OBJECTIVE, REQUIREMENTS & CONSTRAINTS

Design a device that is remotely controlled through a minimum of one (1) metre of cable using only the materials provided. It must be able to collect the treasure from the cliff described in the above scenario. The treasures are of varying values and will not be revealed until your demonstration on Saturday. Additional obstacles to the treasure may be introduced at demonstration time as well. The vehicle must not exceed 20 cm x 20 cm (L x W) in dimension and should be able to retrieve treasure from along the entire cliff and not just one section (there is no height restriction). Due to toxic waste at the bottom of the cliff, the device must operate from the top of the cliff. High wind conditions are frequently a problem at this location so it is ideal that your device is able to work in such windy conditions, so as to prevent a loss in productivity. If your device is halted due to inclement weather, points will be deducted.

Your device may not damage the competition problem setup.

The remote control and the attached cable must not have direct physical impact on the retrieving vehicle, i.e. steering by pulling the vehicle is not allowed. Only two people are allowed to operate the device at any point which includes a person holding up the cable to prevent physical interference. Teams are not permitted to touch the vehicle during demonstration with the exception of retrieving treasure from the device once the treasure is over solid ground (The silver line). You have \$6,000 leftover from your work terms at the oilsands in Fort McMurray. Any other money that you spend will be added to your student debt, that you have to recover on your treasure hunt.

Overall, your goal is to eliminate your student debt as much as possible. See the marking form for complete details.

PROTOTYPE TESTING RULES

A portion of the terrain will be available for teams to perform prototype testing. Each testing period is 10 minutes, and is signed-up for on a first-come-first-serve basis.

Reservations

Each team may only have one reservation at any time, and must use up the testing period before reserving the next one. Teams may only reserve whichever time slot is available next (i.e. teams may not specify a time).

Cancellations

Teams are allowed to make cancellations to reservations. A cancelled time slot then becomes the next available testing period, and can be reserved by whichever team makes the reservation next. Time slots after the cancellation will not be bumped up.

Consumable Items

Some items are consumable, for example: batteries. Teams are responsible for purchasing enough of these consumable items from the shop during the design and build phase to successfully complete the presentation and demonstration.

SHOP RULES

1. A maximum of two (2) people per team may be in the shop at any time.
2. All sales are final. Be sure to verify purchased items and quantities before leaving the shop.
3. Teams may not trade building materials. Violation of this rule will result in immediate disqualification for both teams.
4. The competition shop will keep track of the official expense forms. However, teams are encouraged to keep track of their own Purchase Requisition Form to have an idea of how much they have spent. The shop will not tell teams how much they have already spent.
5. The shop will close 30 minutes before the development and build stage ends.

DELIVERABLES

At the end of the six- (6) hour development and build stage, each team is required to submit the following items:

1. A working prototype of the machine
2. A PowerPoint presentation
3. Purchase Requisition Form

MARKING SCHEME

The following marking scheme is specific to the Spring 2011 Senior Team Design competition and will be used by judges during presentation and demonstration.

Design & Performance	60%
Workmanship / Aesthetics	5%
Able to retrieve treasure from left-side of course	5%
Able to retrieve treasure from center of course	5%
Able to retrieve treasure from right-side of course	5%
Student Debt Reduction	30%
<i>This metric will be a direct correlation between the percentage if your team's student debt reduction. For example, if your team starts with \$150,000 in debt and are able to reduce it to \$75,000, your team will receive 15% on this metric.</i>	
Weatherproof	10%
Not able to move at all†	- 60%
Falls off the cliff	- 10% each time*
Fails to meet constraints	- 20%
Presentation	30%
Explanation of Design Process	15%
Demonstration of Teamwork	7%
Knowledge	3%
Presentation Quality and Flow	3%
Effective use of Time	2%
Cost below \$2500	+ 10%*
Not Following Dress Code	- 5%*
Originality	10%
Daring/Outside the Box	4%
Creativity	3%
Uniqueness	3%
TOTAL	100%

In case of a tie in total marks, the teams will be ranked based on their points scored in Design & Performance.

Completed marking sheets will not be disclosed to competitors; however, if teams wish to know their strengths and weaknesses for improvement in future competitions, judges will be available after the competition for questions.

* The \pm signs denote bonus or penalty points, respectively. Lowest possible score for each marking category is zero (0) points.

† The WEC marking scheme explicitly states that a vehicle not being able to move constitutes as a design fail. Be sure to keep this in mind when competing at the OEC, as the same rule applies but is not stated in the marking scheme.

Item Description	Size	Price	Item Description	Size	Price
General			Foam Sheet	Per cm ²	\$5
Tin Foil	Per cm	\$10	Plywood 1/4"	Per cm ²	\$10
Cotton String	Per cm	\$5	Wood Dowel (ø 1/4")	30cm	\$150
Sisal Twine	Per cm	\$7	Wood Dowel (ø 1/2")	30cm	\$180
All-Purpose Rope	Per cm	\$15	Wood Dowel (ø 3/4")	30cm	\$210
Florist Wire	Per cm	\$10	Adhesives		
Nail (Various Sizes)		\$5	Hot Glue Stick	1 Stick	\$150
Screw (Various Sizes)		\$7	White Glue	1/4 Cup	\$100
Tin Food Container		\$700	White Glue Stick	1 Stick	\$110
Pot Pie Tray		\$500	Super Glue	sml. Tube	\$90
Paper Plate		\$200	Double Sided Tape	Per cm	\$8
Plastic Hook		\$400	Packing Tape	Per cm	\$8
Metal Hook		\$450	Electrical Tape	Per cm	\$5
Eye Hook		\$425	Duct Tape	Per cm	\$12
Styrofoam Cup		\$200	Electrical		
Mouse Trap		\$500	Electric Motor #1	0.07A*	\$ 600
Balloon		\$100	Electric Motor #2	1.2 A*	\$ 600
Plastic Spoon		\$100	Electric Motor #3	0.3 A*	\$500
Paint Roller		\$150	Battery Holder #4	1.5 A*	\$250
Wheel		\$240	Battery Holder	2x AA	\$100
Rubber Band		\$25	Battery Holder	4x AA	\$200
Styrofoam Ball	1.5"	\$50	Battery Holder	6x AA	\$300
Styrofoam Ball	2"	\$65	Battery Holder	8x AA	\$400
Styrofoam Cup		\$80	Recycled Resistors		\$20
Metal Rod	9 cm	\$150	Brand New Resistors		\$50
Pipe Cleaner		\$25	Potentiometers	1k, 10k, 100k	\$300
Zip Tie	7½"	\$30	Capacitors		\$100
Popsicle Stick		\$20	555 timer		\$400
BBQ Skewer		\$30	Quad 2 input NAND IC		\$400
Clothes Pin		\$30	NPN BJT		\$150
Stone		\$20	Red LED		\$75
Party Drinking Straw		\$40	Toggle Switch		\$100
Cupcake Holder		\$50	Off-Mom Switch		\$200
Paper Clip		\$10	Off-Mom/On-Mom Switch		\$175
Ziploc Bag		\$200	Electrical Wire	Per cm	\$5
Construction			Battery	AA	\$25
Cardboard	Per cm ²	\$4	1N4004 Diode		\$150

*Motor current measurements were taken at 3 volts at no load condition.

PURCHASE REQUISITION FORM

Team Number: _____

Team Member #1: _____

Team Member #2: _____

Team Member #3: _____

Team Member #4: _____

Item	Unit Price	Quantity	Total Price	Volunteer Initial

PURCHASE REQUISITION FORM (continued)

Team Number: _____

Team Member #1: _____

Team Member #2: _____

Team Member #3: _____

Team Member #4: _____

Item	Unit Price	Quantity	Total Price	Volunteer Initial