For Use by Participants in
CAT Applications in the Discipline Workshop

(Not for General Disclosure)

A Subset of Skills Assessed by the CAT Instrument

Skill Set 2		
Skill	**Questions**	**Descriptions**
Skill 1	Q10, Q11	Separate relevant from irrelevant information when searching for information to solve a real-world problem.
Skill 2	Q14	Identify and explain the best solution for a real-world problem using relevant information.
Skill 3	Q15	Explain how changes to a real-world problem situation might alter the recommended solution.

Discipline: Interdisciplinary

Sub-Discipline: Problem Solving / Life-long Learning

Topic: Off Grid Solar System

Identify Relevant Course: Problem Solving

Keywords: Solar Energy System, Life Long Learning, Problem Solving

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Skill Set 2: Search for relevant and useful information to solve a real-world problem; use that information to formulate and explain an optimal solution; explain how the recommended solution might change if the problem constraints changed.

Define your goals in terms of what discipline specific knowledge is involved in this assessment task and what types of skills in using and applying that knowledge you are trying to assess.

Prepare students to learn about an unfamiliar area.
Clearly defining learning goals
Searching for relevant information
Evaluating the quality of sources
Applying new information to solve a problem
Understanding how changes to problem situation might alter the recommended solution

Define the type of information that students will be able to search to develop solutions (e.g., internet, scientific database, or a set of predetermined articles with irrelevant distractors). How will student's performance be evaluated in this search activity? Will students have to use a rubric for screening relevant information on the Internet and will you evaluate their rubric? Alternatively, you can provide a set of readings to severely limit their choices of information and evaluate their choices based on your own rubric.

Students will use the internet to find any available information. A rubric is provided to help students organize their search strategy.

Formulate a prompt of a real-world problem in your discipline that will require searching for relevant information and analyzing/applying that information to solve the problem.

This could involve the selection of new lab equipment, the design of a set for a play, the selection of food for a diabetic patient, the best medical treatment for an illness, the best way to deal with a chemical spill, the design of a waste water treatment facility for an impoverished village, building an informational resource like a website, etc.

The real-world problem should include a variety of constraints that are articulated in the scenario you develop. The constraints should be specific enough to severely limit the range of optimal solutions.

The prompt should require the student to:

1. Separate relevant from irrelevant information when searching for information to solve the problem.
2. Identify and explain the best solution for the problem using relevant information.

Question Prompt:

Jane and Tom have recently acquired a newly built remote cabin in the Rockies that they plan on living in during the summer. The cabin is close to a lake and gets good sun exposure most of the day. They would like to equip the cabin with an off-the-grid solar system to run some 120 volt LED lights for 2 hours each night, an electric expresso maker, and a small 4.4 cu ft electric refrigerator, recharging their Oral B electric toothbrush, Recharging Panasonic razor, and to recharge their Iphones for playing music. The cabin is only accessible by hiking, horseback, or mule. Your task is to design a solar system that would satisfy their needs, be easily transportable to the site by mules, and be economical and reliable.

Here are some pertinent facts to get you started:
• Average sunlight per day at cabin sight during summer months = 6 hours
• Number of expected consecutive overcast days without full sun = 2
• LED lights draw ~ 24 watts
• Refrigerator rated at ~ 1.5 amps at 120 volts (daily power estimate = 600 watt hours) Peak power may reach 540 watts for a moment when compressor starts
• Expresso maker requires a peak of 1450 watts but averages 1000 watts an hour, assume it will run for 8 minutes a day.
• Mules cannot carry panels larger than 2 x 4 feet in this terrain.
• Panels will be mounted on their roof which faces south.

Design a complete solar system to supply the power needs for Jane and Tom that will be reliable and economical and explain why it appears to best suit their needs. Assume that all devices may be operated simultaneously for short periods of time for maximum reliability.

Other helpful hints:
Ohms law: Power (watts) = Volts * amps
1 watt hour = 1 watt of power consumed for 1 hour
Deep cycle batteries are frequently rated in amp hours: 1 amp hour at 12 volts = 12 watt hours

Skill 1: Searching and Finding Relevant Information

Method 1

If you are having students search for information on the web or in a scientific database *(recommended)* consider using a template like that on the following page to help them articulate their information selection process. You should have them evaluate the quality of the sources in addition to the relevance (e.g. CRAAP test). This could be scored in a number of ways including: (1) did they search for all of the types of information needed to solve the problem, (2) did they appropriately evaluate the quality of the information sources, and (3) did they search in appropriate places for the needed information. Be sure to indicate the number of points awarded for each piece of information identified.

Example rubric for evaluating internet search

Identification of Information Needed to Solve Problem	Points Awarded
1. Information Needed: Solar panels and battery storage	1
a. Evaluation of Quality of Sources	1
b. Searched Appropriate Sources	1
2. Information Needed: Peak power vs Continuous power requirements	1
a. Evaluation of Quality of Sources	1
b. Searched Appropriate Sources	1
3. Information Needed: Modified vs Pure Sine Wave Invertors	1
a. Evaluation of Quality of Sources	1
b. Searched Appropriate Sources	1
4. Information Needed: MPPT vs PWM Solar Charger Controllers	1

Method 2

If you are providing a set of relevant preselected readings be sure to include an equal number of irrelevant but somewhat related sounding readings to choose from. The scoring rubric for method 2 could simply be the number of relevant readings selected by the student.

Example rubric for evaluating selected readings

Title of Readings	Points Awarded
	1
	1
	1
	1
	0
	0
	0
	0

Example Rubric for Students to Use When Searching For Information

Define Search Goal: ____

Pre Search Rubric				Post Search Observations			
Type of Information Needed	**Best Source**	**Why useful**		**Information available?**	**Meets quality standards?**	**Other Information Needed**	**Why Useful**

Define Search Goal: ____

Pre Search Rubric				Post Search Observations			
Type of Information Needed	**Best Source**	**Why useful**		**Information available?**	**Meets quality standards?**	**Other Information Needed**	**Why Useful**

Define Search Goal: ____

Pre Search Rubric				Post Search Observations			
Type of Information Needed	**Best Source**	**Why useful**		**Information available?**	**Meets quality standards?**	**Other Information Needed**	**Why Useful**

Calculations for Solar System

Device	Peak Power (Watts)	Continuous Power (Watts)	Hours Operated per day	Daily Power Consumption (Watt hours)	Batteries (Amp hours)	Panel wattage needed
expresso machine				0		
LED lights				0		
toothbrush				0		
razor				0		
iphone				0		
refrigerator						
Subtotal per day =	0	0		0		0
		2 day backup supply =		0	0	0

* blue cells are calculated for you
* fill in white cells

Purchase List

Device	cost	Summary of Reviews
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
fill in	fill in	
Total Cost =	0	

Skill 2: Identify and Explain the Best Solution for the Problem

This rubric will depend on the complexity of solution and whether it involves evaluation the quality of explanations provided by the student or the quality of the presentation. Indicate the number of points awarded for each feature. Some features and explanations may be awarded more points for use of specific discipline content.

Example Rubric for Evaluating Problem Solution

Step 1

Evaluate the Inclusion of Important Components in the Solution

Important Component or Feature	Points Awarded
Solar panels (500 watts)	5
Inverter (1500 watt continuous; 2500 watt peak; pure sine wave)	3
Solar Charge Controller (min. 30 amp or min. 100 volt; MPPT)	2
Batteries (min. 150 AH or min. 300 AH)	2

Step 2

Evaluate Explanations *(if relevant)*

Explanation of Component or Feature	Points Awarded
Reliability Evidence	1
Cost Effective Price Range	1
125 amp fuse to inverter ; 30 amp circuit breaker ; Circuit breaker box	2
Wire 10 AWG to connect device ; mounting clips/hardware	2
Grounding rod/ surge protector	2

Step 3

Evaluate Presentation of Solution *(if relevant)*

Features of Effective Communication	Points Awarded
(ex) Well Organized	1
(ex) Effective use of visual aids	1
(ex) Clear explanations	1

Skill 3: Explain how Changes to the Problem Situation Would Change the Recommended Solution

Formulate a prompt to see if students can explain how the recommended solution might change if the problem constraints change. In other words, can students understand how changes in problem constraints would alter their solution and explain how the changes in problem constraints will impact their recommended solution?

Question Prompt:

What new information about the Jane and Tom's situation would change your recommended solar system. How would these changes alter your recommended solar system?

Skill 3: Explain how Changes to the Problem Situation Would Change the Recommended Solution

It is important that students not only identify a change to the problem situation or constraints but to also provide a new recommendation based on those changes. Indicate the number of points awarded for each change and corresponding recommendation.

Example Rubric for Evaluating Impact of Changes to Problem Constraints on Solution
(fill in possible student responses including zero point answers)

Description of Change to Problem Situation	New Recommendation	Points Awarded
Full size refrigerator for the cabin	900 watts of panels, and 300 amp batteries	1
Less sunlight (5 hours per day)	Add additional panel (extra 100 watts)	1
Host guests and need to make more espresso	6 solar panels for 600 watts required	1

Rubric for Solar System Evaluation

Calculations for Solar System

Device	Peak Power (Watts)	Continuous Power (Watts)	Daily Power Consumption (Watt hours)	Batteries (Amp hours)	Panel wattage needed
expresso machine	1450	1000	133		
LED lights	24	24	48		
toothbrush	3	3	24		
razor	18	18	3.6		
iphone	18	18	11		
refrigerator	540	180	600		
Subtotal per day =	**2053**	**1243**	942.5		157.1
		2 day backup supply =	**1884.9**	**157.1**	**471.2**

			Total possible points	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
Spreadsheet for Calculations that is within +- 10% range = 2 pts			2										
Components Needed	**Reliability Evidence**	**Cost Effective Price Range**											
Solar Panels (500 watts) = 2 pts	1 pt	1 pt ($100 - $180 per panel)	4										
Inverter	1 pt	1 pt ($200 - $480)	2										
1500 watt continuous = 1 pt			1										
2500 watt peak = 1 pt			1										
if pure sine wave= 1 pt			1										
Solar charge controller													
minimum 30 amp or minimum 100 v =1 pt	1 pt	1 pt ($20 - $50 for PWM)	3										
MPPT = 1 pt		($100 - $200)	1										
Batteries													
minimum 150 AH = 1 pt	1 pt	1 pt ($150-$200 for 100 ah)	3										
Better minimum 300 AH = 1pt			1										
Additional Items that may be needed - up to 2pts	Any two items included gets 2 pts		2										
125 amp Fuse and holder battery to inverter													
30 amp Circuit breaker from panel to Charge controller													
30 amp Circuit breaker from Charge controller to battery													
Circuit breaker box													
Wire 10 AWG to connect devices													
Mounting clips/hardware													
Grounding rod/Surge arrestor													
Completed IDEAL Outline													
Goals - upto 2 pts			2										
References and CRAAP test up to 2 pts			2										
New information to be learned up to 2 pts			2										
Mistakes corrected upto 2 pts			2										
What information is still needed to install this system and get it working - up to 2 pts			2										
Note: What new information about the situation would change your recommendation and how would it change your recommendation. -1 pt per well specified change up to 3 pts maximum			3										
Presentation - up to 3 pts			3										
		Total =	**37**										