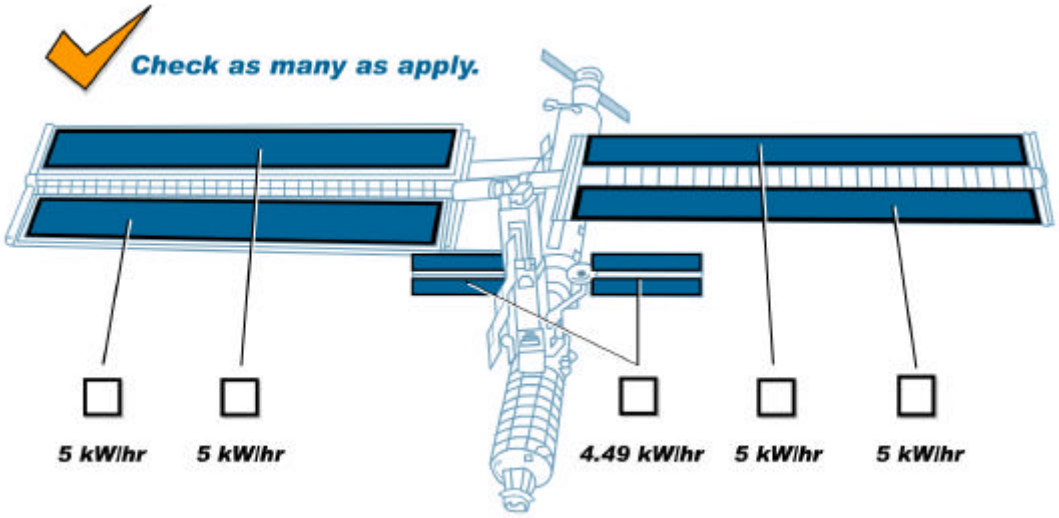
Practice Exercise: Power on the Space Station

This is your chance to build an electrical system for a space station. You may install up to five Photovoltaic (PV) modules to generate power, but remember they are very expensive and may block your view from the space station's portholes. The items you select for your electrical system are described below. You may add as many electrical items to your station's circuits as you wish. However, each item consumes a certain amount of power, so you will have to balance the output of power from your completed PV array with the total power consumption of the items you select for your station. Choose wisely!

Power Generation

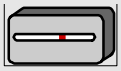
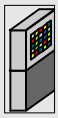


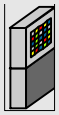
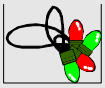
Select the number of Photovoltaic modules you want in your station's PV Array and add together the total number of kilowatts per hour (kW/hr) and write it below:

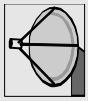
_____ kW/hr power being generated

Now, *carefully* select the items you *must* have on your space station and complete the power consumption table. Write the "Power Load" of those items you select in the fourth column and add up the total.

Power Loads

	Item	Description	Power Load	Write the kW/hr for your choices here
	Thermal control systems	Controls heating and cooling of the station	8.5 kW/hr	
	Environmental control and life support systems	Monitors all life support systems to keep them in proper balance	7 kW/hr	
	Command and data computers	Controls many of the essential support functions	3.5 kW/hr	

	Flight Crew system	Housekeeping and trash management, on-orbit maintenance, & inventory management	3 kW/hr	
	Tracking systems	Guidance, navigation and control	1.75 kW/ hr	
	Communication systems	Links with Mission Control to exchange information	1.75 kW/hr	
	Food system	Includes microwave and oven, refrigeration system, and waste control system	2 kW/hr	
	Lighting system	Provides lighting to all parts of the station	2 kW/hr	
	Hair Dryer		1.5 kW/hr	
	250 Christmas Lights		1.25 kW/hr	
	Curling Iron		1.2 kW/hr	
	Coffee maker		1 kW/hr	
	Television		0.16 kW/hr	
	Electric guitar		0.6 kW/hr	
	Personal hygiene system	Restroom facilities	0.5 kW/hr	
	Personal laptop		0.5 kW/hr	
	Stereo with CD player		0.03kW/hr	
	Nintendo Game Cube		0.03kW/hr	
	DVD player		0.03kW/hr	

	Satellite Receiver		0.03kW/hr	
	Electric Razor		0.03kW/hr	
	Electric Toothbrush		0.03kW/hr	
			Total kW/hr	

Follow-Up Questions

1. How many kilowatts per hour (kW/h) are generated by your space station's PV array?
2. How many kW/h would be consumed by your appliances if all systems were running at the same time?
3. Calculate the **percentage** of the total power load used by the top three power consumers on your list.
   For example, if your station generates 15 kW/h, then the hair dryer, which uses 1.5 kW/h, would consume 10% of the total energy output of the Photovoltaic array. (1.5kWh/15kWh=.10 or 10%)
4. Suppose you had an item which consumed 3.5 % of the total power being generated every hour. If the total power being generated was 55 kW/h, how many kW/h is the item consuming?

Going further: The appliances in your home also require electricity. Each appliance consumes electrical power. By doing a little research, you can calculate how much electrical power is being used by you and your family every month and what that electricity costs.

1. Determine the cost of electricity and how many kW/h of electricity are used in your building each month. How much does one kW/h of electricity cost where you live? You will need an electric bill. If you live in an apartment and your family does not receive a bill, you may check with the landlord or head custodian. On the electric bill it will state how much a kW/h of electricity costs. For example, a kW/h may cost $0.08. The bill will also state the total kW/h consumed where you live in a month. Write these amounts here: Cost of electricity per kW/h: _____ Total kW/h consumed: _____.

2. Now, select an appliance and find how much power it needs to run. Examine an appliance. On the label, cord, back, or underside of the appliance, there should be information about the appliance's energy usage. Sometimes this is listed under "input". If an appliance is not available, you may add up the watts needed to light all the light bulbs in a room or throughout your house. On most appliances, and all light bulbs, the electrical power required to run that appliance is stated in watts (W), amps (A), volts (V), or sometimes volt-amps (VA). If the power is given in any unit of measure other than watts, use the following conversion formulas: watts = volts x amps, volt/amps = watts. Do your work on a separate piece of paper. Total wattage required to run the appliance(s) = _____.

3. Now that you know the cost of a kWh of electricity and the wattage of an appliance, multiply the *cost* of a kW/h by the kW used by the appliance in one hour. This will give you the amount it will cost to run this appliance for one hour. Here is an example. You may input your own numbers to solve the problem. Remember first you need to convert from watts to kilowatts.

Appliance	Wattage	W ÷ 1000 = kW	Rate	Cost per Hour= kW x Rate
Hair Dryer	1500 W	**1500 W ÷ 1000 = 1.5 kW**	**$0.08**	**1.5 kWh x $0.08 = $0.12 per kWh**