Workshop Exercises - How to determine maximum demand in an off-grid system

Question 1

You have been approached by an expat property owner who is building a new house where there is no power. After an initial inspection of their property you have developed the following load sheet.

(a) Complete the load table to show them what their daily load is (in kWh).

Appliance	No.	Power	Energy Usage	
			Usage time	Energy
		W	h	Wh
Kitchen lights	1	6.5	6	
Kitchen Exhaust Fan	1	50	0.5	
Kitchen: Mixmaster	1	400	0.3	
Toaster	1	1200	0.1	
Kettle	1	2400	0.3	
Lounge Room Lights	2	15	3	
Bedroom 1 Lights	1	15	1	
Bedroom 2 Lights	1	15	1	
Bathroom Lights	1	15	1	
Plasma TV and Entertainment System	1	450	6	
Fridge	1	150	14	
Freezer	1	150	10	
Old Computer	1	450	6	
Laptop Computer	1	50	2	
Vacuum Cleaner	1	2400	0.28	
Iron	1	1200	0.14	
Water Pump	1	450	1	
Washing Machine	1	600	0.75	
Microwave	1	1600	0.2	
Drill	1	600	0.2	
Daily Load Energy – a.c Loads (Wh)				

b) The following has been recommended as energy efficiency initiatives that could be implemented Note there could be many solutions, following are some recommendations:

- Replace kettle and toaster with gas kettle and toaster
- Downsize TV and entertainment system, alternatively they may be able to get a cheap tv for normal use and keep the big one for "special occasions"
- Stop using old computer and use the laptop in preference.
- Downsize vacuum cleaner, or at least replace the motor with one that has a soft start on the motor

Based on your recommendations the client has

- completely changed to LPG to replace the kettle and toaster
- halved the size of the entertainment system
- has disposed of the old computer and monitor.
- has kept the vacuum cleaner but were able to replace with a soft start motor with a surge of 2x.

Based on your energy efficiency recommendations complete the load assessment to determine the required inverter size for this system. Make some assumptions on how the loads operate throughout the day and calculate the max demand contribution and design surge demand. What are the assumptions you made?

Appliance	**No.**	**Power**	**Energy Usage**		**p.f.**	**Contribution to max. demand**	**Surge factor**	**Contribution to surge demand**	
			Usage time	**Energy**				**(potential)**	**(design)**
		W	**h**	**Wh**		**VA**		**VA**	
Kitchen lights	1	6.5	6		0.8		1		
Kitchen Exhaust Fan	1	50	0.5		0.8		3		
Kitchen: Mixmaster	1	400	0.3		0.8		4		
Lounge Room Lights	2	15	3		0.9		1		
Bedroom 1 Lights	1	15	1		0.9		1		
Bedroom 2 Lights	1	15	1		0.9		1		
Bathroom Lights	1	15	1		0.8		1		
Plasma TV and Entertainment System	1	225	6		0.8		1		
Fridge	1	150	14		0.9		4		
Freezer	1	150	10		0.9		4		

Laptop	1	50	2		0.9		1		
Vacuum Cleaner	1	2400	0.28		0.7		2		
Iron	1	1200	0.14		1		1		
Water Pump	1	450	1		0.7		5		
Washing Machine	1	600	0.75		0.8		4		
Microwave	1	1600	0.2		0.8		1		
Drill	1	600	0.2		0.8		2		
Daily Load Energy – a.c Loads (Wh)									
Maximum Demand (VA)									
Surge Demand (VA)									

Question 2

a) Complete the following table. Make some assumptions on how the loads operate throughout the day and calculate the max demand contribution and design surge demand. **What are the assumptions you made?**

b) What size inverter would you select?

Appliance	**No.**	**Power W**	**Energy Usage**		**p.f.**	**Contribution to max. demand VA**	**Surge factor**	**Contribution to surge demand**	
			Usage time h	**Energy Wh**				**(potential) VA**	**(design) VA**
Kitchen Lights	2	20	3		0.8		1		
Lounge Room Lights	3	20	3		0.8		1		
Bedroom 1 Lights	1	20	1		0.8		1		
TV	1	120	8		0.8		4		
Fridge	1	200	14		0.8		4		
Computer	1	200	5		0.8		1.1		
Vacuum Cleaner	1	1200	0.14		0.7		6		
Iron	1	1200	0.14		1				
Water Pump	1	450	1		0.7		6		
Washing Machine	1	400	0.75		0.7		6		
Microwave	1	1200	0.2		0.8				
Daily Load Energy – a.c Loads (Wh)									
Maximum Demand (VA)									
Surge Demand (VA)									