Question 1

A house has the following electrical appliance usage:

- One 18 Watt fluorescent lamp with electronic ballast used 4 hours per day.
- One 60 Watt fan used for 2 hours per day.
- One 75 Watt refrigerator that runs 24 hours per day with compressor run 12 hours and off 12 hours.
- The system will be powered by 12 Vdc, 110 Wp PV module.
- Assume an average of 3.4 peak sunlight hours per day and 3days of autonomy.

Size the PV system including, PV modules, Inverter, Battery, Solar charge controller. State all assupmptions.

Question 2

An offshore wind turbine generator situated at sea level has a rotor blade diameter of 100 metres. The air density is 1.23 kg/m^3. The turbine is rated at 5MW in 30mph (14m/s) winds. Calculate the power generated with a power coefficient of 0.25

Question 3

You need to decide which energy system is more suitable to power the following household requirement. This system will be installed in Perth, Australia. Since the average annual daytime temperatures are quite mild, we need not to worry about temperatures effects on the battery capacity

This exercise is divided into four parts. In part one you will calculate the system requirements. In the second part you will calculate the energy production of a PV system and part three you will calculate the energy production of a wind system. In the final part, You will conclude on the most suitable option after modelling the system.

Please see the instructions for the software **"Homer Beta 2.68"**

Appliance	Watts	Quantity	Total Watts	Hours/day	Watts/hrs/Day
40W Bulb	40	10		4	
100W Bulb	100	2		3	
TV	75	2		3	
Heater/air con	2000	2		3	
Music system	200	1		2	
Refrigerator	325	1		6	
Freezer	325	1		6	
Oven	1200	1		1	
Coffee Maker	1000	1		0.5	
Total					

PART 1: System Requirement

1. Calculate is the total power requirement (Wh) per day.
2. Assuming that peak load occurs when the refrigerator the heater/air con and the TV work simultaneously. Calculate the peak load.
3. Calculate the voltage of your battery bank.
4. Calculate the amp-hour requirement per day.
5. The system is required to work even if there are 3 consecutive cloudy days and the batteries must not run down more than 50%. Calculate the Ah you need to store.
6. Adjust this figure for an inverter efficiency of 93%.
7. Using the lead-acid batteries listed in the appendix, design a battery bank:
   - Battery Model?
   - Number of batteries in series?
   - Number in batteries parallel?

PART 2: PV Power

1. Your PV array needs to point true North. Where is true North in Perth, assuming that your compass points to 000 (magnetic North)?
2. What is the recommended tilt angle for Perth?
3. Assuming that the total sun hours for Perth is 4 hours in June. What is the amperage required from your PV array?

PART 3: Wind Power

Refer to the following websites for the specifications of the D400:

http://www.duogen.co.uk/page21.html
http://www.hybridenergy.com.au/pdf/d400windgenerator.pdf

1. How many amperes should you be able to supply from the D400 at 7.5m/s?
2. If the wind drops to 1m/s, what will the output current be?
   What is, theoretically, the maximum current you can obtain from the D400?
3. Let's say there is a possibility of installing the turbine on top of a 20m high mast instead. Assuming that Zo=0.012, what would you expect the wind speed to be at that height?