

EXERCISE 1

We want to have a house isolated from the main grid for a period of 6 days.

During this 6 days the house electric loads (TV, Microwave, Whasing machine, oven, fridge, lighting) shall be supplied from a Battery Pack. At the seventh day the Battery Pack will be completely recharged again.

List of electric loads in the house:

- The TV consumes 50W and works for 4 hours a day
- The lighting consumes 10W and works for 6 hours a day
- The whasing machine consumes 1kW and and works for 2 hours a day
- The oven consumes 2kW and works during 1 hour a day
- The fridge consumes 300W and woks 4 hours a day

The Battery Pack shall be able to supply the house loads during the 6 days the house is isolated from the grid.

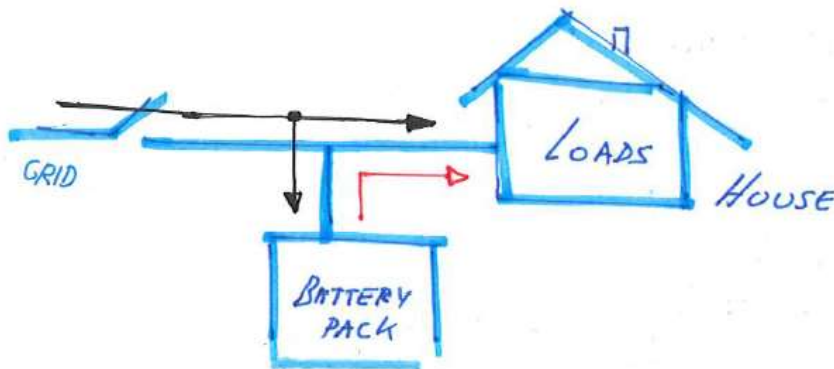


Image 1

Question 1: Determine the needed Battery Pack Nominal Energy (Wh) have a maximun Depth of Discharge DOD of 30% during those 6 days in which the house is isolated from the main electrical grid.

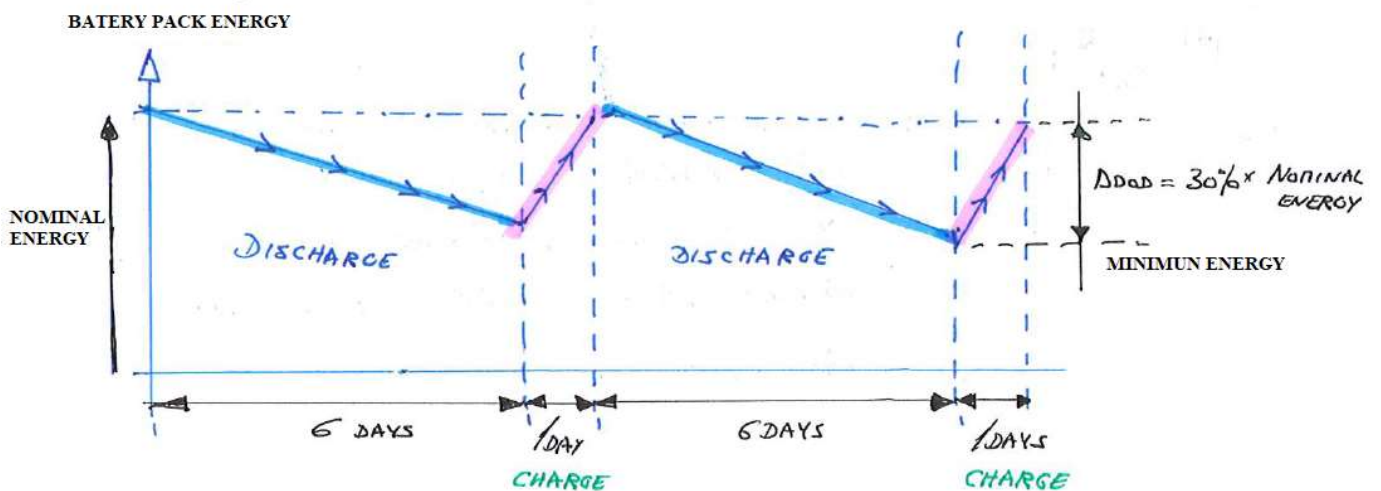


Image 2

Calculations:

DAY →

$$TV \text{ consumption} = 50W \cdot 4h = 200Wh$$

$$LIGHTNING \text{ CONSUMPTION} = 10W \cdot 6h = 60Wh$$

$$WHASING \text{ MACHINE CONSUMPTION} = 1000W \cdot 2h = 2kWh$$

$$OVEN \text{ CONSUMPTION} = 2000W \cdot 1h = 2000Wh$$

$$FRIDGE \text{ CONSUMPTION} = 300W \cdot 4h = 1200Wh$$

$$\text{TOTAL CONSUMPTION PER DAY} \Rightarrow 5460Wh.$$

$$\text{TOTAL ENERGY CONSUMPTION ON 6 DAYS} = 5460Wh \times 6 = 32760Wh.$$

32760 Wh IS THE ENERGY DISCHARGED FROM THE BATTERY PACK DURING 6 DAYS UNTIL RECHARGE AGAIN AND IT CORRESPONDS TO 30% OF NOMINAL ENERGY.

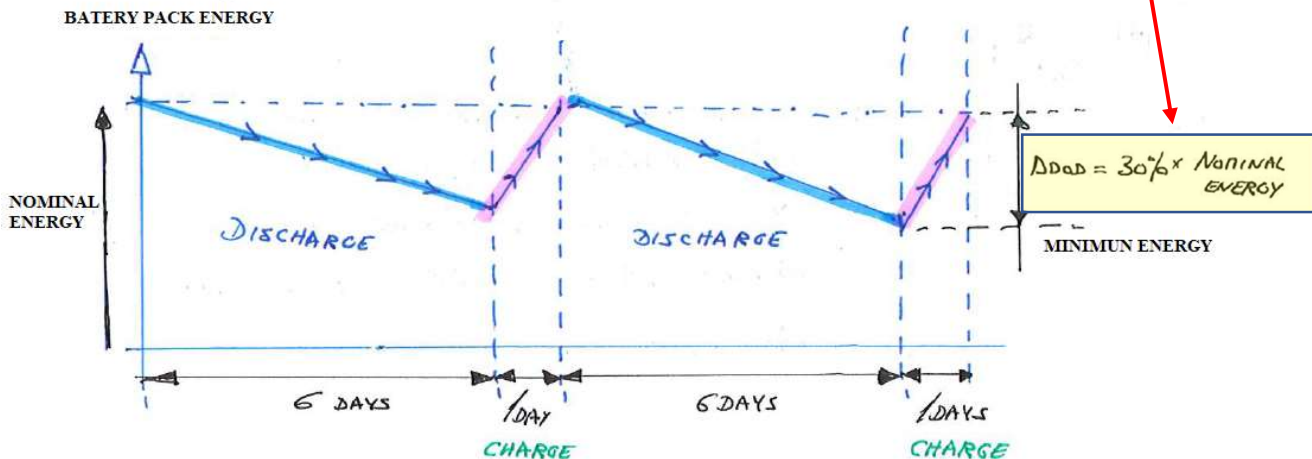


Image 3

32760 wh → 30% OF NOMINAL ENERGY

X ← TOTAL OF NOMINAL ENERGY

$$\text{NOMINAL ENERGY} = \frac{32760 \text{ wh}}{30\%} = 1092 \text{ kWh.}$$

Question 2:



→ USE THIS BATTERY TO MAKE THE BATTERY PACK.
THE POWER CONVERTER ON THE BATTERY PACK NEEDS 48VDC IN THE DC SIDE:

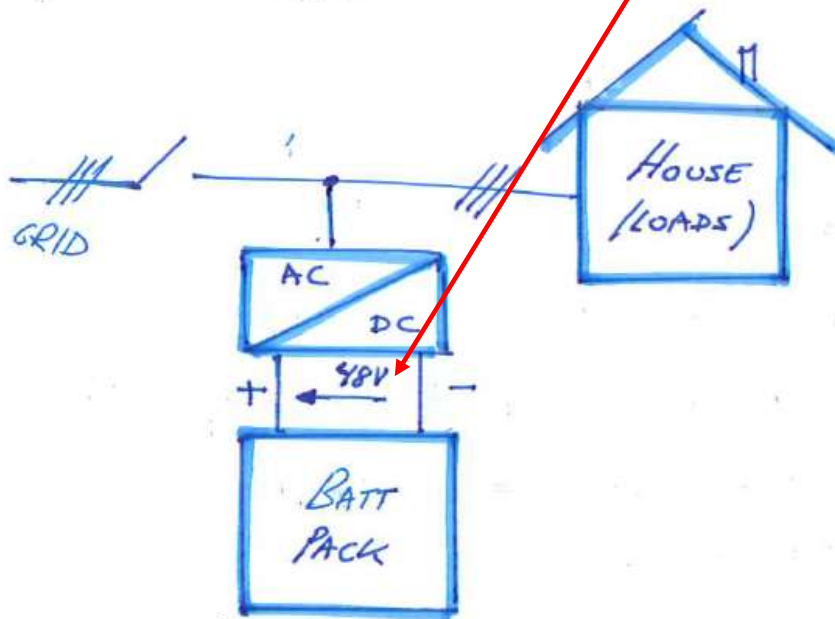
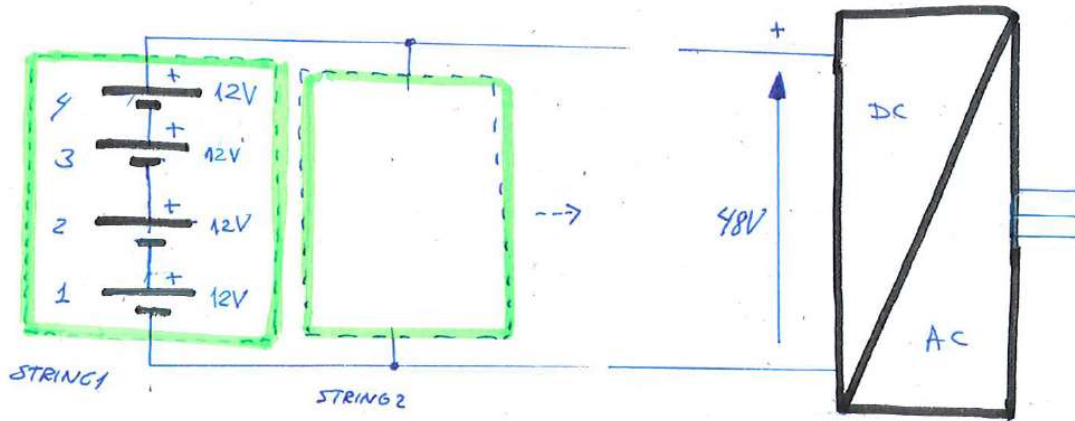


Image 4

BATTERY PACK:



STRING \Rightarrow FOUR BATTERY MODULES IN SERIES TO REACH A NOMINAL VOLTAGE OF $48V = 12V \times 4$

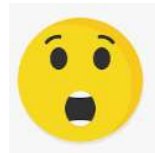
STRING NOMINAL ENERGY: $4 \times 12V \times 60Ah = 2,8 kWh$

IF A TOTAL OF $109,2 kWh$ IS NEEDED WE NEED TO INSTALL \rightarrow

$$\begin{aligned} \text{NUMBER OF STRINGS IN PARALLEL} &\rightarrow \frac{109,2 kWh}{2,88 kWh} = 37,91 \\ &\downarrow \\ &\text{CLOSEST UPPER INTEGER} \end{aligned}$$

$$\text{TOTAL OF} = 38 \times 4 = 152 \text{ BATT MODULES } \checkmark$$

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CHECKING:

$$\begin{aligned} \text{TOTAL NOMINAL ENERGY} &= 152 \times 12V \cdot 60Ah = 109,2 kWh \end{aligned}$$