Series N°: 3

Exercise N:1

A solar panel has an initial efficiency of 18% when first installed, and over its lifetime, it degrades at an average rate of 0.5% per year. The expected lifespan of the PV system is 25 years.

1. Calculate the efficiency of the solar panel after 25 years of operation.
2. If the PV system produces 2000 kWh of energy in its first year of operation, how much energy will the system produce in its 25th year of operation, assuming a linear degradation in efficiency?
3. What is the total energy output of the PV system over the 25 years, assuming it produces 2000 kWh in the first year and its efficiency degrades at a rate of 0.5% per year?
4. What factors could contribute to a higher degradation rate in a PV system? Name at least three factors and explain how they affect PV efficiency.
5. In a scenario where the system is located in an area with high temperatures and frequent sandstorms, how might the degradation rate change compared to a system located in a temperate climate? Justify your reasoning.

Exercise 2 :

A solar panel has an initial efficiency of 22%. The degradation rate is not constant and varies over time as follows:

- **Years 1-5:** 0.5% per year,
- **Years 6-10:** 0.7% per year,
- **Years 11-20:** 1% per year.

Calculate the efficiency of the solar panel after 20 years.

Exercise 3 :

A solar panel has an initial efficiency of 20%. The degradation rate is influenced by temperature, and the effective degradation rate is given by:

$$d\text{effective} = d\text{base} \times (1 + \alpha \Delta T)$$

Where:

- $d\text{base} = 0.5\%$ per year (base degradation rate),
- $\alpha = 0.02$ (temperature coefficient),
- $\Delta T = 10 \circ C$ (average temperature increase above standard conditions).

Calculate the efficiency of the solar panel after 15 years, considering the temperature effect.

Exercise 4 :

A solar panel has an initial efficiency of 25%. The degradation rate is 0.8% per year for the first 10 years. After 10 years, the panel undergoes maintenance that reduces the degradation rate to 0.4% per year for the next 10 years. Calculate the efficiency of the solar panel after 20 years.

Exercise 5 :

You are working with a **solar panel** with the following specifications:

- Initial efficiency (E0): 18% (0.18)
- Annual degradation rate (D): 0.7% per year (0.007)
- Solar panel area: 2 m^2
- Solar insolation: 5 kWh/m^2/day (average daily sunlight received per square meter)
- Temperature coefficient: -0.4% per degree Celsius above 25°C
- Ambient temperature: 40°C (15°C above the nominal 25°C temperature)

1. **Calculate the efficiency of the panel after 20 years**.
2. **Determine the energy produced in the first year and the 20th year**, considering the temperature effect.
3. **Account for the temperature coefficient** in both the first year and the 20th year.