Thermodynamics **MCQ March 21st 2025**

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⟵ Please enter you student number, and write your name above.

NAME, First Name :

Duration : 30 minutes - Lecture/tutorial booklet and personal notes allowed, all calculators authorised - No wifi no 4/5G

Q1 A cyclist (isolated system) of $m = 50\,\text{kg}$ started a climbing from an initial height $h_{ini} = 0.0\,\text{m}$ to $h_{fin} = 55\,\text{m}$ with initial speed $v_{ini} = 13\,\text{km/h}$. Assuming that $v_{fin} = 13\,\text{m/s}$, demonstrate the literal expression of its internal energy variation during the climbing as function of the given data.
Reminder : $g = 9.81\,\text{m/s}^2$, $R = 8.314\,\text{J/(mol K)}$.

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Q2 Give the numerical value of internal energy variation ΔU in kJ.

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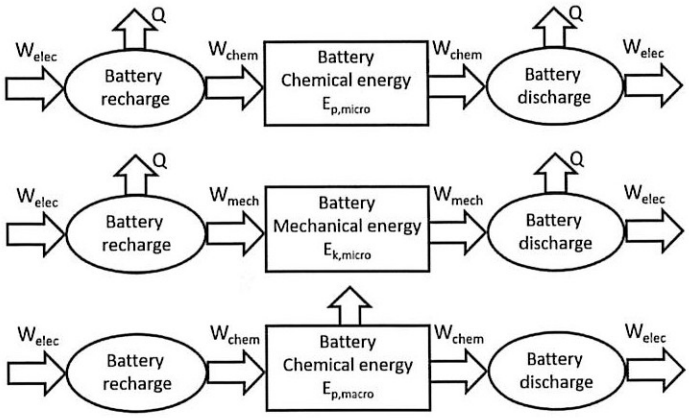
Q3 A closed system with humid air ($RH_{ini} = 100\%$) at $T_{ini} = 100\,°\text{C}$ and $P_{ini} = 1\,\text{bar}$ is cooled down to $T_{fin} = 60\,°\text{C}$. Considering that the final state is at thermodynamic equilibrium, what phases do you expect to find ?

Liquid air Liquid water Gaseous air Gaseous water

Q4 A battery is an energy storage device that can be charged or discharged through electric work. In order to be stored, this work is transformed in chemical work. Which energy chain represents correctly this process ?



Q5 A solar panel has a peak efficiency of 20%. However, its average efficiency over one day is 4.8%. How many hours over one day should the solar panel work at its peak efficiency to match its average efficiency ?

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Q6 What type of energy is the wind ?

Macroscopic kinetic energy | Microscopic kinetic energy | Macroscopic potential energy
Primary energy | Useful energy | Microscopic potential energy

Q7 In a closed system of constant volume $V = 40\,\mathrm{m}^3$ there is humid air at $T_{ini} = 90\,^\circ\mathrm{C}$, $P_{ini} = 1.0\,\mathrm{bar}$ and $RH_{ini} = 19\%$. The system temperature is decreased to $T_{fin} = 76\,^\circ\mathrm{C}$. Demonstrate the literal expression of the final relative humidity RH_{fin} as function of the given data. Reminder : $P_w^*(90\,^\circ\mathrm{C}) = 0.7015\,\mathrm{bar}$, $P_w^*(76\,^\circ\mathrm{C}) = 0.3971\,\mathrm{bar}$, $R = 8.314\,\mathrm{J/(mol\,K)}$, $1\,\mathrm{bar} = 10^5$ Pa, $0\,^\circ\mathrm{C} = 273\,\mathrm{K}$.

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Q8 Give the numerical value of RH_{eq} in %.

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Q9 A closed vessel of $V = 10\,\mathrm{L}$ at $T = 32\,^\circ\mathrm{C}$ contains $n_{tot} = 20\,\mathrm{mol}$ of an ideal gas mixture of O_2 and N_2. Knowing that $P_{O_2} = 19\,\mathrm{bar}$, demonstrate the literal expression of the N_2 molar fraction x_{N_2} as function of the given variables. Reminder : $M_{N_2} = 28\,\mathrm{g/mol}$, $M_{O_2} = 32\,\mathrm{g/mol}$, $R = 8.314\,\mathrm{J/(mol\,K)}$, $1\,\mathrm{bar} = 10^5$ Pa, $0\,^\circ\mathrm{C} = 273\,\mathrm{K}$.

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Q10 Give the numerical value of x_{N_2} in %.

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