HIDEUX LELAHEL
Mark: 10.5/20 (total score: 10.5/20)

Thermodynamics **MCQ March 11th 2022**

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

NAME, First Name :
HIDEUX Lélahel

Duration : 30 minutes - No document allowed and all calculators authorised - No wifi no 4/5G

Q1 The Clapeyron equation of the liquid-gas equilibrium curve of a pure substance is :

$$ln\left(\frac{p^*}{65513\ \text{atm}}\right) = \frac{-4546\,\text{K}}{T} \qquad (38)$$

The latent molar heat of vaporisation for this pure substance is (give the result in kJ/mol to 0.01 kJ/mol) :

Data : $C_p = 29.1$ J/(mol K), $C_v = 20.8$ J/(mol K), $R = 8.31$ J/(mol K) and 0°C = 273 K

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Q2 From the initial state A ($P_A = 4$ bar ; $V_A = 150.0$ L ; $T_A = 240$ K) an ideal diatomic gas undergoes an irreversible adiabatic process leading to the final state B ($T_B = 340$ K). The system is closed and no change of state takes place during the process.
Calculate the variation of internal energy of the system (give the result in kJ to 1 kJ).
Data : 1 bar = 10^5 Pa, $R = 8.31$ J/(K mol), $C_p = 29.1$ J/(mol K), $C_v = 20.8$ J/(mol K).

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Q3 An ideal gas undergoes an irreversible monothermal compression from state A to state B. Please select one or more answers

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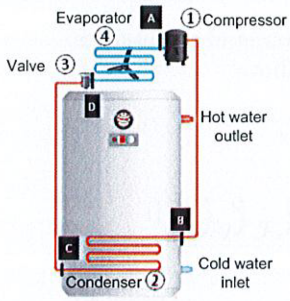
- ☐ There is no heat exchanged since $T_A = T_B$.
- ☐ Created entropy is nil.
- ☒ Exchanged entropy is not nil.
- ☒ The variation of the gas entropy is nil since the transformation is monothermal.

Q4 A thermodynamic water heater is designed to heat water and keep it at the right temperature in a tank (in grey). Its diagram is presented below, showing the following elements :



- A compressor **1**, which compresses the refrigerant fluid in the gaseous state (A → B).
- A condenser **2** in which the fluid in the gaseous state completely liquefies (B → C).
- A valve **3** through which the fluid in the liquid state undergoes expansion (Q=0, W=0), which causes a pressure and temperature drop (C → D).
- An evaporator **4** in which the fluid in the liquid state vaporizes completely (D → A). The evaporator is coupled to room air, drawn in by a fan.

The energies being all counted for the system refrigerant fluid undergoing this cycle, the coefficient of performance of this machine can be defined as follows (only one answer is possible) :

☐ $COP = \left|\frac{Q_{DA}+Q_{BC}}{W_{AB}}\right|$

☐ $COP = \left|\frac{Q_{DA}}{W_{AB}}\right|$

0/4 ☒ $COP = \left|\frac{Q_{BC}}{W_{AB}}\right|$

☐ $COP = \left|\frac{W_{AB}}{Q_{DA}+Q_{BC}}\right|$

Q5 How many moles of C will be present in the system after complete reaction ?

$$A_{(g)} + \frac{5}{2}\,B_{(g)} \rightarrow 5\,C_{(g)} + 4\,D_{(g)}$$

Initial composition before reaction : $n_A = 10$ moles, $n_B = 14$ moles, $n_C = 9$ moles, $n_D = 2$ moles

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Q6 A system is composed of 4 moles of an ideal diatomic gas in a vessel of constant volume $V = 30$L and initial temperature $T_A = 57\,°C$. It is connected to a thermostat ($T_{ext} = 130\,°C$) until its final temperature is $T_B = 130\,°C$.
Compute the entropy created. (Give the result in J/K with a precision of 0.01 J/K).
Data : $C_p = 29.1$ J/(mol K), $C_v = 20.8$ J/(mol K), $R = 8.31$ J/(mol K) and 0°C = 273 K

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