PHYSQ 261, LEC A1 : Physique de l'énergie et de l'environnement
Professeur : Marc de Montigny
Aide-mémoire : Examen 2 et final, automne 2021

Nom : ________________________________

À compléter des deux côtés. À retourner avec l'examen quand vous aurez terminé.

1 cal = 4.184 J, 1 Cal = 4184 J, 1 btu = 1055 J, 1 eV $= 1.6\times10^{-19}$ J , 1 hp = 746 W

$$\frac{\Delta m}{\Delta t} = \rho v A \qquad N(t) = N_0 e^{-\lambda t} \quad \lambda = \frac{\ln 2}{T_{1/2}} \quad N(t) = N_0 e^{kt} \quad k = \frac{\ln 2}{T_2}$$

$$N(t) = N_M \exp\left(-\frac{(t-T_M)^2}{2\sigma^2}\right) = N_M \exp\left(-\frac{z^2}{2}\right) \qquad z = \frac{|t-T_M|}{\sigma} \quad N(t) = \frac{Q_\infty}{\sigma\sqrt{2\pi}}\exp\left(-\frac{z^2}{2}\right)$$

$$Q_\infty = \sqrt{2\pi}\sigma N_M \quad T_K = T_C + 273.15 \quad N_A = 6.02214\times10^{23}\ \text{mole}^{-1}$$

$$\frac{dQ}{dt} = rQ\left(1-\frac{Q}{Q_\infty}\right) \quad Q(t) = \frac{Q_\infty Q_0 e^{rt}}{Q_\infty + Q_0\left(e^{rt}-1\right)} = \frac{Q_\infty Q_0}{Q_0 + (Q_\infty - Q_0)e^{-rt}} = \frac{Q_\infty}{1+e^{-r(t-t^*)}}$$

$$\left.\frac{dQ}{dt}\right|_{t=0} = R_0 Q_0 = rQ_0\left(1-\frac{Q_0}{Q_\infty}\right) \Rightarrow R_0 = r\left(1-\frac{Q_0}{Q_\infty}\right) \quad \eta_{\max} = 1-\frac{Q_c}{Q_h} = 1-\frac{T_c}{T_h}$$

$$C = \frac{Q}{\Delta T} \quad c = \frac{Q}{m\Delta T} \quad Q = mL \quad W = Q_h - Q_c \quad \eta = \frac{\text{travail de sortie}}{\text{chaleur fournie}} = \frac{W}{Q_h} = 1-\frac{Q_c}{Q_h}$$

$$\text{COP} = \frac{Q_c}{W} \quad \text{COP} = \frac{Q_h}{W} \qquad 1\ \text{m}^3 = 1000\ \text{L}$$

$$\rho_{\text{eau}} = [\text{eau}] = 1\ \text{kg/L} = 1000\ \text{kg/m}^3 = 10^6\ \text{g/m}^3 \quad 1\ \text{g/m}^3 = 10^{-6}\ \rho_{\text{eau}}$$

$$\left[\frac{\text{mg}}{\text{m}^3}\right] = \frac{[\text{ppm}]w}{22.4}\times\frac{273}{T(^\circ\text{K})}\times\frac{P\ (\text{atm})}{1\ \text{atm}} \qquad \text{entrée} = \text{sortie} + \text{conversion} + \text{accumulation}$$

$$S = \rho Q + \kappa\rho V + V\frac{d\rho}{dt} \quad \rho(t) = (\rho_0 - \rho_\infty)\exp\left[-\left(\kappa + \frac{Q}{V}\right)t\right] + \rho_\infty \quad \rho_\infty = \frac{S}{Q+\kappa V}$$

$$\eta = \frac{E_{\text{out}}}{E_{\text{in}}} = \frac{\text{énergie utile}}{\text{énergie utile + énergie perdue}} \quad c = \lambda f \quad I = \frac{P}{4\pi r^2} \quad \lambda_m(\text{nm}) = \frac{2.8972\times10^6\ \text{nm}\cdot{}^\circ\text{K}}{T(^\circ\text{K})}$$

$$I(T) = \sigma T^4, \qquad \sigma = 5.67\times10^{-8}\ \frac{W}{\text{m}^2\text{K}^4} \quad P_A = \pi R^2 I_0 \rightarrow \quad I = \frac{P_A}{4\pi R^2} = \frac{\pi R^2 I_0}{4\pi R^2} = \frac{I_0}{4}$$

$$P_R = \sigma 4\pi R^2 T^4 \quad P_A = (1-\alpha)\pi R^2 I_0 \quad T_e = \left(\frac{I_0(1-\alpha)}{4\sigma}\right)^{1/4} \quad P_{\text{nette}} = \pi R^2 I_0(1-\alpha) - 4\pi R^2\sigma T_e^4$$

$$I_{\text{nette}} = \frac{P_{\text{nette}}}{4\pi R^2} = \frac{1}{4} I_0 (1-\alpha) - \sigma T_e^4 \quad \lambda_m(\mu\text{m}) = \frac{2898\ \mu\text{m}\cdot{}^\circ\text{K}}{T({}^\circ\text{K})} \quad I_E = 2I_A = \frac{1}{2} I_0 (1-\alpha) = \sigma T_E^4$$

$$\Delta T = \frac{\Delta T_d}{\ln 2} \ln\left(\frac{\rho}{\rho_0}\right) \ \rightarrow \ \rho = \rho_0 \times 2^{\frac{\Delta T}{\Delta T_d}} \qquad 1 \text{ pp } CO_2 \Leftrightarrow 2.12 \text{ Gtonnes C} \quad \% \text{ C atmos} = 48\%$$

$$m(t) = m(0)e^{-t/\tau} \quad \frac{dm(t)}{dt} = -\frac{1}{\tau} m(t) \quad m(t) = m(0)e^{-t/\tau} + m(\infty)\left[1 - e^{-t/\tau}\right] \quad m(\infty) = P\tau$$

$$V = RI \quad R = \frac{\rho L}{A} \quad \rho(T) = \rho_0\left[1 + \alpha(T - T_0)\right] \quad P = VI \quad V = \underbrace{NBA\omega}_{V_{\max}} \cos(\omega t)$$

$$P(t) = V(t)I(t) = V_p I_P \cos^2 \omega t \quad P_{\text{av}} = \frac{1}{2} V_p I_p = V_{\text{rms}} I_{\text{rms}} \quad I_{\text{rms}} = \frac{1}{\sqrt{2}} I_p, \quad V_{\text{rms}} = \frac{1}{\sqrt{2}} V_p$$

$$P_{\text{av}} \equiv R I_{\text{av}}^2 = \frac{1}{2} R I_{\text{max}}^2 \equiv R I_{\text{rms}}^2 \qquad \frac{I_2}{I_1} = \frac{V_1}{V_2} = \frac{N_1}{N_2} \quad A \equiv \left|\frac{dN}{dt}\right|$$

$$e^{-\lambda_e t} \equiv e^{-\lambda_p t} \cdot e^{-\lambda_b t} \rightarrow \lambda_e = \lambda_p + \lambda_b \rightarrow T_{1/2,e}^{-1} = T_{1/2,p}^{-1} + T_{1/2,b}^{-1} \qquad N = N_0 e^{-\lambda_e t}$$

$$n = \frac{N_a m}{A} \qquad n\sigma_{\text{geom}} = \frac{N_a m \sigma_{\text{geom}}}{A} \qquad \frac{\Delta N}{N} = \frac{N_a m \sigma_{\text{geom}}}{A} \rightarrow \Delta N = \frac{N_a m \sigma_{\text{geom}} N}{A}$$

$$B = \left(Z m_p + N m_n - m_{noyau}\right) c^2 \quad N(x) = N_0 e^{-\mu x} \quad \mu = \frac{\ln 2}{L_{1/2}}$$

$$H_T = \sum_R \left(w_R D_R\right) \quad E = \sum_T \left(w_T H_T\right) \quad v = \sqrt{\frac{3 k_B T}{m}} \quad T\tau n > 6 \times 10^{28} \text{ m}^{-3} \cdot \text{s} \cdot \text{K}$$

$$P_{in} = \frac{K}{t} = \frac{1}{2} \rho_{\text{air}} \pi r^2 v_i^3 \quad P = \frac{1}{4} \rho_{\text{air}} \pi r^2 \left(v_i + v_f\right)\left(v_i^2 - v_f^2\right) \quad P_{\max} = R_{\max} P_{in} = \frac{16}{27} \frac{1}{2} \rho_{air} \pi r^2 v_i^3 = \frac{8}{27} \rho_{air} \pi r^2 v_i^3$$

$$P_e = \frac{1}{2} \rho_{air} \pi r^2 v_i^3 \eta \eta_e \qquad r_1^2 v_1 = r_2^2 v_2$$

$$\frac{P}{\ell} = \frac{1}{4} \rho g A^2 \frac{\lambda}{T} = \frac{1}{4} \rho g^{\frac{3}{2}} A^2 \sqrt{\frac{\lambda}{2\pi}} \quad \frac{\lambda}{T} = \sqrt{\frac{g\lambda}{2\pi}} \quad \frac{P}{\ell} \approx 3A^2 \sqrt{\lambda} \text{ kW/m}$$