BACCALAUREAT DE L'ENSEIGNEMENT GENERAL – MADAGASCAR
Série : **C - SESSION 2011**

CHIMIE ORGANIQUE

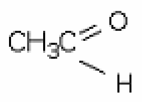
1) Nature de B : aldéhyde

2) Formule semi- développée de A et B

B : $C_nH_{2n}O$

$$14n + 16 = 45$$

$$n = \frac{45 - 16}{14} = 2{,}07 \approx 2$$

B 

A CH_3CH_2OH

3) a) Les deux demi- équation redox :

$$2 \times (M_nO_4^{-} + 8H^{+} + 5e^{-} \rightarrow M_n^{2+} + 4H_2O)$$

$$5 \times (C_2H_6O \rightarrow C_2H_4O + 2H^{+} + 2e^{-})$$

b) Equation bilan ionique :

$$5\ C_2H_6O + 2M_nO_4^{-} + 6H^{+} \rightarrow 5C_2H_4O + 2M_n^{2+} + 8H_2O$$

$$\boxed{5\,C_2H_6O + 2\left(K^{+}, MnO_4^{-}\right) + 3\left(2H^{+}, SO_4^{2}\right) \rightarrow 5C_2H_4O + 2\left(Mn^{2+}, SO_4^{-2}\right) + \left(2K^{+}, SO_4^{2-}\right) + 8H_2O}$$

CHIMIE GENERALE

1) Définition d'un acide : composé susceptible de libérer le proton H^{+}

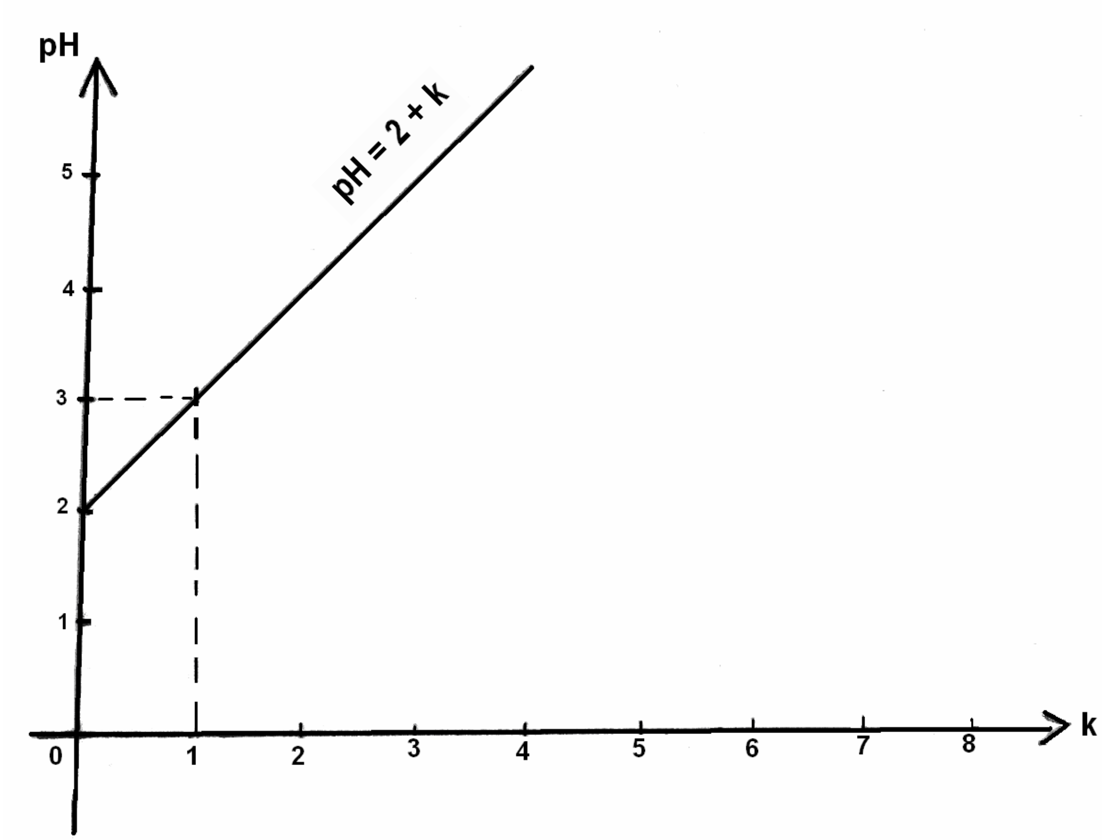
Définition d'une base : composé susceptible de capter le proton H^{+}

2) a) pH de la solution obtenir : $pH = 2 \Rightarrow c = 10^{-2}\,moll^{-1}$

$$c_k = \frac{c}{10^k} \qquad pH = -\log C_k = -\log\frac{C}{10^K} = -\log C + k$$

$$\boxed{pH = 2 + k}$$

b) Représentation graphique :



3) a) Equation bilan de la réaction :

$$NH_3 + H_3O^+ \rightleftharpoons NH_4^+ + H_2O$$

b) Valeur de V pour que pH = 8,2

Espèces chimiques : $H_2O, H_3O^+, OH^-, NH_3, NH_4^+, Cl^-$

$pH = 8,2 \Rightarrow [H_3O^+] = 10^{-8,2} = 6,30.10^{-9} moll^{-1}$

$$[OH^-] = \frac{10^{-14}}{6,3010^{-9}} = 0,158.10^{-15} moll^{-1}$$

$$[Cl^-] = \frac{C_A V_A}{V_A + V_B}$$

Electroneutralité : $[Cl^-] + [OH^-] = [H_3O^+] + [NH_4^+]$

$[H_3O^+] \prec\prec [OH^-] \prec\prec [Cl^-] \Rightarrow [Cl^-] \approx [NH_4^+]$

Conservation de la matière :

$$\Rightarrow [NH_4{}^+] + [NH_3] = \frac{C_B V_B}{V_B + V_A}$$

$$pk_A = pH - \log\frac{[NH_3]}{[NH_4{}^+]} \qquad \Rightarrow \qquad \frac{[NH_3]}{[NH_4{}^+]} = 10^{-(pK_A - pH)} = 10^{-1}$$

$$[NH_3] = 10^{-1}[NH_4{}^+]$$

$$[NH_4{}^+] + 0{,}1[NH_4{}^+] = \left(\frac{C_B V_B}{V_A + V_B}\right)$$

$$1{,}1[NH_4{}^+] = \frac{C_B V_B}{V_A + V_B}$$

$$[NH_4{}^+] = \frac{C_B V_B}{(V_A + V_B)1{,}1} = \frac{C_A V_A}{V_A + V_B}$$

$$C_B V_B = 1{,}1.C_A V_A$$

$$V_A = \frac{C_B V_B}{1{,}1 C_A} = \frac{20 \times 4 10^{-2}}{1{,}1 \times 3 10^{-2}} cm^3 = 24{,}24 cm^3$$

III PHYSIQUE NUCLEAIRE :

1° Nombre de désintégration α et β

$${}^{226}_{88}Ra \rightarrow {}^{206}_{82}Pb + x\ {}^{4}_{2}He + y\ {}^{0}_{-1}e$$

$$226 = 206 + 4x \quad \Rightarrow x = \frac{226 - 206}{4} = 5 \qquad\qquad \text{donc } \chi = 5$$

$$88 = 82 + 2x - y \quad = 82 + 2x5 - y \Rightarrow y = 4$$

2° a) masse du noyau restant à la date nT

$m(t) = \frac{m_o}{2^n}$ d'où la masse de Ra désintégré $m_0 - \frac{m_0}{2^n}$

b) durée nécessaire :

$$(m_o - m_0 e^{-\lambda t}) = \frac{4}{9} m_0.$$

$$m_o(1 - e^{-\lambda t}) = \frac{4}{9} m_0$$

$$1 - e^{-\lambda t} = \frac{4}{9} \quad \Rightarrow e^{-\lambda t} = 1 - \frac{4}{9} = \frac{5}{9}$$

$$-\lambda t = \ln\frac{5}{9}$$

$$t = -\frac{1}{\lambda}\ln\frac{5}{9} = -\frac{T}{\ln 2}\ln\frac{5}{9} \qquad \boxed{\Rightarrow \quad t = 3{,}258 j}$$

OPTIQUE

1° a) Caractéristiques de l'image A_1B_1

- Position $\dfrac{1}{\overline{O_1A_1}} - \dfrac{1}{\overline{O_1A}} = \dfrac{1}{f_1'}$

$$\frac{1}{\overline{O_1A_1}} = \frac{1}{f_1'} + \frac{1}{\overline{O_1A}} = \frac{\overline{O_1A} + f_1'}{f_1'\,\overline{O_1A}} \quad \Rightarrow \quad \overline{O_1A_1} \;=\; \frac{f_1' \times \overline{O_1A}}{\overline{O_1A} + f_1'}$$

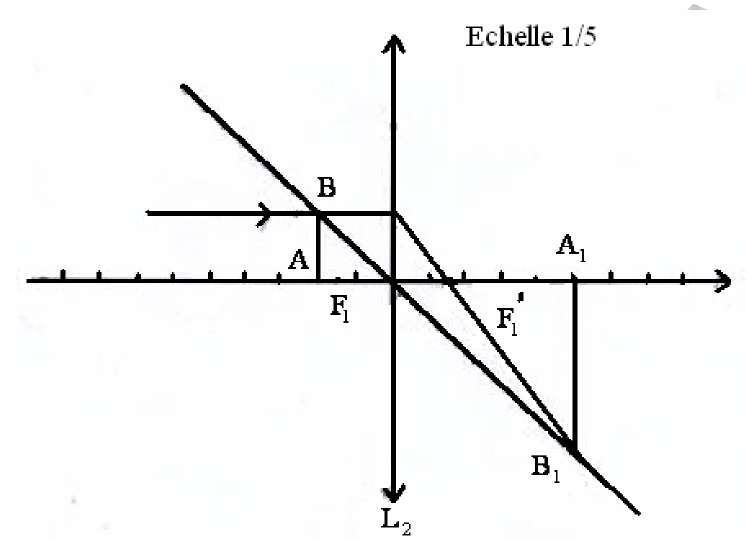
AN $\qquad \overline{O_1A_1} = \dfrac{7{,}5 \;+\; -10}{-10 \times 7{,}5} = 30\,\text{cm}$

$-$ nature: $\qquad \overline{O_1A_1} = 30\text{cm} \succ 0 \qquad$:image réelle

$-$ grandeur : $\qquad \gamma = \dfrac{\overline{O_1A_1}}{\overline{O_1A}} = \dfrac{\overline{A_1B_1}}{\overline{AB}} = \dfrac{30}{-10} = -3$

$-$ sens : $\quad \gamma < 0$ donc c'est une image renversée.

b) Vérification graphique :
Echelle 1/5



2° a) Calcul de f'

$\gamma = \dfrac{\overline{OA'}}{\overline{OA}} = -1 \;\Rightarrow\; \overline{OA'} = -\overline{OA}$

$$\frac{1}{\overline{OA'}} - \frac{1}{\overline{OA}} = \frac{1}{f'}$$

$$-\frac{2}{\overline{OA}} = \frac{1}{f'} \succ\succ f' = -\frac{\overline{OA}}{2} = -\frac{(-10)}{2} = 5\text{cm}$$

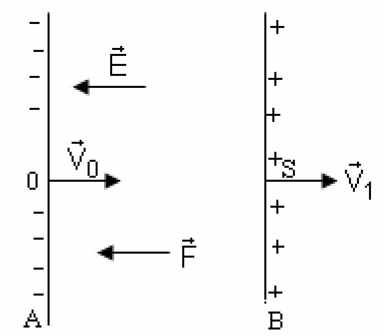
b) Calcul de f_2'

$C = C_1 + C_2$

$$\frac{1}{f'} = \frac{1}{f_1} + \frac{1}{f_2} \Rightarrow \frac{1}{f_2} = \frac{1}{f'} - \frac{1}{f_1} = \frac{f_1 - f'}{f' \times f_1} \qquad f_2' = \frac{f' \times f_1}{f_1 - f'} = \frac{5 \times 7{,}5}{7{,}5 - 5} = 15\,\text{cm}$$

V. ELECTROMAGNETISME

A)



$V_o = 10^6 ms^{-1}$ $\qquad V_1 = 2 10^5 ms^{-1}$

$V_1 < V_0$: MRU.R

$\vec{F} = q\vec{E} = e\vec{E}$: $q > 0$ $\vec{E}$ même sens de $\vec{F}$

plaque B ⊕ et plaque A ⊖

$U_{AB} \prec 0$

Valeur de U_{AB} :

TEC $\quad \frac{1}{2}mV_1^2 - \frac{1}{2}mV_2^2 = e\vec{E}.\overrightarrow{AB} = -e\vec{E}\,\overrightarrow{AB}$

$= -eE\,AB$

$= -e|U_{AB}|.$

$|U_{AB}| = -\frac{m}{2e}(V_1^2 - V_0^2)$ $\qquad$ AN. $\quad |U_{AB}| = -\frac{1{,}67 10^{-27}}{2 \times 1{,}6.10-19}((2 10^5)^2 - (10^6)^2)$

$|U_{AB}| = 5{,}19.10^4 V$

B) $u(t) = U\sqrt{2}\sin(\omega t + \varphi)$

1- a) ω_o à la résonance

$\omega_0 = \sqrt{\frac{1}{LC}} = \frac{1}{\sqrt{LC}}$ $\qquad$ AN $\quad \omega_0 = \frac{1}{\sqrt{0{,}4 \times 2{,}5 10^{-6}}}$

$\omega_0 = 10^3 rad.s^{-1}$

$\frac{U_L}{U} = \frac{L\,\omega_0 I}{U}$ $\qquad I = \frac{U}{Z} = \frac{U}{\sqrt{R^2 + (L\omega_0 - \frac{1}{c\omega_0})}} = \frac{U}{R}$

$I = \frac{90}{180}A = 0{,}5A$

$\frac{U_C}{U} = \frac{U_L}{U} = \frac{L\omega_o I}{U} = \frac{0{,}4 \times 10^3 \times 0{,}5}{90} = 2{,}22$

2) a) Montrons qu'il existe une relation entre $\Delta\omega$, R et L

$\varphi_2 = -\varphi_1 = \frac{\pi}{4}$

Pour $\varphi = \varphi_2 = \frac{\pi}{4}$ $\quad tg\ \varphi_2 = tg\frac{\pi}{4} = \frac{L\omega_2 - \frac{1}{c\,\omega_2}}{R}$

$$1 = \frac{L\omega_2 - \frac{1}{c\omega_2}}{R} \quad \rightarrow \quad L\omega_2 - \frac{1}{c\omega_2} = R$$

$L\,c\,\omega_2{}^2 - Rc\,\omega_2 - 1 = 0 \qquad \Delta = (RC)^2 + 4Lc \succ 0$

$\omega_2{}' = \frac{RC + \sqrt{(RC)^2 + 4c}}{2LC} \succ 0$

$\omega_2{}'' = \frac{RC - \sqrt{(RC)^2 + 4c}}{2LC} \prec 0$

Donc la solution $\omega_2 = \frac{RL + \sqrt{(RC)^2 + 4c}}{2LC}$

Pour $\varphi = \varphi_1 = -\frac{\pi}{4} \quad \Rightarrow tg(-\frac{\pi}{4}) = \frac{L\omega_1 - \frac{1}{c\,\omega_1}}{R}$

$$-1 = \frac{L\omega_1 - \frac{1}{c\,\omega_1}}{R}$$

$c\,L\omega_1{}^2 + Rc\omega_1 - 1 = 0 \qquad \Delta = (RC)^2 + 4\,L\,e \succ 0$

$\omega_1{}' = \frac{-RC + \sqrt{(RC)^2 + 4Lc}}{2\,cL} > 0$

$\omega_1{}'' = \frac{-RC - \sqrt{(RC)^2 + 4Lc}}{2\,cL} < 0$

Donc la solution $\omega_1 = \frac{-RC + \sqrt{(RC)^2 + 4Lc}}{2\,LC}$ et $\omega_2 = \frac{RC + \sqrt{(RC)^2 + 4LC}}{2\,LC}$

D'où $\Delta\omega = \omega_2 - \omega_1 = \frac{RC + \sqrt{(RC)^2 + 4Lc}}{2LC} - \frac{-RC + \sqrt{(RC)^2 + 4Lc}}{2LC}$

$= \frac{2RC}{2LC} = \frac{R}{L}$

D'où $\quad \Delta\omega = \frac{R}{L}$

b) Calcul de ω_1 et ω_2 :

$$\omega_2 = \frac{RC + \sqrt{(RC)^2 + 4LC}}{2LC} = \frac{180 \times 2{,}510^{-6} + \sqrt{(180 \times 2{,}510^{-6}) + 4 \times 0{,}4 \times 2{,}510^{-6}}}{2 \times 0{,}4 \times 2{,}510^{-6}}$$

$$\omega_2 = 1{,}24510^3 rads^{-1}$$

$$\omega_1 = \frac{-RC + \sqrt{(RC)^2 + 4LC}}{2LC} = \frac{-180 \times 2{,}510^{-6} + \sqrt{(180 \times 2{,}510^{-6}) + 4 \times 0{,}4 \times 2{,}510^{-6}}}{2 \times 0{,}4 \times 2{,}510^{-6}}$$

$$\omega_1 = 0{,}799.10^3 rads^{-1}$$

PROBLEME :

Partie 1

1) Calcul de Vo

T.E.C : $\frac{1}{2} mV_B{}^2 - \frac{1}{2} mV_0{}^2 = -mgh = -mgl\sin\alpha$

$$\frac{1}{2} mV_0{}^2 = \frac{1}{2} mV_B{}^2 + mgl\sin\alpha$$

$$V_0 = \sqrt{V_B{}^2 + 2gl\sin\alpha}$$

AN $V_0 = \sqrt{3^2 + 2 \times 10 \times 1{,}56 \times \sin 30}$

$$V_0 = 4{,}959\, ms^{-1}$$

2) Intensité de force de Frottement f :

T.E.C $\frac{1}{2} mV_c{}^2 - \frac{1}{2} mV_B{}^2 = -mgh' - f\,BC$ $h' = R(1 - \cos\alpha)$ avec $BC = R\alpha$

$$-\frac{1}{2} mV_B{}^2 = -mgR(1 - \cos\alpha) - fR\alpha$$

$$f = \frac{+\frac{1}{2} mV_B{}^2 - mgR(1 - \cos\alpha)}{R\alpha}$$ $\alpha = 30° = \frac{\pi}{6} = 0{,}52$ rad

$$f' = \frac{\frac{1}{2}.0{,}125.3^2 - 0{,}125 \times 10 \times 0{,}9(1 - 0{,}866)}{0{,}9 \times 0{,}52}$$

$$f' = 0{,}879N$$

3) Vitesse de solide en m en fonction de R, g et β **:**

$$\frac{1}{2}mV_M^{\ 2} - \frac{1}{2}mV_C^{\ 2} = mgh' = mgR(1 - \sin\beta)$$

$$V_M = \sqrt{2gR(1 - \sin\beta)}$$

Vitesse en D

$$V_D = \sqrt{2\,gR(1 - \sin\beta')}$$

AN $V_D = \sqrt{2 \times 10 \times 0{,}9(1 - \frac{2}{3})}$

$$= \sqrt{6} = 2{,}449\ ms^{-1}$$

$$V_D = 2{,}449\ ms^{-1}$$

4) Intensité N de la réaction en N

T.C.I $\vec{N} + \vec{P} = m\vec{a}$

$x'x$ $N + P = m a_N$

$$-N + P\sin\beta = m\frac{V_m^{\ 2}}{R}$$

$$N = mg\sin\beta - \frac{m}{R}2\,gR(1 - \sin\beta)$$

$$= mg\sin\beta - mg2 + 2mg\sin\beta$$

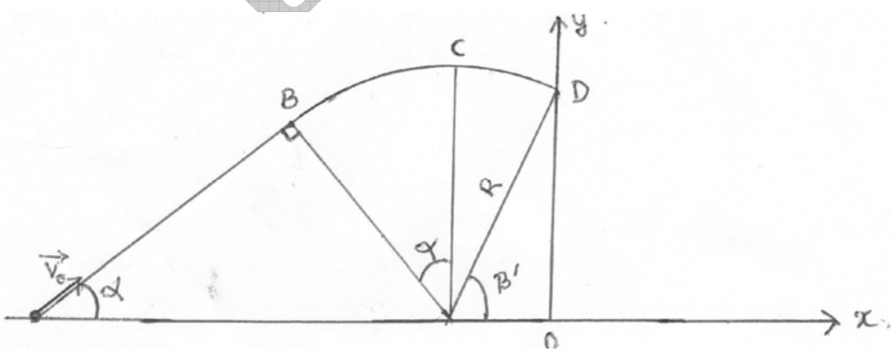
$$= 3\,mg\sin\beta - 2\,mg$$

$$N = m\,g\,(3\sin\beta - 2\,)$$

$$N_D = m\,g\,(3\sin\beta' - 2\,)$$

$$N_D = m\,g\,(3 \times \frac{2}{3} - 2\,) = 0 \Rightarrow N_D = 0$$

5) a)



Equation de la trajectoire du solide

$$D \begin{cases} x_D = 0 \\ y_D = y_D = R.\sin\beta' \end{cases} \qquad \overrightarrow{V_D} \begin{cases} V_{Dx} = V_D \sin\beta' \\ V_{Dy} = -V_D \cos\beta' \end{cases}$$

$$\vec{g} \begin{cases} g_x = 0 \\ g_y = -g \end{cases}$$

T.C.I $\vec{a} = \vec{g}$ $\quad a_x = g_x = 0 = \dfrac{dV_x}{dt} \Rightarrow V_x = C^{te} = V_{Dx} = V_0 \sin\beta'$

$V_D \sin\beta' = \dfrac{dx}{dt} \Rightarrow x = V_D \sin\beta' t + x_D = V_D \sin\beta' t$ avec $x_D = 0$

$a_y = g_y = -g = \dfrac{dV_y}{dt} = -gt + V_{Dy} = -gt - V_0 \cos\beta'$

$\Rightarrow y = -\dfrac{g}{2}t^2 - V_0 \cos\beta' t + y_D$ avec $y_D = OD = R\sin\beta'$

$$y = -\frac{g}{2}t^2 - V_0 \cos\beta' t + R\sin\beta'$$

D'où l'équation cartésienne :

$$y = -\frac{g}{2}\frac{x^2}{V_D{}^2 \sin^2\beta'} - \cot g\beta' x + R\sin\beta'$$

b) Distance du point O et le point d'impact sur $\overline{ox}$:

$y = -1{,}875\,x^2 - 1{,}118\,x + 0{,}49$

$I \begin{pmatrix} X_I \\ Y_I = -R\sin\beta' \end{pmatrix}$

$-0{,}49 = -1{,}875\,x^2 - 1{,}118x + 0{,}49$

$-1{,}875\,x^2 - 1{,}118x + 0{,}98 = 0$

$\Delta = (1{,}118)^2 + 4(1{,}875)(0{,}98) = 8{,}599 \Rightarrow \sqrt{\Delta} = 2{,}93$

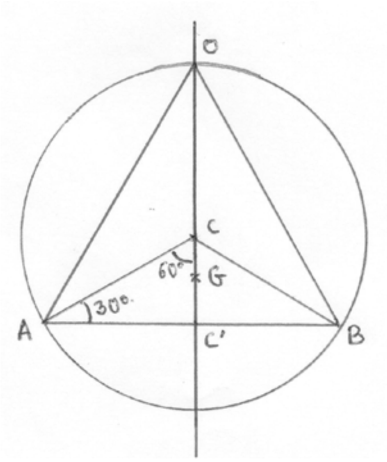
$x_1' = \dfrac{1{,}118 + 2{,}93}{2x - 1{,}875} \prec 0$

$x_2' = \dfrac{1{,}118 - 2{,}93}{2x - 1{,}875} = 0{,}48\,\text{m}$

D'où le point d'impact sur ox : 0,48m

PARTIE 2

1° a) Montrons que $OG = \frac{6}{5}R$.



$$(M + m + m)\overline{OG} = M\overline{OC} + (m + m)\overline{OC'}$$

$$(3m + 2m)\overline{OG} = 3m\overline{OC} + 2m\,\overline{OC'}$$

$$5m\,\overline{OG} = 3mR + 2m\,\overline{OC'}$$

$$\sin 30° = \frac{CC'}{R} \Rightarrow R\sin 30° = \frac{R}{2} = CC'$$

$$OC' = OC + CC' = R + \frac{R}{2} = \frac{3R}{2}$$

$$5m\,\overline{OG} = 3mR + 3mR$$

$$5m\,\overline{OG} = 6mR$$

$$\overline{OG} = \frac{6}{5}R$$

b) Montrons que $J_\Delta = \frac{21}{2}mR^2$

$$J_A = J_{D/\Delta} + J_{A/\Delta} + J_{B/\Delta}$$

$$J_{D/\Delta} = \frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2 = \frac{9}{2}mR^2$$

$$J_{A/\Delta} = m\,a^2 \qquad \cos 30° = \frac{a/2}{R} \qquad a = 2R\cos 30°$$

$$a = 2R\frac{\sqrt{3}}{2} = \sqrt{3}R$$

$$J_{A/\Delta} = m\,a^2 = 3m\,R^2$$

$$J_{B/\Delta} = 3mR^2$$

$$J_\Delta = \frac{9}{2}mR^2 + 3mR^2 + 3mR^2 = \frac{9}{2}mR^2 + 6mR^2$$

$$J_\Delta = \frac{21}{2}mR^2$$

2) a) Période des petites oscillations :

T.A.A $\sum M_{F_{ext/\Delta}} = J_\Delta\ddot{\theta}$

$$-P\,OG\sin\theta = J_\Delta\ddot{\theta}$$

$$-(M + m_A + m_B)g\frac{6R}{5}\theta = \frac{21}{2}J_\Delta\ddot{\theta}$$

$$-5m.g\frac{6}{5}R\theta = \frac{21}{2}m\,R^2\ddot{\theta}$$

$$-\frac{12}{21}\frac{g}{R}\theta = \ddot{\theta}$$

$$\ddot{\theta} + \frac{12}{21}\frac{g}{R}\theta = 0 \qquad \text{Posons} \quad \omega^2 = \frac{12}{21}\frac{g}{R}$$

$$\ddot{\theta} + \omega^2\theta = 0$$

$$\Rightarrow T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{21R}{12g}} = 2\pi\sqrt{\frac{7R}{4g}}$$

AN $T = 2\times 3{,}14\sqrt{\frac{7\times 0{,}1}{4\times 10}} = 0{,}83\text{s}$

b) Longueur du pendule simple synchrone au pendule pesant :
$T_{simple} = T_{composé}$

$$\left.\begin{array}{l} T_{simple} = 2\pi\sqrt{\frac{l}{g}} \\ T_{composé} = 2\pi\sqrt{\frac{7R}{4g}} \end{array}\right\} \Rightarrow l = \frac{7R}{4} = \frac{7R}{4} = 17{,}5\,\text{cm}$$

Equation différentielle du mouvement :

Système : $\{$disque + ressort$\}$: système isolé

$$\Rightarrow E_m = \text{constante}$$

$$E_m = E_{P_{Pesanteur}} + E_{P_{élastique}} + Ec$$

$$E_{pp} = 5mgh = 5mg\overline{OG}(1-\cos\theta)$$

$$E_{P_{élastique}} = \frac{1}{2}kx^2 \qquad x : \text{allongement}$$

$$E_c = \frac{1}{2}J_\Delta\dot{\theta}^2$$

$$\Rightarrow E_m = 5mg\times\frac{6}{5}R(1-\cos\theta) + \frac{1}{2}kx^2 + \frac{1}{2}J_\Delta\dot{\theta}^2 = \text{constante}$$

$$\Rightarrow E_m = 6mgR(1-\cos\theta) + \frac{1}{2}kx^2 + \frac{1}{2}J_\Delta\dot{\theta}^2 = \text{constante}$$

$$\frac{dE_m}{dt} = 0 = 6mgR\sin\theta\,\dot{\theta} + kR\dot{\theta}\times R\theta + J_\Delta\dot{\theta}\ddot{\theta} = 0$$

$6mgR\sin\theta + kR^2\theta + J_\Delta\dot{\theta}\ddot{\theta} = 0$ avec $\sin\theta \approx \theta(\text{rad})$

$$\ddot{\theta} + \frac{(6mgR\sin\theta + kR^2)}{J_\Delta}\theta = 0$$

Posons $\omega^2 = \frac{(6mgR\sin\theta + kR^2)}{J_\Delta} \Rightarrow \ddot{\theta} + \omega'^2\theta = 0$

C’est une équation différentielle de second ordre à coefficient constant $\omega'^2 = \frac{6mgR + 4R^2}{J_\Delta}$