Correction DM Guitare électrique.

1] Filtre passe ~~haute~~ du 2^{nd} ordre. (

$\boxed{f_r = 3\ \text{kHz}}$ $\quad Y_{BF} = 0 \quad Y_{HF} = -40 \log \frac{\omega_1}{\omega_0}$

2] (i) → Passe bas du 1er ordre.

(ii) → $x \to \infty \quad |H| \to \infty$ Divergence en ∞

(iv) → Passe bande

(iii) → Passe bas du 2^{nd} ordre.

3] $H = \dfrac{H_0}{1 + j\frac{x}{Q} - x^2}$

a) $G_{dB} = 20 \log |H|$ et $G_{dB}(x=1) = 20 \log \left(\frac{H_0 \cdot Q}{1}\right)$

b) BF $\quad H \to H_0 \quad \to Y_{BF} = 20 \log H_0$.

HF $\quad H \to \frac{H_0}{-x^2} \to Y_{HF} = 20 \log H_0 - 40 \log x$.

$\Gamma \left| \begin{array}{l} x=1 \\ 20\log H_0 \end{array} \right.$

4) Sur le diagramme ~~Y~~$_{BF} = 0 \to H_0 = 1$

les asymptotes se croisent pour $f_0 = 3\ \text{kHz}$

$G_{dB}(\omega = \omega_0) = 14\ \text{dB} = 20 \log Q \to Q = 10^{\frac{14}{20}} \simeq 5$.

Rq $\quad \omega_r = \omega_0 \sqrt{1 - \frac{1}{2Q^2}} = \omega_0 \sqrt{1 - \frac{1}{50}} \simeq \omega_0$.

(6)

→ (ω).

et $|H(\omega)| = 10^{\frac{G_{dB}(\omega)}{20}}$.

Application. $U_e = 1\ \text{V}$

$f = 300\ \text{Hz} \to |H| = H_0 = 1 \to U_s = 1\ \text{V}$

$f = 8\ \text{kHz} \to G_{dB} = 14 \to |H| = 5 \to U_s = 5\ \text{V}$

$f = 8\ \text{kHz} \quad G_{dB} = -16 \to |H| = 10^{-\frac{16}{20}} = 0{,}16 \to U_s = 0{,}16\ \text{V}$.

6) 18 pics entre 2 kHz et 8 kHz ~~et~~ chaque pic est distant de f_0 du précédent.

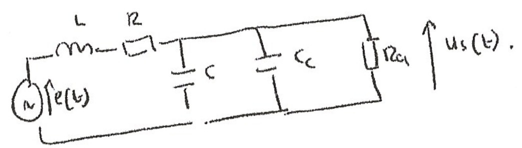
$\to f_0 = \frac{6}{18} \simeq 0{,}333 \to \boxed{f_0 \simeq 300\ \text{Hz}}$.

$f_0 = 300\ \text{Hz} \quad 20 \log \frac{U_1}{U_{ref}} = 50 \to U_1 = U_{ref} \cdot 10^{\frac{5}{2}} = (10 \cdot 10^{\frac{5}{2}})\ \text{mV} = 3{,}2\ \text{V} \to U_s = 3{,}2\ \text{V}$

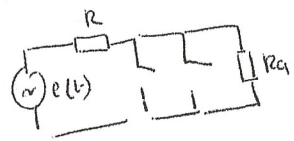
$f_0 = 3\ \text{kHz} \quad 20 \log \frac{U_2}{U_{ref}} = 10 \to U_2 = (10 \cdot 10^{\frac{1}{2}})\ \text{mV} = 0{,}03\ \text{V} \to U_s = 0{,}15\ \text{V}$

$f_0 = 8\ \text{kHz} \quad 20 \log \frac{U_3}{U_{ref}} = -10 \to U_3 = (10 \cdot 10^{-\frac{1}{2}})\ \text{mV} = 0{,}003\ \text{V} \to U_s = 0{,}5\ \text{mV}$

7]



BF



$\frac{U_s}{U_e} = \frac{R_a}{R_a + R}$. $\Big\}$ Filtre passe bas.

HF

$u_s(t) = 0$

$$H = \frac{Z_{eq}}{jL\omega + R + Z_{eq}} = \frac{1}{1 + (R + jL\omega) Y_{eq}} = \frac{1}{1 + (R + jL\omega)\left(j(C + C_c)\omega + \frac{1}{R_a}\right)}$$

$$= \frac{1}{1 + jR(C + C_c)\omega + \frac{R}{R_a} + j\frac{L\omega}{R_a} + (j\omega)^2 L(C + C_c)}$$

(7)

$$\underline{H} = \frac{\quad}{1 + \frac{R}{Ra} + j\left(\frac{L}{Ra} + R(C+Cc)\right)\omega + (j\omega)^2 L(C+Cc)}$$

avec $1 + \frac{R}{Ra} \rightarrow 1$ lorsque $Ra \gg R$. d'où $\boxed{H_0 = 1}$

$$\underline{H} = \frac{1}{1 + j\left(\frac{L}{Ra} + R(C+Cc)\right)\omega + (j\omega)^2 L(C+Cc)}$$ d'où $$\boxed{\omega_0 = \frac{1}{\sqrt{L(C+Cc)}}}$$

et $\frac{1}{Q\omega_0} = \frac{L}{Ra} + R(C+Cc) \rightarrow \boxed{Q = \frac{\sqrt{L(C+Cc)}}{\frac{L}{Ra} + R(C+Cc)}}$

<u>AN</u>

$L = 4,6\ H$.

$R = 20\ k\Omega$

$C = 150\ pF$.

$C_c = 420\ pF$.

$Ra = 10\ M\Omega$

$$\boxed{\begin{array}{l} f_0 = 3,90\ kHz \\ Q = 13 \end{array}}$$

Problème : Piscine à vagues.

1- a) $c^2 = gH + \dfrac{4\pi^2 H \cdot A}{\rho \cdot \lambda^2}$ $\qquad [\rho] = ML^{-3}$.

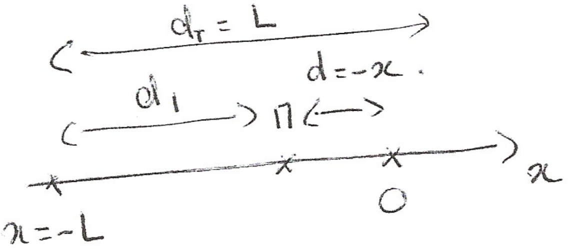
d'où $[c]^2 = \dfrac{[H]\cdot[A]}{[\rho]\cdot[\lambda]^2} \Rightarrow L^2T^{-2} = \dfrac{L\cdot[A]}{ML^{-3}\cdot L^2} = M^{-1} L^2 \cdot [A]$.

d'où $\boxed{[A] = MT^{-2}}$

b) $A = 0 \to c^2 = gH$ $\qquad \boxed{H = \dfrac{c^2}{g}.}$

AN

$\boxed{H = \dfrac{16}{10} = 1{,}6\,m.}$



Rq : $d>0$ et $x<0$.

$z_i(-L;t) = Z_m \cos \omega t$.

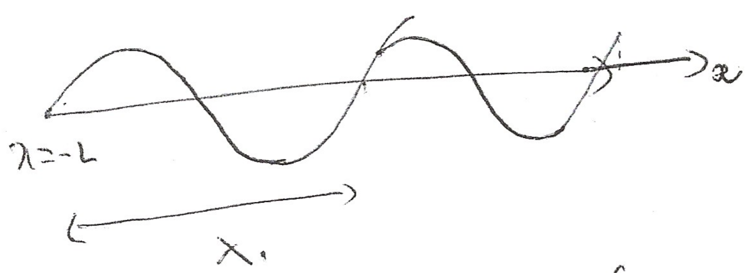
$z_i(M;t) = z_i(-L;t-\tau)$ $\qquad \tau = \dfrac{d_1}{c} = \dfrac{d_T - d}{c} = \dfrac{L+x}{c}$ ($<L$ car $x<0$).

$z_i(M,t) = Z_m \cos \omega \left(t - \left(\dfrac{L+x}{c}\right)\right) =$

$\boxed{z_i(M,t) = Z_m \cos(\omega t - kx - kL)}$ $\qquad$ avec $k = \dfrac{\omega}{c} = \dfrac{2\pi}{c\cdot T} = \dfrac{2\pi}{\lambda}$.

Rq $z_i(-L,t) = Z_m \cos(\omega t - k(-L) - kL) = Z_m \cos \omega t$. On retrouve bien l'expression de $z_i(M,t)$

b) $z_i\left(x, \dfrac{T}{4}\right) = Z_m \cos\left(\underbrace{\omega \cdot \dfrac{T}{4}}_{\frac{2\pi}{T}\cdot\frac{T}{4} = \frac{\pi}{2}} - kx - kL\right) = Z_m \sin\left(k(x+L)\right)$.



$$Z_i(0;t) = Z_m \cos(\omega t - kL).$$

L'onde reflechie est en phase en $x=0$:

$$Z_r(0;t) = Z_{m_r} \cos(\omega t - kL).$$

$$Z_r(x;t) = Z_r(0; t-\tau') \quad \text{avec } \tau' = -\frac{x}{c} \quad (\tau' > 0 \text{ car } x < 0).$$

$$Z_r(x;t) = Z_{mr} \cos\omega\left((t-\tau') - kL\right) = Z_{mr} \cos(\omega t + kx - kL)$$

Pour déterminer Z_{mr}, on utilise que l'amplitude de l'onde (Somme des ondes incidente et reflechie) est maximale en $x=0$.

donc $\frac{d}{dx}\left[Z_r(x,t) + Z_i(x;t)\right](x=0) = 0, \ \forall t$

$$+k(Z_m - Z_{mr}) \sin(\omega t - kL) = 0 \implies \boxed{Z_{mr} = Z_m.}$$

donc
$$\boxed{\begin{aligned} Z_i(x;t) &= Z_m \cos(\omega t - kx - kL) \\ Z_r(x,t) &= Z_m \cos(\omega t + kx - kL). \end{aligned}}$$

4. Ondes stationnaires.

a] En utilisant $\cos a + \cos b = 2\cos\frac{a+b}{2} \cos\left(\frac{a-b}{2}\right)$

$$\boxed{Z_i(x,t) + Z_r(x;t) = \underbrace{2 Z_m \cos kx}_{A(x)} \cos(\omega t - kL).}$$

Onde stationnaire car $A(x)$: amplitude dépend de x.

en $x=-L$: noeud de vibration.

$\cos kL = 0 \qquad kL = (2n+1)\frac{\pi}{2} = \left(n+\frac{1}{2}\right)\pi$

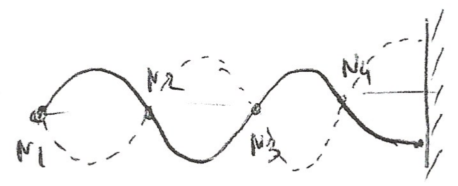
$\frac{2\pi}{\lambda}\cdot L = \left(n+\frac{1}{2}\right)\pi \Rightarrow L = (2n+1)\frac{\lambda}{4} = \boxed{\left(n+\frac{1}{2}\right)\frac{\lambda}{2} = L}$

l'onde commence par un noeud et finit par un ventre puisque l'amplitude est maximale.

donc $\boxed{L = n\frac{\lambda}{2} + \frac{\lambda}{4}}$ avec $\frac{\lambda}{2}$: distance entre 2 noeuds

$\frac{\lambda}{4}$: distance entre 1 noeud et 1 ventre.

c]



AN $\quad n = 3 \Rightarrow L = \frac{7}{4}\lambda = \frac{7}{4}\cdot cT \qquad \begin{cases} c = 4{,}0\,m.s^{-1} \\ T = 3{,}0\,s. \end{cases}$

$\boxed{L = 21\,m.}$

II Utilisations d'injecteur.

5] $3d = L$ car $d = \frac{\lambda}{2}$ (distance entre 2 ventres)

$\Rightarrow L = \frac{3\lambda}{2} \Rightarrow \boxed{d = \frac{L}{3}} \qquad d = \frac{\lambda}{2} = \frac{c}{2f} = \frac{L}{3}$

$\Rightarrow \boxed{f = \frac{3}{2}\frac{c}{L} = 0{,}50\,Hz.}$

Les ventres vibrent en opposition de phase, donc ils sont déphasés de π et $\Delta\varphi = \frac{2\pi\Delta t}{T} \Rightarrow \Delta t = \frac{T}{2} = \frac{1}{2f} = \boxed{1\,s = \Delta t}$

7] Avec un noeud de plus, il faut 1 jet supplémentaire et $d = \frac{L}{4}$

$\boxed{\text{FIN}}$

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