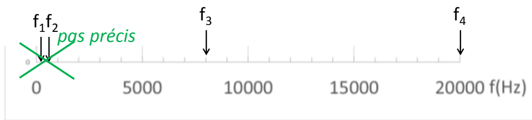
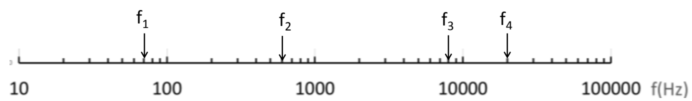
Correction des exercices Chapitres 2 : Le son et effet Doppler.

Exercice 1 :

f_1 = 70Hz, f_2=600Hz , f_3= 8000 Hz et f_4= 20 000 Hz.

1.2.





Une échelle logarithmique permet de représenter des valeurs de f extrêmement différentes.

Exercice 2:

$L = 10.\log\frac{I}{I_0}$: niveau sonore au centre de la salle engendré par une seule source.

$L_{tot} = 10.\log\frac{I_{tot}}{I_0}$: niveau sonore au centre de la salle engendré par toutes les sources.

Augmentation du niveau sonore: $\Delta L = L_{tot} - L$

$$L_{tot} = 10.\log\frac{I_{tot}}{I_0} = 10.\log\frac{4.I}{I_0} = 10.\log\left(4 \times \frac{I}{I_0}\right) = 10.\left(\log 4 + \log\frac{I}{I_0}\right) = 10.\log 4 + 10.\log\frac{I}{I_0}$$

L_{tot}= 10.log 4 + L donc $\Delta L = L_{tot} - L$ = 10.log 4 = 6,0 dB

Exercice 3 :

1. $A = L_1 - L_2$

$$A = 10.\log\frac{I_1}{I_0} - 10.\log\frac{I_2}{I_0}$$

$$A = 10.\log\frac{\frac{P}{\Pi.d_1^2}}{I_0} - 10.\log\frac{\frac{P}{\Pi.d_2^2}}{I_0}$$

$$A = 10.\log\frac{P}{I_0.\Pi.d_1^2} - 10.\log\frac{P}{I_0.\Pi.d_2^2}$$

$$A = 10.\left(\log\frac{P}{I_0.\Pi.d_1^2} - \log\frac{P}{I_0.\Pi.d_2^2}\right)$$

$$A = 10.\log\frac{\frac{P}{I_0.\Pi.d_1^2}}{\frac{P}{I_0.\Pi.d_2^2}}$$

$$A = 10.\log\left(\frac{d_2}{d_1}\right)^2$$

2. $A = 10.\log\left(\frac{100}{50}\right)^2$

A = 6,0 dB

Rq: qd la distance double L diminue de 6 dB.

3. $A = L_{ext} - L_{int}$

$$A = 10.\log\frac{I_{ext}}{I_0} - 10.\log\frac{I_{int}}{I_0}$$

$$A = 10.\left(\log\frac{I_{ext}}{I_0} - \log\frac{I_{int}}{I_0}\right)$$

$$A = 10.\log\frac{\frac{I_{ext}}{I_0}}{\frac{I_{int}}{I_0}} = 10.\log\frac{I_{ext}}{I_{int}}$$

I_{int} est égale à 40% de I_{ext} → $I_{int} = 0,4 \times I_{ext}$ → $\frac{I_{ext}}{I_{int}} = \frac{1}{0,40}$

$$A = 10.\log\frac{1}{0,40} = 4,0 \text{ dB}$$

Exercice 4 :

$$V_{voiture} = \frac{3{,}00.10^8 x2500}{2x24{,}125.10^9 x\cos 25°} = 17{,}2 \text{ m/s}$$

$$= 17{,}2x3{,}6 = 61{,}9 \text{ km/h}$$

Le véhicule est en infraction.

Exercice 5 :

1.a.

$$V = V_{son} \, x \, \frac{f_A - f_0}{f_0} \qquad V = V_{son} \, x \, \frac{f_0 - f_E}{f_0}$$

$$V_{son} \, x \frac{f_A - f_0}{f_0} = V_{son} \, x \frac{f_0 - f_E}{f_0}$$

$$f_A - f_0 = f_0 - f_E$$

$$f_A + f_E = 2.f_0$$

$$f_0 = \frac{f_A + f_E}{2}$$

1.b. $f_0 = \dfrac{f_A + f_E}{2}$ or $c = \lambda \; x \; f$

$$f_0 = \frac{1}{2} \, x \, (f_A + f_E) = \frac{1}{2} \, x \, \left(\frac{c}{\lambda_A} + \frac{c}{\lambda_E} \right) = \frac{c}{2} \, x \, \left(\frac{1}{\lambda_A} + \frac{1}{\lambda_E} \right)$$

2.

$4x\lambda_A = 5{,}5$cm $\quad \lambda_A = \dfrac{5{,}5}{4} = 1{,}4$ cm $\quad$ En réalité : $\lambda_A = 1{,}4x40 = 55$ cm $= 0{,}55$ m

$3x\lambda_E = 6{,}5$cm $\quad \lambda_E = \dfrac{6{,}5}{3} = 2{,}2$ cm $\quad$ En réalité : $\lambda_A = 2{,}2x40 = 87$ cm $= 0{,}87$ m

3.

$$f_0 = \frac{346}{2} \, x \left(\frac{1}{0{,}55} + \frac{1}{0{,}87} \right)$$

$$f_0 = 5{,}1.10^2 \text{ Hz}$$

Exercice 6 :

1. $V = c \, x \left(\dfrac{f_E}{f_R} - 1 \right) \qquad f = \dfrac{c}{\lambda}$

$$V = c \, x \left(\frac{\frac{c}{\lambda_E}}{\frac{c}{\lambda_R}} - 1 \right)$$

$$V = c \, x \left(\frac{\lambda_R}{\lambda_E} - 1 \right)$$

2. $V = 3{,}00.10^8 \, x \left(\dfrac{683}{656} - 1 \right) = 1{,}23.10^7$ m/s

3. $V = c \, x \left(\dfrac{f_E}{f_R} - 1 \right) = c \, x \left(\dfrac{f_E - f_R}{f_R} \right) = - c \, x \, \dfrac{\Delta f}{f_R}$

$(\Delta f = f_R - f_E$ donc $\Delta f < 0)$