problème 1.

> The Root Mean Square (RMS) value of a signal $f(t)$ that is periodic with period T is given by the equation $\sqrt{\frac{1}{T}\int_0^T (f(t))^2 dt}$ It can be shown that the RMS value of $u(t) = B\sin\omega t$ is $\frac{B}{\sqrt{2}}$

? 1.a

Square wave

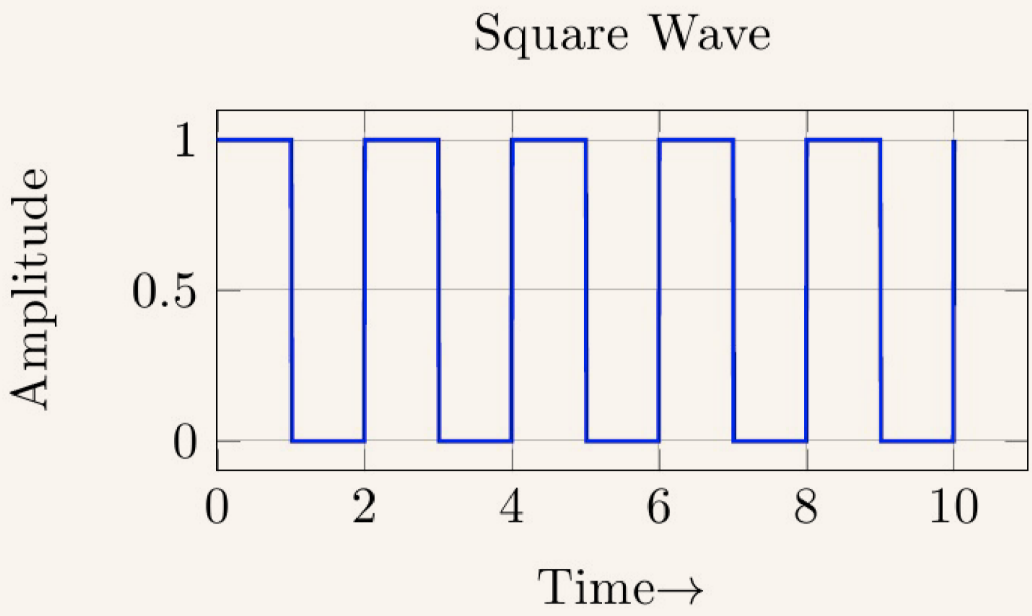

Figure 1: Square wave signal

The square wave function is defined as:

$$f(t) = \begin{cases} 1 & \text{if } 0 \leq t < \frac{T}{2} \\ 0 & \text{if } \frac{T}{2} \leq t < T \end{cases}$$

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import sympy as sp

t = sp.symbols('t')
T = 2

RMS = sp.sqrt(1/T * sp.integrate(1, (t, 0, T/2)))
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> RMS = $\frac{1}{\sqrt{2}}$

1.b

Sawtooth wave

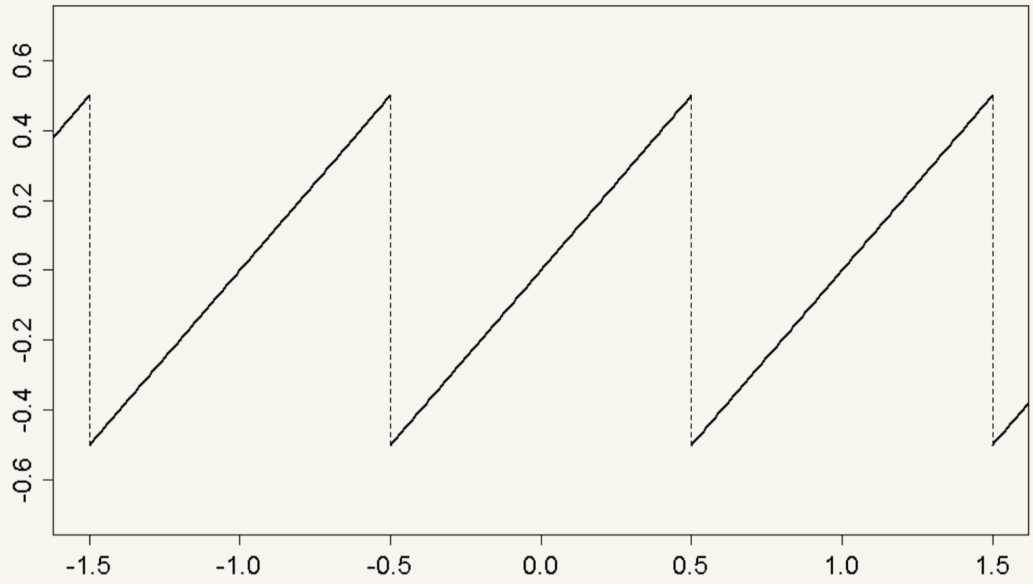

Figure 2: Sawtooth wave signal

A sawtooth wave function is defined as:

$$f(t) = \frac{2A}{T}(t - \frac{T}{2})$$

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import sympy as sp

t = sp.symbols('t')
T = 1
A = 0.5

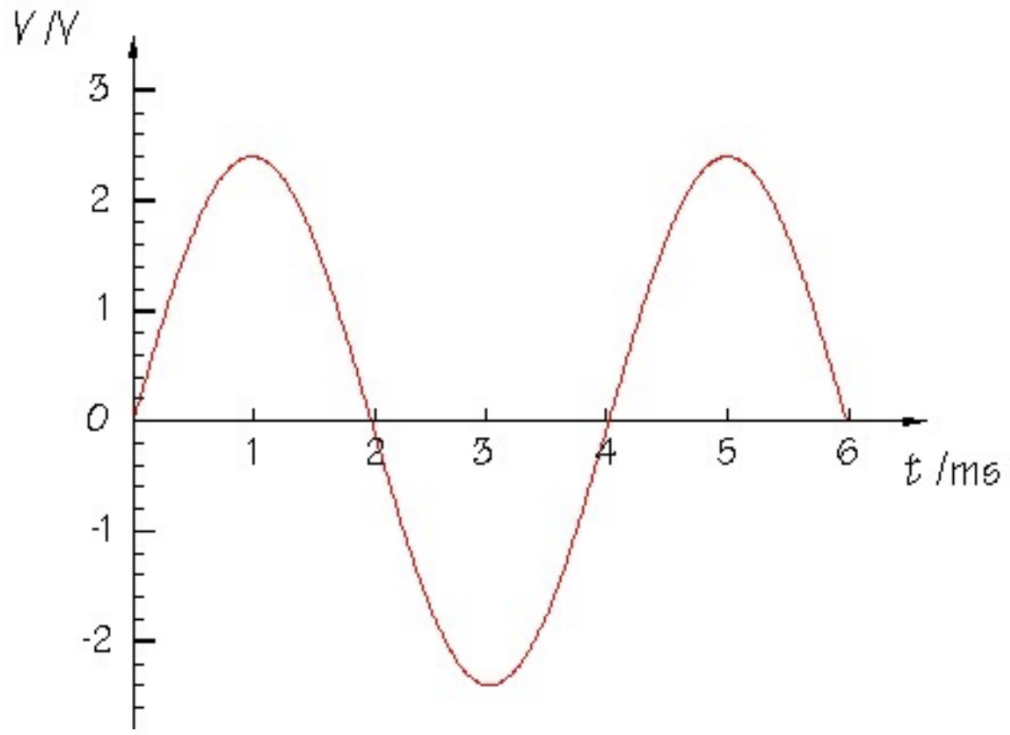
f_t = 2 * A / T * (t - T/2)

RMS = sp.sqrt(1/T * sp.integrate(f_t**2, (t, 0, T)))
```

> RMS = $\frac{\sqrt{3}}{6}$

1.c

sine wave



A general form of the sine wave can be written as

$$f(t) = A\sin(\omega t + \phi)$$

Amplitude is 2.3, no phase shift

> RMS = $\frac{2.3}{\sqrt{2}}$

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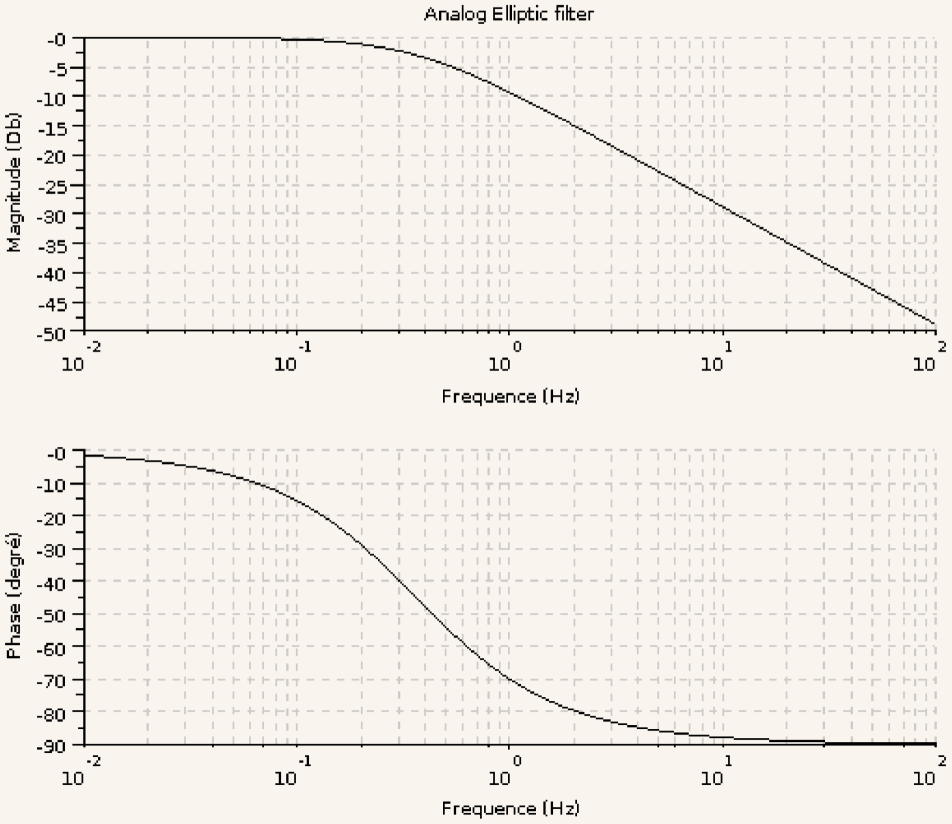
problème 2.

Find the cutoff frequency of the following low-pass filters.

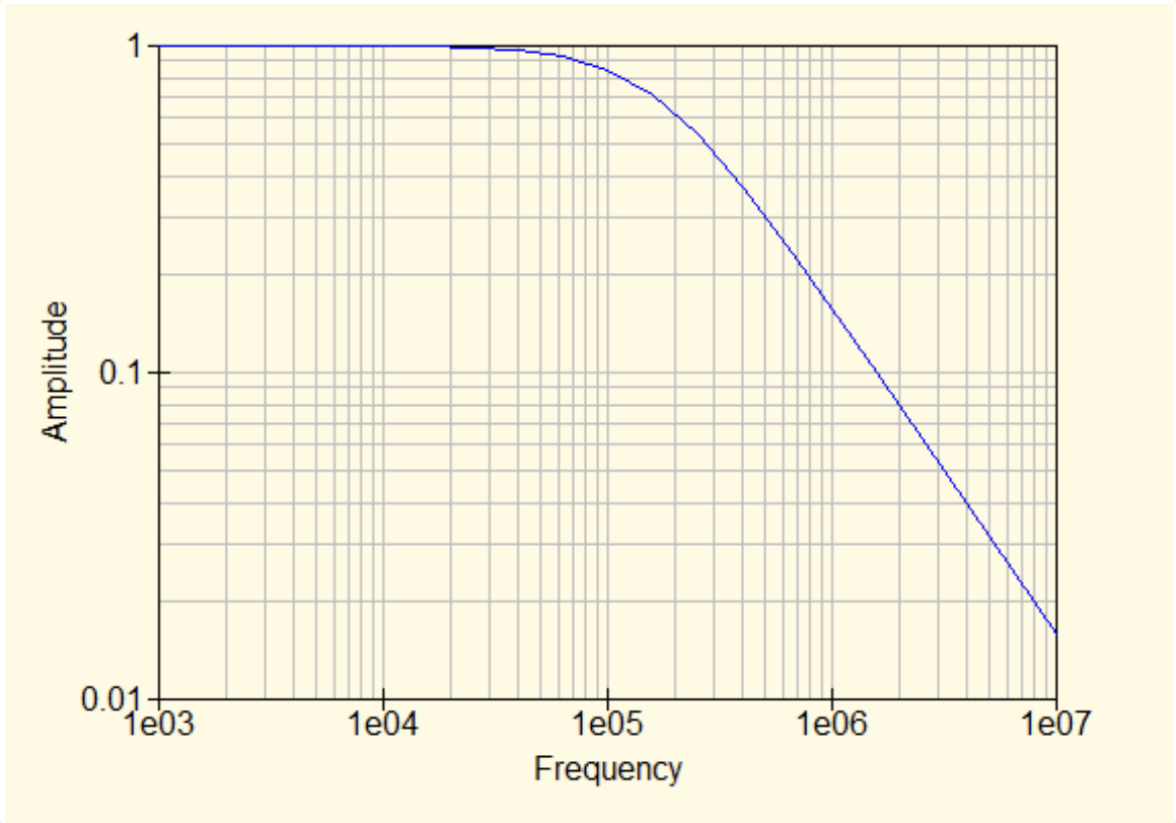
Cutoff frequency of low-pass filters, the frequency at which the amplitude falls to $\frac{1}{\sqrt{2}} \approx 0.707$

? 2.a


Analog Elliptic filter
Magnitude (Db)
-0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10^-2
10^-1
10^0
10^1
10^2
Frequence (Hz)
Phase (degré)
-0
-10
-20
-30
-40
-50
-60
-70
-80
-90
10^-2
10^-1
10^0
10^1
10^2
Frequence (Hz)

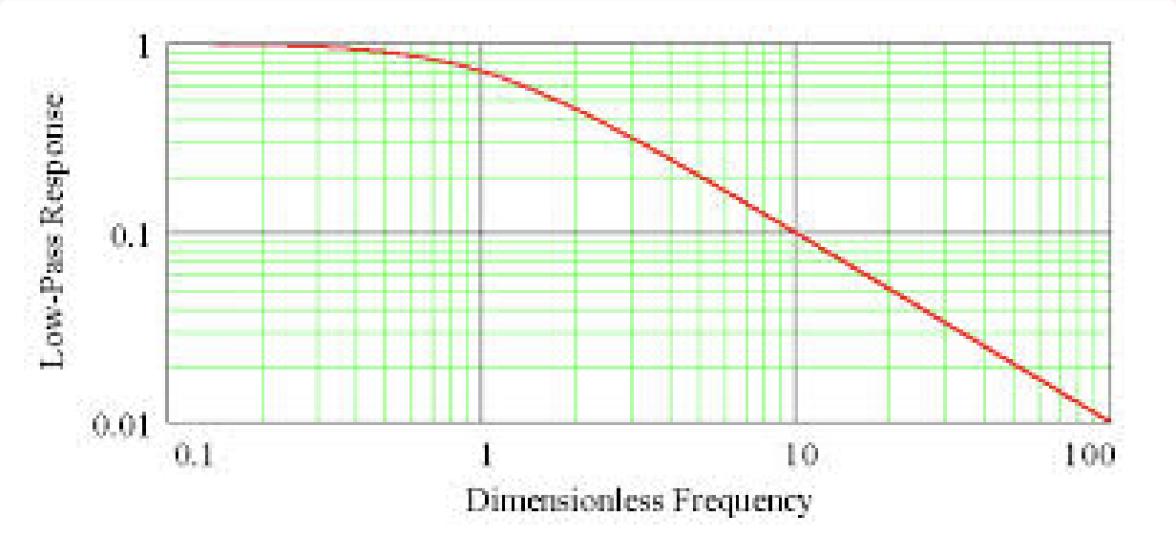
0.05Hz

? 2.b



approx. 1.1e05 Hz

2.c



approx 1.1Hz