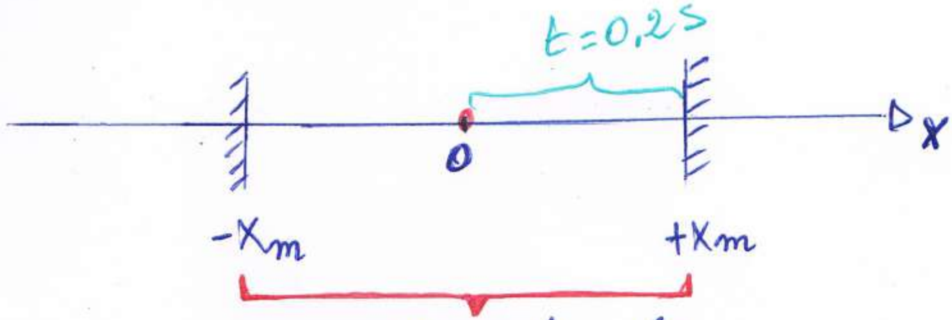
Ex3: $x(t) = X_m \cos(\omega t + \varphi)$

- Maximum elongation X_m ??



$$2X_m = L = 6cm$$

we have $2X_m = L = 6cm \Rightarrow X_m = \frac{6}{2} = 3\,cm \Rightarrow \boxed{X_m = 3\,cm}$

- Period T:

we have: $T = 4t = 4(0,2) = 0,8s \Rightarrow \boxed{T = 0,8S}$

- Pulsation ω: $\omega = \frac{2\pi}{T} \Rightarrow \omega = \frac{2\pi}{0,8} \Rightarrow \boxed{\omega = 2,5\pi\,(rad/s)}$

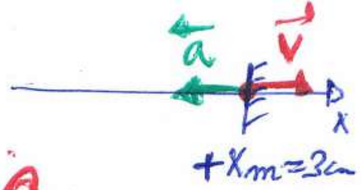
- frequency f: $f = \frac{1}{T} \Rightarrow f = \frac{1}{0,8} \Rightarrow \boxed{f = 1.25\,Hz}$

- phase initiale φ: from the initial conditions at

$$t = 0 \begin{cases} x = 0 \\ V = 3(m/s) > 0 \end{cases}$$

mobile is at the origin

$x(t) = X_m \cos(\omega t + \varphi) \Rightarrow x(t) = \overset{cm}{3} \cos(2,5\pi t + \varphi)\ (cm)$



$$\Rightarrow \begin{cases} x(t) = \overset{cm}{3} \cos(2{,}5\pi t + \varphi) \ (cm) \\ V(t) = -\overset{cm}{3}(2{,}5\pi) \sin(2{,}5\pi t + \varphi) > 0 \end{cases}$$

$$\Rightarrow \text{at } t=0 \Rightarrow \begin{cases} 0 = 3\cos(\cancel{2{,}5\pi(0)}^{0} + \varphi) \\ V = -3(2{,}5\pi)\sin(\cancel{2{,}5\pi(0)}^{0} + \varphi) > 0 \end{cases}$$

$$\Rightarrow \begin{cases} 3\cos\varphi = 0 \\ -7{,}5\pi \sin\varphi > 0 \end{cases} \Rightarrow \begin{cases} 3\cos\varphi = 0 \\ 7{,}5\pi \sin\varphi < 0 \end{cases} \Rightarrow$$

$$\boxed{\varphi = \frac{-\pi}{2}} \text{ phase initiale}$$

$$\Rightarrow \boxed{x(t) = 3\cos\left(2{,}5\pi t - \frac{\pi}{2}\right)}$$

2/ the $\underset{t??}{\underline{\text{time}}}$ does the mobile pass through the coordinate point $\underbrace{x = 3cm}_{X_m}$ for the first time is:

$$\underset{x=3cm}{\text{at } t = t_1} \begin{cases} x = \cancel{3}^{cm} \cos\left(2{,}5\pi t_1 - \frac{\pi}{2}\right) = \cancel{3}\,cm \\ \underbrace{-7{,}5\pi \sin\left(2{,}5\pi t_1 - \frac{\pi}{2}\right)}_{V} > 0 \quad (V>0) \end{cases}$$

$$\Rightarrow \begin{cases} \cos\left(2{,}5\pi t_1 - \frac{\pi}{2}\right) = 1 \\ \sin\left(2{,}5\pi t_1 - \frac{\pi}{2}\right) < 0 \end{cases} \Rightarrow 2{,}5\cancel{\pi} t_1 - \frac{\cancel{\pi}}{2} = 0 + 2k\cancel{\pi}$$

$$\Rightarrow 2{,}5\,\cancel{\pi}\, t_1 - \frac{\cancel{\pi}}{2} = 0 + 2k\cancel{\pi}$$

for $k=0 \Rightarrow 2{,}5\, t_1 = \frac{1}{2} + 2\cancel{k}^{\,0}$

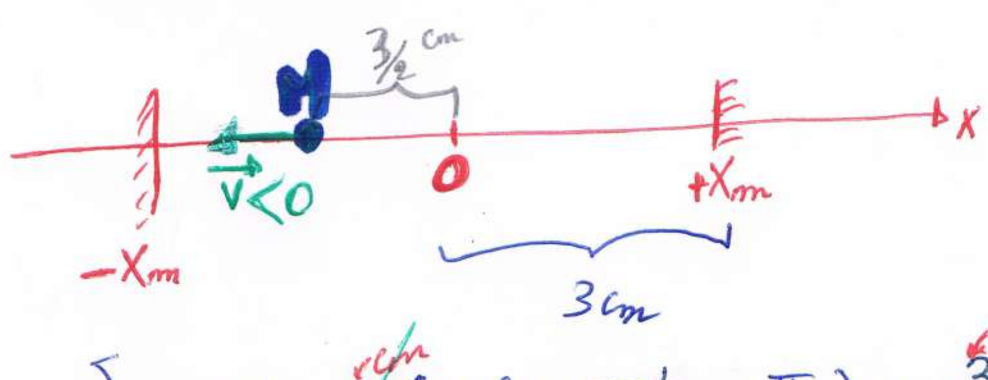
for $k=0 \Rightarrow 2{,}5\, t_1 = \frac{1}{2} \Rightarrow \boxed{t_1 = 0{,}2\,s}$

$\rightarrow$ Velocity at this date ($t_1 = 0{,}2s$) ant $x = X_m = 3cm$

$$V = -\overbrace{3\times10^{-2}}^{m}\,(2{,}5\pi)\,\sin\big(\underbrace{2{,}5\pi(0{,}2) - \frac{\pi}{2}}_{0}\big)$$

$\boxed{V = 0\,(m/s)}$ at $t_1 = 0{,}2s$ and $x = X_m = 3\,cm$

3/ the time (t ??) the moving mobile passes through the coordinate point $x = \frac{3}{2}$ cm for the first time in the negative direction ($V<0$)



at $t = t_2 \Rightarrow$ $x = \frac{3}{2}\,cm$

$$\begin{cases} x(t) = \cancel{3}\cos\left(2{,}5\pi t_2 - \frac{\pi}{2}\right) = \frac{\cancel{3}}{2} \\ V(t) = -7{,}5\pi \sin\left(2{,}5\pi t_2 - \frac{\pi}{2}\right) < 0 \end{cases}$$

$$\Rightarrow \begin{cases} \cos\left(2{,}5\pi t_2 - \frac{\pi}{2}\right) = \frac{1}{2} \\ \sin\left(2{,}5\pi t_2 - \frac{\pi}{2}\right) > 0 \end{cases}$$

$$\Rightarrow \begin{cases} \cos\left(2{,}5\pi t_2 - \frac{\pi}{2}\right) = \frac{1}{2} \\ \sin\left(2{,}5\pi t_2 - \frac{\pi}{2}\right) > 0 \end{cases}$$

$$\Rightarrow 2{,}5\cancel{\pi} t_2 - \frac{\cancel{\pi}}{2} = \frac{\cancel{\pi}}{3} + 2k\cancel{\pi}$$

$$\text{for } k=0 \Rightarrow 2{,}5\, t_2 = +\frac{1}{2} + \frac{1}{3} + \cancel{2k}^{\to 0}$$

$$\underline{\underline{\text{for } k=0}} \Rightarrow 2{,}5\, t_2 = \frac{3+2}{6} = \frac{5}{6}$$

$$\Rightarrow \boxed{t_2 = 0{,}33\,s}$$

$$\begin{cases} x(t) = 3 \cdot 10^{-2} \cos\left(2{,}5\pi t - \frac{\pi}{2}\right) \\ V(t) = -3 \times 10^{-2}\,(2{,}5\pi) \sin\left(2{,}5\pi t - \frac{\pi}{2}\right) \\ a(t) = -3 \times 10^{-2}\,(2{,}5\pi)^2 \cos\left(2{,}5\pi t - \frac{\pi}{2}\right) \end{cases}$$