1. Accelerometer ($\pm 4g$) w/ power supply of $+3V$. ↳ swing is 8

Find θ if $V_x = 1.852\,V$ and
$V_y = 1.372\,V$

$V_x = a_o + s\cos(\theta)$ $\quad a_o = \frac{V_{cc}}{2} = \frac{3}{2}$

$V_y = a_o - (s\sin(\theta))$ $\quad s = \frac{V_{cc}}{a_{swing}} = \frac{3}{8}$

$\theta = a\tan^{-1}\left(\frac{a_y}{a_x}\right)$

for V_x

$$1.852 = \frac{3}{2} + \frac{3}{8}\cos(\theta)$$

$$\cos\theta = 0.9386$$

for V_y

$$1.372 = \frac{3}{2} - \left(\frac{3}{8}\sin(\theta)\right)$$

$$\sin\theta = -0.341\overline{3}$$

final θ

$$\theta = \tan^{-1}\left(\frac{a_y}{a_x}\right) = \tan^{-1}\left(\frac{-0.3413}{0.9386}\right)$$

$$\theta = -19.98^\circ \approx \boxed{-20^\circ}$$

3. input $x(t)$ output $y(t)$ wants response

initial conds: response $y(t)$

$$y(0-)=0 \quad \left.\frac{dy}{dt}\right|_{t=0} = 1 \qquad x(t)=u(t)$$

$\hookrightarrow \mathcal{L}[x(t)] = \frac{1}{s}$

$$\ddot{y}(t) + 2\dot{y}(t) + 10y(t) = \dot{x}(t)$$

$\hookrightarrow u'(t) = \delta = 1$

Goal: $y(t) = \mathcal{L}^{-1}[\cancel{X(s)}H(s)]$ $\quad H(s) = \frac{Y(s)}{X(s)}$

$u'(t) = \delta(t)$

$$\mathcal{L}[y''(t) + 2y'(t) + 10y(t)] = \mathcal{L}[x'(t)] \quad \mathcal{L}\{\delta(t)\} = 1$$

$$s^2Y(s) - s\cancel{y(0-)}^{0} - \cancel{y'(0)}^{1} + 2[sY(s) - \cancel{y(0-)}^{0}] + 10Y(s) = 1$$

$$s^2Y(s) - 1 + 2sY(s) + 10Y(s) = 1 \quad X(s) =$$

$$Y(s)[s^2 + 2s + 10] = 2$$

$$Y(s) = \frac{2}{\underbrace{s^2+2s+10}_{H(s)}}$$

$$y_r(t) = \mathcal{L}^{-1}\left[\frac{2}{s^2+2s+10}\right] \rightarrow \text{Matlab for laplace}$$

From MATLAB

$$y(t) = \frac{(2\sin(3t)e^{-t})}{3} \cdot u(t) \rightarrow \text{all transient, no steady state}$$

Find $y(t)$ when $t = 0.8s$

$$y(0.8) = \boxed{0.2023}$$