Link 02/04/2020

- Link alle due lezioni registrate:
  - https://drive.google.com/open?id=13_x5WBZ1xglby3a88IIXOf9zN0aBy0xT
  - https://drive.google.com/open?id=10IVZR9kDHVoD9RKygQ31jDjtJdd0f1E-

02/04/2020

$x, y, z, w, \ldots \longrightarrow$ best value (1)

$\delta x, \delta y, \delta z, \delta w, \ldots$

$q = x + y + z - w + \ldots$

$$\delta q \sim \delta x \oplus \delta y \oplus \delta z \oplus \delta w + \ldots$$

$$\sim \sqrt{(\delta x)^2 + (\delta y)^2 + (\delta z)^2 + (\delta w)^2}$$

$q = \frac{x}{y} \cdot z + w$

$$\frac{\delta q}{|q_b|} \sim \frac{\delta x}{|x_b|} \oplus \frac{\delta y}{|y_b|} \oplus \frac{\delta z}{|z_b|} \oplus \frac{\delta w}{|w_b|}$$

$$\varepsilon = \frac{mgR}{\nu L t}$$

m, R, V, L — 1%

t — 5%

$$\frac{\delta\varepsilon}{\varepsilon} = (1+1+1+1+5)\% = 9\%$$

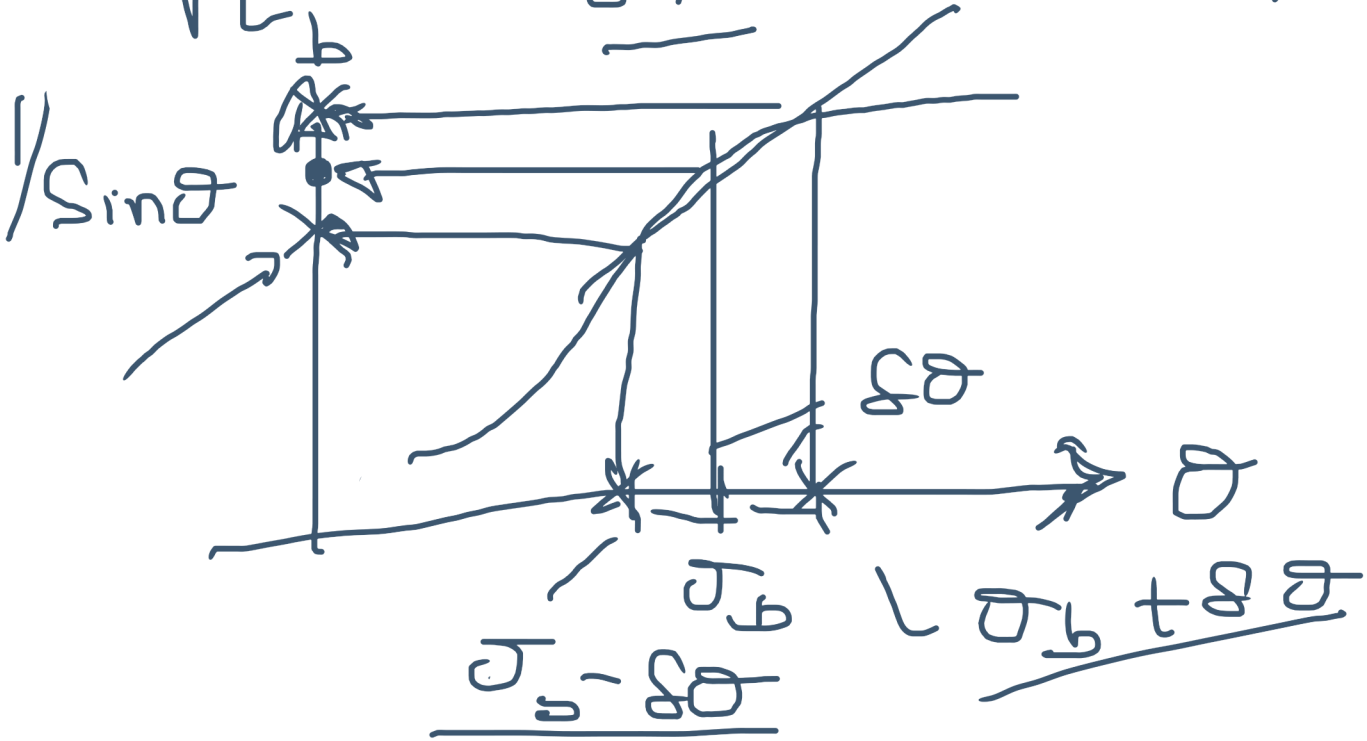
$$= \sqrt{1+1+1+1+25} = \sqrt{29} \sim 5\%$$

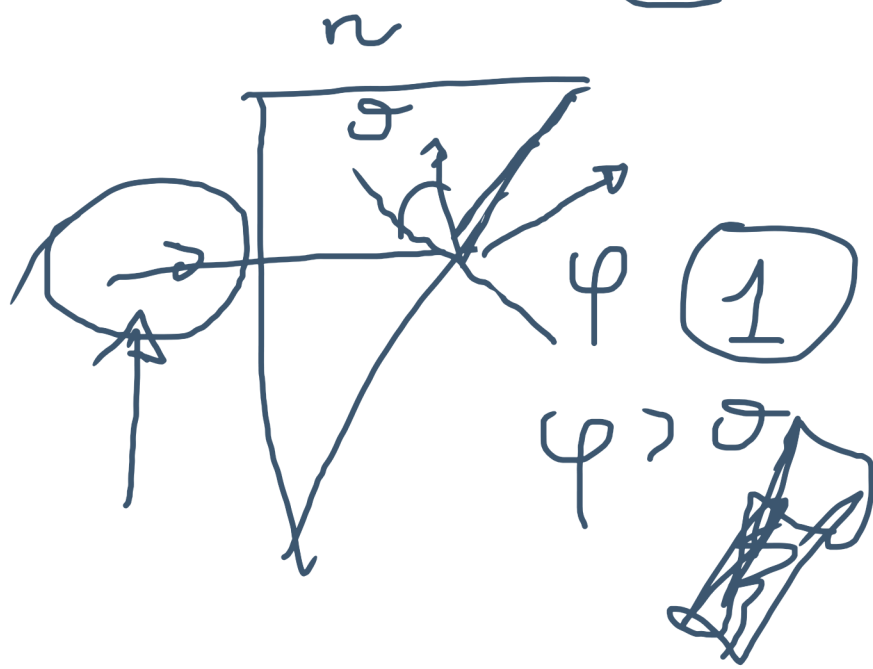
$$\frac{\delta\varepsilon}{\varepsilon} \sim \frac{\delta t}{t} \sim 5\%$$

$n = \frac{1}{\sin\vartheta}$

$(\vartheta) = \vartheta_b \pm \delta\vartheta$

δn ?





$y_b = \frac{1}{\sin\vartheta_b} = n_b$

$$\delta q \sim q(x_b + \delta x) - q_b$$

$$\sim q_b - q(x_b - \delta x)$$

$$\delta q \sim q(x_b + \delta x) - q(x_b - \delta x)$$

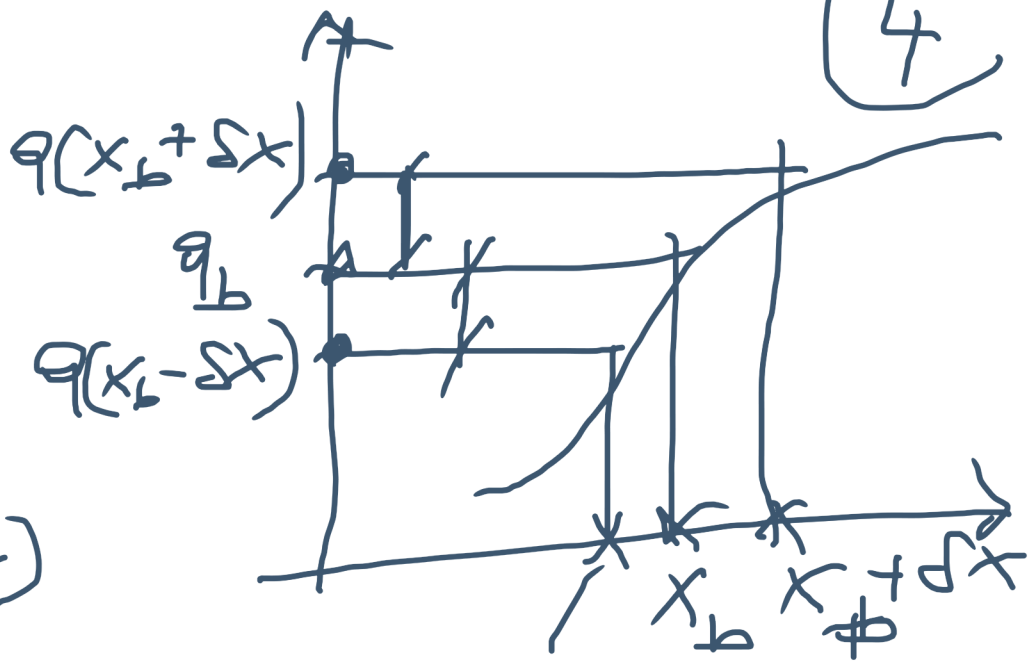
$$\frac{dq}{dx} \rightsquigarrow \frac{q(x+u) - q(x)}{x+u-x}$$

$$u \sim \delta x$$

$$x \sim x_b$$

$$\delta q \sim \left.\frac{dq}{dx}\right|_{x_b} \delta x$$

$$q = x + A$$



$$q(x+u) - q(x)$$

$$u \rightsquigarrow \frac{dq}{dx}$$

$$q(x+u) - q(x) \rightsquigarrow \frac{dq}{dx} \cdot u$$

$$x \longrightarrow x_b \qquad u \longrightarrow \delta q$$

$q = f(x)$

$q = \frac{1}{\sin(x)}$ $\quad 20^\circ \pm 3^\circ$

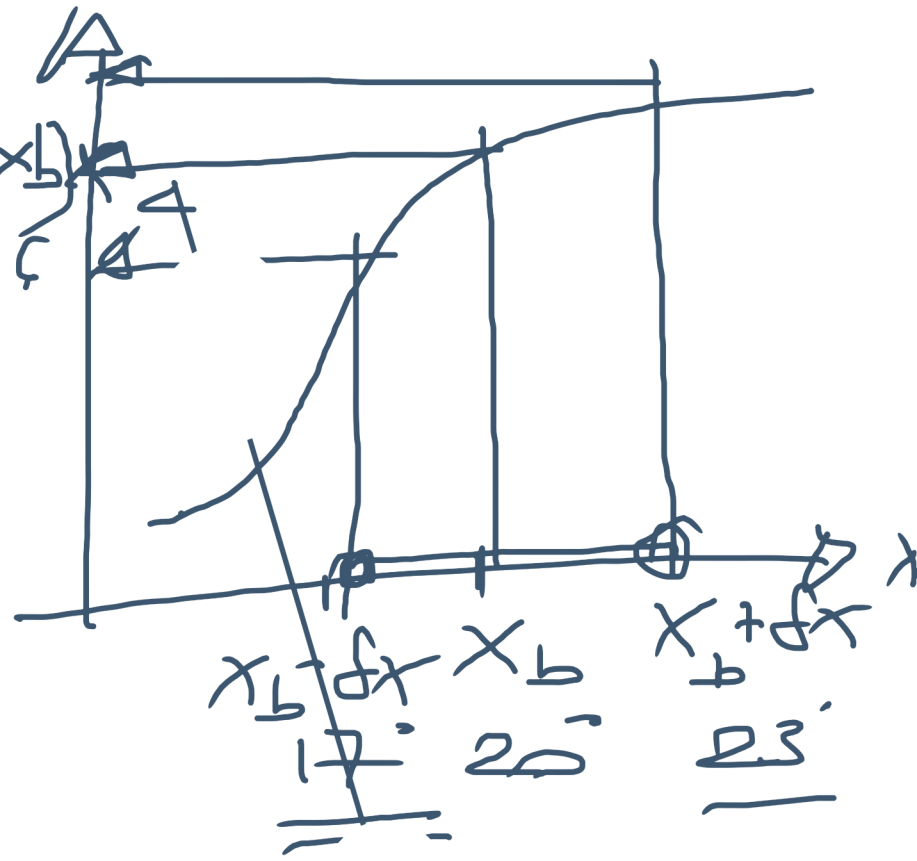
$q_b = \frac{1}{\sin 20} = 2.9$

$q(x_b + \delta x) = \frac{1}{\sin 23^\circ} = 2.6$

$q(x_b - \delta x) = \frac{1}{\sin 17^\circ} = 3.4$

$\delta x = 3.4 - 2.9 \sim 0.5$

$\sim 2.9 - 2.6 \sim 0.3$



2.9 ± 0.4

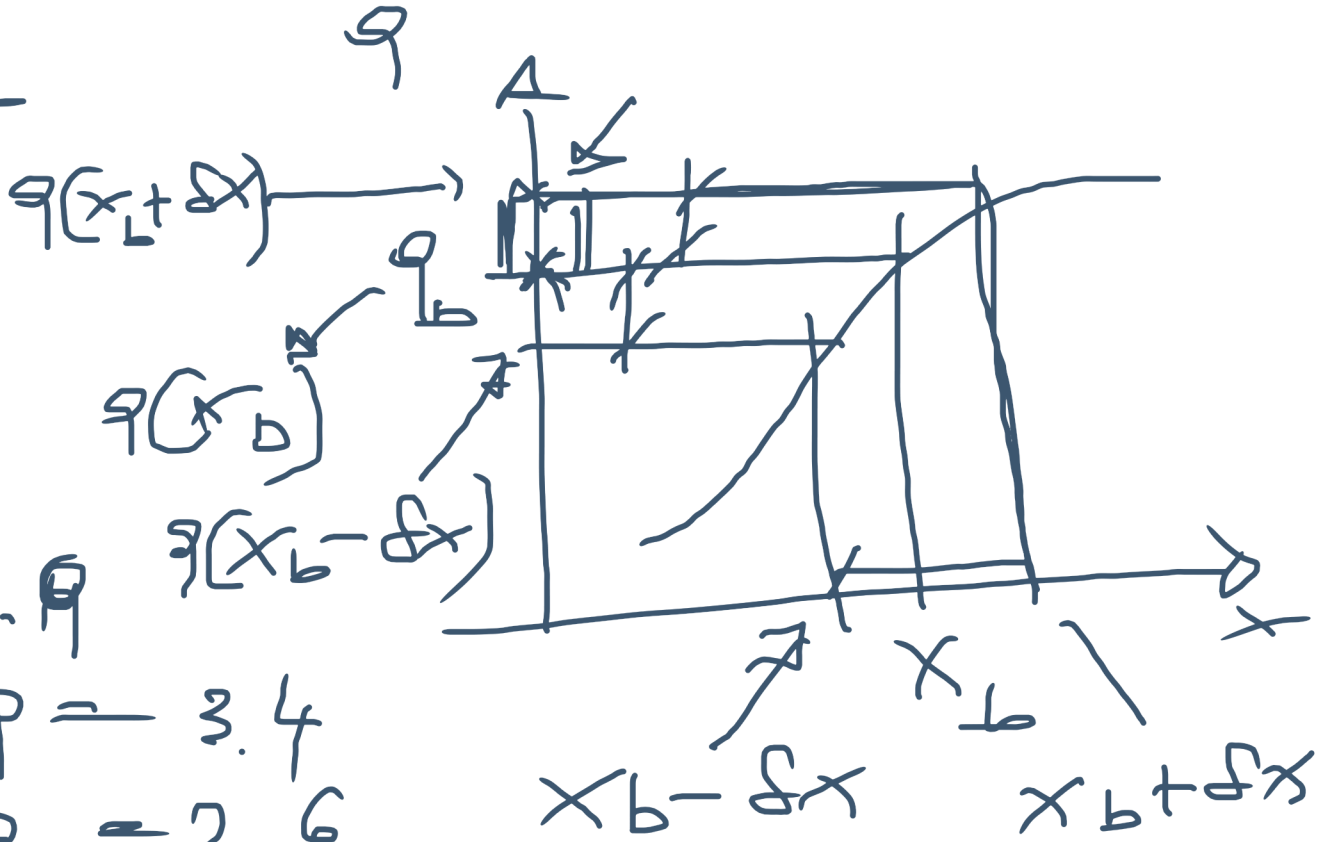
$$\delta q = q(x_b + \delta x) - q(x_b)$$

$$q = \frac{1}{\sin\theta}$$

$q(25^\circ) = q_b = 2.9$

$q(28^\circ) = q_b + \delta q = 3.4$

$q(17^\circ) = q_b - \delta q = 2.6$



$$\delta q = q(x_b + \delta x) - q(x_b) = 3.4 - 2.9 = 0.5$$

$$\frac{dq}{dx} \longrightarrow \lim_{u \to 0} \frac{q(x+u) - q(x)}{x+u-x} = \lim_{u \to 0} \frac{q(x+u) - q(x)}{u}$$

$$\frac{dq}{dx} \sim \frac{q(x+\delta x) - q(x)}{\delta x} = \frac{\delta q}{\delta x}$$

$u \to \delta x$

$$\delta q = \frac{dq}{dx} \cdot \delta x$$

$g(x) = \cos x$ $\quad x_b = 20^\circ$ $\quad \delta x = 3^\circ = 0.05$ (rad)

$(x) = 20^\circ \pm 3^\circ$

$g_b = g(x_b) = \cos 20^\circ = 0.94$

$\delta g = \left|\frac{dg}{dx}\right|_{x_b} \delta x$

$\frac{dg}{dx} = -\sin\theta$ $\quad \left|\frac{dg}{dx}\right|_{x_b} = |\sin 20^\circ| = 0.342$

$3^\circ = 0.05$ rad

$\delta g = 0.342 \cdot 0.05 = 0.018 = 0.02$

$(\text{HIS } g) = 0.94 \pm 0.02$

$\cos(x_b + \delta x) = \cos(23^\circ) = 0.921 = g_b + 0.2\%$

$\cos(x_b - \delta x) = \cos(17^\circ) = 0.956 = g_b - 0.2$

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$$q = x\left(y - \underbrace{z \sin m}_{2}\right)$$

$x_b \pm \delta x \qquad y_b \pm \delta y \qquad z_b \pm \delta z$

$m_b \pm \delta m$

$$\delta w_b = \left|\frac{dw}{dm}\right| \delta m$$

1. $w = \sin m \longrightarrow \boxed{w_b \pm \delta w}$

$q = x(y - z \cdot w)$

2. $p = z \cdot w$

$p_b = z_b \cdot w_b$

$$\frac{\delta p}{|p_b|} = \frac{\delta z}{|z_b|} \oplus \frac{\delta w}{|w_b|}$$

δp

$q = x(y - p)$

3. $e = y - p \qquad e_b = y_b - p_b \qquad \delta e = \delta y \oplus \delta p$

$q = x \cdot e$

4. $$\frac{\delta q}{|q_b|} = \frac{\delta x}{|x_b|} \oplus \frac{\delta e}{|e_b|}$$

3.6 $t = 3{,}0 \pm 0{,}5$ s

$d = \frac{1}{2} g t^2$ (9)

$g = 9{,}8\ m\,s^{-2}$

$d_b = \frac{1}{2} 9{,}8 \times 9 \sim 44$ m

$\frac{\delta d}{|d_b|} = \frac{\delta t}{|t_b|} \oplus \frac{\delta t}{|t_b|} = \sqrt{2\left(\frac{\delta t}{|t_b|}\right)^2} = \frac{\delta t}{|t|}\sqrt{2}$

$= 1{,}4 \cdot \frac{\delta t}{|t_b|}$

$\frac{\delta d}{|d_b|} = 14 \frac{0.5}{3{,}0_2}$

d_b

$\delta d = 0.25 \times 44 \sim 10$

3.1 $\theta = 125^\circ \pm 2^\circ$ ← $0{,}035\,\text{rad}$ $\sin\theta = q$ (10)

$q_b = \sin 125^\circ = 0{,}82$

$\delta q = \left(\frac{dq}{d\theta}\right|_{\theta_b} \delta\theta = \cos(125^\circ) \cdot 0{,}03 = 0{,}02$

$\cos(125^\circ) \to 0{,}57$

$0{,}82 \pm 0{,}02$

$f(a) = e^a$ ← a ← δa

$a = 3{,}0 \pm 0{,}1$

$f_b, \delta f$

$f_b = f(a_b) = e^3 = 20$

$\frac{df}{da} = e^a$ $f(x) = e^x$ $\frac{df}{dx} = e^x$

$\delta f = |e^3| \cdot \delta x = 20 \cdot 0{,}1 = 2$

$f = 20 \pm 1$

$f(x) = \log x$ $\quad x_b = 3{,}0 \quad \delta x = 0.1$ (11

$f_b = \log(3{,}0) = 1{,}10$

$\frac{df}{dx} = \frac{1}{x} \qquad \delta x = \frac{1}{3} \times 0.1 = 0{,}03$

$(f) = 1{,}10 \pm 0{,}03$

3,19

$$q = \frac{x+y}{x+z}$$

$x = 20 \pm 1$

$y = 2$

$z = \phi$

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$q = q(x)$

$p = x + y$

$e = x + z$

$p_b = 22$

$e_b = 20$

$\delta p = 1$

$\delta e = 1$

$$q = \frac{p}{e} \qquad \frac{\delta q}{|q_b|} = \sqrt{\frac{\delta p}{|p|} \oplus \frac{\delta e}{|e_b|}}$$

$$q_b = \frac{22}{20} = 1{,}1 \qquad = \sqrt{\left(\frac{1}{22}\right)^2 + \left(\frac{1}{20}\right)^2} = \sqrt{0.0045} = 0{,}07$$

$\left(\frac{1}{22}\right)^2 \to 0.002 \qquad \left(\frac{1}{20}\right)^2 \to 0.0025$

$(q) = 1.10 \pm 0.07$

$$q = \frac{x+y}{x+2} = f(x)$$

(13

$$\frac{dq}{dx} = \frac{1\cdot(x+2) - (x+y)\cdot 1}{(x+2)^2} = \frac{x+2-x-y}{(x+2)^2}$$

$$= \frac{2-y}{(x+2)^2} = \frac{-y}{x^2}$$

$y = 2 \quad x = 20$

$$\left|\frac{dq}{dx}\right| = \left|\frac{-2}{400}\right| = \frac{1}{200} = 0{,}005$$

$$\Delta q = 0{,}005 \times 1.1 = 0{,}005$$

$$(q) = 1{,}100 \pm 0{,}005$$