57, 53, 52, 57, 58

relativer Fehler des Mittelwerts.

x_i	$\bar{x} - x_i$	$(\bar{x} - x_i)^2$
57	−1.6	2.56
53	2.4	5.76
52	3.4	11.56
57	−1.6	2.56
58	−2.6	6.76

$$\Delta\bar{x} = \sqrt{\frac{\sum_{i=1}^{n}(\bar{x} - x_i)^2}{n(n-1)}}$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$\sum_{i=1}^{n}(\bar{x} - x)^2 = 29.2$$

$$\bar{x} = 55.4$$

$$= \frac{29.2}{20}$$

$$= \sqrt{1.46} \rightarrow 1.2083$$

absoluter Fehler

5 (4) = 20

relativer Fehler

$$\frac{\Delta\bar{x}}{\bar{x}} = \frac{1.2083}{55.4} \times 100 = 2.2\,\%$$

$t_1 = 18.9\,^\circ C$ $t_2 = 21.5\,^\circ C$ $t_3 = 19.4\,^\circ C$ $t_4 = 18.5\,^\circ C$ $t_5 = 21\,^\circ C$

absoluter Fehler des Mittelwerts

x_i	$\bar{x} - x_i$	$(\bar{x} - x_i)^2$
18.9	1	1
21.5	−1.6	2.56
19.4	0.4	0.16
18.5	1.4	1.96
21	−1.1	1.21

$$\Delta\bar{x} = \sqrt{\frac{\sum_{i=1}^{n} (\bar{x} - x)^2}{n(n-1)}}$$

$5(4) = 20$

$= 6.89$

$$\frac{6.89}{20} = 0.3445$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$\bar{x} = \frac{99.3}{5} = 19.9\,^\circ C$$

$$\sqrt{0.3445} = 0.59\,^\circ C$$

$$\bar{x} = 19.9 \pm 0.59\,^\circ C$$

B # 20

$y(x) = \underbrace{\sin 2x}_{u} \cdot \underbrace{\cos x}_{v}$ $\qquad x = \pi$

$y(x) = u.v \qquad \frac{dy}{dx} = uv' + vu'$

$u = \sin 2x$

$u' = (\cos \underbrace{2x}_{\omega}) \cdot 2$

$\omega = 2x$

$\omega' = 2$

$v = \cos x$

$v' = -\sin x$

$\frac{dy}{dx} = (\sin 2x)(-\sin x) + (\cos x)(\cos 2x)2$

$x = \pi \qquad \frac{dy}{dx} = (\sin 2\pi)(-\sin \pi) + (\cos \pi)(\cos 2\pi)2$

$= (0)(-0) + (-1)(1)(2)$

$= 0 + (-2) = \boxed{-2}$

D #15 $y = 9x^3 - \sqrt{8x^4 + \ln x + 1}$ wann $x = 1$

$$\frac{dy}{dx} = 27x^2 - \frac{1}{2}(8x^4 + \ln x + 1)^{-\frac{1}{2}}(32x^3 + \frac{1}{x})$$

z

$y = ax^p$

$y' = a \cdot px^{p-1}$

$z = (8x^4 + \ln x + 1)^{1/2}$

$z' = \frac{1}{2}(8x^4 + \ln x + 1)^{-1/2}(32x^3 + \frac{1}{x})$

noch nicht fertig

$z' = \frac{1}{2}(8x^4 + \ln x + 1)^{-1/2}(32x^3 + \frac{1}{x})$

$x = 1$

$$\frac{dy}{dx} = 27(1)^2 - \frac{1}{2}(8(1)^4 + \ln 1 + 1)^{-\frac{1}{2}}(32(1)^3 + \frac{1}{1})$$

$$= 27 - \frac{1}{2}(8 + 0 + 1)^{-1/2}(32 + 1)$$

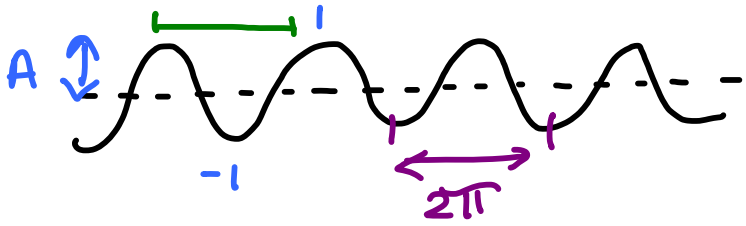
$$= 27 - \frac{1}{2}(9)^{-1/2}(33)$$

$$= 27 - \frac{1}{2}\cdot\frac{1}{3}(33)$$

$$= 27 - \frac{33}{6} = 27 - 5.5 = 21.5$$

$9^{-1/2} = \frac{1}{\sqrt{9}} = \frac{1}{3}$

Phasen usw!



sin x

A = amplitude

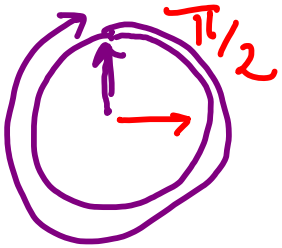
A sin x

frequenz ⇒ s^{-1} = Hz Hertz

wellenlänge ⇒ m

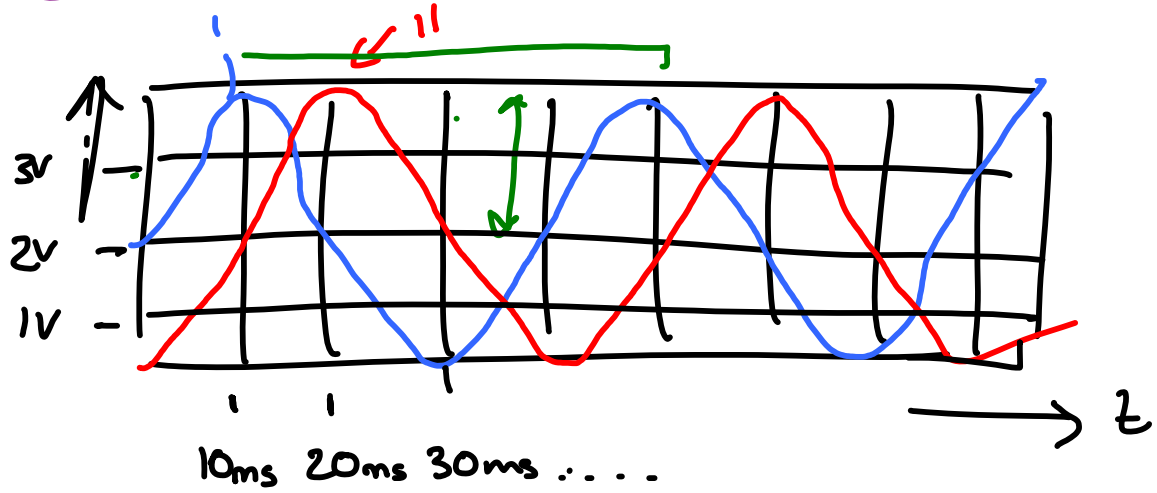
eine ganze Schwingung hat immer periode 2π

D #7



360°

2π rad



Amplitude = 2V

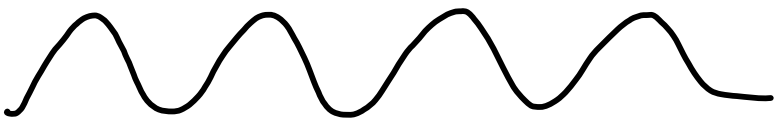
Frequenz $\frac{1000\,ms}{40\,ms}$ = 25 Hz

2π ⇒ 4 x skalenteile

abstand zwischen 1 & 2

$\frac{2\pi}{4} = \frac{\pi}{2}$ ← phasen unterschied.

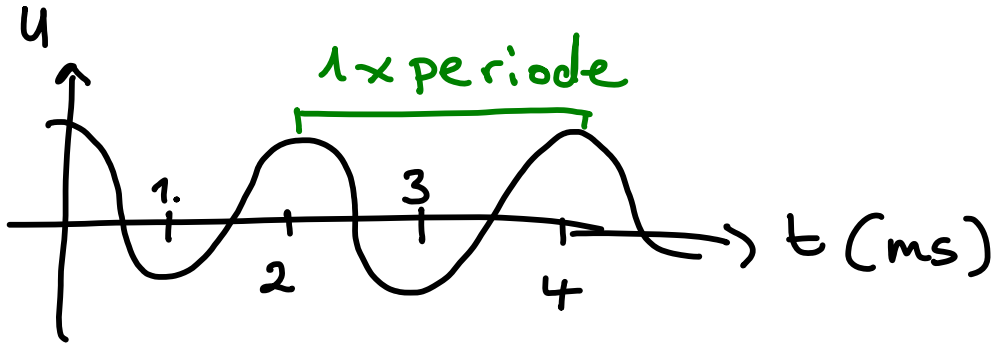
Phasen usw 2



(harmonisch)
(periodisch)

(periodisch)

C #5



Aussage 1 → periodendauer $T = 2ms$ ✓

Aussage 2 – frequenz $f = 50\ Hz$ ✗ $\frac{1000ms}{2ms} = 500\ Hz$

Aussage 3 – kreisfrequenz $\omega = 3.14 \times 10^4\ s^{-1}$ ✗
↳ 31400 Hz

phaser/wellen

D # 9

$y = \sin\left(\frac{3}{2}x - \frac{3}{8}\right)$ → phasenunterschied.

$y = \sin\left(\frac{3}{2}x\right)$

$y = \sin\left(\frac{3}{2}x - \frac{3}{8}\right)$

ändert nicht der periode

was ist die periode?

periode ist 2π

$$\frac{3}{2}x = 2\pi$$

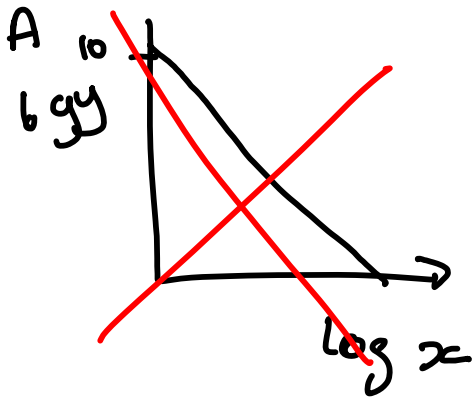
$$x = \frac{2 \times 2\pi}{3}$$

$$x = \frac{4\pi}{3}$$

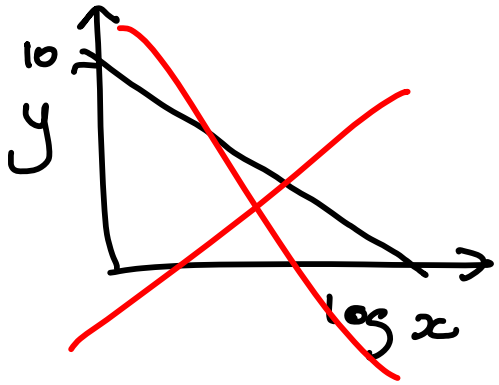
linear v. log achsen

C #8 $I(x) = I_0 e^{-\mu x}$ $I(0) = 10$

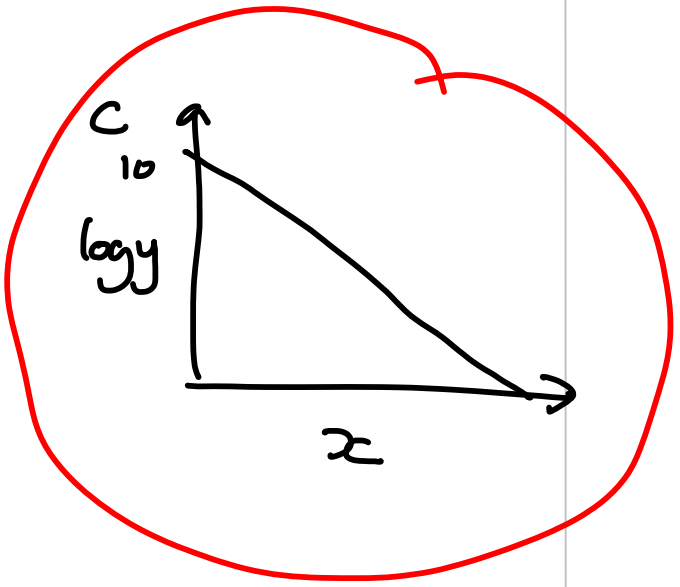
A



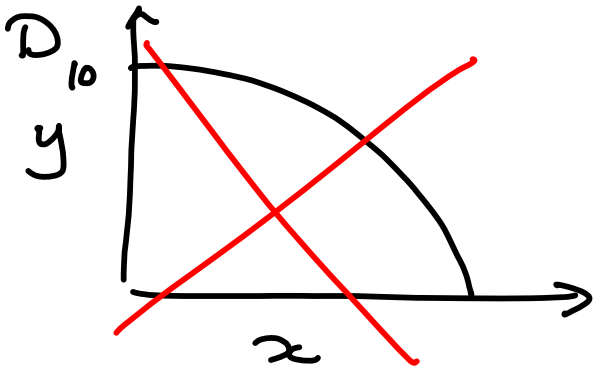
B



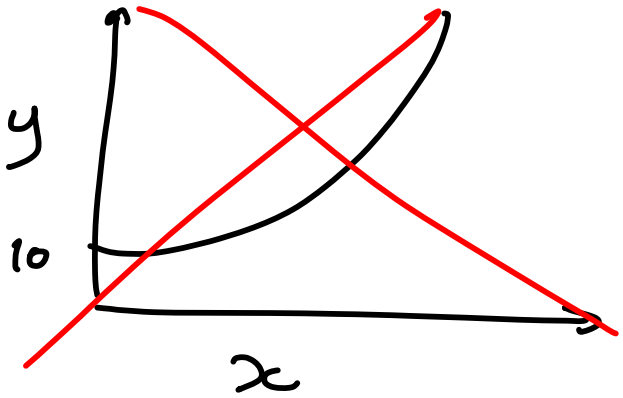
C



D



E



$\log I(x) = -\mu x + I_0$

m c

passt zu C

$y = a x^k$

$\log y = k \, a \log x$

(passt zu A)

Brennweite frage

Δf ?

$$\frac{1}{f} = \frac{1}{b} + \frac{1}{g}$$

$$\frac{1}{f} = \frac{(g+b)}{bg}$$

$$f = \frac{bg}{(g+b)}$$

$$f = bg \cdot \frac{1}{(g+b)}$$

gleiche denominator

$$\frac{1}{b} + \frac{1}{g} =$$

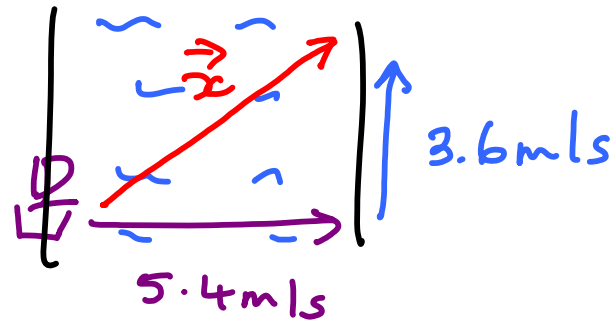
$$\frac{g}{bg} + \frac{b}{bg}$$

$$= \frac{(g+b)}{bg}$$

$$\boxed{\frac{\Delta f}{f} = \frac{\Delta(bg)}{(bg)} + \frac{\Delta(g+b)}{(g+b)}}$$

D #17

Boot → 5.4 m/s

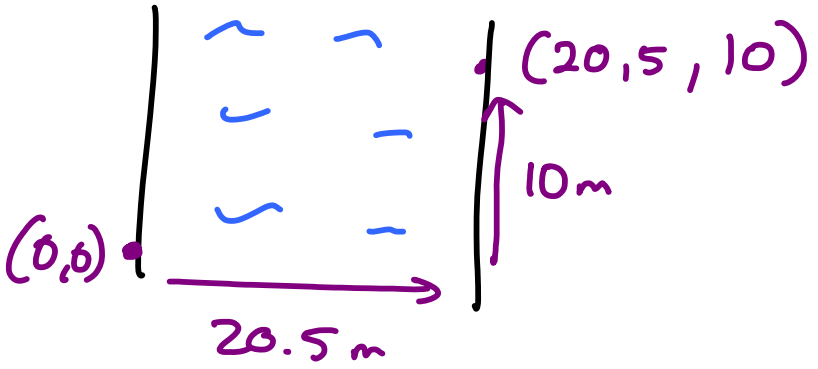


$(\vec{x})^2 = (5.4)^2 + (3.6^2)$

$\vec{x} = \sqrt{29.16 + 12.96} = 6.5$ m/s

---

andere Formulierung:
Flußrate = 4m/s
breites Fluß = 20,5m
distance = 10m



was ist geschwindigkeit mit den der Boot fahren muß senkrecht zum fluß?

$t = \frac{10m}{4m/s} = 2.5s$ $\quad v_B = \frac{20,5m}{2.5s} = 8.2$ m/s