1) $A = \{x \in [4;14]_{\mathbb{N}} \mid x \bmod 3 = 0\} = \{6;9;12\}$

a) $A \cup B = \{6;7;9;11;12;\ldots;19;20\}$

$= \{x \in [6;20]_{\mathbb{N}} \setminus \{8;10\}\}$

b) $A \cap B = \underline{\{9;12\}} = \{x \in [9;12]_{\mathbb{N}} \mid x \bmod 3 = 0\}$

Negation

c) $A \setminus B = \{6\} = \{x \in \mathbb{N} \mid x > 5 \wedge x < 7\}$

d) $B \setminus A = \{7;11;13;14;\ldots;19;20\}$

$= \{x \in [7;20]_{\mathbb{N}} \setminus \{8;9;10;12\}\}$

2) $A = \{1 ; \{2;3;4\} ; \{5\} ; \{\{6\};7\} ; 8\}$

X: $\{1; \{5\}; \{8\}\}$

$\{\{2;3;4;7\}\}$

$\{\{5\}\}$

$\cap \Rightarrow \{5\} \neq \{\}$

$\Rightarrow$ nicht disjunktiv

Y: I $\{\{5\}; \{2;3;4\}\}$

II $\{\{6\};7\}$

III $\{8;1\}$

$\cap \Rightarrow \{\} \Rightarrow$ disjunktiv

U: $\mathrm{I} \cup \mathrm{II} \cup \mathrm{III} = \{\{5\};\{2;3;4\};\{6\},7;8,1\}$

$\Rightarrow$ keine Klasseneinteilung

$\Rightarrow$ Änderung II : $\{\{\{6\};7\}\}$

3) $(x \cup (\overline{y \cap x})) \cap ((z \cup x) \cup (\bar{x} \cup z))$

de Morgan

$(x \cup (\bar{y} \cup \bar{x})) \cap ((z \cup x) \cup (\bar{x} \cup z))$

Komm.
assoz..

$$(\underbrace{(x \cup \bar{x})}_{\text{Komplement}} \cup \bar{y}) \cap (\underbrace{(z \cup z)}_{\text{Neutral}} \cup \underbrace{(x \cup \bar{x})}_{\text{Komplement}})$$

$(\Omega \cup \bar{y}) \cap (z \cup \Omega)$

Idempotenz
Dominanz

$\Omega \cap \Omega$

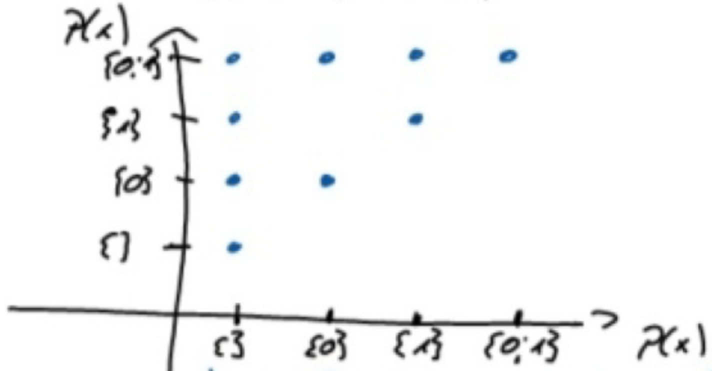
Ω

4) $X = \{0; 1\}$; $a \leq b$: $(a, b) \in R$

a) $\mathcal{P}(X) = \{ \{\} ; \{0\} ; \{1\} ; \{0; 1\} \}$

b) $R = \{ (\{\} ; \{\}), (\{\} ; \{0\}), (\{\}, \{1\}), (\{\}, \{0; 1\})$
$(\{0\} ; \{0\}) ; (\{0\} ; \{0; 1\})$
$(\{1\} ; \{1\}) ; (\{1\} ; \{0; 1\})$
$(\{0; 1\} ; \{0; 1\}) \}$

c)



keine Funktion!

5) $(r \lor (p \to q)) \land (\neg r \lor q)$

$$\underbrace{(r \lor \neg p \lor q)}_{\text{Maxterm}} \underset{\uparrow \text{ Konjunktion}}{\land} \underbrace{(\neg r \lor q)}_{\text{Disjunktionsterm}} \Bigg\} \text{ KNF}$$

→ **Distributivgesetz:**

$$(r \land \neg r) \lor (\neg p \land \neg r) \lor (q \land \neg r) \lor (r \land q) \lor (\neg p \land q) \lor \underbrace{(q \land q)}_{q}$$

$\{\}$ ⇒ Neutral

DNF: $(\neg p \land \neg r) \lor (q \land \neg r) \lor (r \land q) \lor (\neg p \land q) \lor q$

6) $(p \to q \iff \neg p \lor q)$?

1. Verfahren Wahrheitstabelle.

$E[A(p,q)] = Bool^2 \Rightarrow$ Tautologie

ergo Äquivalenz

$a \iff b = (\neg a \land \neg b) \lor (a \land b)$

$$[\neg(p \to q) \land \neg(\neg p \lor q)] \lor [(p \to q) \land (\neg p \lor q)]$$

$$[\neg(\neg p \lor q) \land (p \land \neg q)] \lor [(\neg p \lor q) \land (\neg p \lor q)]$$

$$[(p \land \neg q) \land (p \land \neg q)] \lor (\neg p \lor q)$$

$$(p \land \neg q) \lor (\neg p \lor q) = [(p \lor \neg p) \lor (p \lor q)] \land [(\neg q \lor q) \lor (\neg q \lor \neg p)]$$

$$\underbrace{\neg(\neg p \lor q)}_{\neg X} \lor \underbrace{(\neg p \lor q)}_{X} \Rightarrow \Omega$$

8) $\Psi = \{ (x;y) \in \mathbb{R}^2 \times \mathbb{R}^2 \mid x_1^2 + x_2^2 = y_1^2 + y_2^2 \}$

$\left(\begin{pmatrix} 3 \\ 4 \end{pmatrix} ; \begin{pmatrix} 0 \\ 5 \end{pmatrix} \right) \in \Psi \qquad 3^2 + 4^2 = 0^2 + 5^2$

$(x,x) \in \Psi \qquad x_1^2 + x_2^2 = x_1^2 + x_2^2 \qquad | -x_1^2 - x_2^2$

<u>reflexiv</u>: $\qquad 0 = 0$ ✓

<u>transitiv</u>: $(x,y) \in \Psi \wedge (y,z) \in \Psi \Rightarrow (x,z) \in \Psi$

$x_1^2 + x_2^2 = y_1^2 + y_2^2 = y_1^2 + y_2^2 = z_1^2 + z_2^2$

$x_1^2 + x_2^2 = z_1^2 + z_2^2$

<u>symmetrisch</u> $\quad (x,y) \in \Psi \wedge (y,x) \in \Psi$

$\Downarrow$

$y_1^2 + y_2^2 = x_1^2 + x_2^2$

$0 = 0$

=> Äquivalenzrelation

g) a) $f(x) = \sqrt{13-3x}$; $D = \mathbb{R}^{\leq 13/3}$; $W = \mathbb{R}_0^+$

$g(x) = x - 1$

$f(x) = g(x)$ | $+3x - 13$

$\sqrt{13-3x} = x - 1 \quad | \uparrow^2 \qquad 13 - 3x = (x-1)^2 = x^2 - 2x + 1$

$x^2 + x - 12 = 0$

$(x+4)(x-3) = 0 \qquad x_1 = -4$

$x_2 = 3$

$x_1 = -4 \Rightarrow \left.\begin{array}{l} f(-4) = \sqrt{25} \\ g(-4) = -5 \end{array}\right\} \lightning$

$x_2 = 3 \Rightarrow \left.\begin{array}{l} f(3) = \sqrt{4} \\ g(3) = 2 \end{array}\right\} = \qquad \Rightarrow \underline{\underline{S(3/2)}}$

10) $\{(x;y) \in \mathbb{R} \times \mathbb{R} \mid 2y = e^{\alpha \cdot x} ; \alpha \in \mathbb{Z}\}$

=> Eigenschaften

=> bijektiv machen

=> Umkehrfunktion

$f(x) = \frac{1}{2} \cdot e^{\alpha \cdot x}$

<u>rechtseindeutig</u> $\quad f(x) = y_1 \wedge f(x) = y_2 \quad\quad y_1 = y_2$

$$y_1 = \tfrac{1}{2} e^{\alpha \cdot x} \quad \wedge \quad y_2 = \tfrac{1}{2} \cdot e^{\alpha \cdot x}$$

$$2y_1 = e^{\alpha \cdot x} \quad | \ln$$

$$\ln(2y_1) = \alpha \cdot x \quad | : \alpha \quad ; \alpha <> 0 \qquad \alpha = 0$$

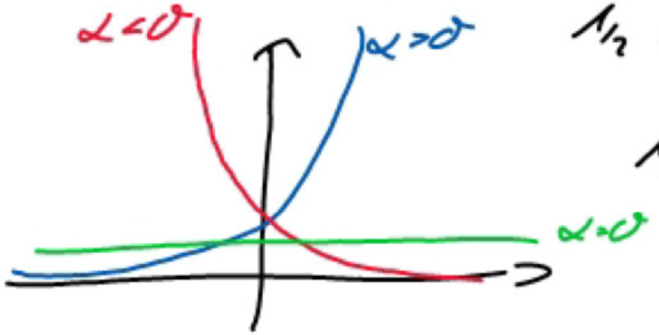
$$x = \underline{\tfrac{1}{\alpha} \cdot \ln(2y_1)} \qquad y = \tfrac{1}{2} \cdot e^{0} = \tfrac{1}{2}$$

$$y_2 = \tfrac{1}{2} \cdot e^{\alpha \cdot \underline{\frac{1}{\alpha} \cdot \ln(2y_1)}}$$

$$y_2 = \tfrac{1}{2} e^{\ln(2y_1)} = \tfrac{1}{2} \cdot 2y_1 = y_1$$

Linkseindeutig : $f(x_1) = y \wedge f(x_2) = y \qquad x_1 = x_2$

injektiv



$$\tfrac{1}{2} e^{\alpha \cdot x_1} = y \wedge \tfrac{1}{2} e^{\alpha \cdot x_2} = y$$

$$\tfrac{1}{2} e^{\alpha \cdot x_1} = \tfrac{1}{2} e^{\alpha \cdot x_2} \quad | \cdot 2 \quad \ln$$

$$\alpha \cdot x_1 = \alpha \cdot x_2 \quad | : \alpha \quad \alpha <> 0$$

$$x_1 = x_2 \qquad \alpha = 0 \Rightarrow 0 = 0 \checkmark$$

$\mathbb{D} = \mathbb{R}$ ↓ total

$W = \mathbb{R}^+$ ↓ nicht surjektiv $\rightarrow y = \tfrac{1}{2} e^{\alpha \cdot x}$

$$\{ (x,y) \in \mathbb{R} \times \mathbb{R}^+ \mid 2y = e^{\alpha \cdot x} ; \alpha \in \mathbb{Z} \}$$

$$x = \tfrac{1}{\alpha} \cdot \ln(2y) \quad ; \quad \alpha <> 0$$

$$f^{-1}(x) = \tfrac{1}{\alpha} \cdot \ln(2x) \quad ; x \in \mathbb{R}^+ \wedge \alpha <> 0$$

11) $9^n + 7 = 8 \cdot k \quad ; n \geq 0 \quad ; k \in \mathbb{Z}$

$n=0 \quad 1+7 = 8 \cdot 1 \quad 1 \in \mathbb{Z}$ ✓

<u>Prämisse</u>: $\boxed{9^n+7}$ ist für $n \geq 0$ durch 8 teilbar

$n+1$: $\quad 9^{n+1} + 7 = 9 \cdot 9^n + 7 = 8 \cdot k_2$

$9 \cdot (9^n + 7) - 56 \qquad 9(8k_1) - 7 \cdot 8 = 8k_2$

$1 \cdot (9^n + 7) + 8 \cdot 9^n \qquad 8k_1 + 8 \cdot 9^n = 8 \cdot k_2$

$8 \cdot (\mathbb{Z} - 7) = 8 \cdot \mathbb{Z}$

$8 \cdot (\mathbb{Z} + \mathbb{N}) = 8 \cdot \mathbb{Z}$

12) $1 + n \cdot a \leq (1+a)^n \quad ; n \in \mathbb{N} \quad ; a \in \mathbb{R}$

$n = 0 \quad 1+0 \leq (1+a)^0$

$\quad 1 \leq 1 \quad \checkmark$

Prämisse: Es gilt $1+n\cdot a \leq (1+a)^n$

$n+1 : 1+(n+1)\cdot a \leq (1+a)^{n+1}$

$1 + n\cdot a + a \leq (1+a)^n \cdot (1+a) = (1+n\cdot a) \cdot (1+a)$

$1 + n\cdot a + a \leq 1 + n\cdot a + a + n\cdot a^2 \quad | -1 - na - a$

$0 \leq n \cdot a^2$

$a^2 \geq 0$, da $a \in \mathbb{R}$

$n \geq 0$; siehe Def.

≥ 0

13) $$\sum_{k=2}^{n} \overbrace{(k-1)\cdot \ln\left(\frac{k}{k-1}\right)}^{a_k} = \overbrace{n\cdot \ln(n) - \ln(n!)}^{S_n}$$

$n=2$: $\quad a_2 = S_2 \quad$: $\quad 1\cdot\ln(2) = 2\cdot\ln(2) - \ln(2)$

$= \ln 2$ ✓

$n+1$: $\quad S_n + a_{n+1} = S_{n+1}$

$$\overbrace{n\cdot\ln(n) - \ln(n!)} + \overbrace{\left[(n+1)-1\right]\cdot \ln\left(\frac{n+1}{(n+1)-1}\right)} =$$

$$(n+1)\cdot\ln(n+1) - \ln\left[(n+1)!\right]$$

$$n\cdot\ln(n) - \ln(n!) + n\cdot\ln\left(\frac{n+1}{n}\right) = n\cdot\ln(n+1) + \ln(n+1)$$

$$- \ln(n+1)!$$

$$n \cdot \ln(n) - \ln(n!) + n \cdot \left[\ln(n+1) - \ln(n)\right] =$$
$$n \cdot \ln(n+1) + \ln(n+1) - (\ln(n+1) + \ln(n!))$$

$$\underline{n \cdot \ln(n)} - \ln(n!) + n \cdot \ln(n+1) \underline{- n \ln(n)} = n \cdot \ln(n+1) + \underline{\ln(n+1)}$$
$$\underline{- \ln(n+1)} - \ln(n!)$$

$$- \ln(n!) + n \cdot \ln(n+1) = n \cdot \ln(n+1) - \ln(n!)$$

$$0 = 0 \quad \checkmark$$

u) $a_n = \sqrt{2} + e^{-2n}$ $\qquad a_{n+1} = \sqrt{2} + e^{-2(n+1)}$

$$a_{n+1} - a_n \gtrless 0 \qquad \underline{\sqrt{2}} + e^{-2n-2} - \underline{(\sqrt{2}} + e^{-2n}) \gtrless 0$$

$$e^{-2n-2} - e^{-2n} \gtrless 0$$
$$e^{-2n}(e^{-2} - 1) \gtrless 0 \quad | \cdot e^{2n} \qquad \boxed{\frac{1}{e^2} - 1 < 0}$$

$$\frac{a_{n+1}}{a_n} < 1$$

$$\frac{\sqrt{2} + e^{-2n-2}}{\sqrt{2} + e^{-2n}} < 1 \qquad \Big| \cdot \left(\sqrt{2} + e^{-2n}\right)$$

$$\sqrt{2} + e^{-2n-2} < \sqrt{2} + e^{-2n} \qquad \Big| - \sqrt{2}$$

$$e^{-2n-2} < e^{-2n} \qquad \Big| \cdot e^{2n}$$

$$e^{-2} < 1 \qquad \checkmark$$

Schranken: $\quad a_{\cancel{1}} = \sqrt{2} + 1/e^2$ ist obere Schranke

$$a_n > \sqrt{2}$$

$$a_{n+1} > \sqrt{2} \qquad \sqrt{2} + e^{-2(n+1)} > \sqrt{2}$$

$$1/e^{2n+2} > 0 \qquad \checkmark$$

15) $a_{n+1} = \sqrt{a_n} + 2$ $\quad a_1 = 2,25$

$a_2 = \sqrt{2,25} + 2 = 3,5$

Behauptung: $a_{n+1} > a_n$

$n = 1$: $a_2 > a_1 \iff 3,5 > 2,25$ ✓

$n+1$: $a_{n+2} > a_{n+1}$

$$\sqrt{a_{n+1}} + 2 > \sqrt{a_n} + 2 \quad | -2$$

$$\sqrt{a_{n+1}} > \sqrt{a_n} \quad | \uparrow^2$$

$$a_{n+1} > a_n$$ ✓

Schranke $a_1 = 2{,}25$ ist untere Schranke

Behauptung $a_n < 4$

$n=1$ $a_1 < 4$ $\Rightarrow 2{,}25 < 4$ ✓

n+1: $a_n < 4$ $\quad | \sqrt{\ }$

$\sqrt{a_n} < 2$ $\quad | +2$

$\sqrt{a_n} + 2 = a_{n+1} < 4$

Grenzwert

$$\left.\begin{aligned} \lim_{n\to\infty} a_{n+1} &= \lim_{n\to\infty} a_n \\ \lim_{n\to\infty} a_n &= \gamma \end{aligned}\right\}$$

$\gamma = \sqrt{\gamma} + 2 \quad | -2$

$\gamma - 2 = \sqrt{\gamma} \quad | \ (\ )^2$

$\gamma^2 - 4\gamma + 4 = \gamma$

$\gamma^2 - 5\gamma + 4 = 0 = (\gamma - 1)(\gamma - 4) = 0$

16)

$$\sum_{k=2}^{\infty} (-1)^{k+1} \cdot \frac{3 \cdot 9^k}{(2k+1)!} \qquad \sin(x) = \sum_{k=0}^{\infty} (-1)^k \cdot \frac{x^{2k+1}}{(2k+1)!}$$

$$-1 \cdot \underbrace{\sum_{k=2}^{\infty} (-1)^k \cdot \frac{3^{2k+1}}{(2k+1)!}}_{-\left[\sin(3) - (a_0 + a_1)\right]}$$

$$a_0 \to \underbrace{(-1)^0 \cdot \frac{3^{0+1}}{(0+1)!}}_{3} \qquad a_1 \to \underbrace{-1 \cdot \frac{3^3}{3!}}_{-9/2}$$

$$\Rightarrow -\left(\sin(3) - \left(3 - \tfrac{9}{2}\right)\right) = -\sin(3) - 1{,}5$$

17) $$\sum_{k=0}^{\infty} \frac{k^n \cdot x^k}{\sqrt{42 \cdot k!}} \; ; \; n \in \mathbb{N}$$

k = Variable

n = Parameter

x = Konvergenzradius

$$\lim_{k\to\infty} \frac{a_{k+1}}{a_k} = \lim_{k\to\infty} \frac{(k+1)^n \cdot x^{k+1} \quad \sqrt{42} \quad \sqrt{k!}}{\sqrt{42} \cdot \sqrt{(k+1)!} \quad k^n \quad x^k}$$

$$\frac{(k+1)^n}{k^n} \cdot \frac{x^{k+1}}{x^k} \cdot \frac{\sqrt{k!}}{\sqrt{(k+1)!}}$$

$$\left(\frac{k+1}{k}\right)^n \cdot x \cdot \sqrt{\frac{k!}{(k+1)\cdot k!}}$$

$$\left(1+\frac{1}{k}\right)^n \cdot x \cdot \sqrt{\frac{1}{k+1}}$$

$$1 \cdot x \cdot 0 < 1 \Rightarrow x \in \mathbb{R}$$

19) a) $\lim\limits_{x \to \infty} \left(\frac{3}{x} - \left(1 + \frac{3}{x}\right)^x \right) = -e^3$

$$\frac{k}{\infty} - \left(1 + \frac{\gamma}{x}\right)^x$$

$$0 - e^{\gamma}$$

b) $\lim\limits_{x \to 2} \frac{\cos(5\pi - x\pi)}{4x - 8} = \left[\frac{-1}{0}\right] = -\infty$

$\lim\limits_{x \to 2} \frac{\sin(5\pi - x\pi)}{4x - 8} = \cancel{\frac{0}{0}}$

$\lim\limits_{x \to 2} \frac{\cos(5\pi - x\pi) \cdot (-\pi)}{4} = \frac{\cos(3\pi) \cdot (-\pi)}{4} = \pi/4$

c) $\lim_{x \to \infty} \left(\sqrt[x]{e} \cdot \frac{3x^2 - 5x + 7}{x - 8 + 6x^2} \right)$

$\lim_{x \to \infty} \sqrt[x]{x} = 1$

$$\frac{x^2 \left(3 - \overbrace{5/x}^{0} + \overbrace{7/x^2}^{0}\right)}{x^2 \left(\underbrace{1/x - 8/x^2}_{0} + 6\right)} = 1/2$$

2a) $\lim_{x \to 0} \frac{2x}{\frac{1}{3}\sqrt{9+2x} - 1} = \frac{0}{0}$

$$\lim_{x \to 0} \frac{2}{\frac{1}{3} \cdot \frac{1}{2 \cdot \sqrt{9+2x}} \cdot 2} = \lim_{x \to 0} \frac{2}{\frac{1}{3 \cdot \sqrt{9+2x}}} = 18$$

$$\lim_{x \to 0} \frac{2x}{\frac{1}{3}\sqrt{9+2x} - 1} \cdot \frac{\frac{1}{3}\sqrt{9+2x} + 1}{\frac{1}{3}\sqrt{9+2x} + 1}$$

$$\lim_{x \to 0} \frac{2x \left(\frac{1}{3}\sqrt{9+2x} + 1 \right)}{\frac{1}{9} \cdot (9+2x) - 1}$$

$$1 + \frac{2}{9}x - 1$$

$$\frac{2}{9}x$$

$$\Rightarrow \lim_{x \to 0} \frac{2\left(\frac{1}{3}\sqrt{9+2x} + 1 \right)}{\frac{2}{9}} = \frac{2 \cdot (1+1)}{\frac{2}{9}} = 18$$

23)

$$\left.\begin{array}{l} \lim\limits_{x \to 1^+} f(x) = 1 + a + b = f(1) \\ \lim\limits_{x \to 1^-} f(x) = 2 - b + 2a \end{array}\right\} \begin{array}{l} 1 + a + b = 2 - b + 2a \\ -1 + 2b = a \end{array}$$

$$\left.\begin{array}{l} \lim\limits_{x \to 1^+} f'(x) = 2 + a = f'(1) \\ \lim\limits_{x \to 1^-} f'(x) = 2 - b \end{array}\right\} \begin{array}{l} 2 + a = 2 - b \\ a = -b \end{array}$$

$$-1 + 2b = -b$$

$$-1 = -3b$$

$$b = \frac{1}{3} \Rightarrow a = -\frac{1}{3}$$

25)

I.

$$f(x) = \cos^4(x) - \ln(x^2) + 42$$

$$f(-x) = \cos^4(-x) - \ln((-x)^2) + 42$$

$=$

$$\boxed{\cos(x) = \cos(-x)}$$

II.

$$h(x) = 4 \cdot \sin^3(x) - \frac{4}{x^5} + 2x^3$$

$$\boxed{\sin(-x) = -\sin(x)}$$

$$h(-x) = 4 \cdot \sin^3(-x) - \frac{4}{(-x)^5} + 2 \cdot (-x)^3$$

$$-4 \cdot \sin^3(x) + 4/x^5 - 2x^3$$

$$-h(-x) = 4 \cdot \sin^3(x) - 4/x^5 + 2x^3 = h(x)$$

$\Rightarrow$ Punktsymmetrie

27) $f(x) = \frac{1}{2}x^3 - 3x^2 + \frac{9}{2}x + 42$

$f'(x) = \frac{3}{2}x^2 - 6x + \frac{9}{2}$

$f''(x) = 3x - 6 = 0 \quad \Rightarrow \quad x = 2$

$f'(2) = 6 - 12 + \frac{9}{2} = -\frac{3}{2}$

$f(2) = 4 - 12 + 9 + 42 = 43$

$43 = -\frac{3}{2} \cdot 2 + b \qquad b = 46$

Kleines Be

$t(x) = -\frac{3}{2}x + 46$

28)

$$A = \frac{\boxed{g} \cdot \boxed{h}}{2}$$

$$U = 6\,\text{cm} = 2a + g$$

$$\boxed{g} = 6 - 2a$$

$$h^2 + \left(\frac{g}{2}\right)^2 = a^2$$

$$h = \sqrt{a^2 - \tfrac{1}{4} g^2}$$

$$\sqrt{a^2 - \tfrac{1}{4}(6-2a)^2}$$

$$\sqrt{a^2 - \tfrac{1}{4} \cdot (36 - 24a + 4a^2)}$$

$$\sqrt{a^2 - 9 + 6a - a^2}$$

$$\boxed{h} = \sqrt{6a - 9}$$

$$A(a) = \frac{(6-2a) \cdot \sqrt{6a-9}}{2}$$

$$(3-a) \cdot \sqrt{6a-9}$$

$$\sqrt{(3-a)^2 \cdot (6a-9)}$$

$$\sqrt{(9 - 6a + a^2)(6a-9)}$$

$$(\sqrt{\heartsuit})' \qquad \frac{1}{2 \cdot \sqrt{\heartsuit}} \cdot \heartsuit'$$

$$\int_{\gamma}^{\infty} \frac{2}{(2x+3)^3}\,dx = 0{,}5$$

$$f(x) = 2 \cdot (2x+3)^{-3} \qquad F(x) = -\tfrac{1}{2} \cdot (2x+3)^{-2}$$

$$T(x) = (2x+3)^{-2}$$

$$t(x) = -2 \cdot (2x+3)^{-3} \cdot 2 = \boxed{-4} \cdot (2x+3)^{-3}$$

$$F(\infty) - F(\gamma) = \tfrac{1}{2}$$

$$\lim_{x \to \infty} -\frac{1}{2 \cdot (2x+3)^2} + \frac{1}{2 \cdot (2\gamma+3)^2} = \tfrac{1}{2} \quad | \cdot 2$$

$$+\frac{1}{(2\gamma+3)^2} = 1$$

$$(2\gamma+3)^2 = 1 \qquad 2\gamma + 3 = \pm 1 \qquad \gamma_1 = -2 \qquad \gamma_2 = -1$$