A1

$$5(2^2)^x + \frac{7^{x+1}}{4} = 20 \cdot 4^{x-2} + \frac{7^{x+2}}{21}$$

D: Es gibt keine Einschränkungen für die Variable x, folglich gilt $\mathbb{D} = \mathbb{R}$ (93)

Lösung (2)

$$5(4)^x + \frac{7^{x+1}}{4} = 20 \cdot 4^{x-2} + \frac{7^{x+2}}{21}$$

$$5 \cdot 4^x + \frac{7^x \cdot 7}{4} = \overset{5}{\cancel{20}} \cdot 4^x \cdot \frac{1}{\underset{4}{\cancel{16}}} + \frac{7^x \cdot \overset{7}{\cancel{49}}}{\underset{3}{\cancel{21}}}$$

$$4^x\left(5 - \frac{5}{4}\right) = 7^x\left(\frac{7}{3} - \frac{7}{4}\right)$$

· Abzüge proportional

$$4^x \cdot \frac{15}{4} = 7^x \cdot \frac{7}{12}$$

$$\left(\frac{4}{7}\right)^x = \frac{7}{\underset{3}{\cancel{12}}} \cdot \frac{\overset{1}{\cancel{4}}}{15}$$

$$\left(\frac{4}{7}\right)^x = \frac{7}{45} \qquad / \ln$$

$$x \cdot \ln\left(\frac{4}{7}\right) = \ln\left(\frac{7}{45}\right)$$

$$x = \frac{\ln\left(\frac{7}{45}\right)}{\ln\left(\frac{4}{7}\right)} = \frac{-1{,}8608}{-0{,}5596}$$

$$x = 3{,}325$$

Kontrolle:

$$5 \cdot 4^{3{,}325} + \frac{7^{4{,}325}}{4} = 1632{,}056$$

$$20 \cdot 4^{1{,}325} + \frac{7^{5{,}325}}{21} = 1632{,}056 \rightarrow \mathbb{L} = \{3{,}325\}$$

(0,7)

2

$$T(x) = \frac{bx^2 + 2{,}5x - 1}{x^2 + x - 6} \quad \wedge \quad x, b \in \mathbb{R}$$

I $\mathbb{D}$: Zähler: Es gibt keine Einschränkung

Nenner: $x^2 + x - 6 \neq 0$

$$\Rightarrow (x-2)(x+3) \neq 0$$

$$\Rightarrow \boxed{\begin{array}{l} x_1 = 2 \\ x_2 = -3 \end{array}}$$

$$\Rightarrow \underline{\underline{\mathbb{D} = \mathbb{R} \setminus \{-3; 2\}}}$$

0,4

II $T(x) = 0$

$$\Rightarrow \frac{bx^2 + 2{,}5x - 1}{x^2 + x - 6} = 0$$

$$bx^2 + 2{,}5x - 1 = 0$$

$$x_{1/2} = \frac{-2{,}5 \pm \sqrt{6{,}25 + 4 \cdot b \cdot 1}}{2b}$$

0,5

$$\underline{x_{1/2}} = \frac{-2{,}5 \pm 2 \cdot \sqrt{1{,}5625 + b}}{2b} = \underline{\frac{-1{,}25 \pm \sqrt{1{,}5625 + b}}{b}}$$

<u>Fallunterscheidung</u>

$\underline{b = 0}$ $\Rightarrow$ lineare Gleichung in x

0,3

$$\Rightarrow 2{,}5x - 1 = 0$$

$$x = 0{,}4 \Rightarrow \underline{\underline{\mathbb{L} = \{0{,}4\}}}$$

$D = 0 \Rightarrow 1{,}5625 + b = 0$

$$\underline{b = -1{,}5625}$$

0,3

$$\Rightarrow x_1 = x_2 = \frac{-1{,}25}{-1{,}5625} = 0{,}8 \Rightarrow \underline{\underline{\mathbb{L} = \{0{,}8\}}}$$

Fortsetzung

II $D > 0 \Rightarrow b^2 - 4ac > 0$

$$6{,}25 + 4b > 0$$

$$\underline{b > -1{,}5625} \wedge b \neq 0$$

0,3

$$\Rightarrow \underline{\underline{x_{1/2} = \frac{-1{,}25 \pm \sqrt{1{,}5625 + b}}{b}}} \Rightarrow \underline{\underline{L = \{\infty\}}}$$

$D < 0 \Rightarrow 6{,}25 + 4b < 0$

$$\underline{b < -1{,}5625}$$

0,3

$$\Rightarrow \underline{\underline{x_{1/2} \notin R}} \Rightarrow \underline{\underline{L = \{\}}}$$

III $T(x) = 1$

$$\frac{bx^2 + 2{,}5x - 1}{x^2 + x - 6} = 1$$

$$bx^2 + 2{,}5x - 1 = x^2 + x - 6$$

$$(b-1)x^2 + 1{,}5x + 5 = 0$$

$$x_{1/2} = \frac{-1{,}5 \pm \sqrt{2{,}25 - 4(b-1) \cdot 5}}{2(b-1)}$$

$$\underline{x_{1/2} = \frac{-1{,}5 \pm \sqrt{22{,}25 - 20b}}{2(b-1)}}$$

0,5

Keine Lösung in R

$D < 0 \Rightarrow 22{,}25 - 20b < 0$

$$\underline{b > 1{,}1125}$$

0,4

$$\Rightarrow \underline{\underline{b \in R^{>1{,}1125}}}$$

A3

I $\quad \tan\left(\frac{\pi}{4}+x\right) = \frac{1+\tan(x)}{1-\tan(x)}$

<u>Additionstheorem</u>

$$\tan\left(\frac{\pi}{4}+x\right) = \frac{\tan\left(\frac{\pi}{4}\right)+\tan(x)}{1-\tan\left(\frac{\pi}{4}\right)\cdot\tan(x)}$$

$\wedge \quad \tan\left(\frac{\pi}{4}\right) = 1$ $\quad$ 0,6

$$\Rightarrow \tan\left(\frac{\pi}{4}+x\right) = \frac{1+\tan(x)}{1-\tan(x)} \qquad \text{q.e.d}$$

II

$\sin(x)\underbrace{\cot(x)}_{=\frac{1}{\tan(x)}} = 1-\cos(2x)$ $\quad \boxed{\mathbb{D} = \mathbb{R}^*}$ $\quad$ 0,2

$\Rightarrow x \neq 0$

$\cancel{\sin(x)}\cdot\frac{\cos(x)}{\cancel{\sin(x)}} = 1-\left[1-2\sin^2(x)\right]$

$\left(\sqrt{1-\sin^2(x)}\right)^2 = \left(2\sin^2(x)\right)^2$ $\quad$ 0,5

$1-\sin^2(x) = 4\cdot\sin^4(x)$

$4\sin^4(x)+\sin^2(x)-1 = 0$

<u>Substitution</u> $\quad \sin^2(x) = a$ $\quad$ 0,3

$\Rightarrow 4a^2+a-1=0$

$$a_{1/2} = \frac{-1\pm\sqrt{1+4\cdot4\cdot1}}{8} = \frac{-1\pm\sqrt{17}}{8}$$

$$a_1 = \frac{-1+4{,}1231}{8} = 0{,}3904$$ $\quad$ 0,4

$$a_2 = \frac{-1-4{,}1231}{8} = -0{,}6404 \Rightarrow |\sin(x)| = \sqrt{a}$$

$\Rightarrow x_{3/4} \notin \mathbb{R}$

A3 II Fortsetzung

$|\sin(x)| = \sqrt{a_1} \Rightarrow \sin(x_{1/2}) = \pm 0{,}6248$

$x_{1/2} = \pm 0{,}6749$ 0,4

Mögliche Lösungen im Intervall $[0; 3\pi]$

Berücksichtigung der Periodizität der Sinusschwingung

$x_n = x_1 + k\cdot\pi \quad , \quad k \in \mathbb{N}$

$\Rightarrow 0{,}6749 \,/\, \pi + 0{,}6749 \,/\, \pi + (-0{,}6749) \,/\, 2\pi + (-0{,}6749) \,/\, 2\pi + 0{,}6749$

$3\pi + (-0{,}6749)$

$\Rightarrow 0{,}6749 \,/\, 2{,}4667 \,/\, 3{,}8165 \,/\, 5{,}6083 \,/\, 6{,}9581 \,/\, 8{,}7499$

Kontrolle : 0,6749 ok. 0,6

2,4667 $\notin \mathbb{L}$ (Scheinlösung)

$\Rightarrow$ Die Scheinlösung sind zu den effektiven Lösungen alternierend d.h.:

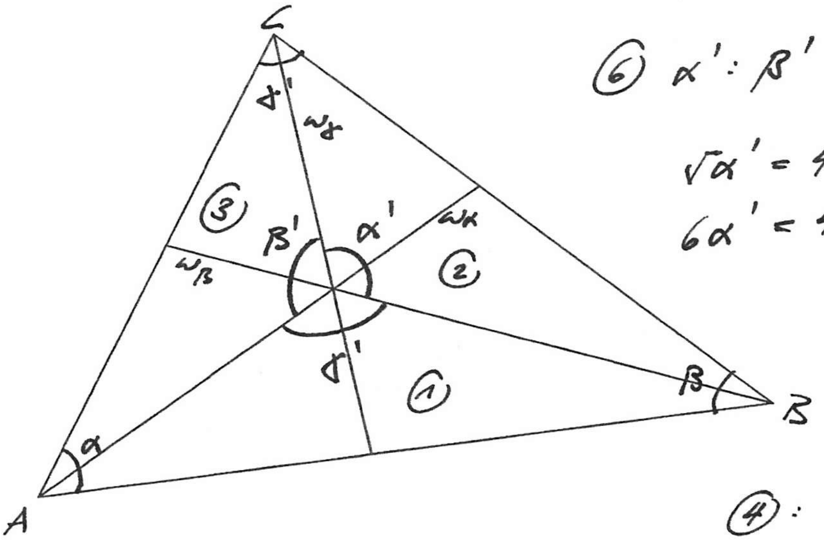
$0{,}6749 \,/\, 6{,}9581 \Rightarrow \in \mathbb{L}$

$5{,}6083 \in \mathbb{L}$

Zusammenfassung : $\mathbb{L} = \{0{,}6749; 5{,}6083; 6{,}9581\}$

· Abzüge proportional

A4



(6) $\alpha' : \beta' : \gamma' = 4 : 5 : 6$

$5\alpha' = 4\beta'$

$6\alpha' = 4\gamma'$

(1) $180 = \frac{\alpha}{2} + \frac{\beta}{2} + \gamma'$

(2) $180 = \frac{\beta}{2} + \frac{\gamma}{2} + \alpha'$

(3) $180 = \frac{\alpha}{2} + \frac{\gamma}{2} + \beta'$

(4) $\alpha' + \beta' + \gamma' = 360$

(5) $\alpha + \beta + \gamma = 180$

0,5

(4): $\Rightarrow \alpha' + \frac{5\alpha'}{4} + \frac{6\alpha'}{4} = 360$

$15\alpha' = 1440$

$\underline{\alpha' = 96^\circ}$

$\underline{\beta' = 120^\circ}$

$\underline{\gamma' = 144^\circ}$

0,3

$\Rightarrow$ 3×3

(1) $(180 - \gamma')\cdot 2 = \alpha + \beta$

(2) $(180 - \alpha')\cdot 2 = \beta + \gamma$

(3) $(180 - \beta')\cdot 2 = \alpha + \gamma$

$\alpha + \beta = 72$

$\beta + \gamma = 168$

$\alpha + \gamma = 120$

0,4

SARRUS

$$D = \left|\begin{array}{ccc|cc} 1 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \end{array}\right| = \underline{2}$$

0,3

3× 0,5

$$D_\alpha = \left|\begin{array}{ccc|cc} 72 & 1 & 0 & 72 & 1 \\ 168 & 1 & 1 & 168 & 1 \\ 120 & 0 & 1 & 120 & 0 \end{array}\right| = 72 + 120 - 168 = \underline{24}$$

$$\underline{\underline{\alpha}} = \frac{D_\alpha}{D} = \frac{24}{2} = \underline{\underline{12^\circ}}$$

$$D_\beta = \left|\begin{array}{ccc|cc} 1 & 72 & 0 & 1 & 72 \\ 0 & 168 & 1 & 0 & 168 \\ 1 & 120 & 1 & 1 & 120 \end{array}\right| = 168 + 72 - 120 = \underline{120}$$

$$\Rightarrow \underline{\underline{\beta}} = \frac{D_\beta}{D} = \underline{\underline{60^\circ}}$$

$$D_\gamma = \left|\begin{array}{ccc|cc} 1 & 1 & 72 & 1 & 1 \\ 0 & 1 & 168 & 0 & 1 \\ 1 & 0 & 120 & 1 & 0 \end{array}\right| = 120 + 168 - 72 = \underline{216} \Rightarrow \underline{\underline{\gamma = 108^\circ}}$$

Kontrolle mit (5)

A5 $\quad f(x) = (6-2a)x + (a-1) \quad \wedge \quad a \in \mathbb{R}$

$\underline{D_f = \mathbb{R}}$

I $\quad f(x)$: steigende Gerade

$\Rightarrow$ Kriterium $m > 0$

$\Rightarrow 6 - 2a > 0$ $\quad$ 0,6

$\underline{a < 3} \Rightarrow \underline{\underline{a \in \mathbb{R}^{<3}}}$

II – Oberhalb der Abszisse:

$f(x) > 0 \Rightarrow (6-2a)x + (a-1) > 0$

$(6-2a)x > (1-a)$ $\quad$ 0,5

pos. Fall: $(6-2a) > 0$

$a < 3$ $\quad$ 0,6

$\Rightarrow \underline{\underline{x > \dfrac{1-a}{6-2a}}} \quad \wedge \quad a < 3$

neg. Fall: $(6-2a) < 0$ $\quad$ · Abszisse proportional

$a > 3$ $\quad$ 0,6

$\Rightarrow \underline{\underline{x < \dfrac{1-a}{6-2a}}} \quad \wedge \quad a > 3$

III $\quad$ ab – Abszisse: $\quad f(x) = 0 \quad \wedge \quad x > 0$

$\Rightarrow (6-2a)x + (a-1) = 0$

$6x - 2ax + a - 1 = 0$ $\quad$ 0,7

$\underline{\underline{a = \dfrac{1-6x}{1-2x}}} \quad \wedge \quad x > 0$

AG

$f(x) = -1{,}5x^2 + 5x + 6 \qquad D_f = \mathbb{R}$

$g_t(x) = 3x + t \quad \wedge \quad t \in \mathbb{R} \qquad D_g = \mathbb{R}$

· Abzüge prop.

I Tangente an Parabel

$f(x) = g_t(x)$

$-1{,}5x^2 + 5x + 6 = 3x + t$ (0,3)

$1{,}5x^2 - 2x + t - 6 = 0 \Rightarrow$ Kriterium $\underline{D = 0}$

$D = b^2 - 4ac$ (0,3)

$\Rightarrow (-2)^2 - 4 \cdot 1{,}5\,(t-6) = 0$

$4 - 6t + 36 = 0$ (0,3)

$\underline{t = \frac{40}{6}}\ (6{,}\bar{6}) \Rightarrow \underline{\underline{g(x) = 3x + \frac{40}{6}}}$

II $t = -4 \Rightarrow g_{-4}(x) = 3x - 4$

$\Rightarrow f(x) = g_{-4}(x)$

$-1{,}5x^2 + 5x + 6 = 3x - 4$ (0,3)

$1{,}5x^2 - 2x - 10 = 0$

$x_{1/2} = \frac{2 \pm \sqrt{4 + 4 \cdot 1{,}5 \cdot 10}}{3} = \frac{2 \pm 8}{3}$ $\quad x_1 = \frac{10}{3}, \quad x_2 = -2$ (0,4)

$y_1 = 3 \cdot \frac{10}{3} - 4 = 6$

$y_2 = 3(-2) - 4 = -10$

$\Rightarrow \underline{\underline{P_1\left(\frac{10}{3} \middle| 6\right)}}, \quad \underline{\underline{P_2(-2|-10)}}$ (0,6)

III $h(x) = mx + q$

Normal: $m_1 \cdot m_2 = -1$

$\Rightarrow m \cdot 3 = -1 \Rightarrow \underline{m = \frac{-1}{3}}$

P_1: $6 = \frac{10}{3} \cdot \frac{-1}{3} + q$

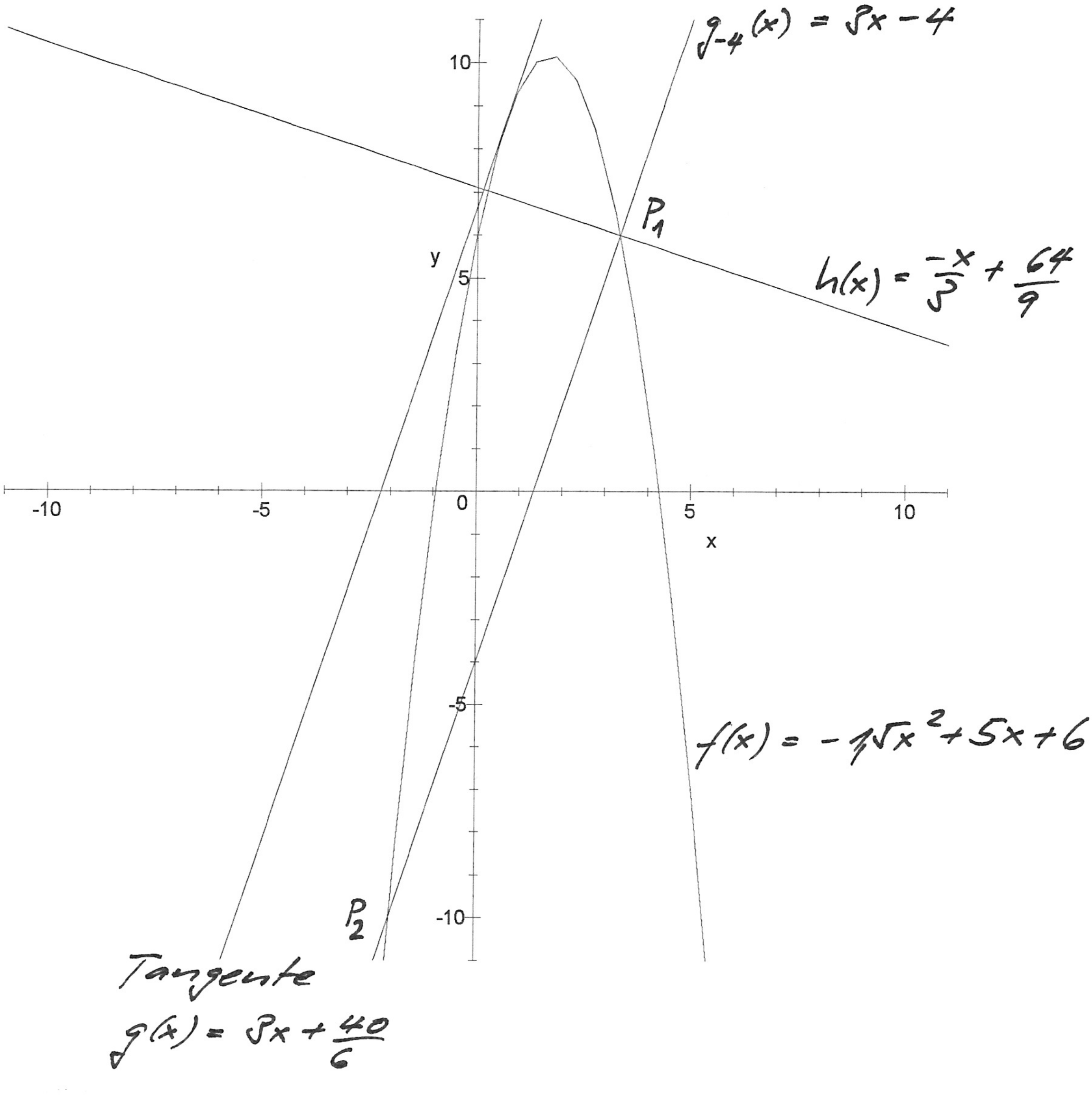
$q = \frac{64}{9} \Rightarrow \underline{\underline{h(x) = \frac{-x}{3} + \frac{64}{9}}}$ (0,8)

A6

Graphen der Funktionen

A6

```
STUDENT > plot([-1.5*x^2+5*x+6,3*x+(40/6),3*x-4,(-1/3)*x+(64/9)],x
=-11..11,y=-11..11,thickness=1,color=[black],linestyle=[
1,1,1,1]);
```



A7 $f(t) = -2\sin\left(\frac{t}{2}+\frac{\pi}{5}\right)+1$, $g(t) = \sin(t)$

I **Amplitude** $a = -2$ (Verdoppelung und Spiegelung an der Abszisse)

Frequenz $\omega = \frac{1}{2}$ (Streckung in x-Richtung t-Richtung)

Phasenverschiebung $\frac{-\varphi}{\omega} = \frac{\pi}{5}\cdot\frac{2}{1} = \frac{2\pi}{5}$

1

$\frac{\varphi}{\omega} = \frac{-2\pi}{5}$ (Verschiebung in t-Richtung nach links)

Vertikale Auslenkung $d = 1$

(1 Einheit in +y-Richtung)

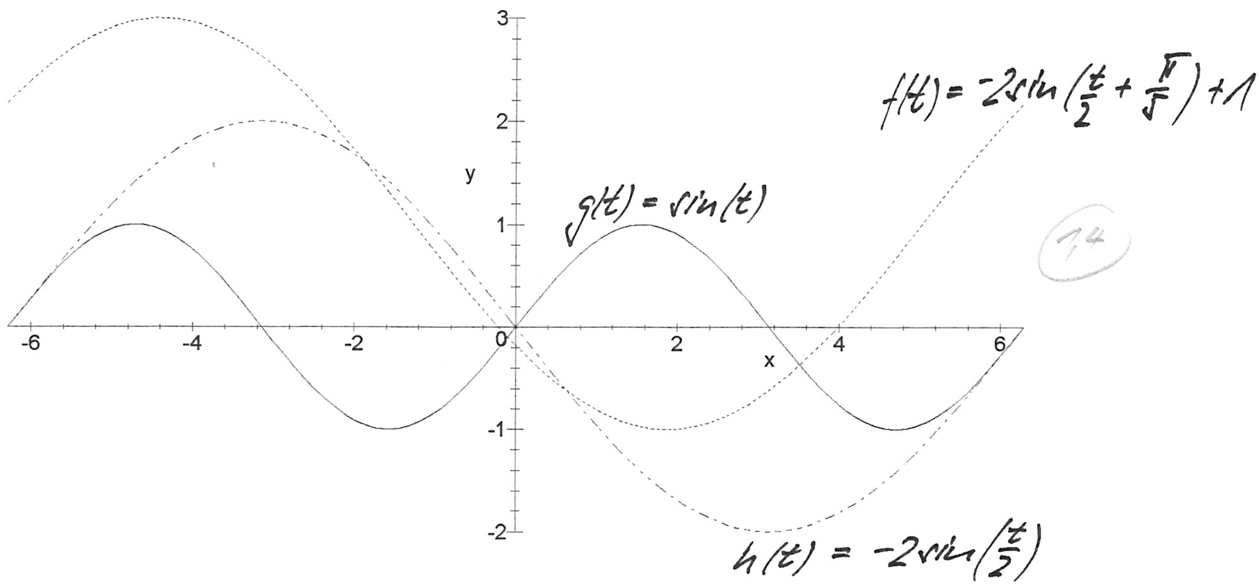
II $\vec{v} = \begin{pmatrix} \frac{2\pi}{5} \\ -1 \end{pmatrix} \Rightarrow h(t) = -2\sin\left[\frac{1}{2}\left(t+\frac{2\pi}{5}-\frac{2\pi}{5}\right)\right]+1-1$

$$h(t) = -2\sin\left(\frac{1}{2}t\right)$$

0,6

III

```
STUDENT > plot([sin(x),-2*sin((1/2)*x+(Pi/5))+1,-2*sin((1/2)*x)],x
          =-2*Pi..2*Pi,y=-2..3,thickness=1,color=[black],linestyle
          =[1,2,4]);
```

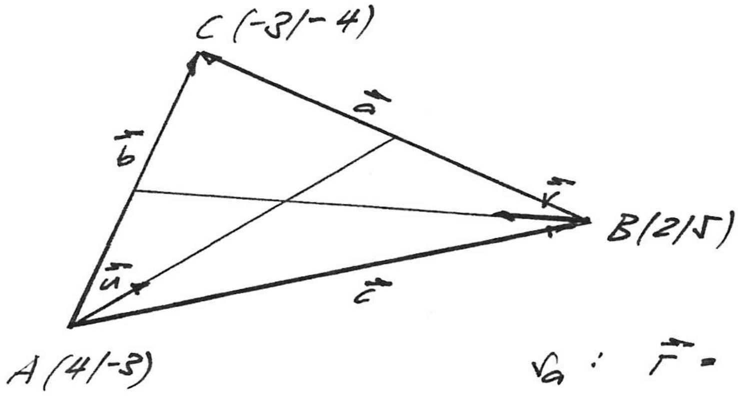


1,4

• Abzüge proportional

A8

• abzüge proportional



$g_a: \vec r = \vec r_A + \mu \vec u$

$g_b: \vec r = \vec r_B + \lambda \vec v$ (0,3)

$\vec u = \vec c + \frac{\vec a}{2}$

$\Rightarrow \vec c = \vec r_B - \vec r_A = \begin{pmatrix} 2 \\ 5 \end{pmatrix} - \begin{pmatrix} 4 \\ -3 \end{pmatrix} = \begin{pmatrix} -2 \\ 8 \end{pmatrix}$

$\vec a = \vec r_C - \vec r_B = \begin{pmatrix} -3 \\ -4 \end{pmatrix} - \begin{pmatrix} 2 \\ 5 \end{pmatrix} = \begin{pmatrix} -5 \\ -9 \end{pmatrix}$ (0,3)

$\vec u = \begin{pmatrix} -2 \\ 8 \end{pmatrix} + \begin{pmatrix} -2{,}5 \\ -4{,}5 \end{pmatrix}$

$\underline{\vec u = \begin{pmatrix} -4{,}5 \\ 3{,}5 \end{pmatrix}}$ (0,3)

$\vec v = \vec a - \frac{\vec b}{2}$

$\Rightarrow \vec b = \vec r_C - \vec r_A = \begin{pmatrix} -3 \\ -4 \end{pmatrix} - \begin{pmatrix} 4 \\ -3 \end{pmatrix} = \begin{pmatrix} -7 \\ -1 \end{pmatrix} \Rightarrow \vec v = \begin{pmatrix} -5 \\ -9 \end{pmatrix} - \begin{pmatrix} -3{,}5 \\ -0{,}5 \end{pmatrix}$

$\underline{\vec v = \begin{pmatrix} -1{,}5 \\ -8{,}5 \end{pmatrix}}$ (0,3)

$\Rightarrow g_a: \vec r = \begin{pmatrix} 4 \\ -3 \end{pmatrix} + \mu \begin{pmatrix} -4{,}5 \\ 3{,}5 \end{pmatrix}$

$\underline{\underline{g_a: \vec r = \begin{pmatrix} 4 \\ -3 \end{pmatrix} + \mu \begin{pmatrix} -9 \\ 7 \end{pmatrix}}}$ (0,3)

$g_b: \vec r = \begin{pmatrix} 2 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} -1{,}5 \\ -8{,}5 \end{pmatrix}$

$\underline{\underline{g_b: \vec r = \begin{pmatrix} 2 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 17 \end{pmatrix}}}$ (0,3)

Schwerpunkt S:

$g_a \cap g_b$ (0,3)

$\Rightarrow \begin{pmatrix} 4 \\ -3 \end{pmatrix} + \mu \begin{pmatrix} -9 \\ 7 \end{pmatrix} = \begin{pmatrix} 2 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 17 \end{pmatrix}$

$\Rightarrow$ 2×2 Gleichungssystem

$\left| \begin{array}{l} 4 - 9\mu = 2 + 3\lambda \\ -3 + 7\mu = 5 + 17\lambda \end{array} \right| \Rightarrow \left| \begin{array}{l} 9\mu + 3\lambda = 2 \\ 7\mu - 17\lambda = 8 \end{array} \right|$

HP: $\begin{pmatrix} 9 & 3 \\ 7 & -17 \end{pmatrix} \begin{pmatrix} \mu \\ \lambda \end{pmatrix} = \begin{pmatrix} 2 \\ 8 \end{pmatrix} \Rightarrow \underline{\mu = 1/3}$, $\underline{\lambda = -1/3}$ (0,6)

$S: \vec r_S = \begin{pmatrix} 4 \\ -3 \end{pmatrix} + \frac{1}{3} \begin{pmatrix} -9 \\ 7 \end{pmatrix} = \begin{pmatrix} 1 \\ -2/3 \end{pmatrix} \rightarrow \underline{\underline{S \begin{pmatrix} 1 \\ -2/3 \end{pmatrix}}}$ (0,3)

A9

Ebenheit? / Viereckform?

I $A\begin{pmatrix}5\\-1\\3\end{pmatrix}$, $B\begin{pmatrix}1\\-1\\5\end{pmatrix}$, $C\begin{pmatrix}-3\\1\\5\end{pmatrix}$, $D\begin{pmatrix}1\\1\\3\end{pmatrix}$

$E: \vec{r} = \vec{r}_A + \mu(\vec{r}_B - \vec{r}_A) + \lambda(\vec{r}_C - \vec{r}_A)$

$$\vec{r} = \begin{pmatrix}5\\-1\\3\end{pmatrix} + \mu\begin{pmatrix}1-5\\-1+1\\5-3\end{pmatrix} + \lambda\begin{pmatrix}-3-5\\1+1\\5-3\end{pmatrix}$$

$$\vec{r} = \begin{pmatrix}5\\-1\\3\end{pmatrix} + \mu\begin{pmatrix}-4\\0\\2\end{pmatrix} + \lambda\begin{pmatrix}-8\\2\\2\end{pmatrix}$$

$$\vec{r} = \begin{pmatrix}5\\-1\\3\end{pmatrix} + \mu\begin{pmatrix}-2\\0\\1\end{pmatrix} + \lambda\begin{pmatrix}-4\\1\\1\end{pmatrix} \rightarrow \underline{D \in E}\ !$$

$$\Rightarrow \vec{r}_D = \begin{pmatrix}1\\1\\3\end{pmatrix} \Rightarrow \begin{pmatrix}1\\1\\3\end{pmatrix} = \begin{pmatrix}5\\-1\\3\end{pmatrix} + \mu\begin{pmatrix}-2\\0\\1\end{pmatrix} + \lambda\begin{pmatrix}-4\\1\\1\end{pmatrix}$$

2×2

$$\left|\begin{array}{l} 2\mu + 4\lambda = 4 \\ 0\mu + \lambda = 2 \end{array}\right| \begin{array}{l} \rightarrow \mu = -2 \\ \rightarrow \lambda = 2 \end{array}$$

0,6

z-Koordinate: $3 = 3 + (-2)\cdot 1 + 2(1)$

$\underline{3 = 3}$ ok.

$$\vec{AB} = \vec{r}_B - \vec{r}_A = \begin{pmatrix}1-5\\-1+1\\5-3\end{pmatrix} = \begin{pmatrix}-4\\0\\2\end{pmatrix}$$

$$\vec{BC} = \vec{r}_C - \vec{r}_B = \begin{pmatrix}-3-1\\1+1\\5-5\end{pmatrix} = \begin{pmatrix}-4\\2\\0\end{pmatrix}$$

$$\vec{DC} = \vec{r}_C - \vec{r}_D = \begin{pmatrix}-3-1\\1-1\\5-3\end{pmatrix} = \begin{pmatrix}-4\\0\\2\end{pmatrix}$$

$$\vec{AD} = \vec{r}_D - \vec{r}_A = \begin{pmatrix}1-5\\1+1\\3-3\end{pmatrix} = \begin{pmatrix}-4\\0\\2\end{pmatrix}$$

$|\vec{AB}| = |\vec{BC}| = |\vec{DC}| = |\vec{AD}|$

→ Quadrat oder Rhombus

→ Skalarprodukt

$$\vec{AB}\cdot\vec{BC} = \begin{pmatrix}-4\\0\\2\end{pmatrix}\begin{pmatrix}-4\\2\\0\end{pmatrix}$$

$\underline{= 16}$

⇒ <u>Rhombus</u> 0,4

A9 Fortsetzung

② → Abzüge proportional 0,2 / Fehler

II

$$\vec{AC} = \vec{r}_C - \vec{r}_A = \begin{pmatrix} -8 \\ 2 \\ 2 \end{pmatrix}$$

$$\vec{DB} = \vec{r}_B - \vec{r}_D = \begin{pmatrix} 1-1 \\ -1-1 \\ 5-3 \end{pmatrix} = \begin{pmatrix} 0 \\ -2 \\ 2 \end{pmatrix}$$

$$\left.\right\} \quad \vec{n} = \vec{DB} \times \vec{AC}$$

$$\vec{n} = \begin{pmatrix} 0 \\ -2 \\ 2 \end{pmatrix} \times \begin{pmatrix} -8 \\ 2 \\ 2 \end{pmatrix}$$

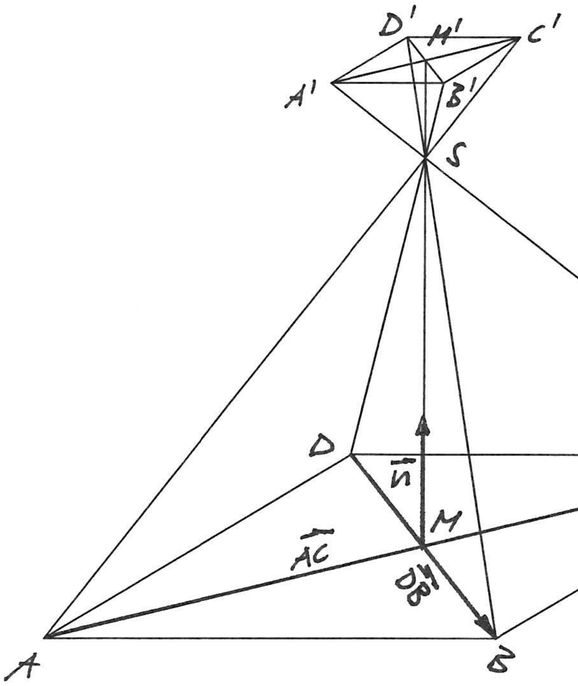
$$\vec{n} = \begin{pmatrix} \begin{vmatrix} -2 & 2 \\ 2 & 2 \end{vmatrix} \\ -\begin{vmatrix} 0 & -8 \\ 2 & 2 \end{vmatrix} \\ \begin{vmatrix} 0 & -8 \\ -2 & 2 \end{vmatrix} \end{pmatrix} = \begin{pmatrix} -8 \\ -16 \\ -16 \end{pmatrix} \rightarrow \vec{n}' = (-1)\cdot\vec{n} = \begin{pmatrix} 8 \\ 16 \\ 16 \end{pmatrix}$$

(pos. z-Koordinate)

$$|\vec{n}'| = \sqrt{8^2 + 2\cdot 16^2} = 24$$

$$|\vec{h}| = 6 \Rightarrow \vec{e}_{h'} = \begin{pmatrix} 1/3 \\ 2/3 \\ 2/3 \end{pmatrix}$$

$$\Rightarrow \underline{\vec{h}} = 6\cdot\vec{e}_{h'} = \underline{\begin{pmatrix} 2 \\ 4 \\ 4 \end{pmatrix}}$$



$$\vec{AM} = \vec{r}_M - \vec{r}_A = \frac{\vec{AC}}{2}$$

$$\vec{r}_M = \frac{\vec{AC}}{2} + \vec{r}_A = \begin{pmatrix} -4 \\ 1 \\ 1 \end{pmatrix} + \begin{pmatrix} 5 \\ -1 \\ 3 \end{pmatrix}$$

$$\underline{\vec{r}_M = \begin{pmatrix} 1 \\ 0 \\ 4 \end{pmatrix}}$$

$$\vec{MS} = \vec{r}_S - \vec{r}_M = \vec{h} \Rightarrow \vec{r}_S = \vec{h} + \vec{r}_M = \begin{pmatrix} 2 \\ 4 \\ 4 \end{pmatrix} + \begin{pmatrix} 1 \\ 0 \\ 4 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \\ 8 \end{pmatrix}$$

$$\Rightarrow \underline{\underline{S\begin{pmatrix} 3 \\ 4 \\ 8 \end{pmatrix}}}$$

III

$$\vec{SM'} = \frac{1}{4}\vec{MS} = \frac{1}{4}\vec{h} = \begin{pmatrix} 0{,}5 \\ 1 \\ 1 \end{pmatrix}$$

$$\vec{SM'} = \vec{r}_{M'} - \vec{r}_S$$

$$\vec{r}_{M'} = \vec{SM'} + \vec{r}_S = \begin{pmatrix} 0{,}5 \\ 1 \\ 1 \end{pmatrix} + \begin{pmatrix} 3 \\ 4 \\ 8 \end{pmatrix}$$

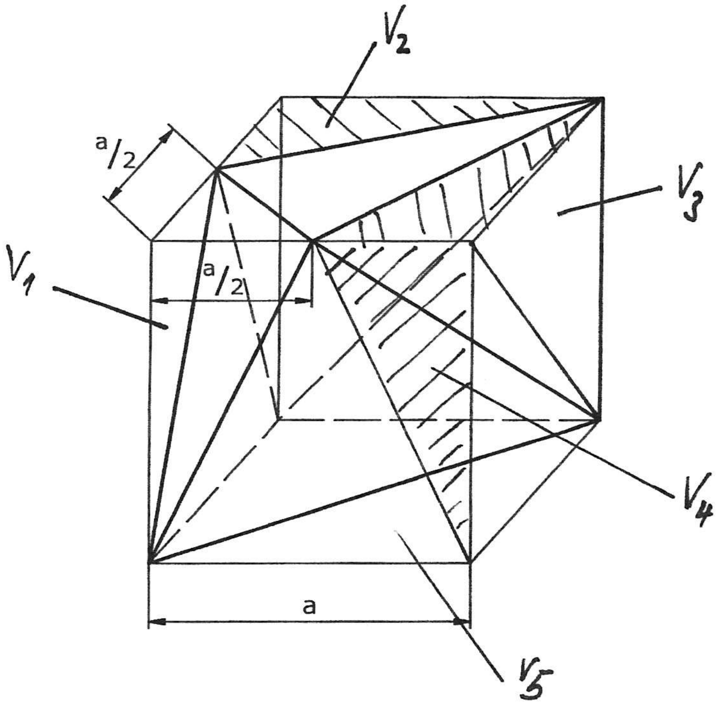
$$\underline{\vec{r}_{M'} = \begin{pmatrix} 3{,}5 \\ 5 \\ 9 \end{pmatrix}}$$

$$\vec{A'M'} = \vec{r}_{M'} - \vec{r}_{A'} = \frac{1}{8}\vec{AC}$$

$$\vec{r}_{A'} = \vec{r}_{M'} - \frac{\vec{AC}}{8} = \begin{pmatrix} 3{,}5 \\ 5 \\ 9 \end{pmatrix} - \begin{pmatrix} -1 \\ 0{,}25 \\ 0{,}25 \end{pmatrix} = \begin{pmatrix} 4{,}5 \\ 4{,}75 \\ 8{,}75 \end{pmatrix} \rightarrow \underline{\underline{A' = \begin{pmatrix} 4{,}5 \\ 4{,}75 \\ 8{,}75 \end{pmatrix}}}$$

A10

I



Körpervolumen = Würfel $- \sum_{i=1}^{5} V_i$

$V_2 = V_3 = V_4$

Pyramide : $V = \frac{A_G \cdot h}{3}$

$\Rightarrow V_2 = \frac{a \cdot \frac{a}{2}}{2} \cdot \frac{a}{3} = \frac{a^3}{12}$

$V_5 = \frac{a \cdot a}{2} \cdot \frac{a}{3} = \frac{a^3}{6}$

$V_1 = \left(\frac{a}{2}\right)^2 \cdot \frac{1}{2} \cdot \frac{a}{3} = \frac{a^3}{24}$

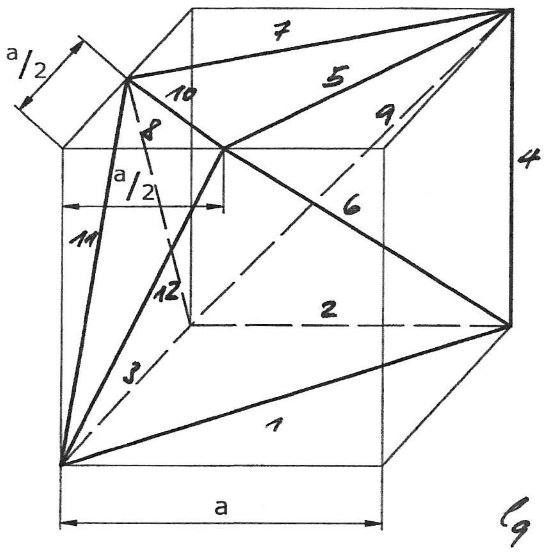
$\Rightarrow V_K = a^3 - \frac{a^3}{24} - 3 \cdot \frac{a^3}{12} - \frac{a^3}{6}$

$V_K = \frac{24a^3 - a^3 - 6a^3 - 4a^3}{24}$

$\underline{\underline{V_K = \frac{13a^3}{24}}}$

1,5

II



$a = 14\,cm$

$l = \sum_{i=1}^{12} l_i$ (12 Kanten begrenzen den Körper)

$l_2 = l_3 = l_4 = 14\,cm$

$l_9 = l_1 = 14 \cdot \sqrt{2} = 19{,}7990\,cm$

$l_{10} = 7 \cdot \sqrt{2} = 9{,}8995\,cm$

$l_6 = \sqrt{7^2 + 14^2 + 14^2} = 21\,cm$

$l_5 = l_7 = l_8 = l_{11} = l_{12} = \sqrt{7^2 + 14^2}$

$l_5 = 15{,}6525\,cm$

$\Rightarrow l = 2 \cdot 14\sqrt{2} + 3 \cdot 14 + 7\sqrt{2} + 21 + 5 \cdot 15{,}6525$

$\underline{\underline{l = 190{,}76\,cm}}$

1,5

· Abzüge proportional 0,3?