Lösungen

1

a

```
>>u=[0 2 4 8 9]; length(u)
ans=5
```

b

```
>>u=[0 2 4 8 9]; size(u)
ans=1 5
```

c

```
>>m=[3,0,-5]; n=[2,1,6]; m+n
ans=5 1 1
```

d

```
>>m=[3,0,-5]; n=[2,1,6]; dot(m,n)
ans=-24
```

e

```
>>m=[3,0,-5]; n=[2,1,6]; cross(m,n)
ans=5-28 3
```

f

```
>>format long; a=sqrt(90)
a=9.48683298050514
```

2

```
Remove["Global`*"]
```

```
Remove::rmnsm : There are no symbols matching "Global`*". Mehr…
```

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y - c z == d}, {x, y, z}]
```

$$\left\{\left\{x \to \frac{2\,(4\,c+3\,d)}{6-3\,a+3\,b+a\,c+b\,c},\ y \to -\frac{4\,a\,c-4\,b\,c+3\,a\,d-3\,b\,d}{2\,(6-3\,a+3\,b+a\,c+b\,c)},\ z \to -\frac{-8+4\,a-4\,b+a\,d+b\,d}{6-3\,a+3\,b+a\,c+b\,c}\right\}\right\}$$

a

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y - c z == d}, {x, y, z}] /.
 {a → 1, b → 1, c → 3, d → 4}
```

$$\{\{x \to 4,\ y \to 0,\ z \to 0\}\}$$

```
% // Simplify
```

$$\{\{x \to 4,\ y \to 0,\ z \to 0\}\}$$

Lösung eindeutig.

b

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y - c z == d}, {x, y, z}] /.
 {b → 1, c → 3, d → 4}
```

$$\left\{\left\{x \to 4,\ y \to \frac{1}{24}\,(24-24\,a),\ z \to \frac{1}{12}\,(8-8\,a)\right\}\right\}$$

```
% // Simplify
```

$$\left\{\left\{x \to 4,\ y \to 1-a,\ z \to -\frac{2}{3}\,(-1+a)\right\}\right\}$$

Unendlich viele Lösungen kommt nicht vor. a ist Parameter.
Dim(L) = 1 (Rang = 2, Ordnung = 3.)

c

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y - c z == d}, {x, y, z}] /.
 {a → 1, c → 3, d → 4}
```

$$\left\{\left\{x \to \frac{48}{6+6\,b},\ y \to -\frac{24-24\,b}{2\,(6+6\,b)},\ z \to 0\right\}\right\}$$

```
% // Simplify
```

$$\left\{\left\{x \to \frac{8}{1+b},\ y \to \frac{2\,(-1+b)}{1+b},\ z \to 0\right\}\right\}$$

b = -1: Keine Lösung. (Nenner wird 0, Zähler bei x ungleich 0.)
Sonst Lösung eindeutig.

d

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y - c z == d}, {x, y, z}] /.
 {a → 1, b → 1, d → 4}
```

$$\left\{\left\{x \to \frac{2\,(12+4\,c)}{6+2\,c},\ y \to 0,\ z \to 0\right\}\right\}$$

```
% // Simplify
```

$$\{\{x \to 4,\ y \to 0,\ z \to 0\}\}$$

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y + 3 z == d}, {x, y, z}] /.
 {a → 1, b → 1, d → 4}
```

```
Power::infy : Infinite expression 1/0 encountered. Mehr…

∞::indet : Indeterminate expression 0 ComplexInfinity encountered. Mehr…

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General::stop : Further output of Power::infy will be suppressed during this calculation. Mehr…

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```

$$\{\{x \to \text{Indeterminate},\ y \to \text{Indeterminate},\ z \to \text{Indeterminate}\}\}$$

```
Reduce[{x + 2 y + 3 z == 4, x - 2 y + 3 z == 4, x + 2 y + 3 z == 4}, {x, y, z}]
```

$$y == 0 \&\& z == \frac{4}{3} - \frac{x}{3}$$

c ungleich -3: Lösung eindeutig.
c = -3: Bei x Zähler und Nenner wird 0. x (6+2c) =2(12+4c) ==> x ist unbestimmt. Unendlich viele x sind möglich, y, z sind fix. x ist als Parameter freil
Dim(L) = 1 (Rang = 2, Ordnung = 3.)

e

```
Solve[{a x + 2 y + 3 z == 4, b x - 2 y + 3 z == 4, x + 2 y - c z == d}, {x, y, z}] /.
 {a → 1, b → 1, c → 3}
```

$$\left\{\left\{x \to \frac{1}{6}\,(12+3\,d),\ y \to 0,\ z \to \frac{1}{12}\,(8-2\,d)\right\}\right\}$$

```
% // Simplify
```

$$\left\{\left\{x \to \frac{4+d}{2},\ y \to 0,\ z \to \frac{4-d}{6}\right\}\right\}$$

Unendlich viele Lösungen kommt nicht vor. d ist Parameter.
Dim(L) = 1 (Rang = 2, Ordnung = 3.)

3

```
Remove["Global`*"]
```

```
v = {1, 2, 3};
b1 = {3, 2, -2};
b2 = {3, 2, 1};
b3 = {2, -1, 2};
```

```
v == λ b1 + μ b2 + ν b3
```

$$\{1, 2, 3\} == \{3\lambda + 3\mu + 2\nu,\ 2\lambda + 2\mu - \nu,\ -2\lambda + \mu + 2\nu\}$$

```
Solve[v == λ b1 + μ b2 + ν b3, {λ, μ, ν}]
```

$$\left\{\left\{\lambda \to -\frac{8}{7},\ \mu \to \frac{13}{7},\ \nu \to -\frac{4}{7}\right\}\right\}$$

```
N[%]
```

$$\{\{\lambda \to -1.14286,\ \mu \to 1.85714,\ \nu \to -0.571429\}\}$$

4

a

```
Det[{b1, b2, b3}] / 6
```

$$\frac{7}{2}$$

```
N[%]
```

```
3.5
```

b

```
winkelGrad[a_, b_] := ArcCos[a.b / Norm[a] / Norm[b]] / Degree // N
```

```
winkelGrad[b1, b2]
```

```
44.5185
```

```
winkelGrad[b1, b3]
```

```
90.
```

```
winkelGrad[b2, b3]
```

```
57.6885
```

Alle Winkel verschieden. Einer rechter Winkel.

5

a

```
w = {2, -1};
d[φ_] := {{Cos[φ], -Sin[φ]}, {Sin[φ], Cos[φ]}};
d[φ] // MatrixForm
```

$$\begin{pmatrix} \text{Cos}[\varphi] & -\text{Sin}[\varphi] \\ \text{Sin}[\varphi] & \text{Cos}[\varphi] \end{pmatrix}$$

```
d[Pi / 2].{{1}, {0}}
```

```
{{0}, {1}}
```

```
d[38.96 Degree].Transpose[{w}] // MatrixForm
```

$$\begin{pmatrix} 2.18395 \\ 0.47997 \end{pmatrix}$$

```
pS = d[38.96 Degree].Transpose[{w}] // Flatten
```

```
{2.18395, 0.47997}
```

b

```
r[t_] := w + t {1.5, 2.5}
```

```
n = {-2.5, 1.5};
```

```
h[s_] := pS + s n;
```

```
solv = Solve[r[t] == h[s], {t, s}] // Flatten
```

```
{t → 0.467747, s → -0.207069}
```

```
sS = r[t] /. solv
```

```
{2.70162, 0.169367}
```

```
pSS = pS + 2 (sS - pS)
```

```
{3.21929, -0.141236}
```

6

```
r1 = {1, 2, 1}; r2 = {2, 2, -1}; a1 = {3, -1, -1}; a2 = {-1, -1, 2}; P0 = {5, 5, 5};
x1[λ_] := r1 + λ a1 ;  x2[μ_] := r2 + μ a2 ;
```

a

Die Reichtungsvektoren sind linear unabhängig (nicht parallel). Prüfung, ob die Geraden einen Schnittpunkt haben:

```
Solve[x1[λ] == x2[μ], {λ, μ}]
```

```
{}
```

Nein! Windschief!

b

```
volumenSpat = Det[{r2 - r1, a1, a2}]
```

```
5
```

```
GrundFlaecheSpat = Norm[Cross[a1, a2]]
```

$$5\sqrt{2}$$

```
abstand = volumenSpat / GrundFlaecheSpat
```

$$\frac{1}{\sqrt{2}}$$

```
N[%]
```

```
0.707107
```

c

```
n = Cross[a2, a1] / Norm[Cross[a2, a1]]
```

$$\left\{\frac{3}{5\sqrt{2}}, \frac{1}{\sqrt{2}}, \frac{2\sqrt{2}}{5}\right\}$$

```
N[%]
```

```
{0.424264, 0.707107, 0.565685}
```

d

```
θ[λ_, μ_] := r1 + λ a1 + μ a2;
```

```
-Det[{P0 - r1, a1, a2}] / Norm[Cross[a1, a2]]
```

$$\frac{43}{5\sqrt{2}}$$

```
N[%]
```

```
6.08112
```