**KEY**

**1**

a = c1

b = s1

**2**

c = c2

d = s2

**3**

e = c3

f = s3

**4**

g = c4

h = s4

**5**

i = c5

j = s5

**6**

k = c6

l = s6

**lengths**

t = a1

u = a2

v = a3

w = a4

x = a5

y = a6

**v**

* **f1ab =** -cos(\theta)\*d\*u-cos(\theta)\*d\*v-cos(\theta)\*d\*g\*w-cos(\theta)\*c\*e\*h\*w+sin(\theta)\*f\*h\*w-cos(\theta)\*d\*g\*x-cos(\theta)\*c\*e\*h\*x+sin(\theta)\*f\*h\*x+i\*cos(\theta)\*c\*e\*g\*k\*y-i\*sin(\theta)\*f\*g\*k\*y-i\*cos(\theta)\*d\*h\*k\*y-sin(\theta)\*e\*j\*k\*y-cos(\theta)\*c\*f\*j\*k\*y-cos(\theta)\*d\*g\*l\*y-cos(\theta)\*c\*e\*h\*l\*y+sin(\theta)\*f\*h\*l\*y
* **f2ab =** -sin(\theta)\*d\*u-sin(\theta)\*d\*v-sin(\theta)\*d\*g\*w-sin(\theta)\*c\*e\*h\*w-cos(\theta)\*f\*h\*w-sin(\theta)\*d\*g\*x-sin(\theta)\*c\*e\*h\*x-cos(\theta)\*f\*h\*x+i\*sin(\theta)\*c\*e\*g\*k\*y+i\*cos(\theta)\*f\*g\*k\*y-i\*sin(\theta)\*d\*h\*k\*y+cos(\theta)\*e\*j\*k\*y-sin(\theta)\*c\*f\*j\*k\*y-sin(\theta)\*d\*g\*l\*y-sin(\theta)\*c\*e\*h\*l\*y-cos(\theta)\*f\*h\*l\*y
* **f3ab =** t+c\*u+c\*v+c\*g\*w-d\*e\*h\*w+c\*g\*x-d\*e\*h\*x+i\*d\*e\*g\*k\*y+i\*c\*h\*k\*y-d\*f\*j\*k\*y+c\*g\*l\*y-d\*e\*h\*l\*y

**w**

* **f4ab =** -cos(\theta)\*d\*g\*k-cos(\theta)\*c\*e\*h\*k+sin(\theta)\*f\*h\*k-i\*cos(\theta)\*c\*e\*g\*l+i\*sin(\theta)\*f\*g\*l+i\*cos(\theta)\*d\*h\*l+sin(\theta)\*e\*j\*l+cos(\theta)\*c\*f\*j\*l
* **f5ab =** -sin(\theta)\*d\*g\*k-sin(\theta)\*c\*e\*h\*k-cos(\theta)\*f\*h\*k-i\*sin(\theta)\*c\*e\*g\*l-i\*cos(\theta)\*f\*g\*l+i\*sin(\theta)\*d\*h\*l-cos(\theta)\*e\*j\*l+sin(\theta)\*c\*f\*j\*l
* **f6ab =** c\*g\*k-d\*e\*h\*k-i\*d\*e\*g\*l-i\*c\*h\*l+d\*f\*j\*l

**v**

* **f1cd =** -a\*sin(\theta)\*u-a\*sin(\theta)\*v-a\*sin(\theta)\*g\*w-a\*cos(\theta)\*e\*h\*w+b\*f\*h\*w-a\*sin(\theta)\*g\*x-a\*cos(\theta)\*e\*h\*x+b\*f\*h\*x+i\*a\*cos(\theta)\*e\*g\*k\*y-i\*b\*f\*g\*k\*y-i\*a\*sin(\theta)\*h\*k\*y-b\*e\*j\*k\*y-a\*cos(\theta)\*f\*j\*k\*y-a\*sin(\theta)\*g\*l\*y-a\*cos(\theta)\*e\*h\*l\*y+b\*f\*h\*l\*y
* **f2cd =** -b\*sin(\theta)\*u-b\*sin(\theta)\*v-b\*sin(\theta)\*g\*w-b\*cos(\theta)\*e\*h\*w-a\*f\*h\*w-b\*sin(\theta)\*g\*x-b\*cos(\theta)\*e\*h\*x-a\*f\*h\*x+i\*b\*cos(\theta)\*e\*g\*k\*y+i\*a\*f\*g\*k\*y-i\*b\*sin(\theta)\*h\*k\*y+a\*e\*j\*k\*y-b\*cos(\theta)\*f\*j\*k\*y-b\*sin(\theta)\*g\*l\*y-b\*cos(\theta)\*e\*h\*l\*y-a\*f\*h\*l\*y
* **f3cd =** t+cos(\theta)\*u+cos(\theta)\*v+cos(\theta)\*g\*w-sin(\theta)\*e\*h\*w+cos(\theta)\*g\*x-sin(\theta)\*e\*h\*x+i\*sin(\theta)\*e\*g\*k\*y+i\*cos(\theta)\*h\*k\*y-sin(\theta)\*f\*j\*k\*y+cos(\theta)\*g\*l\*y-sin(\theta)\*e\*h\*l\*y

**w**

* **f4cd =** -a\*sin(\theta)\*g\*k-a\*cos(\theta)\*e\*h\*k+b\*f\*h\*k-i\*a\*cos(\theta)\*e\*g\*l+i\*b\*f\*g\*l+i\*a\*sin(\theta)\*h\*l+b\*e\*j\*l+a\*cos(\theta)\*f\*j\*l
* **f5cd =** -b\*sin(\theta)\*g\*k-b\*cos(\theta)\*e\*h\*k-a\*f\*h\*k-i\*b\*cos(\theta)\*e\*g\*l-i\*a\*f\*g\*l+i\*b\*sin(\theta)\*h\*l-a\*e\*j\*l+b\*cos(\theta)\*f\*j\*l
* **f6cd =** cos(\theta)\*g\*k-sin(\theta)\*e\*h\*k-i\*sin(\theta)\*e\*g\*l-i\*cos(\theta)\*h\*l+sin(\theta)\*f\*j\*l

**v**

* **f1ef =** -a\*d\*u-a\*d\*v-a\*d\*g\*w-a\*c\*cos(\theta)\*h\*w+b\*sin(\theta)\*h\*w-a\*d\*g\*x-a\*c\*cos(\theta)\*h\*x+b\*sin(\theta)\*h\*x+i\*a\*c\*cos(\theta)\*g\*k\*y-i\*b\*sin(\theta)\*g\*k\*y-i\*a\*d\*h\*k\*y-b\*cos(\theta)\*j\*k\*y-a\*c\*sin(\theta)\*j\*k\*y-a\*d\*g\*l\*y-a\*c\*cos(\theta)\*h\*l\*y+b\*sin(\theta)\*h\*l\*y
* **f2ef =** -b\*d\*u-b\*d\*v-b\*d\*g\*w-b\*c\*cos(\theta)\*h\*w-a\*sin(\theta)\*h\*w-b\*d\*g\*x-b\*c\*cos(\theta)\*h\*x-a\*sin(\theta)\*h\*x+i\*b\*c\*cos(\theta)\*g\*k\*y+i\*a\*sin(\theta)\*g\*k\*y-i\*b\*d\*h\*k\*y+a\*cos(\theta)\*j\*k\*y-b\*c\*sin(\theta)\*j\*k\*y-b\*d\*g\*l\*y-b\*c\*cos(\theta)\*h\*l\*y-a\*sin(\theta)\*h\*l\*y
* **f3ef =** t+c\*u+c\*v+c\*g\*w-d\*cos(\theta)\*h\*w+c\*g\*x-d\*cos(\theta)\*h\*x+i\*d\*cos(\theta)\*g\*k\*y+i\*c\*h\*k\*y-d\*sin(\theta)\*j\*k\*y+c\*g\*l\*y-d\*cos(\theta)\*h\*l\*y

**w**

* **f4ef =** -a\*d\*g\*k-a\*c\*cos(\theta)\*h\*k+b\*sin(\theta)\*h\*k-i\*a\*c\*cos(\theta)\*g\*l+i\*b\*sin(\theta)\*g\*l+i\*a\*d\*h\*l+b\*cos(\theta)\*j\*l+a\*c\*sin(\theta)\*j\*l
* **f5ef =** -b\*d\*g\*k-b\*c\*cos(\theta)\*h\*k-a\*sin(\theta)\*h\*k-i\*b\*c\*cos(\theta)\*g\*l-i\*a\*sin(\theta)\*g\*l+i\*b\*d\*h\*l-a\*cos(\theta)\*j\*l+b\*c\*sin(\theta)\*j\*l
* **f6ef =** c\*g\*k-d\*cos(\theta)\*h\*k-i\*d\*cos(\theta)\*g\*l-i\*c\*h\*l+d\*sin(\theta)\*j\*l

**v cos => -sin sin => cos**

* **f1gh =** -a\*d\*u-a\*d\*v+a\*d\*h\*w-a\*c\*e\*g\*w+b\*f\*g\*w+a\*d\*h\*x-a\*c\*e\*g\*x+b\*f\*g\*x-i\*a\*c\*e\*h\*k\*y+i\*b\*f\*h\*k\*y-i\*a\*d\*g\*k\*y-b\*e\*j\*k\*y-a\*c\*f\*j\*k\*y+a\*d\*h\*l\*y-a\*c\*e\*h\*l\*y+b\*f\*g\*l\*y
* **f2gh =** -b\*d\*u-b\*d\*v+b\*d\*h\*w-b\*c\*e\*g\*w-a\*f\*g\*w+b\*d\*h\*x-b\*c\*e\*g\*x-a\*f\*g\*x-i\*b\*c\*e\*h\*k\*y-i\*a\*f\*h\*k\*y-i\*b\*d\*g\*k\*y+a\*e\*j\*k\*y-b\*c\*f\*j\*k\*y+b\*d\*h\*l\*y-b\*c\*e\*g\*l\*y-a\*f\*g\*l\*y
* **f3gh =** t+c\*u+c\*v-c\*h\*w-d\*e\*h\*w-c\*h\*x-d\*e\*g\*x-i\*d\*e\*h\*k\*y+i\*c\*g\*k\*y-d\*f\*j\*k\*y-c\*h\*l\*y-d\*e\*g\*l\*y

**w**

* **f4gh =** a\*d\*h\*k-a\*c\*e\*g\*k+b\*f\*g\*k+i\*a\*c\*e\*h\*l-i\*b\*f\*h\*l+i\*a\*d\*g\*l+b\*e\*j\*l+a\*c\*f\*j\*l
* **f5gh =** b\*d\*h\*k-b\*c\*e\*g\*k-a\*f\*g\*k+i\*b\*c\*e\*h\*l+i\*a\*f\*h\*l+i\*b\*d\*g\*l-a\*e\*j\*l+b\*c\*f\*j\*l
* **f6gh =** -c\*h\*k-d\*e\*g\*k+i\*d\*e\*h\*l-i\*c\*g\*l+d\*f\*j\*l

**v**

* **f1ij =** -a\*d\*u-a\*d\*v-a\*d\*g\*w-a\*c\*e\*h\*w+b\*f\*h\*w-a\*d\*g\*x-a\*c\*e\*h\*x+b\*f\*h\*x-j\*a\*c\*e\*g\*k\*y+j\*b\*f\*g\*k\*y+j\*a\*d\*h\*k\*y-b\*e\*i\*k\*y-a\*c\*f\*i\*k\*y-a\*d\*g\*l\*y-a\*c\*e\*h\*l\*y+b\*f\*h\*l\*y
* **f2ij =** -b\*d\*u-b\*d\*v-b\*d\*g\*w-b\*c\*e\*h\*w-a\*f\*h\*w-b\*d\*g\*x-b\*c\*e\*h\*x-a\*f\*h\*x-j\*b\*c\*e\*g\*k\*y-j\*a\*f\*g\*k\*y+j\*b\*d\*h\*k\*y+a\*e\*i\*k\*y-b\*c\*f\*i\*k\*y-b\*d\*g\*l\*y-b\*c\*e\*h\*l\*y-a\*f\*h\*l\*y
* **f3ij =** t+c\*u+c\*v+c\*g\*w-d\*e\*h\*w+c\*g\*x-d\*e\*h\*x-j\*d\*e\*g\*k\*y-j\*c\*h\*k\*y-d\*f\*i\*k\*y+c\*g\*l\*y-d\*e\*h\*l\*y

**w**

* **f4ij =** -a\*d\*g\*k-a\*c\*e\*h\*k+b\*f\*h\*k+j\*a\*c\*e\*g\*l-j\*b\*f\*g\*l-j\*a\*d\*h\*l+b\*e\*i\*l+a\*c\*f\*i\*l
* **f5ij =** -b\*d\*g\*k-b\*c\*e\*h\*k-a\*f\*h\*k+j\*b\*c\*e\*g\*l+j\*a\*f\*g\*l-j\*b\*d\*h\*l-a\*e\*i\*l+b\*c\*f\*i\*l
* **f6ij =** c\*g\*k-d\*e\*h\*k+j\*d\*e\*g\*l+j\*c\*h\*l+d\*f\*i\*l

**v**

* **f1kl =** -a\*d\*u-a\*d\*v-a\*d\*g\*w-a\*c\*e\*h\*w+b\*f\*h\*w-a\*d\*g\*x-a\*c\*e\*h\*x+b\*f\*h\*x-i\*a\*c\*e\*g\*l\*y+i\*b\*f\*g\*l\*y+i\*a\*d\*h\*l\*y+b\*e\*j\*l\*y+a\*c\*f\*j\*l\*y-a\*d\*g\*k\*y-a\*c\*e\*h\*k\*y+b\*f\*h\*k\*y
* **f2kl =** -b\*d\*u-b\*d\*v-b\*d\*g\*w-b\*c\*e\*h\*w-a\*f\*h\*w-b\*d\*g\*x-b\*c\*e\*h\*x-a\*f\*h\*x-i\*b\*c\*e\*g\*l\*y-i\*a\*f\*g\*l\*y+i\*b\*d\*h\*l\*y-a\*e\*j\*l\*y+b\*c\*f\*j\*l\*y-b\*d\*g\*k\*y-b\*c\*e\*h\*k\*y-a\*f\*h\*k\*y
* **f3kl =** t+c\*u+c\*v+c\*g\*w-d\*e\*h\*w+c\*g\*x-d\*e\*h\*x-i\*d\*e\*g\*l\*y-i\*c\*h\*l\*y+d\*f\*j\*l\*y+c\*g\*k\*y-d\*e\*h\*k\*y

**w**

* **f4kl =** a\*d\*g\*l+a\*c\*e\*h\*l-b\*f\*h\*l-i\*a\*c\*e\*g\*k+i\*b\*f\*g\*k+i\*a\*d\*h\*k+b\*e\*j\*k+a\*c\*f\*j\*k
* **f5kl =** b\*d\*g\*l+b\*c\*e\*h\*l+a\*f\*h\*l-i\*b\*c\*e\*g\*k-i\*a\*f\*g\*k+i\*b\*d\*h\*k-a\*e\*j\*k+b\*c\*f\*j\*k
* **f6kl** = -c\*g\*l+d\*e\*h\*l-i\*d\*e\*g\*k-i\*c\*h\*k+d\*f\*j\*k