

## Exercise 1.11 Cycling free indices – preferred solution

```
1 {a,b,c,d,e,f,u,v,w}::Indices.
2
3 expr := A_{a b c}.                                # cdb (ex-0111.101,expr)
4
5 rule := T_{a b c} -> @(expr).
6 expr := T_{b c a}.                                # cdb (ex-0111.102,expr)
7
8 substitute (expr, rule)                            # cdb (ex-0111.103,expr)
```

$A_{abc}$	(ex-0111.101)
$T_{bca}$	(ex-0111.102)
$A_{bca}$	(ex-0111.103)

## Exercise 1.11 Cycling free indices – alternative solution

This alternative solution uses two rounds of Kronecker deltas. It does the job but is not as simple as the previous solution.

```

1  {a,b,c,d,e,f,u,v,w}::Indices.
2
3  \delta{#}::KroneckerDelta.
4
5  expr := A_{a b c}.                                # cdb (ex-0111.201,expr)
6
7  expr := \delta^{a}_{u} \delta^{b}_{v} \delta^{c}_{w} @(expr). # cdb (ex-0111.202,expr)
8
9  eliminate_kronecker (expr)                        # cdb (ex-0111.203,expr)
10
11 expr := \delta^{u}_{b} \delta^{v}_{c} \delta^{w}_{a} @(expr). # cdb (ex-0111.204,expr)
12
13 eliminate_kronecker (expr)                        # cdb (ex-0111.205,expr)

```

$A_{abc}$	(ex-0111.201)
$\delta^a_u \delta^b_v \delta^c_w A_{abc}$	(ex-0111.202)
$A_{uvw}$	(ex-0111.203)
$\delta^u_b \delta^v_c \delta^w_a A_{uvw}$	(ex-0111.204)
$A_{bca}$	(ex-0111.205)