Exercise 4.5 Reformatting complex expressions

```
1
2   {a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v,w#}::Indices(position=independent).
3
4   \nabla{#}::Derivative.
5
6   def get_term (obj,n):
7
8       x^{a}::Weight(label=xnum).      # assign weights to x^{a}
9
10      foo := @(obj).                  # make a copy of obj
11      bah  = Ex("xnum = " + str(n))   # choose a target
12      keep_weight (foo,bah)           # extract the target
13
14      return foo
15
16  def reformat (obj,scale):
17
18      {x^{a},A_{a},B_{a},A_{a b},B_{a b},C_{a b},C_{a b c},g^{a b}}::SortOrder.  # choose a sort order
19
20      foo  = Ex(str(scale))           # create a scale factor
21      bah := @(foo) @(obj).           # apply the scale factor, clears all fractions
22
23      distribute      (bah)           # only required if (bah) contains brackets
24      sort_product    (bah)
25      rename_dummies  (bah)
26      canonicalise    (bah)
27      factor_out      (bah,$x^{a?}$)
28
29      ans := @(bah) / @(foo).         # undo previous scaling
30
31      return ans
32
33  # ------------------------------------------------------------
34
35  # a messy unformatted expression
36
```

```
expr :=    (1/7) A_{e} x^{e}
        -  (1/3) B_{f} x^{f}
        +  (1/3) A_{a b} x^{a} x^{b}
        +  (1/9) B_{e c} x^{c} x^{e}
        -  (1/5) C_{p c} B_{d q} g^{c d} x^{p} x^{q}
        +  (3/7) A_{a b c} x^{a} x^{b} x^{c}
        -  (1/5) B_{a b} C_{c d e} g^{c d} x^{a} x^{b} x^{e}
        + (7/11) B_{a b} B_{c d} C_{e f g} g^{b c} g^{d f} x^{a} x^{e} x^{g}.  # cdb (ex-0405.100,expr)

# split the expression into seprate terms

term1 = get_term (expr,1)        # cdb(term1.101,term1)
term2 = get_term (expr,2)        # cdb(term2.101,term2)
term3 = get_term (expr,3)        # cdb(term3.101,term3)

# reformat terms and tidy fractions

term1 = reformat (term1, 21)     # cdb(term1.102,term1)
term2 = reformat (term2, 45)     # cdb(term2.102,term2)
term3 = reformat (term3,385)     # cdb(term3.102,term3)

# rebuild the expression

expr := @(term1) + @(term2) + @(term3).  # cdb (ex-0405.101,expr)
```

$$g = \frac{1}{7}A_e x^e - \frac{1}{3}B_f x^f + \frac{1}{3}A_{ab}x^a x^b + \frac{1}{9}B_{ec}x^c x^e - \frac{1}{5}C_{pc}B_{dq}g^{cd}x^p x^q + \frac{3}{7}A_{abc}x^a x^b x^c - \frac{1}{5}B_{ab}C_{cde}g^{cd}x^a x^b x^e + \frac{7}{11}B_{ab}B_{cd}C_{efg}g^{bc}g^{df}x^a x^e x^g \quad \texttt{(ex-0405.100)}$$

$$= \frac{1}{21}x^a\left(3A_a - 7B_a\right) + \frac{1}{45}x^a x^b\left(15A_{ab} + 5B_{ab} - 9B_{ca}C_{bd}g^{dc}\right) + \frac{1}{385}x^a x^b x^c\left(165A_{abc} - 77B_{ab}C_{dec}g^{de} + 245B_{ad}B_{ef}C_{bgc}g^{de}g^{fg}\right) \quad \texttt{(ex-0405.101)}$$