MA410 Artificial Intelligence - Problem Sheet 3 - KBs, Unification

1. For each of the following pairs of atoms, either give a most general unifier (MGU) or explain why one doesn't exist:

   (a) `p(X,Y,a,b,W),  p(E,c,F,G,F)`

   (b) `p(Y,a,b,Y),  p(T,F,G,F)`

   (c) `g(d(F), B, C, d(E)), g(E, a(F), b(B), d(d(t))).`

   (d) `f(r(u,A), H, H) , f(X, r(c,X), r(c, r(u,v))).`

   (e) `m(F,c(b,c(B,L)),c(a,c(b,c(b,c(a,emp))))),  m(c(H,T),L,c(H,R)).`

2. Given the knowledge base KB containing the clauses:

   - $a \leftarrow b \wedge d.$
   - $b \leftarrow e \wedge f.$
   - $c \leftarrow h \wedge e.$
   - $d \leftarrow e.$
   - $d \leftarrow b \wedge g.$
   - $e \leftarrow h.$
   - $g \leftarrow c \wedge d.$
   - $h.$

   (a) Show how the bottom up proof procedure works for this example. Show at each stage the value of the set of consequences (statements that can be deduced from the KB). Give all logical consequences of KB.

   (b) a is not a logical consequence of KB. Explain what this means. Show why a is not a logical consequence of KB.

   (c) g is a logical consequence of KB. Explain what this means. Give a top-down derivation for the query $?g$.

3. Fill in the result in the table of applying the substitution in the row to the expression in the column.

	$f(a,b)$	$f(g(x),x)$	$f(x,f(y,z))$	y
$\{\}$				
$\{x \mapsto y, y \mapsto z, z \mapsto x\}$				
$\{x \mapsto g(y), y \mapsto g(x)\}$				
$\{x \mapsto f(y,y), z \mapsto a\}$				

4. In each box of the following table enter the most general unifier of the expression for the row and the expression for the column, or enter "none" to indicate that they have no unifiers.

	$f(x;x)$	$f(y;g(y))$	$f(a;y)$	$f(a;b)$	$f(y;g(x))$
$f(x_0,x_0)$					
$f(y_0,g(y_0))$					
$f(a,y_0)$					
$f(a,b)$					
$f(y,g(x_0))$					