CSC238S **Term Test 2 Solutions**

1. i) $(x_1 \vee x_2) \wedge (\bar{x}_1 \vee \bar{x}_2)$

   ii) $(\bar{x}_1 \vee \bar{x}_2) \wedge (x_1 \vee \bar{x}_2) \wedge (\bar{x}_3 \vee x_4) \wedge (x_3 \vee \bar{x}_4)$.

   iii) "$x_1 = x_2$" $\wedge$ "$x_1 = x_3$" $\wedge$ "$x_1 = x_4$" where "$x_i = x_j$" is expressed as in part ii).

2. (a) $\mathrm{GE}(X, 2) \wedge \neg\exists Y \exists Z(\mathrm{MULT}(Y, Z, X) \wedge \mathrm{GE}(Y, 2) \wedge \mathrm{GE}(X, Y))$

   (b) $\forall X \exists Y(\mathrm{PRIME}(Y) \wedge GE(Y, X))$

3. i) Everyone is a male or female and not both.

   ii) Everyone has a male parent and a female parent.

   iii) There cannot be two male parents nor can there be two female parents.

4. i) Logically follows: F_1 and F_2 imply that there must be at least two parents. F_1 and F_3 imply that there are at most two parents.

   ii) Does not logically follow (nor is it biologically necessary). Consider:

   PARENT (JOHN, ALEX), PARENT (MARY, ALEX),
   PARENT (TED, JOHN), PARENT (SARA, JOHN),
   PARENT (TED, MARY), PARENT (ANNE, MARY).

   iii) Logically follows:

   COUSIN $(X, Y) \equiv$ COUSIN (Y, X) since $\wedge$ is commutative.

   iv) Does not logically follow (although biologically necessary). Consider

   PARENT (JOHN, MARY), PARENT (MARY, MARY),
   PARENT (MARY, JOHN), PARENT (JOHN, JOHN).