Exercise : show G1 - G3

(G1) take $g_1, g_1', g_1'' \in G_1$
$g_2, g_2', g_2'' \in G_2$

$$(((g_1, g_2), (g_1', g_2')), (g_1'', g_2'')) = (((g_1 *_{G_1} g_1') *_{G_1} g_1''), ((g_2 *_{G_2} g_2') *_{G_2} g_2''))$$

but since G_1 is a group then its binary operator is associative, and so too is $*_{G_2}$

$$\therefore (((g_1 *_{G_1} g_1') *_{G_1} g_1''), ((g_2 *_{G_2} g_2') *_{G_2} g_2'')) =$$
$$((g_1 *_{G_1} (g_1' *_{G_1} g_1'')), (g_2 *_{G_2} (g_2' *_{G_2} g_2'')))$$

so G1 holds

(G2) Since G_1, G_2 are defined as groups then the identity is (e_{G_1}, e_{G_2})

so $(g_1, g_2) \times (e_{G_1}, e_{G_2}) = (g_1, g_2)$

(G3) Similarly, since G_1, G_2 are given as groups then $\forall g_1 \in G_1, g_1^{-1} \in G_1$
same argument for G_2

Then $G_1 \times G_2$
$$((g_1, g_2), (g_1^{-1}, g_2^{-1})) = (g_1 g_1^{-1}), (g_2 g_2^{-1})$$
$$= (e_{G_1}, e_{G_2})$$