2. (a) Say $G$ has a perfect matching. Then $G \Box H$ has a spanning subgraph consisting of copies of $G$. Take the perfect matching withing each copy of $G$.
(b) $K_3 \Box K_3$ does not have a perfect matching. $K_3 \Box K_{1,3}$ does have a perfect matching.

3. (a) $K_{2,2,2}$
   (b) Petersen Graph
   (c) 99
   (d) $1 \leq \kappa \leq 198$
   (e) $99 \leq \chi \leq 198$

4. (a) $\chi(G) + \chi(H)$.
   (b) If we remove edge $e$ in $G$, then the overall chromatic number goes down. From (a) this means $\chi(G - e) < \chi(G)$, so $G$ is color-critical.
   (c) If we remove an edge $e$ inside $G$, then the overall chromatic goes down since $G$ is color-critical. Similarly with an edge in $H$. So consider an edge $e$ between graphs $G$ and $H$; say joining $g$ of $G$ to $h$ of $H$. Since $G$ is color-critical, $\chi(G - g) < \chi(G)$. Similarly $\chi(H - h) < \chi(H)$. Take the colorings of $G - g$ and $H - h$ and give $g$ and $h$ the same new color. This uses $\chi(G) + \chi(H) - 1$ colors.