Q3,

There are 3 conditions that must be kept when dealing with 3 coloured graphs.

1. Each vertex must have at least one of the three colours, thus must satisfy the following clause by having at least one colour (vRed|vWhite|vBlack).
2. Each vertex must also not take up more than one colour at a time. The vertex must support not being at least 2 of the colours. The clauses needed to be satisfied include (~vWhite|~vRed), (~vBlack|~vRed), (~vWhite|~vBlack).

Thus every vertex in G must satisfy 4 clauses.

3. For edges, they must maintain not having the same colour as their adjacent vertex neighbours. Given 2 vertices per edge, 1 and 2, at least one vertex must not have a given colour per colour. These clauses include (~v1White|~v2White), (~v1Red|~v2Red), (~v1Black|~v2Black).

Each edge in G must satisfy 3 clauses.

Number of clauses needed for G = 4n + 3m