To determine the number of clauses in terms of the number of vertices (n) and the number of edges (m) of graph G, we need to consider two types of clauses generated by the CNF expression for the 3-colouring problem:

Vertex-colouring constraints: Each vertex has a clause specifying that it must be assigned exactly one colour and another clause that ensures it cannot be assigned all three colours simultaneously. This results in 2 * n clauses.

Adjacent vertices having different colours: For each edge in the graph, we have clauses that ensure the adjacent vertices have different colours. Since there are m edges in the graph, this results in 3 * m clauses.

An expression for the number of clauses of φG, after adding these two types of clauses together in terms of n (the number of vertices of G) and m (the number of edges of G), the total number of clauses (C) in terms of n and m is:

C = 2 * n + 3 * m

For graph G, the number of vertices (n) is 4, and the number of edges (m) is 5. Substituting these values into the formula:

C = 2 * 4 + 3 * 5 = 8 + 15 = 23

So, the expression for the number of clauses in terms of n and m is **2n + 3m**, which in this case is 23.

This matches the number of clauses in the output given by the awk script from problem 2.