hw18

Farrah Rahman

1. tetrahedron F: 4 V: 4 E: 6

cube F: 6 V: 8 E: 12

octahedron F: 8 V: 6 E: 12

dodecahedron F: 12 V: 20 E: 30

icosahedron F: 20 V: 12 E: 30

2. Given a planar map with V vertices, E edges, F faces, a graph can be made into a tree by removing 1 edge from edge face, also removing that face. This will remove all faces (F=0) but leave some edges. The reduced graph has V vertices, E-F edges, and 0 faces. This graph can be further reduced by continually removing a vertex of degree 1, which would remove 1 edge as well. In this way you will eventually eliminate all edges and all vertices but the root vertex. This means that there is one more vertex than edge in the tree version of the planar graph; in other words, $\underbrace{V}_{\#\text{vertices}} = \underbrace{E - F}_{\#\text{edges in tree}} + 1$, or $V - E + F = 1$.

3. i) there are 5 platonic solids:

tetrahedron: $V = 4 = \frac{2(6)}{3}$ ✓ $F = 4 = \frac{2(6)}{3}$ ✓

cube: $V = 8 = \frac{2(12)}{3}$ ✓ $F = 6 = \frac{2(12)}{4}$ ✓

octahedron: $V = 6 = \frac{2(12)}{4}$ ✓ $F = 8 = \frac{2(12)}{3}$ ✓

dodecahedron: $V = 20 = \frac{2(30)}{3}$ ✓ $F = 12 = \frac{2(30)}{5}$ ✓

icosahedron: $V = 12 = \frac{2(30)}{5}$ ✓ $F = 20 = \frac{2(30)}{3}$ ✓

ii) $\frac{2E}{a} - E + \frac{2E}{b} = 2$

$E(2b - ab + 2a) = 2ab$

$E = \frac{2ab}{2a - ab + 2b}$

iii) $a = 3$, $b = 3$: tetrahedron

$a = 3$, $b = 4$: cube

$a = 3$, $b = 5$: dodecahedron

4. A soccer ball isn't because it's made of hexagons and pentagons — faces not congruent.