Section 1.2.2

1 We have an edge for every distinct pairs of vertices, so $\binom{n}{2} = \frac{n(n-1)}{2}$.

2 We prove the contrapositive. Suppose $r_1 \neq r_2$, $|X| = r_1$ and $|Y| = r_2$. Then for $x \in X$, $deg(x) = r2$ and for $y \in Y$ $deg(y) = r1$, but $r2 \neq r1$, so K_{r_1,r_2} is not regular.

3 No, no matter which 4 vertices you choose, 2 of them will be in the same subset, and would have no edges between them.

4 a) $[A^3]_{j,j}$ equals the number of length 3 walks from v_j to itself. Length 3 closed walks form a triangle that contains v_j, but the walk v_j, v_x, v_y, v_j and v_j, v_y, v_x, v_j are both counted. These two walks form the same triangle, so we must divide the entry by two.

b) a) implies that $\frac{1}{2}\mathrm{Tr}(A^3)$ equals the number of triangles that contains v_1 or v_2 or ... or v_n. However every triangle consists of three vertices, so we are counting every triangle 3 times. Thus the number of unique triangles is $\frac{1}{6}\mathrm{Tr}(A^3)$.

5

6 a)

7

8 We prove the contrapositive. Suppose G was not complete. $\exists v_i, v_j \in V(G)$ such that $uv \notin E(G)$, meaning $A_{i,j} = 0$. If there exists a $v_i v_j$ path, then $D_{i,j} > 0$. Otherwise, $D_{i,j} = \inf$. In either case, $D_{i,j} \neq 0$, thus $A \neq D$.

9