1. Consider matrix $M_0$ below:

(a) List the ordered pairs in the relation $R_0$ on $S = \{1, 2, 3, 4\}$
- $\{(1,1), (1,2), (2,1), (2,2), (3,3), (3,4), (4,3), (4,4)\}$

(b) Draw the undirected graph $G_0 = (S, R_0)$

(c) Is $G_0$ connected or disconnected?
Disconnected

(d) What are the connected components of $G_0$?
- $\{1, 2\}$ and $\{3, 4\}$

(e) How many paths of length 3 are between 1 and 2?
- 4

(f) Does $G_0$ have a Euler path? If so, find it. If not, why not?
- No $G_0$ doesn’t have a Euler path because it is not connected.

(g) Does $G_0$ have a Euler cycle? If so, find it. If not, why not?
- No $G_0$ doesn’t have a Euler cycle because it is not connected.

(h) Does $G_0$ have a Hamilton path? If so, find it. If not, list the minimum edges added to $G_0$ to create one.
- No $G_0$ doesn’t have a Hamilton path. One edge needs to be added to create a Hamilton path. The edge that needs to be added can be either one of $(1,3),(2,4),(1,4)$ and $(2,3)$.

(h) Does $G_0$ have a Hamilton cycle? If so, find it. If not, list the minimum edges added to $G_0$ to create one.
- No $G_0$ doesn’t have a Hamilton cycle. Two edges needs to be added to create a Hamilton cycle. The edges that needs to be added can be either $\{(1,3),(2,4)\}$ or $\{(1,4),(2,3)\}$. 
2. Consider matrix $M_1$ below:

(a) List the ordered pairs in the relation $R_1$ on $S = \{1, 2, 3, 4, 5\}$
- $\{(1, 1), (1, 3), (1, 4), (1, 5), (2, 1), (2, 3), (3, 1), (3, 2), (4, 1), (4, 5), (5, 1), (5, 4)\}$

(b) Draw the undirected graph $G_1 = (S, R_1)$

(c) Is $G_1$ connected or disconnected?
- Connected

(d) What are the connected components of $G_1$?
- $G_1$ itself is a connected component of $G_1$.

(e) How many paths of length 3 are between 1 and 2?
- 5

(f) Does $G_1$ have a Euler path? If so, find it. If not, why not? - Yes $G_1$ does have a Euler path. The euler path is 1-2-3-1-4-5-1

(g) Does $G_1$ have a Euler cycle? If so, find it. If not, why not? - Yes $G_1$ does have a Euler cycle. The euler cycle is 1-2-3-1-4-5-1

(h) Does $G_1$ have a Hamilton path? If so, find it. If not, list the minimum edges added to $G_1$ to create one.
- Yes, $G_1$ does have a Hamilton path. It is: 2-3-1-4-5

(h) Does $G_1$ have a Hamilton cycle? If so, find it. If not, list the minimum edges added to $G_1$ to create one.
- No $G_1$ doesn’t have a Hamilton cycle. One edge is to be added to $G_1$ to create a Hamilton path. The edge to be added is (3,4) or (2,5) or (2,4) or (3,5)