(a)

Following are the four chromosomes. each number represent position of the queen in that row and row count start from 1

1	3	2	5	4
3	5	1	2	4
4	1	5	4	2
3	1	2	5	4

(b) Objective function will be how many queen pairs are under attacks.

We can turn it into maximization problem by using this function

$$\left(\frac{N^2}{2} - L\right)$$

N is number of queen and L is number of pairs of queen that attack each other.

(c) maximum fitness value will be

$$\frac{N^2}{2} - L = \frac{(5)^2}{2} - 0$$

$$= 12.5$$

L=0 means no queen pair is attacking.

(d) Population:

P(1) = 1 3 2 5 4 fitness = 10.5
P(2) = 3 5 1 2 4 fitness = 11.5
P(3) = 4 1 5 4 2 fitness = 10.5
P(4) = 3 1 2 5 4 fitness = 10.5

Selection:

P(1) = $\frac{10.5}{43}$ =

P(2) = $\frac{11.5}{43}$

P(3) = $\frac{10.5}{43}$

P(4) = $\frac{10.5}{43}$ =

Modification;
generate random number
& crossover point = 2

P(1) 1 3 2 : 5 4 C(1) = 1 3 2 2 4

P(2) 3 5 1 : 2 4 C(2) = 3 5 1 5 4

P(2) : 3 5 1 : 2 4 C(3) = 3 5 1 4 2

P(3) : 4 1 5 : 4 2 C(4) = 4 1 5 2 4

Mutation ; with 0.01 prob only mutate C(1).

C(1) = [5] 3 2 2 4

Evaluation:

C(1) = 5 3 2 2 4 fitness = 10.5

C(2) = 3 5 1 5 4 fitness = 10.5

C(3) = 3 5 1 4 2 fitness = 12.5

C(4) = 4 1 5 2 4 fitness 12.5