Problem 1

Part A

Consider the Prisoner's dilemma:

	C	D
C	2, 2	0, 3
D	3, 0	1, 1

Now, add a strategy called "cooperative punisher" or CP for short. CP plays cooperate in the Prisoner's Dilemma, but before he plays the game he hires a private security firm to punish the other guy *if the other guy defects*. CP must pay the firm regardless of what the other guy does.

Suppose the cost of the firm is c and the cost to defector is p. Draw the normal form and find all the Nash equilibria. (It might depend on the value of c and p. If it does say how.)

Part B

What would happen if the CP's contract with the security firm changed, so CP only had to pay the cost, c, if the security firm actually had to punish the other guy. Draw out the normal form and find all the Nash equilibria. (It might depend on the value of c and p. If it does say how.)

Problem 2

Now consider the Stag Hunt:

	S	H
S	3, 3	0, 2
H	2, 0	2, 2

Again, we'll add a CP strategy that hunts stag, and hires a firm to punish the other guy if he hunts hare.

Part A

Like before, CP must pay an up-front fee to the security agency, but the agency only punishes the hare hunting opponent. What is the normal form and the Nash equilibria?

Part B

Now what happens if CP is only changed if the punishment takes place? What is the normal form and the Nash equilibria?

Problem 3

Consider the following indefinitely repeated game, where the probability of continuing is equal to 3/4.

	A	B
A	2,2	0,0
B	0,0	1,1

The strategy Grim-B starts by playing B and continues to plays B so long as the other player continues to play B. If the other player ever deviates from playing B, even for one round, Grim-B plays A for every round after.

Part A

Is Grim-B a Nash equilibrium when played against itself in this repeated game? If so, illustrate why. If not, show the strategy that does better against Grim-B than it does against itself.

Part B

Consider the same repeated game and the same strategies, but with a continuation probability of 1/10. Is Grim-B against itself a Nash equilibrium? If so, illustrate why. If not show the strategy that does better.

Part C

Let's stay with a continuation probability of 1/10. Now consider the strategy Grim-A. Grim-A starts by playing A and continues playing A so long as the other player does the same. But if the other player ever deviates, he plays B from there out. Is Grim-A a Nash equilibrium of the repeated game? If so, illustrate why. If not, show the strategy that does better against Grim-A than it does against itself.

Problem 4

Recall the game of chicken (here the strategies are named "hawk" and "dove"):

	H	D
H	0, 0	3, 1
D	1, 3	2, 2

Consider the indefinitely repeated game of chicken with discount factor δ. Strategy **ALT-H** alternates between H and D every round (starting with H) so long as the other player does the opposite action. If a player deviates and fails to do the opposite action, then **ALT-H** plays H forever. Strategy **ALT-D** is exactly the same, except it starts with D and alternatives D and H. Like **ALT-H**, if the opponent does not do the opposite action **ALT-D** plays H forever.

For what values of δ is the pair (**ALT-H**, **ALT-D**) a Nash equilibrium in the repeated game? Show how you got your answer. How does this equilibrium compare to the three Nash equilibria in the single shot game?