Note: This is only a sample set of problems to facilitate your preparation for the final. The questions in the final will come from the set of topics in this sample. **However, please be aware that the actual problems in the final will not be exactly the same as the ones in this sample.** While studying these problems, you need to go over the lecture notes and also study the topics!

**Question 1:** Consider two put options on the same stock with the same expiration date.

- Put option #1 has a strike price of $X_1 = 150$ and its price is given by $p_1 = 20$.
- Put option #2 has a strike price of $X_2 = 140$ and its price is given by $p_2 = 8$.

The gross risk free rate of return from today until the expiration date is $r = 1.1$.

a) Given that we must have (as shown in class),

$$p_1 - p_2 \leq X_1 - X_2$$

state whether arbitrage is possible.

b) Precisely specify the arbitrage position.

c) (10 points) Find the arbitrage profit for all possible values of $S_T$, the stock price at the expiration date.
Question 3  State whether the following statement is true or false and explain why in one or two sentences. Be precise and concise for full credit.

Statement: If an investor expects that interest rates will go up and if that investor is holding a bond portfolio with a positive duration gap, the investor needs to reduce the duration of the liability side of the portfolio to reduce his/her interest rate risk exposure and protect net worth.

Question 4  State whether the following statement is true or false and explain why in one or two sentences. Be precise and concise for full credit.

Statement: If an investor sells call options on a stock and also buys put options on the same stock, then this investor can offset his/her risk with respect to the underlying stock price by buying shares of the underlying stock.

Question 5  State whether the following statement is true or false and explain why in one or two sentences. Be precise and concise for full credit.

Statement: Suppose you are holding a bond portfolio with a negative duration gap, and you further increase the duration of your liabilities. If the interest rates go down, your net worth will increase.
Question 6

<table>
<thead>
<tr>
<th></th>
<th>Fixed</th>
<th>Floating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell</td>
<td>10%</td>
<td>Libor +3%</td>
</tr>
<tr>
<td>Intel</td>
<td>14%</td>
<td>Libor +10%</td>
</tr>
</tbody>
</table>

Dell requires a fixed rate loan. Intel requires a floating rate loan.

A) Which company has comparative advantage in Fixed Rate Loan market? Which company has comparative advantage in Floating Rate Loan market? What is size of the potential gain from a swap agreement in the above situation?

B) (12 points) Suppose DELL and INTEL CANNOT engage directly with each other and they NEED a BANK to act as an intermediary. Design a PAIR OF SWAPS between DELL, BANK and INTEL which distributes the surplus you identified in part a equally between the three parties (There is a bank in between the two parties in this situation)
**Question 7**

If the following two portfolios contain the same delta points, what should be the number of PUT options contracts N in portfolio B?

Portfolio A: 1000 shares of IBM and 30 long put option contracts on IBM (each contract contains 100 put options) with put delta -0.30.

Portfolio B: 3200 shares of IBM and N short call option contracts on IBM (each contract contains 100 call options) with put delta -0.50.
Question 8

Consider a bank with the following balance sheet:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Value</th>
<th>Duration of the Asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 year loan @5%</td>
<td>$10,000</td>
<td>2</td>
</tr>
<tr>
<td>5yr loan @5%</td>
<td>$5,000</td>
<td>4</td>
</tr>
<tr>
<td>4yr loan @6%</td>
<td>$5,000</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Value</th>
<th>Duration of the Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>4yr loan @ Libor</td>
<td>$5,000</td>
<td>1</td>
</tr>
<tr>
<td>3yr loan @5%</td>
<td>$5,000</td>
<td>2</td>
</tr>
<tr>
<td>6yr loan @6%</td>
<td>$10,000</td>
<td>5</td>
</tr>
</tbody>
</table>

a) (5 points) Find the duration gap. When does the net worth suffer a loss, if interest rate goes up or if it goes down?
b) (10 points) Suppose the portfolio manager wants to make Duration Gap equal to -0.25 (minus 0.25).

For that purpose he wants to swap $x$ of the 6yr loan @ 6% with a 6yr loan at Libor. The duration of 6yr loan at Libor is 2.

What is the size $x$ of the swap that makes duration gap equal to -0.25?
Question 9: (10 points)

A trader sells 500 shares of IBM stock short at share price $30 each and hence generates $15,000 in cash. Consider the following two strategies that the trader can follow.

Strategy 1: The trader holds the short position of 500 shares for one year, and invests $15,000 cash in a risk free bond for an annual return of 10%.

Strategy 2: The trader buys 500 call options on IBM with strike price $X=40 that expire in one year. The price of each call option is $c=8$. The trader holds the short position of 500 shares for one year and invests the remaining cash in the risk free bond for an annual return of 10%.

For what values of IBM share price $S_T$ in one year at the expiration date, does Strategy 2 prove to be the better one?