This exam is out of 140. As a winter break gift you get 30 points. Answer 110 points worth of problems. You may answer individual parts of questions and leave others. We will throw away/scale down your worst problem(s) if you answer more than 110 points worth. Your answers should be concise – short and to the point, but including the important technical issues. Be specific. Clearly state any assumptions. Good luck!

**Problem 0:** (10 points)
If you had to select one concept as the most important you learned in this class, what would it be? Explain what makes it so important.

**Problem 1:** (30 points)
Explain the deployment barrier and data plane implications for each of the following ideas (i.e., what needs to change for the idea to be deployed):

1. Application Level Multicast
2. IPNL
3. PIM
4. An extension to UDP that implements flow control in a way similar to TCP
5. IntServ

**Problem 2:** (24 points)
Provide a brief explanation of each of the following, explaining its importance.
(a) Head of Line Blocking
(b) Weighted Fair Queueing
(c) Congestion Avoidance
(d) Shared Learning as was discussed in the SRM and RLM multicast papers.

**Problem 3:** (32 points)
For any 4 of the following areas, select two significantly different solutions A and B. Select two relevant metrics such that A outperforms B according to one metric and B outperforms A according to the other.

1. IP Lookup
2. Searching in P2P networks
3. Congestion handling
4. QoS
5. IP address exhaustion problem
**Problem 4:** (36 points)
You are part of a startup company trying to survive the dot com collapse. Employeed in your company are encouraged to come up with ideas, which are then discussed to decide which should be pursued. The employees whose ideas get adopted get big raises. The following ideas are on the table. Give your opinion.

1. End point admission control as in the paper we discussed in class

2. As a way of supporting IntServ, an extension of Core Stateless Fair queueing to specify the relative importance of an admitted flow is proposed. More specifically, edge routers now specify the rate $r$ and the relative weight $w$ of the flow to which a packet belongs. The router then forwards a packet with probability $\min(1, \frac{w \cdot f}{r})$.

3. An extension of Core Based Trees to implement reliability as follows. Every node ensures that a multicast packet is received correctly by its siblings in the shared tree (e.g., using ARQ).

4. You need a raise. Suggest your own idea and why it is worth doing

**Problem 5:** (24 points)
(a) In links that are lossy, such as wireless links, TCP performs badly. Explain why this is the case, and suggest a solution for it.
(b) Consider two TCP connections with different round trip times that pass through the same bottleneck link. Ignore the effect of other interfering traffic. Will the two connections fairly share the available bandwidth? Explain.