This exam is out of 150. As a winter break gift you get 30 points. Answer 120 points worth of problems. If you answer a problem, you must attempt all parts (i.e., you cannot just pick the straightforward parts of each problem). I 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 1:** (12 points) Describe three important concepts that you learned in this class. Explain why they are important. This problem will be graded based on the importance of your selection and your explanation.

**Problem 2:** (28 points) Comment on the following potentially wrong statements

1. Subnetting can result in 100% efficiency in using address space
2. The Internet is scalable because bandwidth is cheap and routers are fast
3. Overlay networks are successful because they lower the deployment barrier
4. Congestion control is more important than flow control
5. Packet reordering can have significant effect on the performance of TCP
6. Mobile IP is more efficient than the DNS based Mobility scheme
7. Shared learning is essential to RLM scalability

**Problem 3:** (32 points) Explain the tradeoffs involved between each of the following. Clearly identify criteria that can help you quantify the effect of these tradeoffs.

1. TCP Vegas vs. TCP Reno
2. DiffServ vs. IntServ
3. Fair Queueing vs. FIFO with RED
4. Application Level Multicast vs. PIM

**Problem 4:** (26 points) Routers in an IP network play an important role in determining the performance of the network. Their functionality can be organized into a data plane (processing that occurs with every packet) and a control plane.

(a) (5 points) Explain which operations are performed in the data plane and which are performed in the control plane in a simple IP router.

(b) (8 points) What additional operations would need to be performed to support multicast using RPM and using Application level multicast?

(c) (8 points) What additional operations would need to be performed to support Intserv?

(d) (5 points) What are the implications of the above on router design?
Problem 5: (26 points)

(a) What is the problem outlined in Floyd’s paper on “Promoting the use of End-to-End Congestion control on the Internet”?
(b) Show that a similar problem can arise if Endpoint Admission Control as proposed in the Breslau et. al.'s paper is used
(c) Discuss one solution for each of these problems and explain why router involvement is necessary
(d) If true Intserv is deployed, would such problems still arise?

Problem 6: (26 points)

(a) (6 points) Briefly explain the basic model and the contribution of the I3 paper
(b) (12 points) The Chord paper makes the case why DNS is not a suitable directory scheme for peer to peer applications. Can you make the reverse case (i.e., why isn’t the chord scheme suitable as a substitute for DNS)
(c) (8 points) What effect, if any, does the fact that the Internet is organized hierarchically into AS’s have on schemes such as Chord and I3. Explain.