1a What is meant by geographical scalability and how can this problem be tackled?   *5pt*

1b One could argue that peer-to-peer systems solve the administrative scalability problem. Explain how. *5pt*

1c Replication is widely applied as a scaling technique, but introduces a new scalability problem. Explain what this problem is and how it can be solved.   *5pt*

2a Give a typical example of client-side software that is needed in a distributed system.   *5pt*

2b Give at least one compelling reason why using mobile agents would be a good idea.   *5pt*

3a Is the URL `http://www.cs.vu.nl/` location independent?
      What about `http://www.van-steen.net/`? Explain your answer!   *5pt*

3b Name spaces generally provide hard links and symbolic links. Explain the difference.   *5pt*

4a Describe a simple, centralized scheme to accomplish totally-ordered reliable multicasting.   *5pt*

4b Ricart and Agrawala's algorithm for distributed mutual exclusion among N processes introduces N points of failures. How?   *5pt*

5a Consider a Web server handing out leases to invalidate client-side caches. When should renewal-frequency based leases be applied in order to obtain maximal effectiveness? Include the lease period in your answer.   *5pt*

5b What do leases such as those just described actually accomplish?   *5pt*

6a Explain how (scalable) NACK-based reliable multicasting works.   *5pt*

6b What is the best way to establish scalable ACK-based reliable multicasting?   *5pt*

7 The remote-access model is becoming less popular in distributed file systems. Why?   *5pt*

8a Systems like Globule determine per Web document the strategy according to which that document will be replicated. What is the advantage of this approach in comparison to adopting a single, site-wide replication policy?   *5pt*

8b Considering that a content delivery network such as Akamai uses existing Web caching techniques for replication, what type of consistency does it provide to clients?   *5pt*

9a What is an important advantage of using a message broker for the implementation of a publish/subscribe system?   *5pt*

9b What makes subject-based publish/subscribe systems so difficult to scale across a wide-area network?   *5pt*

Grading: *The final grade is calculated by accumulating the scores per question (maximum: 90 points), and adding 10 bonus points. The maximum total is therefore 100 points.*