Question 1: Two-Phase Locking . . . . [230 points]

(i) **[10 points] Locks vs. Latches:**
Distinguish between: (1) locks and (2) latches.

(ii) **[10 points] Locks vs. Latches:**
Why are locks held during the entire duration of a transaction?

(iii) **[10 points] Lock Types:**
Distinguish between: (1) shared locks and (2) executive locks.

(iv) **[10 points] Lock Types:**
Explain why executing with locks is not sufficient.

(v) **[10 points] Two-Phase Locking:**
Explain why the protocol does not need to know all the queries that a txn will execute ahead of time.

(vi) **[10 points] Two-Phase Locking:**
Explain why the txn is not allowed to acquire/upgrade locks after the growing phase finishes is enough to satisfy the isolation property.

(vii) **[10 points] Two-Phase Locking:**
Illustrate how 2PL is subject to cascading aborts.

(viii) **[10 points] Two-Phase Locking:**
Illustrate how 2PL on its own is sufficient to guarantee conflict serializability.

(ix) **[10 points] Two-Phase Locking:**
Illustrate how 2PL may still lead to deadlocks.

(x) **[10 points] Two-Phase Locking:**
Illustrate how 2PL may still lead to dirty reads.

(xi) **[10 points] Two-Phase Locking:**
Explain why 2PL is used in almost all DBMSs.

(xii) **[10 points] Strong Strict Two-Phase Locking:**
Define a strict schedule.

(xiii) **[10 points] Strong Strict Two-Phase Locking:**
Explain how strong strict 2PL does not incur cascading aborts.

(xiv) **[10 points] Deadlocks:**
Distinguish between: (1) deadlock detection and (2) deadlock prevention.

(xv) **[10 points] Deadlock Prevention:**
Distinguish between: (1) Wait-Die and (2) Wound-Wait.

(xvi) **[10 points] Deadlock Prevention:**
Why do these schemes guarantee no deadlocks?

(xvii) **[10 points] Deadlock Prevention:**
When a txn restarts, what is its (new) priority?

(xviii) **[10 points] Hierarchical Locking:**
Explain the benefits and drawbacks of hierarchical locking.

(xix) **[10 points] Hierarchical Locking:**
Explain the purpose of intention locks.

(xx) **[10 points] Hierarchical Locking:**
Illustrate the utility of: (1) IS lock, (2) IX lock, and (3) SIX lock.

(xxi) **[10 points] Hierarchical Locking:**
Explain the purpose of lock escalation.

(xxii) **[10 points] Locking in Practice:**
When would an user explicitly lock a table?

(xxiii) **[10 points] Locking in Practice:**
Explain the purpose of 'select... for update'.