

1.

**SQL:**

```
SELECT DISTINCT S.SID FROM SUPPLY S, PART P
WHERE (P.COLOR = 'red') OR (P.COLOR = 'blue') AND S.PID = P.PID;
```

**Linear Relational Algebra:**

```
T1(sid, pid, color) = supply(sid, pid) Join[pid = pid] part(pid, color)
T2(sid, pid, color) = Select[color = 'red'](T1)
T3(sid, pid, color) = Select[color = 'blue'](T1)
T4(sid) = Project[sid](T2)
T5(sid) = Project[sid](T3)
T6(sid) = T4 Union T5
```

2.

**SQL:**

```
SELECT P.PID FROM PART P
WHERE NOT EXISTS(
    SELECT SR.SID
    FROM SUPPLIER SR
    WHERE NOT EXISTS(
        SELECT B.SID FROM SUPPLY B
        WHERE(B.SID = SR.SID AND B.PID = P.PID) AND B.COST < 100
    )
);
```

**Linear Relational Algebra:**

```
T1(sid,pid,cost) = supply(sid,pid,cost)
T2(sid,pid,cost) = Select[cost < 100](T1)
T3(sid,pid) = Project[sid,pid](T2)
T4(sid) = Project[sid](supplier(sid))
T5(pid) = T3(sid,pid)/T4(sid)
```

3.

**SQL:**

```
SELECT S.SID
FROM SUPPLIER S
WHERE(
    (S.CITY = 'san diego')
    OR S.SID IN(
        SELECT S1.SID FROM SUPPLY S1, PART P
        WHERE(
            P.COLOR = 'red' AND S1.PID = P.PID
        )
    )
);
```

**Linear Relational Algebra:**

```
T1(sid, city) = Select[city = 'san diego']Supplier(sid, city)
T2(sid) = Project[sid](T1)
T3(pid,sid,color) = supply(sid, pid) Join[pid = pid] part(pid,color)
T4(pid,sid,color) = Select[color = 'red'](T3)
T5(sid) = Project[sid](T4)
T6(sid) = T2 Union T5
```

4.

**SQL:**

```
SELECT DISTINCT S.SID
FROM SUPPLY S, PART P
WHERE(
    P.COLOR = 'red' AND S.PID = P.PID
    AND EXISTS(
        SELECT 1
        FROM SUPPLY S2, PART P2
        WHERE(
            P2.COLOR = 'green' AND S2.PID = P2.PID
            AND S2.SID = S.SID
        )
    )
);
```

**Linear Relational Algebra:**

```
T1(sid,pid,color) = Supply(sid,pid) Join[pid = pid] part(pid, color)
T2(sid,pid,color) = Select[color = 'red'](T1)
T3(sid,pid,color) = Select[color = 'green'](T1)
T4(sid) = Project[sid](T2)
T5(sid) = Project[sid](T3)
T6(sid) = T4 Intersect T5
```

5.

**SQL:**

```
SELECT S1.SID AS S1SID, S2.SID AS S2SID
FROM SUPPLY S1, SUPPLY S2
WHERE S1.PID = S2.PID AND S1.SID != S2.SID
AND S1.COST > S2.COST;
```

**Linear Relational Algebra:**

```
T1(sid1,pid1,cost1) = Rename[sid1,pid1,cost1] supply(sid,pid,cost)
T2(sid2,pid2,cost2) = Rename[sid2,pid2,cost2] supply(sid,pid,cost)
T3(sid1,pid1,cost1,sid2,pid2,cost2) = T1(sid1,pid1,cost1) Join[cost1 > cost2] T2(sid2,pid2,cost2)
T4(sid1,pid1,cost1,sid2,pid2,cost2) = T1(sid1,pid1,cost1) Join[pid1 = pid2] T2(sid2,pid2,cost2)
T5(sid1,pid1,cost1,sid2,pid2,cost2) = T1(sid1,pid1,cost1) Join[sid1 != sid2] T2(sid2,pid2,cost2)
T6(sid1,pid1,cost1,sid2,pid2,cost2) = T3 Intersect T4
```

$T7(sid1, pid1, cost1, sid2, pid2, cost2) = T6 \text{ Intersect } T5$   
 $T8(sid1, sid2) = \text{Project}[sid1, sid2](T7)$