Q1.

a) 
\[ \pi_{age}(\pi_{eid}(\pi_{did}(\sigma_{\text{dname='Catering',Dept}}) \bowtie \text{Works}) \bowtie \text{Emp}) \]

b) 
\[ \pi_{salary}(\pi_{eid}(\pi_{did}(\sigma_{\text{budget} \geq 50000 \text{Dept}}) \bowtie (\sigma_{\text{pct}_{\text{time}} \geq 30 \text{Works}})) \bowtie \text{Emp}) \]

c) 
\[ \pi_{salary}(\text{Dept} \bowtie \text{Dept.managerid=Emp.eid Emp}) \]

d) 
\[ \pi_{ename}(\text{Emp } \bowtie (\pi_{eid}(\pi_{did}(\sigma_{\text{dname='Marketing',Dept}}) \bowtie \text{Works})) \cup \pi_{eid}(\sigma_{\text{pct}_{\text{time}} \geq 50 \text{Works}})) \]

e) 
\[ \rho(\text{TMP,Dept }) \]
\[ \pi_{\text{managerid Dept}} - \pi_{\text{managerid}} (\text{Dept } \bowtie (\text{Dept.managerid=TMP.managerid}) \bowtie (\text{Dept.did } \leftrightarrow \text{TMP did}) \text{ TMP}) \]
Q2.

a)  
CREATE TABLE Works(
    eid INTEGER,
    did INTEGER,
    pct_time INTEGER,
    PRIMARY KEY(eid,did),
    FOREIGN KEY eid REFERENCES Emp,
    FOREIGN KEY did REFERENCES Dept
)

b)  
SELECT E.ename  
FROM Emp E, Works W, Dept D, Emp M  
WHERE E.eid=W.eid AND W.did=D.did AND D.managerid=M.eid AND M.ename='Steve Smith';

c)  
SELECT E1.age  
FROM Emp E1  
WHERE E1.eid NOT IN (  
    SELECT E.eid  
    FROM Emp E, Works W, Dept D  
    WHERE E.eid=W.eid AND W.did=Dept.did AND D.budget < 20000
  )
d)
SELECT E.age
FROM Emp E
WHERE E.salary = (SELECT MAX(salary) FROM Emp)

e)
SELECT D.did, AVG(E.salary)
FROM Emp E, Works W, Dept D
WHERE E.eid=W.eid AND W.did=D.did AND E.age < 45
GROUP BY D.did
HAVING 10 <= (SELECT COUNT(*) FROM Works W1
    WHERE W1.did=D.did
     )

f)
SELECT E.ename
FROM Emp E WHERE NOT EXISTS(
    SELECT D.did FROM Dept D
    MINUS
    SELECT D1.did FROM Dept D1, Works W
    WHERE D1.did=W.did and W.eid=E.eid
     )
g)

SELECT TMP.dname
FROM (SELECT D.did, D.dname, AVG(E.salary) AS avgsal
      FROM Dept D, Emp E, Works W
      WHERE D.did=W.did AND W.eid=E.eid
      GROUP BY D.did, D.dname
     ) AS TMP
WHERE TMP.avgsal = (SELECT MAX(avgsal) FROM TMP);