Q1.

a)

$$\pi_{age}((\pi_{eid}(\pi_{did}(\sigma_{dname='Catering'}Dept)) \bowtie Works) \bowtie Emp)$$

b)

$$\pi_{salary}((\pi_{eid}(\left(\pi_{did}(\sigma_{budget\geq 50000}Dept)\right) \bowtie (\sigma_{pct_{time}\geq 30}Works))) \bowtie Emp)$$

c)

$$\pi_{salary}(Dept \bowtie_{Dept.managerid=Emp.eid} Emp)$$

d)

$$\pi_{ename}(Emp \bowtie (\ (\pi_{eid}(\pi_{did}(\sigma_{dname='Marketing'}Dept)) \bowtie Works)$$

$$\cup$$

$$(\pi_{eid}(\sigma_{pct_{time}\geq 50}Works)) \ ))$$

e)

$$\rho(TMP, Dept)$$

$$\pi_{managerid}Dept - \pi_{managerid}(Dept \bowtie_{(Dept.managerid=TMP.managerid)^{\wedge}(Dept.did<>TMP.did)} TMP))$$

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);