```
SQL – underspecified (74)
 Domain Relational Calculus (59)
                                                         SELECT Iname, dname
\{<|,n>| \exists <|,f.s,x,d> \in Employee
                                                         FROM Employee, Department
        \exists <n,i,m> \in Department (
                                                         WHERE sex = 'M'
           ^{\wedge} x = ^{\prime}M^{\prime} ^{\wedge} d=i))
                                                              and dno = dnumber
 Tuple Relational Calculus (89)
                                                       SQL - aliased (82)
\{t \mid \exists e \in Employee (
                                                        SELECT e.Iname, d.dname
     \exists d \in Department (
                                                        FROM Employee e, Department d
       t.Iname = e.Iname
                                                        WHERE e.sex = 'M'
       ^ t.dname = d.dname
                                                             and e.dno = d.dnumber
       ^ e.sex = 'M' ^ e.dno = d.dnumber))]
            Relational Algebra [in RC/SQL style] (71)
             e ← Employee
             d ← Department
              t \leftarrow \Pi Iname, dname
                    (Oe.sex='M' \land e.dno = d.dnumber (e x d))
```

Relational Algebra [in "native" (and underspecified) style] (64)

```
\Pi Iname, dname (\sigma sex='M' (Employee \bowtie dno = dnumber Department))
```

English (82)

List the last name and department number of all male employees.

Color Meaning

Red = Existentialization
Green = Projection
Blue = Selection
Gold = Join

```
SQL – underspecified (74)
 Domain Relational Calculus (59)
                                                        SELECT Iname, dname
\{<|,n>| \exists <|,f.s,x,d> \in Employee
                                                        FROM Employee, Department
        \exists <n,i,m> \in Department (
                                                        WHERE sex = 'M'
           ^{\wedge} x = ^{\prime}M^{\prime} ^{\wedge} d=i))
                                                             and dno = dnumber
 Tuple Relational Calculus (89)
                                                      SQL - aliased (82)
{t|∃e∈Employee(
                                                       SELECT e.Iname, d.dname
     \exists d \in Department (
                                                       FROM Employee e, Department d
       t.Iname = e.Iname
                                                       WHERE e.sex = 'M'
        ^ t.dname = d.dname
                                                            and e.dno = d.dnumber
       ^{\circ} e.sex = 'M' ^{\circ} e.dno = d.dnumber))}
Relational Algebra [in RC/SQL style] (71)
                                                        QBE (29)
e ← Employee
                                                        EMPL
                                                                                       dno
                                                                         Iname
                                                                  ssn
                                                                                 sex
d ← Department
                                                                                  M
                                                                                       d
t \leftarrow \Pi Iname, dname
                                                          DEPT
      (Oe.sex='M' \land e.dno = d.dnumber (e x d))
                                                                 dnumber |
                                                                           dname
                                                                                    mgrssn
                                                                             _n
Relational Algebra [in "native" (underspecified) style] (64)
                                                        RESULT
                                                                      Iname
                                                                                dname
  II Iname, dname (\sigma sex='M' (
                                                                      P._I
                                                                                  P._n
  Employee M dno = dnumber Department))
                                                                    Red = Existentialization
English (82)
                                           Color Meaning;
                                                                   Green = Projection
 List the last name and department
                                                                   Blue = Selection
 number of all male employees.
                                                                   Gold = Join
```

```
Domain Relational Calculus (59)  \{ \langle I,n \rangle | \exists \langle I,f.s,x,d \rangle \in \text{Employee (} \\ \exists \langle n,i,m \rangle \in \text{Department (} \\ \land x = \text{'M'} \land d=i)) \}
```

Tuple Relational Calculus (89)

```
{t| ∃ e ∈ Employee (
    ∃ d ∈ Department (
    t.Iname = e.Iname
    ^ t.dname = d.dname
    ^ e.sex = 'M'    ^ e.dno = d.dnumber))]
```

SQL – underspecified (74)

SELECT Iname, dname FROM Employee, Department WHERE sex = 'M' and dno = dnumber

SQL - aliased (82)

```
SELECT e.Iname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
and e.dno = d.dnumber
```

Relational Algebra [in RC/SQL style] (71)

```
e ← Employee
d ← Department
t ← Π Iname, dname
(O e.sex='M' ^ e.dno = d.dnumber (e x d))

(O e.sex='M' (O e.dno = d.dnumber (e x d)))
(O e.sex='M' (e ⋈ e.dno = d.dnumber d))
```

Relational Algebra [in "native" (and underspecified) style] (64)

 Π Iname, dname (σ sex='M' (Employee \bowtie dno = dnumber Department))

```
Domain Relational Calculus (84)  \{ \langle I,n \rangle | \exists \langle I,f.s,x,d \rangle \in \text{Employee (} \\ \exists \langle n,i,m \rangle \in \text{Department (} \\ \land x = 'M' \land d = i \\ \land \neg \exists \langle p,a,q \rangle \in \text{Dependent(s=p))) \}
```

Tuple Relational Calculus (119)

```
{t|∃e∈ Employee (
∃d∈ Department (
t.lname = e.lname
^t.dname = d.dname
^e.sex = 'M' ^e.dno = d.dnumber
^~∃c∈Dependent(e.ssn=c.essn)))}
```

English (82)

List the last name and department number of all male employees without dependents.

SQL - aliased (127)

SELECT e.Iname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
and e.dno = d.dnumber
and e.ssn not in (SELECT essn
FROM Dependent)

Relational Algebra [in RC/SQL style] (109)

```
e \leftarrow Employee d \leftarrow Department c \leftarrow Dependent A \leftarrow \Pi Iname, dname,ssn (\sigma e.sex='M' ^{\circ} e.dno = d.dnumber (e x d)) W \leftarrow \pi Iname, dname,ssn A a.ssn = c.essn C T \leftarrow \pi Iname, dname (A - W)
```

Relational Algebra [in "native" (and underspecified) style] (102)

 $A \leftarrow \Pi$ Iname, dname (σ sex='M' (Employee \bowtie dno = dnumber Department))

Domain Relational Calculus (84)

```
{<|,n>| \exists <|,f.s,x,d> \in Employee (}
\exists <n,i,m> \in Department (
^{\land} x = 'M' ^{\land} d=i
^{\land} \sim \exists <p,a,g> \in Dependent(s=p)))}
```

Tuple Relational Calculus (119)

```
{t| ∃ e ∈ Employee (
    ∃ d ∈ Department (
    t.Iname = e.Iname
    ^ t.dname = d.dname
    ^ e.sex = 'M'    ^ e.dno = d.dnumber
    ^~∃c∈Dependent(e.ssn=c.essn)))}
```

Relational Algebra [in RC/SQL style] (109)

```
e ← Employee
d ← Department
c ← Dependent
A ← Π Iname, dname,ssn (O e.sex='M'

^ e.dno = d.dnumber (e x d))
W ← Π Iname, dname,ssn A ⋈

a.ssn = c.essn C
T ← Π Iname, dname (A - W)
```

English (82)

List the last name and department number of all male employees without dependents.

SQL - aliased (127)

SELECT e.Iname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
and e.dno = d.dnumber
and e.ssn not in (SELECT essn
FROM Dependent)

QBE (34)

EMPL	ssn	Iname	sex	dno
	_\$	_	M	_d

DEPT	dnumber	dname	mgrssn
	_d	_n	

DEPN	essn	depname	
~	_\$		
RESULT	Iname	dname	
	PI	Pn	