For the above schema (the primary key for each relation is denoted by the underlined attribute), provide relational algebra expressions for the following queries:

Note: For notational convenience, I am using pname instead of person-name, cname instead of company-name, and mname instead of manager-name. In addition, instead of \textit{lives}[pname] i am using the equivalent notation \textit{lives}.\textit{pname} in an SQL like syntax in some queries – you can use either.

1. Find the name of all employees (i.e., persons) who work for the City Bank company (which is a specific company in the database).
\[
\{ p \mid \exists w \in \text{works}(w[pname]=p[pname]) \land (w[cname] = 'City Bank') \}
\]

2. Find the name and city of all employees who work for City Bank. Similar to previous query, except we have to access the lives table to extract the city of the employee. Note the join condition in the query.
\[
\{ p \mid \exists w \in \text{works}, \exists l \in \text{lives} \}
\]
\[
((w[cname] = 'City Bank') \land (w[pname] = l[pname])) \}
\]

3. Find the name, street and city of all employees who work for City Bank and earn more than $10,000. Similar to previous query except an additional condition on salary attribute.
\[
\{ p \mid \exists w \in \text{works}, \exists l \in \text{lives} \}
\]
\[
((w.salary > 10000) \land (w.cname = 'City Bank') \land (w.pname = l.pname)) \}
\]

4. Find all employees who live in the same city as the company they work for. For this query we need to access the lives table to get city of the employee and the located-in table to get city of the company; plus the works table to associate employee with their company. The selection condition is then that the two cities are the same.
\[
\{ p \mid \exists w \in \text{works}, \exists l \in \text{lives} \exists y \in \text{locatedin} \}
\]
\[
((l.city = w.city) \land (w.cname = y.cname) \land (w.pname = l.pname) \land (p.pname = l.pname)) \}
\]
5. Find all persons who do not work for City Bank. Can write this in multiple ways - one solution is to use set difference:
\[ \{ x | \exists y \in \textit{works}(x.pname = y.pname \land y.cname \neq 'City Bank') \} \]

6. Find all employees who live in the same city and on the same street as their manager. This requires accessing lives table twice – once for finding city of employee and a second time for finding city of manager. Therefore we need two variables from lives with different names; one will refer to employee and the other will refer to the manager.

\[ \{ x | \exists y, z \in \textit{lives} \exists m \in \textit{manages} \\
\quad \left( (z.city = y.city) \land (y.street = z.street) \land \\
\quad \quad (y.pname = m.pname) \land (z.pname = m.managername) \land (x.pname = y.pname) \right) \} \]