Relational Algebra Queries

One relational database schema is given below.
person (driver-id, name, address)
car (license, year, model)
accident (report-number, location, date)
owns (driver-id, license)
participated (report-number, driver-id, license, damage-amount)
employee (person-name, street, city)
works (person-name, company-name, salary)
company (company-name, city)
manages (person-name, manager-name)
Give an expression in the relational algebra to express each of the following queries:
[answer hints mentioned in bracket]
a. Find the names of all employees who work for First Bank Corporation.
b. Find the names and cities of residence of all employees who work for First Bank Corporation. [use Join]
c. Find the names, street address, and cities of residence of all employees who work for First Bank Corporation and earn more than $10,000 per annum.
d. Find the names of all employees in this database who live in the same city as the company for which they work. [use Joins]
e. Find the names of all employees who live in the same city and on the same street as do their managers. [use Joins]
f. Find the names of all employees in this database who do not work for First Bank Corporation. [either you can use difference operation or you can use subqueries]
g. Find the names of all employees who earn more than every employee of Small Bank Corporation. [you can use difference operation]
h. Assume the companies may be located in several cities. Find all companies located in every city in which Small Bank Corporation is located. [you can use division operation]

Here are the relational algebra expressions for the given queries:

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a. Find the names of all employees who work for First Bank Corporation.

$$\pi_{\text{name}}(\sigma_{\text{company-name}='FirstBankCorporation'}(\text{works}))$$

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b. Find the names and cities of residence of all employees who work for First Bank Corporation.

$$\pi_{\text{employee.name,employee.city}}(\sigma_{\text{works.company-name}='FirstBankCorporation'}(\text{works} \bowtie \text{employee}))$$

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c. Find the names, street address, and cities of residence of all employees who work for First Bank Corporation and earn more than $10,000 per annum.

$$\pi_{\text{employee.name,employee.street,employee.city}}(\sigma_{\text{works.company-name}='FirstBankCorporation' \wedge \text{works.salary}>10000}(\text{works} \rhd$$

d. Find the names of all employees in this database who live in the same city as the company for which they work.

$$\pi_{\text{employee.name}}(\sigma_{\text{employee.city}=\text{company.city}}(\text{works} \bowtie \text{employee} \bowtie \text{company}))$$

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e. Find the names of all employees who live in the same city and on the same street as do their managers.

$$\pi_{\text{e1.name}}(\sigma_{\text{e1.city}=\text{e2.city} \wedge \text{e1.street}=\text{e2.street}}(\text{manages} \bowtie \text{employee}\rho_{\text{e2}}(\text{employee})))$$

Here, $\rho_{\text{e2}}(\text{employee})$ is a renaming operation for the second instance of the `employee` relation.

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f. Find the names of all employees in this database who do not work for First Bank Corporation.

Using difference operation:

$$\pi_{\text{name}}(\text{employee}) - \pi_{\text{employee.name}}(\sigma_{\text{works.company-name}='FirstBankCorporation'}(\text{works} \bowtie \text{employee}))$$

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g. Find the names of all employees who earn more than every employee of Small Bank Corporation.

Using subquery:

$$\pi_{\text{name}}\left(\sigma_{\text{salary}>\text{ALL}(\pi_{\text{salary}}(\sigma_{\text{company-name}='SmallBankCorporation'}(\text{works})))}\right)$$

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h. Find all companies located in every city in which Small Bank Corporation is located.

Using division operation:

$$\pi_{\text{company-name}}(\text{company} \div \pi_{\text{city}}(\sigma_{\text{company-name}='SmallBankCorporation'}(\text{company})))$$

Let me know if you need further clarification!