1. Let $r$ and $s$ be relations as follows.

$$r = \begin{array}{cc}
A & B \\
1 & 1 \\
2 & 1 \\
4 & 5 \\
\end{array} \\

s = \begin{array}{cc}
B & C \\
1 & 1 \\
1 & 3 \\
6 & 7 \\
\end{array}$$

Compute the relation for each of the following:

(a) $\pi_B r$

(b) $\sigma_{A>2} r$

(c) $r \times s$

(d) $r \bowtie \rho_{B \leftarrow D} s$

(e) $(\pi_B r) - (\pi_B s)$

(f) $r \otimes s$

(g) $r \bowtie s$

(h) $r \div \pi_B \sigma_{C<4} s$

(i) $\rho_{A \leftarrow B} \rho_{B \leftarrow C} r \div \pi_B \sigma_{C<4} s$

2. Consider the following database scheme.

supplier$(SName, SAddress)$ key : Sname
text$(MenuItemNumber, ItemName, Color, Weight)$ key : MenuItemNumber
shipment$(SName, ItemNumber, Quantity, ShipDate)$ key : {Sname, ItemNumber}

Using this scheme, write relational-algebra expressions for the following queries.

(a) Find the names and numbers of all blue items.

(b) Find the names and addresses of suppliers who have shipments in quantities greater than 500.

(c) Find the names of suppliers who have shipments of items that weigh more than 50.

(d) Find the supplier name and item number for shipments that have a quantity less than 200 or an item weight greater than 20.

(e) ! List pairs of item numbers of items that have the same color. Do not list an item number with itself, and do not list a pair of item numbers in both orders.

(f) ! Find names of suppliers who are currently shipping all items. (Use the division operator.) Note: The appearance of an entry in the shipment table means that the supplier for the entry is “currently shipping” the item in the entry.

(g) !! Find names of suppliers who are currently shipping all green items that weigh less than 50. (Do not use the division operator.)

(h) ! List the names and addresses of suppliers who are currently not shipping items.

(i) List the names of blue items along with their shipment information. Include all blue items even if they are not currently being shipped.