a.

$$\pi_{zipcode} \left(\pi_{sid}(\pi_{pid} \left(\sigma_{year=2010}(Parts) \right)) \bowtie Orders) \bowtie Suppliers \right)$$

b.

$$\pi_{price} \left(\pi_{pid}(\pi_{sid} \left(\sigma_{state='California'}(Suppliers) \right)) \bowtie \sigma_{quantity \geq 10}(Orders)) \bowtie Parts \right)$$

c.

$$\pi_{sname}\left((\pi_{sid}(Orders) - \pi_{sid}(\sigma_{price \leq 100}(Parts) \bowtie Orders)) \bowtie Suppliers\right)$$

d.

$$\pi_{price} \left(\pi_{pid}(\pi_{sid}(\sigma_{zipcode='02125'}(Suppliers)) \bowtie Orders) \bowtie \sigma_{price>200}(Parts) \right)$$

e.

$$\rho(P_{2020}, \pi_{pid} \left(\sigma_{year=2020}(Parts) \right))$$
$$\rho(Ordered, \pi_{pid}(Orders))$$
$$\rho(Maine, \pi_{pid}(\pi_{sid}(\sigma_{state='Maine'}(Suppliers)) \bowtie Orders))$$
$$\rho(Valid, (P_{2020} \bowtie Ordered) - Maine)$$
$$\pi_{pname}(Valid \bowtie Parts)$$

f.

$$\rho(High, \pi_{sid} \left(\sigma_{price=1000}(Parts) \bowtie Orders \right))$$
$$\rho(Low, \pi_{sid} \left(\sigma_{price<10}(Parts) \bowtie Orders \right))$$
$$\pi_{zipcode} \left((High - Low) \bowtie Suppliers \right)$$

g.

$$\rho(O1, Orders)$$
$$\rho(O2, Orders)$$
$$\rho(Two, \pi_{O1.sid} \left(\sigma_{O1.sid=O2.sid \wedge O1.pid \neq O2.pid}(O1 \times O2) \right))$$
$$\pi_{sname}(Two \bowtie Suppliers)$$

h.

$$\rho(P1, Parts)$$
$$\rho(P2, Parts)$$
$$\rho(Max, \pi_{pid}(Parts) - \pi_{P1.pid} \left(\sigma_{P1.price<P2.price}(P1 \times P2) \right))$$
$$\pi_{pname}(Max \bowtie Parts)$$

i.

$$\rho(P1, Parts)$$
$$\rho(P2, Parts)$$
$$\rho(Max, \pi_{pid}(Parts) - \pi_{P1.pid}(\sigma_{P1.price<P2.price}(P1 \times P2)))$$

$$\rho(Remaining, Parts - (Max \bowtie Parts))$$

$$\rho(R1, Remaining)$$
$$\rho(R2, Remaining)$$
$$\rho(Second, \pi_{pid}(Remaining) - \pi_{R1.pid}(\sigma_{R1.price<R2.price}(R1 \times R2)))$$

$$\pi_{sid}(Second \bowtie Orders)$$