1.

σ inventory.amount > 0 books $\bowtie$ books.book_id = inventory.book_id inventory

2.

π order_id, order_date, cust_id, first_name, suppliers.supp_id, supp_name, book_id, title, amount, tot_price, stat_type

ρ cust_info (

    π order_id, order_date, customers.cust_id, first_name, supp_id, book_id, title, amount, tot_price, stat_type

    ρ book_info (

        π order_id, order_date, cust_id, supp_id, books.book_id, title, amount, tot_price, stat_type, stat_order.status_id

        ρ stat_order (

            π order_id, order_date, cust_id, supp_id, book_id, amount, tot_price, stat_type, orders.status_id

            σ (cust_id ≠ null ∧ orders.status_id ≠ 5 ∧ orders.status_id ≠ 6) ∨ (cust_id = null ∧ orders.status_id ≠ 3 ∧ orders.status_id ≠ 6)

            orders $\bowtie$ orders.status_id = order_status.status_id order_status

)

        $\bowtie$ books.book_id = stat_order.book_id books

)

    $\bowtie$ book_info.cust_id = customers.cust_id customers

)

$\bowtie$ cust_info.supp_id = suppliers.supp_id suppliers

3.

π customers.cust_id, first_name, last_name, phone

ρ cust_who_bought (

    π cust_id

    σ canceled = false purchases

)

$\bowtie$ customers.cust_id = cust_who_bought.cust_id customers

4.

suppliers

5.

τ _purch_id_ asc

π _purch_id, book_id, title, seller_id, seller_name, customers.cust_id, customers.first_name, purch_date, canceled, cust_pay_

ρ _ans_with_sellername_ (

    ρ _seller_name←sellers.first_name_

    π _purch_id, book_id, title, sellers.seller_id, sellers.first_name, cust_id, purch_date, canceled, cust_pay_

    ρ _answer_ (

        π _purch_id, purch.book_id, books.title, seller_id, cust_id, purch_date, canceled, cust_pay_

        ρ _purch_ (

            π _purch_id, book_id, seller_id, cust_id, purch_date, canceled, origin_price, cust_pay_

            σ _purch_date ≥ 'fromDate' ∧ purch_date ≤ 'tilDate'_ purchases

)

        $\bowtie$ _books.book_id = purch.book_id_ books

)

    $\bowtie$ _answer.seller_id = sellers.seller_id_ sellers

)

$\bowtie$ _customers.cust_id = ans_with_sellername.cust_id_ customers

6.

π _book_id, title, author_name, original_price, disc_price_

σ _discount > 0_

ρ _books_info_ (

    ρ _original_price←price_

    π _books.book_id, title, author_name, price, (price * (100 − discount) / 100)→disc_price, discount_ store_items

    $\bowtie$ _store_items.book_id = books.book_id_ books

)

7.

π _inventory.book_id, title, author_name, amount_

ρ _search_book_ (

    π _book_id, title, author_name_

    σ _title = 'bookTitle' ∧ author_name = 'bookAuthor'_ books

)

$\bowtie$ _search_book.book_id = inventory.book_id_ inventory

8.

π suppliers.supp_id, supp_name, phone, bank_acc, book_id, price

ρ supplied_books (

       π book_prices.book_id, supp_id, price

       ρ search_book (

             π book_id

             σ title = 'bookTitle' ∧ author_name = 'bookAuthor' books

)

       $\bowtie$ search_book.book_id = book_prices.book_id book_prices

) $\bowtie$ suppliers.supp_id = supplied_books.supp_id suppliers

9.

π book_sold, title, author_name

γ author_name; COUNT(book_id)→books_sold

ρ books_purch (

       π purch_id, purchases.book_id, title, author_name, purch_date, canceled

       σ purch_date ≥ 'fromDate' ∧ canceled = false

       ρ search_book (

             π book_id, title, author_name

             σ title = 'bookTitle' ∧ author_name = 'bookAuthor' books

)

       $\bowtie$ purchases.book_id = search_book.book_id purchases

)

10.

π tot_books, diff_books

γ ; COUNT(book_id)→tot_books, COUNT(DISTINCT book_id)→diff_books

ρ cust_purch (

       σ cust_id = custID ∧ canceled = false ∧ purch_date ≥ 'fromDate' purchases

)

11.

π top_cust.cust_id, book_amount, first_name, last_name, phone

ρ top_cust (

    σ rownum() = 1

    τ book_amount desc

    ρ custs_books (

        π cust_id, book_amount

        γ cust_id; COUNT(cust_id)→book_amount

        ρ purch (σ canceled = false ∧ purch_date ≥ 'fromDate' purchases)

)

)

$\bowtie$ customers.cust_id = top_cust.cust_id customers

12.

π amount, max_supp.supp_id, supp_name, phone, bank_acc

ρ max_supp (

    σ rownum() = 1

    τ amount DESC

    ρ supps_amounts (

        π supp_id, amount

        γ supp_id; SUM(amount)→amount

        σ order_date ≥ 'fromDate' ∧ status_id ≠ 1 orders

)

)

$\bowtie$ suppliers.supp_id = max_supp.supp_id suppliers

13.

π orders_amount, books_amount_ordered

γ ; COUNT(order_id)→orders_amount, SUM(amount)→books_amount_ordered

ρ orders_range (σ order_date ≥ 'fromDate' ∧ order_date ≤ 'tilDate' ∧ status_id ≠ 1 orders)

14.

π orders_amount, books_amount_ordered

γ ; COUNT(order_id)→orders_amount, SUM(amount)→books_amount_ordered

ρ orders_range (σ order_date ≥ 'fromDate' ∧ order_date ≤ 'tilDate' ∧ cust_id ≠ null ∧ status_id = 5 orders)

15.

π ; total_disc

γ ; SUM(discount)→total_disc

ρ disc_sum (

    π origin_price − cust_pay→discount

    ρ purch_disc (σ purch_date ≥ 'fromDate' ∧ cust_id = custID ∧ canceled = false purchases)

)

16.

ρ revenue (

    ρ Q1 (

        π tot_Q1

        γ ; SUM(cust_pay)→tot_Q1

        σ purch_date ≥ 'y-01-01' ∧ purch_date ≤ 'y-03-31' ∧ canceled = false purchases

)

    $\bowtie$ tot_Q1 ≠ null ∨ tot_Q1 = null

    ρ Q1Q2 (

        ρ Q2 (

            π tot_Q2

            γ ; SUM(cust_pay)→tot_Q2

            σ purch_date ≥ 'y-04-01' ∧ purch_date ≤ 'y-06-30' ∧ canceled = false purchases

)

)

    $\bowtie$ tot_Q1 ≠ null ∨ tot_Q1 = null

    ρ Q1Q2Q3 (

        ρ Q3 (

            π tot_Q3

            γ ; SUM(cust_pay)→tot_Q3

            σ purch_date ≥ 'y-07-01' ∧ purch_date ≤ 'y-09-30' ∧ canceled = false purchases

)

)

    $\bowtie$ tot_Q1 ≠ null ∨ tot_Q1 = null

    ρ Q1Q2Q3Q4 (

        ρ Q4 (

            π tot_Q4

            γ ; SUM(cust_pay)→tot_Q4

            σ purch_date ≥ 'y-10-01' ∧ purch_date ≤ 'y-12-31' ∧ canceled = false purchases

)

)

)

17.

π new_custs

γ ; COUNT(cust_id)→new_custs

σ purch_date ≥ 'fromDate'

ρ count_cust (

      ρ ordered_date (

            τ purch_date ASC

            ρ cust_purch_date (

                  π cust_id, purch_date

                  σ canceled = false purchases

)

)

)

18.

π tot_shekels

γ ; SUM(tot_price)→tot_shekels

ρ supp_orders (σ supp_id = suppID ∧ order_date ≥ 'fromDate' ∧ order_date ≤ 'tilDate' ∧ status_id ≠ 1 orders)

19.

π tot_shekels

γ ; SUM(cust_pay)→tot_shekels

ρ seller_purch (σ seller_id = sellID ∧ purch_date ≥ 'fromDate' ∧ purch_date ≤ 'tilDate' ∧ canceled = false purchases)

20.

σ rownum() > 0 ∧ rownum() ≤ 10

τ amount DESC

ρ books_order (

      π books.book_id, title, author_name, amount

      ρ count_amount (

            π book_id, amount

            γ book_id; COUNT(*)→amount

            σ purch_date ≥ 'fromDate' ∧ purch_date ≤ 'tilDate' ∧ canceled = false purchases

)

      ⋈ books.book_id = count_amount.book_id books

)