

Level: 2nd Year Bachelor's in Computer Science (2025/2026)
MODULE: DATABASES
TD No. 3: Relational Algebra

Exercise 1:

Let the following Sale relation be given:

Sale_ID	Sale_Date	Client_ID	Amount	Payment_Mode	Product
1	2026-02-10	101	25000	Credit Card	Laptop
2	2026-02-12	102	1500	Cash	Wireless Mouse
3	2026-02-14	103	10000	Credit Card	External Hard Drive
4	2026-02-16	104	18000	Bank Transfer	Laser Printer
5	2026-02-17	105	30000	Credit Card	Laptop
6	2026-02-18	106	45000	Credit Card	Laser Printer

What do the following queries return?

1. $\Pi\{\text{Payment_Mode}\}(\text{Sale})$
2. $\sigma\{\text{Product}='Laptop'\}(\text{Sale})$
3. $\Pi\{\text{Client_ID}, \text{Amount}\}\{\sigma\{\text{Payment_Mode}='Credit Card'\}(\text{Sale})\}$
4. $\sigma\{\text{Amount} > 20000\}(\text{Sale})$
5. $\sigma\{\text{Sale_Date} > '2026-02-15'\}(\text{Sale}) \cap \sigma\{\text{Product}='Laser Printer'\}(\text{Sale})$
6. $\sigma\{(\text{Amount} > 20000) \wedge (\text{Payment_Mode} = 'Credit Card')\}(\text{Sale})$?

Exercise 2

Consider the following relational schema for sales

PRODUCT (**ProductID**, Name, Brand, Price, Quantity_in_Stock)

CLIENT (**ClientID**, F_Name, L_Name, Phone_Number, E-Mail, City)

ORDER (**OrderID**, # ClientID, OrderDate, TotalAmount)

ORDER_LINE (**# OrderID**, **#ProductID**, Quantity)

Express the following queries using relational algebra:

- 1- Which **clients** live in the city "Constantine"?
- 2- What are the **ProductID**, **Name**, and **Price** of all products available in stock?
- 3- Find the ProductIDs of products from the 'Apple' and 'Samsung' brands using the UNION operation, and then using the OR operator.

- 4- Find the orders placed in the month of January, 2026 with a total amount greater than 500,000 DZD using the INTERSECTION operation, and then using the AND operator.
- 5- List all products that do not exist in the Sony brand
- 6- Find all orders with the associated client information.
- 7- Find the ProductID, Name, and Quantity of each product ordered.
- 8- Find all orders ID that contain 'Printers'.
- 9- Find the names of clients who have ordered "Apple" products.
- 10- Find the OrderID, ProductID, and Quantity for each product ordered, but only for orders placed in 2022.
- 11- Find all clients who have ordered every product from the "Printers" category
- 12- Express queries (2, 5, 8, 9, and 11) with algebraic trees."