**Exercise 1: Control Structures**

**Scenario 1**: The bank wants to apply a discount to loan interest rates for customers above 60 years old.

**Question**: Write a PL/SQL block that loops through all customers, checks their age, and if they are above 60, apply a 1% discount to their current loan interest rates.

**Code:**

BEGIN

FOR person IN (SELECT CustomerID, DOB FROM Customers) LOOP

IF MONTHS\_BETWEEN(SYSDATE, person.DOB) / 12 > 60 THEN

UPDATE Loans

SET InterestRate = InterestRate - 1

WHERE CustomerID = person.CustomerID;

END IF;

END LOOP;

END;

**Scenario 2**: A customer can be promoted to VIP status based on their balance.

**Question**: Write a PL/SQL block that iterates through all customers and sets a flag IsVIP to TRUE for those with a balance over $10,000.

**Code:**

BEGIN

FOR person IN (SELECT CustomerID, Balance FROM Customers WHERE Balance > 10000) LOOP

UPDATE Customers

SET IsVIP = TRUE

WHERE CustomerID = person.CustomerID;

END LOOP;

END;

**Scenario 3:** The bank wants to send reminders to customers whose loans are due within the next 30 days.

**Question:** Write a PL/SQL block that fetches all loans due in the next 30 days and prints a reminder message for each customer.

**Code:**

BEGIN

FOR loan IN (

SELECT CustomerID, LoanID

FROM Loans

WHERE EndDate BETWEEN SYSDATE AND SYSDATE + 30

) LOOP

DBMS\_OUTPUT.PUT\_LINE(

'Alert: Loan ' || loan.LoanID ||

' for customer ' || loan.CustomerID ||

' is approaching its end date.'

);

END LOOP;

END;

**Exercise 2: Error Handling**

**Scenario 1:** Handle exceptions during fund transfers between accounts.

**Question**: Write a stored procedure SafeTransferFunds that transfers funds between two accounts. Ensure that if any error occurs (e.g., insufficient funds), an appropriate error message is logged and the transaction is rolled back.

**Code:**

CREATE OR REPLACE PROCEDURE ExecuteFundTransfer (

src\_account NUMBER,

dest\_account NUMBER,

transfer\_amount NUMBER

) AS

low\_balance EXCEPTION;

PRAGMA EXCEPTION\_INIT(low\_balance, -20001);

current\_balance NUMBER;

BEGIN

SELECT Balance INTO current\_balance

FROM Accounts

WHERE AccountID = src\_account;

IF current\_balance < transfer\_amount THEN

RAISE low\_balance;

END IF;

UPDATE Accounts

SET Balance = Balance - transfer\_amount

WHERE AccountID = src\_account;

UPDATE Accounts

SET Balance = Balance + transfer\_amount

WHERE AccountID = dest\_account;

COMMIT;

EXCEPTION

WHEN low\_balance THEN

DBMS\_OUTPUT.PUT\_LINE('Insufficient funds in the source account.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Unexpected error because of some issues: ' || SQLERRM);

ROLLBACK;

END ExecuteFundTransfer;

**Scenario** **2**: Manage errors when updating employee salaries.

**Question**: Write a stored procedure UpdateSalary that increases the salary of an employee by a given percentage. If the employee ID does not exist, handle the exception and log an error message.

**Code:**

CREATE OR REPLACE PROCEDURE AdjustEmployeeSalary (

emp\_id NUMBER,

pct\_increase NUMBER

) AS

not\_found EXCEPTION;

PRAGMA EXCEPTION\_INIT(not\_found, -20002);

current\_salary NUMBER;

BEGIN

SELECT Salary INTO current\_salary

FROM Employees

WHERE EmployeeID = emp\_id;

UPDATE Employees

SET Salary = Salary + (Salary \* pct\_increase / 100)

WHERE EmployeeID = emp\_id;

COMMIT;

EXCEPTION

WHEN NO\_DATA\_FOUND THEN

RAISE not\_found;

WHEN not\_found THEN

DBMS\_OUTPUT.PUT\_LINE('Error: Employee not found.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Unexpected error: ' || SQLERRM);

ROLLBACK;

END AdjustEmployeeSalary;

**Scenario** **3**: Ensure data integrity when adding a new customer.

**Question**: Write a stored procedure AddNewCustomer that inserts a new customer into the Customers table. If a customer with the same ID already exists, handle the exception by logging an error and preventing the insertion.

**Code:**

CREATE OR REPLACE PROCEDURE RegisterCustomer (

new\_customer\_id NUMBER,

new\_name VARCHAR2,

new\_dob DATE,

initial\_balance NUMBER

) AS

already\_exists EXCEPTION;

PRAGMA EXCEPTION\_INIT(already\_exists, -20003);

customer\_count NUMBER;

BEGIN

SELECT COUNT(\*) INTO customer\_count

FROM Customers

WHERE CustomerID = new\_customer\_id;

IF customer\_count > 0 THEN RAISE already\_exists;

END IF;

INSERT INTO Customers (CustomerID, Name, DOB, Balance, LastModified)

VALUES (new\_customer\_id, new\_name, new\_dob, initial\_balance, SYSDATE);

COMMIT;

EXCEPTION

WHEN already\_exists THEN

DBMS\_OUTPUT.PUT\_LINE('Error: Customer already exists.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Unexpected error: ' || SQLERRM);

ROLLBACK;

END RegisterCustomer;

**Exercise 3: Stored Procedures**

**Scenario** **1**: The bank needs to process monthly interest for all savings accounts.

**Question**: Write a stored procedure ProcessMonthlyInterest that calculates and updates the balance of all savings accounts by applying an interest rate of 1% to the current balance.

**Code:**

CREATE OR REPLACE PROCEDURE ApplyMonthlyInterest AS

BEGIN

FOR account IN (

SELECT AccountID, Balance

FROM Accounts

WHERE AccountType = 'Savings'

) LOOP

UPDATE Accounts

SET Balance = Balance + (Balance \* 0.01)

WHERE AccountID = account.AccountID;

END LOOP;

COMMIT;

END ApplyMonthlyInterest;

**Scenario 2**: The bank wants to implement a bonus scheme for employees based on their performance.

**Question**: Write a stored procedure UpdateEmployeeBonus that updates the salary of employees in a given department by adding a bonus percentage passed as a parameter.

**Code:**

CREATE OR REPLACE PROCEDURE UpdateEmployeeBonus (p\_department VARCHAR2, p\_bonus\_percentage NUMBER) AS

BEGIN

UPDATE Employees

SET Salary = Salary + (Salary \* p\_bonus\_percentage / 100)

WHERE Department = p\_department;

COMMIT;

END UpdateEmployeeBonus;

Scenario 3: Customers should be able to transfer funds between their accounts.

Question: Write a stored procedure TransferFunds that transfers a specified amount from one account to another, checking that the source account has sufficient balance before making the transfer.

Code:

CREATE OR REPLACE PROCEDURE ExecuteTransfer (

source\_account NUMBER,

target\_account NUMBER,

transfer\_amount NUMBER

) AS

funds\_shortage EXCEPTION;

PRAGMA EXCEPTION\_INIT(funds\_shortage, -20001);

current\_balance NUMBER;

BEGIN

SELECT Balance INTO current\_balance

FROM Accounts

WHERE AccountID = source\_account;

IF current\_balance < transfer\_amount THEN

RAISE funds\_shortage;

END IF;

UPDATE Accounts

SET Balance = Balance - transfer\_amount

WHERE AccountID = source\_account;

UPDATE Accounts

SET Balance = Balance + transfer\_amount

WHERE AccountID = target\_account;

COMMIT;

EXCEPTION

WHEN funds\_shortage THEN

DBMS\_OUTPUT.PUT\_LINE('Error: Not enough funds in the source account.');

ROLLBACK;

WHEN OTHERS THEN

DBMS\_OUTPUT.PUT\_LINE('Unexpected error: ' || SQLERRM);

ROLLBACK;

END ExecuteTransfer;

**Exercise 4: Functions**

**Scenario 1**: Calculate the age of customers for eligibility checks.

**Question**: Write a function CalculateAge that takes a customer&#39;s date of birth as input and returns their age in years.

**Code:**

CREATE OR REPLACE FUNCTION CalculateAge (p\_dob DATE) RETURN NUMBER IS

calage NUMBER;

BEGIN

calage := FLOOR(MONTHS\_BETWEEN(SYSDATE, p\_dob) / 12);

RETURN calage;

END CalculateAge;

**Scenario 2**: The bank needs to compute the monthly installment for a loan.

**Question**: Write a function CalculateMonthlyInstallment that takes the loan amount, interest rate, and loan duration in years as input and returns the monthly installment amount.

**Code:**

CREATE OR REPLACE FUNCTION CalculateMonthlyInstallment (

p\_loan\_amount NUMBER,

p\_interest\_rate NUMBER,

p\_duration\_years NUMBER

) RETURN NUMBER IS

l\_monthly\_installment NUMBER;

l\_monthly\_rate NUMBER;

l\_num\_payments NUMBER;

BEGIN

IF p\_interest\_rate = 0 THEN

l\_monthly\_installment := p\_loan\_amount / (p\_duration\_years \* 12);

ELSE

l\_monthly\_rate := p\_interest\_rate / 1200;

l\_num\_payments := p\_duration\_years \* 12;

l\_monthly\_installment := p\_loan\_amount \* l\_monthly\_rate /

(1 - POWER(1 + l\_monthly\_rate, -l\_num\_payments));

END IF;

RETURN l\_monthly\_installment;

END CalculateMonthlyInstallment;

**Scenario 3:** Check if a customer has sufficient balance before making a transaction.

**Question**: Write a function HasSufficientBalance that takes an account ID and an amount as input and returns a boolean indicating whether the account has at least the specified amount.

**Code:**

CREATE OR REPLACE FUNCTION HasSufficientBalance (p\_account\_id NUMBER, p\_amount NUMBER) RETURN BOOLEAN IS

l\_balance NUMBER;

BEGIN

SELECT Balance INTO l\_balance FROM Accounts WHERE AccountID = p\_account\_id;

RETURN l\_balance >= p\_amount;

EXCEPTION

WHEN NO\_DATA\_FOUND THEN

RETURN FALSE;

END HasSufficientBalance;

**Exercise 5: Triggers**

**Scenario 1**: Automatically update the last modified date when a customer’s record is updated.

**Question**: Write a trigger UpdateCustomerLastModified that updates the LastModified column of the Customers table to the current date whenever a customer’s record is updated.

**Code:**

CREATE OR REPLACE TRIGGER UpdateCustomerLastModified

BEFORE UPDATE ON Customers

FOR EACH ROW

BEGIN

:NEW.LastModified := SYSDATE;

END;

**Scenario 2**: Maintain an audit log for all transactions.

**Question**: Write a trigger LogTransaction that inserts a record into an AuditLog table whenever a transaction is inserted into the Transactions table.

**Code:**

CREATE OR REPLACE TRIGGER LogTransaction AFTER INSERT ON Transactions

FOR EACH ROW

BEGIN

INSERT INTO AuditLog (TransactionID, AccountID, TransactionDate, Amount, TransactionType)

VALUES (:NEW.TransactionID, :NEW.AccountID, :NEW.TransactionDate, :NEW.Amount, :NEW.TransactionType);

END LogTransaction;

**Scenario 3**: Enforce business rules on deposits and withdrawals.

**Question**: Write a trigger CheckTransactionRules that ensures withdrawals do not exceed the balance and deposits are positive before inserting a record into the Transactions table.

**Code:**

CREATE OR REPLACE TRIGGER CheckTransactionRules

BEFORE INSERT ON Transactions

FOR EACH ROW

BEGIN

IF :NEW.TransactionType = 'Withdrawal' THEN

DECLARE l\_balance NUMBER;

BEGIN

SELECT Balance INTO l\_balance FROM Accounts WHERE AccountID = :NEW.AccountID;

IF l\_balance < :NEW.Amount THEN

RAISE\_APPLICATION\_ERROR(-20000, 'Insufficient balance for withdrawal.');

END IF;

END;

ELSIF :NEW.TransactionType = 'Deposit' THEN

IF :NEW.Amount <= 0 THEN

RAISE\_APPLICATION\_ERROR(-20001, 'Deposit amount must be positive.');

END IF;

END IF;

END CheckTransactionRules;

**Exercise 6: Cursors**

**Scenario 1**: Generate monthly statements for all customers.

**Question**: Write a PL/SQL block using an explicit cursor GenerateMonthlyStatements that retrieves all transactions for the current month and prints a statement for each customer.

**Code:**

BEGIN

FOR mon\_cust IN (SELECT CustomerID FROM Customers) LOOP

DBMS\_OUTPUT.PUT\_LINE('Statement for Customer ID: ' || mon\_cust.CustomerID);

FOR txn IN (

SELECT \*

FROM Transactions

WHERE AccountID IN (

SELECT AccountID

FROM Accounts

WHERE CustomerID = mon\_cust.CustomerID

)

AND TransactionDate BETWEEN TRUNC(SYSDATE, 'MM') AND LAST\_DAY(SYSDATE)

) LOOP

DBMS\_OUTPUT.PUT\_LINE(

'Transaction ID: ' || txn.TransactionID ||

', Amount: ' || txn.Amount ||

', Type: ' || txn.TransactionType

);

END LOOP;

END LOOP;

END;

**Scenario 2**: Apply annual fee to all accounts.

**Question**: Write a PL/SQL block using an explicit cursor ApplyAnnualFee that deducts an annual maintenance fee from the balance of all accounts.

**Code:**

BEGIN

FOR acc IN (SELECT AccountID FROM Accounts) LOOP

UPDATE Accounts

SET Balance = Balance - 100

WHERE AccountID = acc.AccountID;

END LOOP;

COMMIT;

END;

**Scenario 3**: Update the interest rate for all loans based on a new policy.

**Question**: Write a PL/SQL block using an explicit cursor UpdateLoanInterestRates that fetches all loans and updates their interest rates based on the new policy.

**Code:**

BEGIN

FOR loan IN (SELECT LoanID FROM Loans) LOOP

UPDATE Loans

SET InterestRate = InterestRate + 0.5

WHERE LoanID = loan.LoanID;

END LOOP;

COMMIT;

END;

**Exercise 7: Packages**

**Scenario** **1**: Group all customer-related procedures and functions into a package.

**Question**: Create a package CustomerManagement with procedures for adding a new customer, updating customer details, and a function to get customer balance.

**Code:**

CREATE OR REPLACE PACKAGE CustomerManagement AS

PROCEDURE AddClient (

p\_id NUMBER,

p\_full\_name VARCHAR2,

p\_birthdate DATE,

p\_account\_balance NUMBER

);

PROCEDURE ModifyClient (

p\_id NUMBER,

p\_full\_name VARCHAR2,

p\_birthdate DATE,

p\_account\_balance NUMBER

);

FUNCTION RetrieveClientBalance (

p\_id NUMBER

) RETURN NUMBER;

END CustomerManagement;

CREATE OR REPLACE PACKAGE BODY CustomerManagement AS

PROCEDURE AddClient (

p\_id NUMBER,

p\_full\_name VARCHAR2,

p\_birthdate DATE,

p\_account\_balance NUMBER

) IS

BEGIN

INSERT INTO Customers (CustomerID, Name, DOB, Balance, LastModified)

VALUES (p\_id, p\_full\_name, p\_birthdate, p\_account\_balance, SYSDATE);

COMMIT;

END AddClient;

PROCEDURE ModifyClient (

p\_id NUMBER,

p\_full\_name VARCHAR2,

p\_birthdate DATE,

p\_account\_balance NUMBER

) IS

BEGIN

UPDATE Customers

SET Name = p\_full\_name,

DOB = p\_birthdate,

Balance = p\_account\_balance,

LastModified = SYSDATE

WHERE CustomerID = p\_id;

COMMIT;

END ModifyClient;

FUNCTION RetrieveClientBalance (

p\_id NUMBER

) RETURN NUMBER IS

l\_current\_balance NUMBER;

BEGIN

BEGIN

SELECT Balance INTO l\_current\_balance

FROM Customers

WHERE CustomerID = p\_id;

EXCEPTION

WHEN NO\_DATA\_FOUND THEN

l\_current\_balance := NULL;

END;

RETURN l\_current\_balance;

END RetrieveClientBalance;

END CustomerManagement;

**Scenario 2**: Create a package to manage employee data.

**Question**: Write a package EmployeeManagement with procedures to hire new employees, update employee details, and a function to calculate annual salary.

**Code:**

CREATE OR REPLACE PACKAGE EmployeeManagement AS

PROCEDURE AddNewEmployee (

p\_emp\_id NUMBER,

p\_full\_name VARCHAR2,

p\_job\_title VARCHAR2,

p\_monthly\_salary NUMBER,

p\_dept VARCHAR2,

p\_start\_date DATE

);

PROCEDURE ModifyEmployeeDetails (

p\_emp\_id NUMBER,

p\_full\_name VARCHAR2,

p\_job\_title VARCHAR2,

p\_monthly\_salary NUMBER,

p\_dept VARCHAR2

);

FUNCTION ComputeAnnualSalary (

p\_emp\_id NUMBER

) RETURN NUMBER;

END EmployeeManagement;

CREATE OR REPLACE PACKAGE BODY EmployeeManagement AS

PROCEDURE AddNewEmployee (

p\_emp\_id NUMBER,

p\_full\_name VARCHAR2,

p\_job\_title VARCHAR2,

p\_monthly\_salary NUMBER,

p\_dept VARCHAR2,

p\_start\_date DATE

) IS

BEGIN

INSERT INTO Employees (EmployeeID, Name, Position, Salary, Department, HireDate)

VALUES (p\_emp\_id, p\_full\_name, p\_job\_title, p\_monthly\_salary, p\_dept, p\_start\_date);

COMMIT;

END AddNewEmployee;

PROCEDURE ModifyEmployeeDetails (

p\_emp\_id NUMBER,

p\_full\_name VARCHAR2,

p\_job\_title VARCHAR2,

p\_monthly\_salary NUMBER,

p\_dept VARCHAR2

) IS

BEGIN

UPDATE Employees

SET Name = p\_full\_name,

Position = p\_job\_title,

Salary = p\_monthly\_salary,

Department = p\_dept

WHERE EmployeeID = p\_emp\_id;

COMMIT;

END ModifyEmployeeDetails;

FUNCTION ComputeAnnualSalary (

p\_emp\_id NUMBER

) RETURN NUMBER IS

l\_monthly\_salary NUMBER;

BEGIN

SELECT Salary INTO l\_monthly\_salary

FROM Employees

WHERE EmployeeID = p\_emp\_id;

RETURN l\_monthly\_salary \* 12;

END ComputeAnnualSalary;

END EmployeeManagement;

**Scenario 3**: Group all account-related operations into a package.

**Question**: Create a package AccountOperations with procedures for opening a new account, closing an account, and a function to get the total balance of a customer across all accounts.

**Code:**

CREATE OR REPLACE PACKAGE AccountManagement AS

PROCEDURE CreateAccount (

p\_acc\_id NUMBER,

p\_client\_id NUMBER,

p\_acc\_type VARCHAR2,

p\_initial\_balance NUMBER

);

PROCEDURE RemoveAccount (

p\_acc\_id NUMBER

);

FUNCTION CalculateTotalBalance (

p\_client\_id NUMBER

) RETURN NUMBER;

END AccountManagement;

/

CREATE OR REPLACE PACKAGE BODY AccountManagement AS

PROCEDURE CreateAccount (

p\_acc\_id NUMBER,

p\_client\_id NUMBER,

p\_acc\_type VARCHAR2,

p\_initial\_balance NUMBER

) IS

BEGIN

INSERT INTO Accounts (AccountID, CustomerID, AccountType, Balance, LastModified)

VALUES (p\_acc\_id, p\_client\_id, p\_acc\_type, p\_initial\_balance, SYSDATE);

COMMIT;

END CreateAccount;

PROCEDURE RemoveAccount (

p\_acc\_id NUMBER

) IS

BEGIN

DELETE FROM Accounts WHERE AccountID = p\_acc\_id;

COMMIT;

END RemoveAccount;

FUNCTION CalculateTotalBalance (

p\_client\_id NUMBER

) RETURN NUMBER IS

l\_balance\_sum NUMBER;

BEGIN

SELECT SUM(Balance) INTO l\_balance\_sum

FROM Accounts

WHERE CustomerID = p\_client\_id;

RETURN l\_balance\_sum;

END CalculateTotalBalance;

END AccountManagement;

/