QUESTION

Write a complete C++ program based on the UML class diagram given in **Figure 1**. Your program should be able to produce the output shown in **Figure 2**.

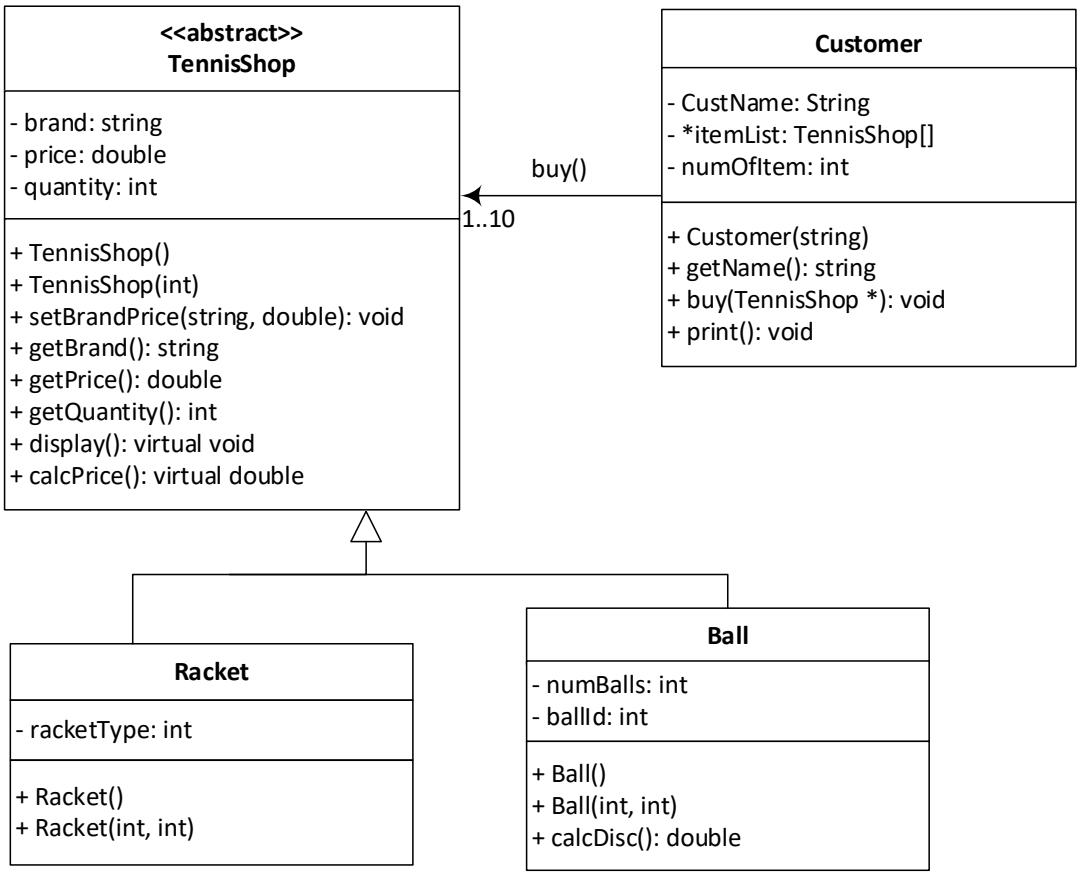

Figure 1: UML class diagram

```
WELCOME ARIF AIMAN

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 1

<< Item to buy >>
  [1] Racket
  [2] Ball
Choice: 1

*** Racket ***
  [1] Wilson: Junior Tennis Racket
  [2] Yonex: Beginners Tennis Racket
  [3] Yonex: Advanced Tennis Racket
  [4] Dunlop: All Tennis Racket
Choice: 2
```

```
Quantity: 3

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 1

<< Item to buy >>
  [1] Racket
  [2] Ball
Choice: 2

*** Ball ***
  [1] Wilson: Roland Garros All Court
  [2] Wilson: US Open
  [3] Dunlop: Fort Max TP KNLTB
  [4] Dunlop: Fort All Court
Choice: 3
Quantity: 2

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 1

<< Item to buy >>
  [1] Racket
  [2] Ball
Choice: 1

*** Racket ***
  [1] Wilson: Junior Tennis Racket
  [2] Yonex: Beginners Tennis Racket
  [3] Yonex: Advanced Tennis Racket
  [4] Dunlop: All Tennis Racket
Choice: 4
Quantity: 1

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 2

LIST OF TENNIS ITEMS BOUGHT

----- Item #1 -----
Tennis Racket
Brand   : Yonex
Type    : Beginners Tennis Racket
Price   : RM 719.70
No Discount!
Quantity: 3
Subtotal: RM 2159.10
```

```
----- Item #2 -----
Tennis Ball
Brand      : Fort Max TP KNLTB
Description: Dunlop
Price      : RM 81.00 for 4 balls per tube
Discount   : 15.00%
Quantity   : 2
Subtotal   : RM 137.70

----- Item #3 -----
Tennis Racket
Brand   : Dunlop
Type    : All Tennis Racket
Price   : RM 989.70
No Discount!
Quantity: 1
Subtotal: RM 989.70

TOTAL: RM 3286.50

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 4

Invalid input. Try again!

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 0

Invalid input. Try again!

==========[MENU]============
  [1] Buy item
  [2] Print all items
  [3] Exit
============================
Choice: 3

Thank you for using this system ;)
```

Figure 2: Example output of the program

Implement all the classes with the member variables (attributes) and member functions (methods) specified in the diagram. The purpose of each function is as the name implies, and some of them are further explained below. Note that the definition for the **`TennisShop`** superclass is fully given (refer to **Figure 3**). Write the program based on the following tasks:

(a) Write a subclass **`Racket`** with the following codes:

(i) Define all the member variables of the class.

(ii) Write the codes for a constructor with no argument that will do nothing.

(iii) Write the codes for a constructor with arguments that will initialize all the member attributes for the class, including the superclass's attribute named **`quantity`**.

```
1   class TennisShop {
2    private:
3       string brand;
4       double price;
5       int quantity;
6
7    public:
8       TennisShop() {}
9
10      TennisShop(int quantity) {
11        this->quantity = quantity;
12      }
13
14        void setBrandPrice(string brand, double price) {
15        this->price = price;
16        this->brand = brand;
17      }
18
19      string getBrand() { return brand; }
20      double getPrice() { return price; }
21      int getQuantity() { return quantity; }
22
23      virtual void display() = 0;
24      virtual double calcPrice() = 0;
25  };
```

Figure 3: `TennisShop` class

(iv) Write the codes for the **`display()`** function that will print the brand, name of racket type, price, and quantity of rackets purchased. **Table 1** shows the prices vary according to the type of racket. The function will also print the total price of rackets purchased by calling **`calcPrice()`**. **Note:** You must use proper output formatting to generate the output, as shown in **Figure 2**.

Table 1: Racket type and price

Racket Type	Name of Racket Type	Brand	Price (RM)
1	Junior Tennis Racket	Wilson	569.70
2	Beginners Tennis Racket	Yonex	719.70
3	Advanced Tennis Racket	Yonex	1289.70
4	All Tennis Racket	Dunlop	989.70

(v) Write the codes for **`calcPrice()`** that will calculate and return the total price of rackets purchased.

(b) Write a subclass **`Ball`** with the following codes:

(i) Define all the member variables of the class.

(ii) Write the codes for a constructor with no argument that will do nothing.

(iii) Write the codes for a constructor with arguments that will initialize all the member attributes for the class, including the superclass's attribute named **`quantity`**.

(iv) Write the codes for **`calcDisc()`** function that will calculate and return the new price after the discount deducted, where the discount received is 15 percent of the price of the balls.

(v) Write the codes for the **`display()`** function that will print the brand, description of the ball, number of balls per tube, price, discount received, and quantity of a set of balls purchased. **Table 2** shows the prices vary according to the id of the ball. The function will also print the total price of a set of balls purchased by calling **`calcPrice()`**. **Note:** You must use proper output formatting to generate the output, as shown in **Figure 2**.

Table 2: Ball id and price

Ball Id	Ball Description	Brand	Number of balls (per tube)	Price (RM)
1	Roland Garros All Court	Wilson	4	38.40
2	US Open	Wilson	3	28.80
3	Fort Max TP KNLTB	Dunlop	4	81.00
4	Fort All Court	Dunlop	3	33.00

(vi) Write the codes for **`calcPrice()`** that will call **`calcDisc()`** and return the total price of balls purchased after the discount deducted.

(c) Write a class named **`Customer`** with the following codes:

(i) Define all the member variables of the class.

(ii) Write the codes for a constructor with arguments that accepts the customer's name. This value should be assigned to the customer's name member variable. Then, initialize **`numOfItem`** member variable to zero.

(iii) Write the codes for **`getName()`** function to return customer's name.

(iv) Write the codes for **`buy`** function that update the pointers array named **`itemList`** to include the new pointer of **`TennisShop`** in the array (assign an element in the array of **`TennisShop`** pointers with the passed argument). Then, update the number of items inserted into the array.

(v) Write the codes for **`print()`** function that prints the information of the items bought (using **`display()`** function) and update the total payment for all items bought (including discount). **Note:** You must use proper output formatting to generate the output, as shown in **Figure 2**.

(d) Write three functions named **`displayMainMenu()`**, **`displayRacketMenu()`**, and **`displayBallMenu()`** to provide the user a menu-driven interaction. The definition for all the functions are fully given in **Figure 4**.

```
1  int displayMainMenu() {
2    int choice;
3    cout << "==========[MENU]============\n"
4         << "  [1] Buy item\n"
5         << "  [2] Print all items\n"
6         << "  [3] Exit\n"
7         << "============================\n"
8         << "Choice: ";
9    cin >> choice;
10   return choice;
11 }
12
13 int displayRacketMenu() {
14   int choice;
15   cout << "  [1] Wilson: Junior Tennis Racket\n"
16        << "  [2] Yonex: Beginners Tennis Racket\n"
17        << "  [3] Yonex: Advanced Tennis Racket\n"
18        << "  [4] Dunlop: All Tennis Racket\n"
19        << "Choice: ";
20   cin >> choice;
21   return choice;
22 }
23
24 int displayBallMenu() {
25   int choice;
26   cout << "  [1] Wilson: Roland Garros All Court\n"
27        << "  [2] Wilson: US Open\n"
28        << "  [3] Dunlop: Fort Max TP KNLTB\n"
29        << "  [4] Dunlop: Fort All Court\n"
30        << "Choice: ";
31   cin >> choice;
32   return choice;
33 }
```

Figure 4: Menu-driven interaction functions

(e) Write **`main()`** function. The definition for **`main()`** function is partially given in **Figure 5**. Complete the function with the following codes:

```
1  int main() {
2    TennisShop *p;
3    Customer c("ARIF AIMAN");
4
5    //Complete your function start from here
6    //Define any suitable variables for the program
7    //Write the codes based on the tasks listed in (e)
8  }
```

Figure 5: Incomplete **`main()`** function

(i) Display welcome message to customer.

(ii) Enter the task chosen.

(iii) In **`case 1`**:

- Enter the item chosen.
- Enter the details of the item chosen.
- Dynamically allocates a new item (racket or ball) object to the **`TennisShop`** pointer.
- Add the item to the **`Customer`** object.

(iv) In **`case 2`**, display the list of the tennis items bought.

(v) In **`case 3`**, display an appropriate message and exit the program.

Figure 2 shows a sample screen output that your program should produce. Note that all the interactions shown in **Figure 2** are continuous in a single run. Note also that the **bold** texts indicate input entered by the user.