

BIG DATA MANAGEMENT

POST GRADUATE DIPLOMA IN DATA ENGINEERING

ASSIGNMENT - 6

SUBMITTED BY:

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SUBMISSION DATE: 15th December, 2024

**DEPARTMENT OF AIDE
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Step – 1:

Cluster configuration

Cluster identifier
This is the unique key that identifies a cluster.

The identifier must be from 1-63 characters. Valid characters are a-z (lowercase only) and - (hyphen).

Choose the size of the cluster

☒ I'll choose
☐ Help me choose

Node type [Info](#)
Choose a node type that meets your CPU, RAM, storage capacity, and drive type requirements.

AZ configuration [Info](#)
Choose if you want to deploy the Redshift cluster in another Availability Zone.

☒ **Single-AZ**
Compute resources are deployed in a single Availability Zone. The cluster is default to use the **Current track**

☐ **Multi-AZ - new**
Compute resources are deployed in two Availability Zones. The cluster is default to use the **Trailing track**

Number of nodes
Enter the number of nodes that you need.

Range (1-16)

Step – 2:

Database configurations

Admin user name
Enter a login ID for the admin user of your DB instance.

The name must be 1-128 alphanumeric characters, and it can't be a [reserved word](#).

Admin password
Select an option to manage your admin password.

☐ **Manage admin credentials in AWS Secrets Manager** [Info](#)
AWS manages a KMS key that encrypts your data.

☐ **Generate a password**
Amazon Redshift generates an admin password.

☒ **Manually add the admin password**
Manually enter the admin password.

Admin user password

Must be 8-64 characters long. Must contain at least one uppercase letter, one lowercase letter and one number. Can be any printable ASCII character except `"/", """, or "@"`.

☐ Show password

☒ **Enable cluster encryption**
Encrypt your cluster's data, using keys managed by the AWS Key Management Service.

Choose a key type
Encrypt all the data on your cluster. Choose one of the following:

☐ AWS managed key
 ☐ Customer managed key.

Step -3:

Additional configurations ☒ Use defaults

These configurations are optional, and default settings have been defined to help you get started with your cluster. Turn off "Use defaults" to modify these settings now.


Network Using default VPC (vpc-007122088dc0ac754) and default subnet .	Backup Automated snapshots are created about every eight hours or following every 5 GB per node of data changes, whichever comes first.
Security Using default (sg-06826a1726efe6941) cluster security group.	Maintenance Using current maintenance track.
Configuration Using default.redshift-1.0 parameter group with no database encryption.	

Step – 4:

Edit publicly accessible

Publicly accessible


☒ Turn on Publicly accessible
 Allow public connections to Amazon Redshift.

 When you turn on this feature, clients can connect to the database from outside the VPC. You will need to configure the security group to accept connections on the respective cluster port and associate the route table and internet gateway to the cluster VPC.

Elastic IP address

Select the Elastic IP address for connecting to the cluster.

None

 It can take about ten minutes for the setting to change and connections to succeed.

Cancel

Save changes

Step – 5:

g23ai2087-cluster

Actions

Edit

Add partner integration

Query data

General information

Cluster identifier

g23ai2087-cluster

Status

Modifying

Node type

ra3.large

Endpoint

g23ai2087-cluster.cndskybccs1r.us-east-1.redshift.amazonaws.com:5439/dev

Custom domain name

-

Date created

December 15, 2024, 12:02 (UTC+05:30)

Number of nodes

1

JDBC URL

jdbc:redshift://g23ai2087-cluster.cndskybccs1r.us-east-1.redshift.amazonaws.com:5439/dev

Cluster namespace ARN

arn:aws:redshift:us-east-1:922761745009:namespace:0b040ff9-7c3e-4258-a17e-e1d30bc4a161

Multi-AZ

No

Patch version

Patch 186

ODBC URL

Driver={Amazon Redshift (x64)}; Server=g23ai2087-cluster.cndskybccs1r.us-east-1.redshift.amazonaws.com; Database=dev

Namespace register status

Deregistered

Cluster configuration

Production

Storage used

0.00 of 8 TB used (0.00%)

Step – 6:

Permissions policies (11)

Remove

Add permissions

Permissions are defined by policies attached to the user directly or through groups.

Filter by Type

All types

Search

< 1 >

Policy name	Type	Attached via
AmazonRedshift-CommandsAccessPolicy-2024...	Customer managed	Directly
AmazonRedshift-CommandsAccessPolicy-2024...	Customer managed	Directly
AmazonRedshiftAllCommandsFullAccess	AWS managed	Directly
AmazonRedshiftDataFullAccess	AWS managed	Directly
AmazonRedshiftFullAccess	AWS managed	Directly
AmazonRedshiftQueryEditor	AWS managed	Directly
AmazonRedshiftQueryEditorV2FullAccess	AWS managed	Directly
AmazonRedshiftQueryEditorV2NoSharing	AWS managed	Directly
AmazonRedshiftQueryEditorV2ReadSharing	AWS managed	Directly
AmazonRedshiftQueryEditorV2ReadWriteSh...	AWS managed	Directly
AmazonRedshiftReadOnlyAccess	AWS managed	Directly

Step – 7:

g23ai2087-user

Delete

Summary

ARN

arn:aws:iam::922761745009:user/g23ai2087-user

Console access

Disabled

Access key 1

Create access key

Created

December 15, 2024, 11:15 (UTC+05:30)

Last console sign-in

-

Permissions

Groups

Tags

Security credentials

Last Accessed

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Step – 8:

Permissions policies (4/1025) [Info](#)

Choose one or more policies to attach to your new role.

Filter by Type All types 18 matches

<input type="checkbox"/>	Policy name	Type	Description
<input type="checkbox"/>	AmazonDataZoneRedshiftGlueProvisioningPolicy	AWS managed	Amazon DataZone is a data managem...
<input type="checkbox"/>	AmazonDataZoneRedshiftManageAccessRolePolicy	AWS managed	This policy gives Amazon DataZone pe...
<input type="checkbox"/>	AmazonDMSRedshiftS3Role	AWS managed	Provides access to manage S3 settings...
<input type="checkbox"/>	AmazonGrafanaRedshiftAccess	AWS managed	This policy grants scoped access to Am...
<input type="checkbox"/>	AmazonMachineLearningRoleforRedshiftDataSource...	AWS managed	Allows Machine Learning to configure ...
<input type="checkbox"/>	AmazonRedshift-CommandsAccessPolicy-20241215T0...	Customer managed	-
<input type="checkbox"/>	AmazonRedshift-CommandsAccessPolicy-20241215T0...	Customer managed	-
<input type="checkbox"/>	AmazonRedshift-CommandsAccessPolicy-20241215T1...	Customer managed	-
<input checked="" type="checkbox"/>	AmazonRedshiftAllCommandsFullAccess	AWS managed	This policy includes permissions to run...
<input checked="" type="checkbox"/>	AmazonRedshiftDataFullAccess	AWS managed	This policy provides full access to Ama...
<input checked="" type="checkbox"/>	AmazonRedshiftFullAccess	AWS managed	Provides full access to Amazon Redshif...
<input type="checkbox"/>	AmazonRedshiftQueryEditor	AWS managed	Provides full access to the Amazon Re...
<input checked="" type="checkbox"/>	AmazonRedshiftQueryEditorV2FullAccess	AWS managed	Grants full access to the Amazon Reds...

Step – 9:

Trusted entity type

☒ **AWS service**
Allow AWS services like EC2, Lambda, or others to perform actions in this account.

☐ **AWS account**
Allow entities in other AWS accounts belonging to you or a 3rd party to perform actions in this account.

☐ **Web identity**
Allows users federated by the specified external web identity provider to assume this role to perform actions in this account.

☐ **SAML 2.0 federation**
Allow users federated with SAML 2.0 from a corporate directory to perform actions in this account.

☐ **Custom trust policy**
Create a custom trust policy to enable others to perform actions in this account.

Use case
Allow an AWS service like EC2, Lambda, or others to perform actions in this account.

Service or use case
Redshift

Choose a use case for the specified service.

Use case

☒ **Redshift - Customizable**
Allows Redshift clusters to call AWS services on your behalf.

☐ **Redshift**
Allows Redshift clusters to call AWS services on your behalf.

☐ **Redshift - Scheduler**
Allow Redshift Scheduler to call Redshift on your behalf.

Role details

Role name

Enter a meaningful name to identify this role.

Reshift-Access-Niraj-Bhagchandani

Maximum 64 characters. Use alphanumeric and '+', '@', '-' characters.

Description

Add a short explanation for this role.

Allows Redshift clusters to call AWS services on your behalf.

Maximum 1000 characters. Use letters (A-Z and a-z), numbers (0-9), tabs, new lines, or any of the following characters: '_', '-', '.', '/', '[', ']', '#', '\$', '%', '^', '~', '*'. Escapes are supported as well.

Step 1: Select trusted entities

Edit

1. Write the method `connect()` to make a connection to the database. [5]

```

1. public Connection connect() {
2.     try {
3.         Class.forName("com.amazon.redshift.jdbc42.Driver");
4.         Properties properties = new Properties();
5.         properties.setProperty("user", masterUsername);
6.         properties.setProperty("password", password);
7.
8.         this.con = DriverManager.getConnection(redshiftUrl, properties);
9.
10.        System.out.println("Connection to Redshift established
successfully.");
11.    } catch (ClassNotFoundException e) {
12.        System.out.println("Error: Redshift JDBC driver not found.");
13.        e.printStackTrace();
14.    } catch (SQLException e) {
15.        System.out.println("Failed to connect to the database.");
16.        e.printStackTrace();
17.    }
18.    return con;
19. }

```

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```

C:\Windows\system32\cmd.exe - java -cp Drivers\*; . AmazonRedshift
D:\iitj\tri-3\BDM\iitj-bdm-assignment\Assignment - 6>java -cp Drivers\*; . AmazonRedshift

===== Amazon Redshift Menu =====
1. Connect to the database
2. Drop all tables
3. Create schema and tables
4. Insert TPC-H Data
5. Execute Query 1
6. Execute Query 2
7. Execute Query 3
8. Close the connection
9. Exit
Enter your choice: 1
Connection to Redshift established successfully.

```

2. Method close() to close the connection to the database. [5]

Code:

```

1. public void close() {
2.     System.out.println("Closing database connection.");
3.     try {
4.         if (con != null && !con.isClosed()) {
5.             con.close();
6.         }
7.     } catch (SQLException e) {
8.         System.out.println("Error closing the connection.");
9.     }
10. }

```

Output:

```

C:\Windows\system32\cmd.exe - java --add-opens java.base/java.net=ALL-UNNAMED -cp "Drivers/*;" AmazonRedshift

===== Amazon Redshift Menu =====
1. Connect to the database
2. Drop all tables
3. Create schema and tables
4. Insert TPC-H Data
5. Execute Query 1
6. Execute Query 2
7. Execute Query 3
8. Close the connection
9. Exit
Enter your choice: 8
Closing database connection.

```

3. Method drop() to drop all the tables from the database. Note: The database schema name will be dev. [5]

Code:

```

1. public void drop() {
2.     System.out.println("Dropping all tables in the 'dev' schema...");
3.     String dropQuery = "SELECT tablename FROM pg_tables WHERE schemaname = 'dev'";
4.
5.     try (Statement stmt = con.createStatement()) {
6.         ResultSet rs = stmt.executeQuery(dropQuery);

```

```

7.         while (rs.next()) {
8.             String tableName = rs.getString("tablename");
9.             String dropTableQuery = "DROP TABLE IF EXISTS dev." + tableName;
10.            stmt.executeUpdate(dropTableQuery);
11.            System.out.println("Dropped table: " + tableName);
12.        }
13.    } catch (SQLException e) {
14.        System.out.println("Error dropping tables: " + e.getMessage());
15.    }
16.    }
17. Output:
18. Method create() to create the database dev and the tables. [5]
19. Code:
20. public void create() throws SQLException {
21.     System.out.println("Creating the 'dev' schema and tables...");
22.     String createSchemaQuery = "CREATE SCHEMA IF NOT EXISTS dev";
23.     try (Statement stmt = con.createStatement()) {
24.         stmt.executeUpdate(createSchemaQuery);
25.         System.out.println("Schema 'dev' created.");
26.     } catch (SQLException e) {
27.         System.out.println("Error creating schema: " + e.getMessage());
28.     }
29.     File ddlFolder = new File("ddl");
30.     File[] ddlFiles = ddlFolder.listFiles((dir, name) ->
        name.endsWith(".sql"));
31.     if (ddlFiles != null) {
32.         for (File ddlFile : ddlFiles) {
33.             try {
34.                 String ddlQuery = new
String(files.readAllBytes(ddlFile.toPath()));
35.                 if (ddlFile.getName().equals("tpch_create.sql")) {
36.                     // Ensure the 'tpch_create.sql' contains CREATE TABLE
queries
37.                     if (ddlQuery.toUpperCase().contains("CREATE TABLE")) {
38.                         try (Statement stmt = con.createStatement()) {
39.                             stmt.executeUpdate(ddlQuery);
40.                             System.out.println("Created table(s) from " +
ddlFile.getName());
41.                         }
42.                     } else {
43.                         System.out.println("No CREATE TABLE queries found in
tpch_create.sql.");
44.                     }
45.                 } else {
46.                     System.out.println("Skipping non-CREATE TABLE SQL file: "
+ ddlFile.getName());
47.                 }
48.             } catch (IOException e) {
49.                 System.out.println("Error reading DDL file: " +
ddlFile.getName() + " - " + e.getMessage());
50.             } catch (SQLException e) {
51.                 System.out.println("Error executing DDL query for file " +
ddlFile.getName() + " - " + e.getMessage());
52.             }

```



```

53.         }
54.     } else {
55.         System.out.println("No DDL files found in 'ddl' folder.");
56.     }
57. }

```

Output:

4. Write the method insert() to add the standard TPC-H data into the database. The DDL files are in the ddl folder. Hint: Files are designed so can read entire file as a string and execute it as one statement. May need to divide up into batches for large files. [10]

Code:

```

1. public void insert() {
2.     File dataFolder = new File("ddl");
3.     File[] dataFiles = dataFolder.listFiles((dir, name) ->
        name.endsWith(".sql") && !name.equals("tpch_create.sql"));
4.
5.     if (dataFiles != null) {
6.         // Use a CountdownLatch to wait for all insertions to complete
7.         CountdownLatch latch = new CountdownLatch(dataFiles.length);
8.
9.         for (File dataFile : dataFiles) {
10.            executorService.submit(() -> {
11.                processFile(dataFile);
12.                latch.countDown(); // Decrease latch count when each file is
processed
13.            });
14.        }
15.        try {
16.            // Wait until all insert tasks are completed
17.            latch.await();
18.            System.out.println("All data insertions completed.");
19.        } catch (InterruptedException e) {
20.            System.out.println("Error waiting for insertions to complete: " +
e.getMessage());
21.        }
22.    } else {
23.        System.out.println("No data files found in the folder.");
24.    }
25. }
26. private void processFile(File dataFile) {
27.     try {
28.         // Read the SQL query from the file
29.         String sqlQuery = new String(Files.readAllBytes(dataFile.toPath()));
30.
31.         // Log the start of the process
32.         System.out.println("Processing file: " + dataFile.getName());
33.
34.         // Open the Statement for executing the insert query
35.         try (Statement stmt = con.createStatement()) {

```

```

36.         // Split the SQL query into individual statements (assuming
multiple INSERT statements in the file)
37.         String[] insertStatements = sqlQuery.split(";");
38.         int totalStatements = insertStatements.length; // Total number of
statements in the file
39.
40.         int batchCount = 0;
41.         int recordCount = 0;
42.
43.         // Process each INSERT statement
44.         for (String statement : insertStatements) {
45.             if (statement.trim().isEmpty()) continue;
46.
47.             // Add the statement to the batch
48.             stmt.addBatch(statement.trim());
49.             batchCount++;
50.
51.             // Execute the batch every 500 records
52.             if (batchCount % 500 == 0) {
53.                 stmt.executeBatch(); // Execute the batch
54.                 recordCount += 500;
55.
56.                 // Calculate and display progress
57.                 double percentageCompleted = (recordCount / (double)
totalStatements) * 100;
58.                 int remainingRecords = totalStatements - recordCount;
59.                 System.out.printf("File: %s | Inserted: %d | Remaining:
%d | Progress: %.2f%%\n",
60.                                 dataFile.getName(), recordCount,
remainingRecords, percentageCompleted);
61.             }
62.         }
63.         if (batchCount > 0) {
64.             stmt.executeBatch();
65.             recordCount += batchCount;
66.             double percentageCompleted = (recordCount / (double)
totalStatements) * 100;
67.             int remainingRecords = totalStatements - recordCount;
68.             System.out.printf("File: %s | Inserted: %d | Remaining: %d |
Progress: %.2f%%\n",
69.                             dataFile.getName(), recordCount, remainingRecords,
percentageCompleted);
70.         }
71.
72.         System.out.println("Insertion completed for file: " +
dataFile.getName());
73.
74.     } catch (SQLException e) {
75.         System.out.println("Error executing statement: " +
e.getMessage());
76.         e.printStackTrace();
77.     }
78.
79.     } catch (IOException e) {

```

```

80.         System.out.println("Error reading file: " + dataFile.getName() + " -
    " + e.getMessage());
81.         e.printStackTrace(); // Optional: log the stack trace for more
    details
82.     }
83. }

```

Output:

```

C:\Windows\system32\cmd.exe - java --add-opens java.base/java.net=ALL-UNNAMED -cp "Drivers/*;" AmazonRedshift
===== Amazon Redshift Menu =====
1. Connect to the database
2. Drop all tables
3. Create schema and tables
4. Insert TPC-H Data
5. Execute Query 1
6. Execute Query 2
7. Execute Query 3
8. Close the connection
9. Exit
Enter your choice: 4
Processing file: nation.sql
Processing file: customer.sql
Processing file: orders.sql
Processing file: lineitem.sql
File: customer.sql | Inserted: 500 | Remaining: 1000 | Progress: 33.33%
File: nation.sql | Inserted: 25 | Remaining: 0 | Progress: 100.00%
Insertion completed for file: nation.sql
File: orders.sql | Inserted: 500 | Remaining: 14500 | Progress: 3.33%
Processing file: part.sql
File: customer.sql | Inserted: 1000 | Remaining: 500 | Progress: 66.67%

```

- Write the method query1() that returns the most recent top 10 orders with the total sale and the date of the order for customers in America. [5]

Code:

```

1. public ResultSet query1() throws SQLException {
2.     System.out.println("Executing query #1.");
3.     String query = " SELECT o.O_ORDERKEY AS order_key, " +
4.         " SUM(l.L_EXTENDEDPRICE) AS total_sale, " +
5.         " o.O_ORDERDATE AS order_date " +
6.         " FROM ORDERS o " +
7.         " JOIN LINEITEM l ON o.O_ORDERKEY = l.L_ORDERKEY " +
8.         " JOIN CUSTOMER c ON o.O_CUSTKEY = c.C_CUSTKEY " +
9.         " JOIN NATION n ON c.C_NATIONKEY = n.N_NATIONKEY " +
10.        " WHERE n.N_NAME = 'UNITED STATES' " +
11.        " GROUP BY o.O_ORDERKEY, o.O_ORDERDATE " +
12.        " ORDER BY o.O_ORDERDATE DESC " +
13.        " LIMIT 10 ";
14.    if (con == null) {
15.        throw new SQLException("Connection is null. Please connect to the
    database first.");
16.    }
17.
18.    Statement stmt = con.createStatement();

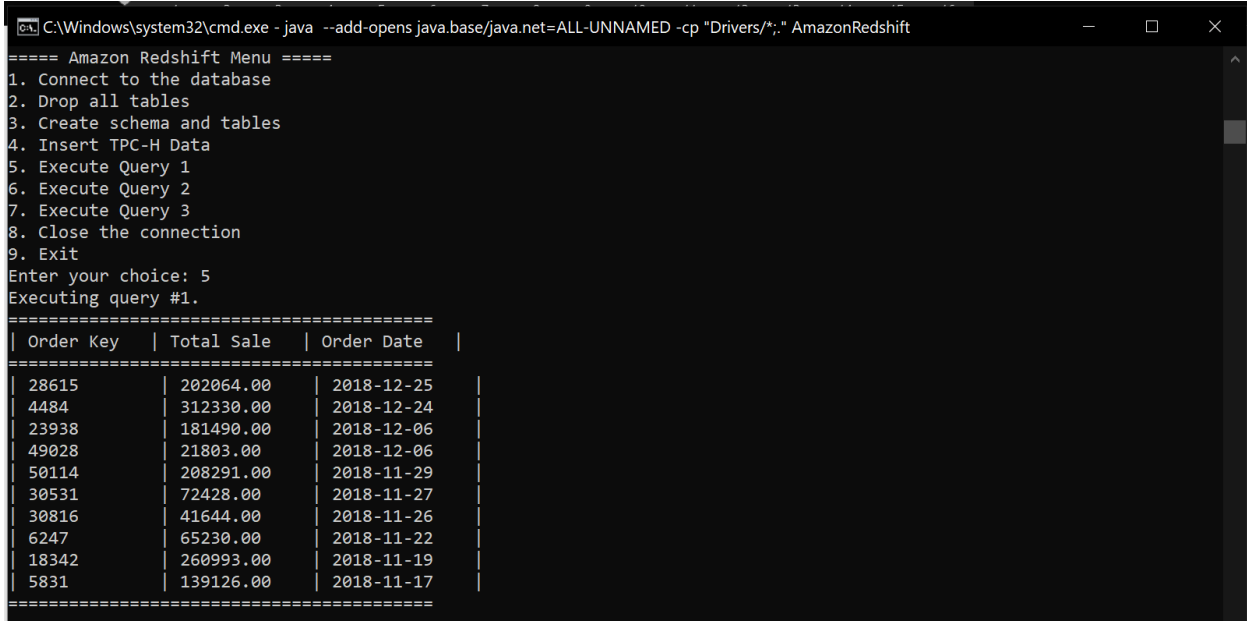
```

```

19.         return stmt.executeQuery(query);
20.     }

```

Output:



```

C:\Windows\system32\cmd.exe - java --add-opens java.base/java.net=ALL-UNNAMED -cp "Drivers/*;" AmazonRedshift
===== Amazon Redshift Menu =====
1. Connect to the database
2. Drop all tables
3. Create schema and tables
4. Insert TPC-H Data
5. Execute Query 1
6. Execute Query 2
7. Execute Query 3
8. Close the connection
9. Exit
Enter your choice: 5
Executing query #1.
=====
| Order Key | Total Sale | Order Date |
=====
| 28615     | 202064.00  | 2018-12-25 |
| 4484      | 312330.00  | 2018-12-24 |
| 23938     | 181490.00  | 2018-12-06 |
| 49028     | 21803.00   | 2018-12-06 |
| 50114     | 208291.00  | 2018-11-29 |
| 30531     | 72428.00   | 2018-11-27 |
| 30816     | 41644.00   | 2018-11-26 |
| 6247      | 65230.00   | 2018-11-22 |
| 18342     | 260993.00  | 2018-11-19 |
| 5831      | 139126.00  | 2018-11-17 |
=====

```

6. Write the method query2() that returns the customer key and the total price a customer spent in descending order, for all urgent orders that are not failed for all customers who are outside Europe and belong to the largest market segment. The largest market segment is the market segment with the most customers. [10]

Code:

```

1. public ResultSet query2() throws SQLException {
2.     System.out.println("Executing query #2.");
3.     String segmentQuery = "SELECT C_MKTSEGMENT " +
4.         "FROM CUSTOMER " +
5.         "GROUP BY C_MKTSEGMENT " +
6.         "ORDER BY COUNT(C_CUSTKEY) DESC " +
7.         "LIMIT 1";
8.
9.     Statement stmt = con.createStatement();
10.    ResultSet segmentResult = stmt.executeQuery(segmentQuery);
11.    String largestSegment = null;
12.    if (segmentResult.next()) {
13.        largestSegment = segmentResult.getString("C_MKTSEGMENT");
14.    }
15.    if (largestSegment != null) {
16.        String query = "WITH NonEuropeanCustomers AS ( " +

```

```

17.         "    SELECT C.C_CUSTKEY " +
18.         "    FROM CUSTOMER C " +
19.         "    JOIN NATION N ON C.C_NATIONKEY = N.N_NATIONKEY "
20.     +
21.         "    JOIN REGION R ON N.N_REGIONKEY = R.R_REGIONKEY "
22.     +
23.         "    WHERE R.R_NAME != 'EUROPE' " +
24.         "    ), " +
25.         "FilteredCustomers AS ( " +
26.         "    SELECT C.C_CUSTKEY " +
27.         "    FROM CUSTOMER C " +
28.         "    WHERE C.C_MKTSEGMENT = ? " +
29.         "    AND C.C_CUSTKEY IN (SELECT C_CUSTKEY FROM
NonEuropeanCustomers) " +
30.         "    ), " +
31.         "UrgentOrders AS ( " +
32.         "    SELECT O.O_CUSTKEY AS CustomerKey,
SUM(L.L_EXTENDEDPRI) AS TotalSpent " +
33.         "    FROM ORDERS O " +
34.         "    JOIN LINEITEM L ON O.O_ORDERKEY = L.L_ORDERKEY "
35.     +
36.         "    WHERE O.O_ORDERPRIORITY = '1-URGENT' " +
37.         "    AND O.O_ORDERSTATUS != 'F' " +
38.         "    AND O.O_CUSTKEY IN (SELECT C_CUSTKEY FROM
FilteredCustomers) " +
39.         "    GROUP BY O.O_CUSTKEY " +
40.         "    ) " +
41.         "SELECT U.CustomerKey, U.TotalSpent " +
42.         "FROM UrgentOrders U " +
43.         "ORDER BY U.TotalSpent DESC";
44.
45.     PreparedStatement preparedStatement = con.prepareStatement(query);
46.     preparedStatement.setString(1, largestSegment); // Set the largest
market segment dynamically
47.     return preparedStatement.executeQuery();
48. }
49. System.out.println("No largest market segment found.");
50. return null;
51. }

```

Output:

```

===== Amazon Redshift Menu =====
1. Connect to the database
2. Drop all tables
3. Create schema and tables
4. Insert TPC-H Data
5. Execute Query 1
6. Execute Query 2
7. Execute Query 3
8. Close the connection
9. Exit
Enter your choice: 6
Executing query #2.
Query #2 Results:

```

Customer Key	Total Spent
962	934276.00
1052	833829.00
103	772835.00
1279	740936.00
1061	734090.00
664	658041.00
1331	654336.00
1415	622849.00
334	620177.00
1316	611696.00
1334	601828.00
1144	601810.00
1345	574253.00
340	570314.00
1013	555097.00
1027	545509.00
694	541472.00
1253	538708.00
818	529872.00
1124	526399.00
229	522166.00
380	513735.00
835	511995.00
575	504550.00
1214	503437.00
1268	489049.00
188	475074.00
767	457100.00
995	456724.00
932	453079.00
134	438663.00
1486	437668.00
1075	425282.00
512	422890.00
1	421274.00
329	413687.00
662	404588.00
844	403041.00
649	402030.00
674	400317.00
508	395928.00
1223	386810.00
814	382438.00
1046	374573.00
803	368071.00
592	366214.00
938	365671.00
185	363520.00
580	359714.00
1414	355840.00
709	355246.00
968	353066.00
553	344943.00
298	334711.00
1163	334638.00
1100	327751.00
1009	327475.00
1115	319143.00

805	316412.00
568	312407.00
1433	308212.00
1237	308206.00
1202	308009.00
1091	306579.00
1400	305537.00
77	304452.00
1295	299133.00
860	297132.00
1430	296181.00
1235	292461.00
1453	292215.00
220	290881.00
610	284676.00
152	283341.00
476	279524.00
722	275900.00
986	271477.00
73	259207.00
428	257247.00
116	248579.00
1318	244310.00
223	244030.00
1208	243368.00
211	242005.00
1405	238524.00
1475	237839.00
944	237457.00
40	235070.00
475	234605.00
790	233068.00
280	232699.00
1201	230542.00
392	224661.00
523	224453.00
1183	220834.00
1460	217412.00
98	215161.00
1312	212232.00
653	210170.00
400	204820.00
1040	198800.00
1114	194242.00
1006	193509.00
224	191248.00
278	191091.00
1085	190796.00
1180	189196.00
1412	187654.00
865	183851.00
766	182136.00
763	175047.00
170	171616.00
1196	169535.00
1447	167667.00
1184	166621.00
64	164606.00
350	162400.00
200	159039.00
784	146507.00

113	146103.00
826	144242.00
670	143332.00
515	142196.00
448	141324.00
328	139529.00
802	138073.00
1396	130749.00
811	128303.00
347	117633.00
1358	117503.00
905	116995.00
548	115519.00
1330	112946.00
1357	109970.00
1370	108208.00
1261	106892.00
562	105994.00
904	101642.00
1385	101477.00
296	100987.00
542	99021.00
1082	96900.00
728	96476.00
793	93905.00
647	91988.00
535	91529.00
859	90163.00
518	89866.00
602	89745.00
13	86102.00
419	81138.00
121	77998.00
1277	76457.00
109	74685.00
557	73613.00
205	71835.00
32	64622.00
1468	58353.00
623	53127.00
785	48653.00
890	43337.00
1033	41460.00
386	33790.00
221	32520.00
1292	28556.00
478	10756.00

7. Write the method query3() that returns a count of all the line items that were ordered within the six years starting on April 1st, 1997 group by order priority. Make sure to sort by order priority in ascending order. [10]

Code:

```
1. public ResultSet query3() throws SQLException {
2.     System.out.println("Executing query #3.");
```



```

3.      String query = "SELECT o.O_ORDERPRIORITY, COUNT(l.L_LINENUMBER) AS
      lineitem_count " +
4.          "FROM orders o " +
5.          "JOIN lineitem l ON o.O_ORDERKEY = l.L_ORDERKEY " +
6.          "WHERE o.O_ORDERDATE >= '1997-04-01' " +
7.          "AND o.O_ORDERDATE < DATEADD(year, 6, '1997-04-01') " +
8.          "GROUP BY o.O_ORDERPRIORITY " +
9.          "ORDER BY o.O_ORDERPRIORITY ASC";
10.     Statement stmt = con.createStatement();
11.     ResultSet rs = stmt.executeQuery(query);
12.
13.     return rs;
14. }

```

Output:

The screenshot shows a Java application window titled "AmazonRedshift". The window contains a menu with the following options:

- 1. Connect to the database
- 2. Drop all tables
- 3. Create schema and tables
- 4. Insert TPC-H Data
- 5. Execute Query 1
- 6. Execute Query 2
- 7. Execute Query 3
- 8. Close the connection
- 9. Exit

The user has entered "7" as their choice. The application is now executing query #3. The output of the query is displayed in a table format:

Order Priority	Line Item Count
1-URGENT	1387
2-HIGH	1303
3-MEDIUM	1287
4-NOT SPECIFIED	1530
5-LOW	1268

Full Code:

```

1. import java.math.BigDecimal;
2. import java.nio.file.Files;
3. import java.sql.Connection;
4. import java.sql.DriverManager;
5. import java.sql.PreparedStatement;
6. import java.sql.ResultSet;
7. import java.sql.ResultSetMetaData;
8. import java.sql.SQLException;
9. import java.sql.Statement;
10. import java.util.Arrays;
11. import java.util.List;
12. import java.util.Properties;
13. import java.util.Scanner;
14. import java.io.File;
15. import java.io.IOException;
16. import java.util.concurrent.CountDownLatch;

```

```

17. import java.util.concurrent.ExecutorService;
18. import java.util.concurrent.Executors;
19.
20. /**
21.  * Performs SQL DDL and SELECT queries on a MySQL database hosted on AWS RDS.
22.  *
23.  * java --add-opens java.base/java.net=ALL-UNNAMED -cp "Drivers/*;"
    AmazonRedshift
24.  */
25. public class AmazonRedshift {
26.     /**
27.      * Connection to database
28.      */
29.     static final String redshiftUrl = "jdbc:redshift://g23ai2087-
cluster.cndskybccc1r.us-east-1.redshift.amazonaws.com:5439/dev";
30.     static final String masterUsername = "admin"; // Replace with your Redshift
admin username
31.     static final String password = "IITj1234"; // Replace with your Redshift
password
32.     private static ExecutorService executorService;
33.     /**
34.      * Main method is only used for convenience. Use JUnit test file to verify
your
35.      * answer.
36.      *
37.      * @param args
38.      *      none expected
39.      * @throws SQLException
40.      *      if a database error occurs
41.      */
42.     public static void main(String[] args) {
43.         Scanner scanner = new Scanner(System.in);
44.         AmazonRedshift q = new AmazonRedshift();
45.         // Initialize the executor service for parallel execution
46.         executorService = Executors.newFixedThreadPool(4);
47.         ResultSet rs;
48.         while (true) {
49.             // Display menu
50.             System.out.println("\n==== Amazon Redshift Menu =====");
51.             System.out.println("1. Connect to the database");
52.             System.out.println("2. Drop all tables");
53.             System.out.println("3. Create schema and tables");
54.             System.out.println("4. Insert TPC-H Data");
55.             System.out.println("5. Execute Query 1");
56.             System.out.println("6. Execute Query 2");
57.             System.out.println("7. Execute Query 3");
58.             System.out.println("8. Close the connection");
59.             System.out.println("9. Exit");
60.             System.out.print("Enter your choice: ");
61.             int choice = scanner.nextInt();
62.
63.             try {
64.                 switch (choice) {
65.                     case 1:

```

```

66.         q.connect();
67.         break;
68.     case 2:
69.         q.drop();
70.         break;
71.     case 3:
72.         q.create();
73.         break;
74.     case 4:
75.         q.insert();
76.         break;
77.
78.     case 5:
79.         if (q.con == null) {
80.             System.out.println("Please connect to the database
first.");
81.         } else {
82.             try {
83.                 rs = q.query1();
84.
85.                 // Display header for the table
86.                 System.out.println("=====
=====");
87.                 System.out.println("| Order Key    | Total
Sale    | Order Date    |");
88.                 System.out.println("=====
=====");
89.
90.                 // Process and display each row in the ResultSet
91.                 while (rs.next()) {
92.                     System.out.printf("| %-12d | %-12.2f | %-13s
|\n",
93.                                     rs.getInt("order_key"),
94.                                     rs.getDouble("total_sale"),
95.                                     rs.getDate("order_date"));
96.                     // Column alias from the query
97.                     // Column alias from the query
98.                     // Column alias from the query
99.                     }
100.                    System.out.println("=====
=====");
101.                    } catch (SQLException e) {
102.                        System.out.println("Error processing result
set: " + e.getMessage());
103.                    }
104.                    break;
105.                case 6:
106.                    try {
107.                        rs = q.query2();
108.                        if (rs != null) {
109.                            System.out.println("Query #2 Results:");

```

```

109.                                     System.out.println("=====
=====");
110.                                     System.out.printf("%-15s %-20s\n", "Customer
Key", "Total Spent");
111.                                     System.out.println("=====
=====");
112.                                     while (rs.next()) {
113.                                         System.out.printf("%-15d %-20.2f\n",
114.                                             rs.getInt("CustomerKey"),
115.                                             rs.getDouble("TotalSpent"));
116.                                     }
117.                                     System.out.println("=====
=====");
118.                                     } else {
119.                                         System.out.println("No results found for Query
#2.");
120.                                     }
121.                                     } catch (SQLException e) {
122.                                         System.out.println("Error executing Query #2: " +
e.getMessage());
123.                                     }
124.                                     break;
125.                                     case 7:
126.                                     if (q.con == null) {
127.                                         System.out.println("Please connect to the database
first.");
128.                                     } else {
129.                                         rs = q.query3();
130.                                         System.out.println("=====
=====");
131.                                         System.out.println("| Order Priority    | Line Item
Count    |");
132.                                         System.out.println("=====
=====");
133.                                         while (rs.next()) {
134.                                             String orderPriority =
rs.getString("O_ORDERPRIORITY");
135.                                             int lineItemCount = rs.getInt("lineitem_count");
136.                                             System.out.printf("| %-16s | %-18d |\n",
orderPriority, lineItemCount);
137.                                         }
138.                                         System.out.println("=====
=====");
139.                                     }
140.                                     break;
141.                                     case 8:
142.                                         q.close();
143.                                         break;
144.                                     case 9:
145.                                         System.out.println("Exiting program...");
146.                                         scanner.close();
147.                                         System.exit(0); // Exit the program
148.                                         break;
149.                                     default:

```

```

150.                System.out.println("Invalid choice. Please try
again.");
151.                break;
152.            }
153.        } catch (SQLException e) {
154.            System.out.println("Error: " + e.getMessage());
155.        } catch (Exception e) {
156.            System.out.println("An unexpected error occurred: " +
e.getMessage());
157.        }
158.    }
159.}
160.
161./**
162. * Makes a connection to the database and returns connection to caller.
163. *
164. * @return
165. *     connection
166. * @throws SQLException
167. *     if an error occurs
168. */
169.
170.// Redshift connection details
171.
172.
173.    private Connection con;
174.
175.    public Connection connect() {
176.        try {
177.            Class.forName("com.amazon.redshift.jdbc42.Driver");
178.            Properties properties = new Properties();
179.            properties.setProperty("user", masterUsername);
180.            properties.setProperty("password", password);
181.
182.            this.con = DriverManager.getConnection(redshiftUrl, properties);
183.
184.            System.out.println("Connection to Redshift established
successfully.");
185.        } catch (ClassNotFoundException e) {
186.            System.out.println("Error: Redshift JDBC driver not found.");
187.            e.printStackTrace();
188.        } catch (SQLException e) {
189.            System.out.println("Failed to connect to the database.");
190.            e.printStackTrace();
191.        }
192.        return con;
193.    }
194.    /**
195.     * Closes connection to database.
196.     */
197.    public void close() {
198.        System.out.println("Closing database connection.");
199.        try {
200.            if (con != null && !con.isClosed()) {

```

```

201.         con.close();
202.     }
203. } catch (SQLException e) {
204.     System.out.println("Error closing the connection.");
205. }
206. }
207.
208. public void drop() {
209.     System.out.println("Dropping all tables in the 'dev' schema...");
210.     String dropQuery = "SELECT tablename FROM pg_tables WHERE schemaname =
'dev'";
211.
212.     try (Statement stmt = con.createStatement()) {
213.         ResultSet rs = stmt.executeQuery(dropQuery);
214.         while (rs.next()) {
215.             String tableName = rs.getString("tablename");
216.             String dropTableQuery = "DROP TABLE IF EXISTS dev." +
tableName;
217.             stmt.executeUpdate(dropTableQuery);
218.             System.out.println("Dropped table: " + tableName);
219.         }
220.     } catch (SQLException e) {
221.         System.out.println("Error dropping tables: " + e.getMessage());
222.     }
223. }
224.
225. public void create() throws SQLException {
226.     System.out.println("Creating the 'dev' schema and tables...");
227.     String createSchemaQuery = "CREATE SCHEMA IF NOT EXISTS dev";
228.     try (Statement stmt = con.createStatement()) {
229.         stmt.executeUpdate(createSchemaQuery);
230.         System.out.println("Schema 'dev' created.");
231.     } catch (SQLException e) {
232.         System.out.println("Error creating schema: " + e.getMessage());
233.     }
234.     File ddlFolder = new File("ddl");
235.     File[] ddlFiles = ddlFolder.listFiles((dir, name) ->
name.endsWith(".sql"));
236.     if (ddlFiles != null) {
237.         for (File ddlFile : ddlFiles) {
238.             try {
239.                 String ddlQuery = new
String(Files.readAllBytes(ddlFile.toPath()));
240.                 if (ddlFile.getName().equals("tpch_create.sql")) {
241.                     // Ensure the 'tpch_create.sql' contains CREATE TABLE
queries
242.                     if (ddlQuery.toUpperCase().contains("CREATE TABLE")) {
243.                         try (Statement stmt = con.createStatement()) {
244.                             stmt.executeUpdate(ddlQuery);
245.                             System.out.println("Created table(s) from " +
ddlFile.getName());
246.                         }
247.                     } else {

```

```

248.                System.out.println("No CREATE TABLE queries found
    in tpch_create.sql.");
249.            }
250.        } else {
251.            System.out.println("Skipping non-CREATE TABLE SQL
    file: " + ddlFile.getName());
252.        }
253.    } catch (IOException e) {
254.        System.out.println("Error reading DDL file: " +
    ddlFile.getName() + " - " + e.getMessage());
255.    } catch (SQLException e) {
256.        System.out.println("Error executing DDL query for file " +
    ddlFile.getName() + " - " + e.getMessage());
257.    }
258.    }
259.    } else {
260.        System.out.println("No DDL files found in 'ddl' folder.");
261.    }
262.    }
263.    public void insert() {
264.        File dataFolder = new File("ddl");
265.        File[] dataFiles = dataFolder.listFiles((dir, name) ->
    name.endsWith(".sql") && !name.equals("tpch_create.sql"));
266.
267.        if (dataFiles != null) {
268.            // Use a CountdownLatch to wait for all insertions to complete
269.            CountdownLatch latch = new CountdownLatch(dataFiles.length);
270.
271.            for (File dataFile : dataFiles) {
272.                executorService.submit(() -> {
273.                    processFile(dataFile);
274.                    latch.countDown(); // Decrease latch count when each file
    is processed
275.                });
276.            }
277.            try {
278.                // Wait until all insert tasks are completed
279.                latch.await();
280.                System.out.println("All data insertions completed.");
281.            } catch (InterruptedException e) {
282.                System.out.println("Error waiting for insertions to complete:
    " + e.getMessage());
283.            }
284.        } else {
285.            System.out.println("No data files found in the folder.");
286.        }
287.    }
288.    private void processFile(File dataFile) {
289.        try {
290.            // Read the SQL query from the file
291.            String sqlQuery = new
    String(Files.readAllBytes(dataFile.toPath()));
292.
293.            // Log the start of the process

```

```

294.         System.out.println("Processing file: " + dataFile.getName());
295.
296.         // Open the Statement for executing the insert query
297.         try (Statement stmt = con.createStatement()) {
298.             // Split the SQL query into individual statements (assuming
multiple INSERT statements in the file)
299.             String[] insertStatements = sqlQuery.split(";");
300.             int totalStatements = insertStatements.length; // Total number
of statements in the file
301.
302.             int batchCount = 0;
303.             int recordCount = 0;
304.
305.             // Process each INSERT statement
306.             for (String statement : insertStatements) {
307.                 if (statement.trim().isEmpty()) continue;
308.
309.                 // Add the statement to the batch
310.                 stmt.addBatch(statement.trim());
311.                 batchCount++;
312.
313.                 // Execute the batch every 500 records
314.                 if (batchCount % 500 == 0) {
315.                     stmt.executeBatch(); // Execute the batch
316.                     recordCount += 500;
317.
318.                     // Calculate and display progress
319.                     double percentageCompleted = (recordCount / (double)
totalStatements) * 100;
320.                     int remainingRecords = totalStatements - recordCount;
321.                     System.out.printf("File: %s | Inserted: %d |
Remaining: %d | Progress: %.2f%%\n",
322.                                     dataFile.getName(), recordCount,
remainingRecords, percentageCompleted);
323.                 }
324.             }
325.             if (batchCount > 0) {
326.                 stmt.executeBatch();
327.                 recordCount += batchCount;
328.                 double percentageCompleted = (recordCount / (double)
totalStatements) * 100;
329.                 int remainingRecords = totalStatements - recordCount;
330.                 System.out.printf("File: %s | Inserted: %d | Remaining: %d
| Progress: %.2f%%\n",
331.                                     dataFile.getName(), recordCount, remainingRecords,
percentageCompleted);
332.             }
333.
334.             System.out.println("Insertion completed for file: " +
dataFile.getName());
335.
336.         } catch (SQLException e) {
337.             System.out.println("Error executing statement: " +
e.getMessage());

```



```

338.         e.printStackTrace();
339.     }
340.
341.     } catch (IOException e) {
342.         System.out.println("Error reading file: " + dataFile.getName() + "
- " + e.getMessage());
343.         e.printStackTrace(); // Optional: log the stack trace for more
    details
344.     }
345. }
346.
347.
348. /**
349.  * Query returns the most recent top 10 orders with the total sale and the
    date
350.  * of the
351.  * order in `America`.
352.  *
353.  * @return
354.  *      ResultSet
355.  * @throws SQLException
356.  *      if an error occurs
357.  */
358. public ResultSet query1() throws SQLException {
359.     System.out.println("Executing query #1.");
360.     String query = " SELECT o.O_ORDERKEY AS order_key, " +
361.         " SUM(l.L_EXTENDEDPRICE) AS total_sale, " +
362.         " o.O_ORDERDATE AS order_date " +
363.         " FROM ORDERS o " +
364.         " JOIN LINEITEM l ON o.O_ORDERKEY = l.L_ORDERKEY " +
365.         " JOIN CUSTOMER c ON o.O_CUSTKEY = c.C_CUSTKEY " +
366.         " JOIN NATION n ON c.C_NATIONKEY = n.N_NATIONKEY " +
367.         " WHERE n.N_NAME = 'UNITED STATES' " +
368.         " GROUP BY o.O_ORDERKEY, o.O_ORDERDATE " +
369.         " ORDER BY o.O_ORDERDATE DESC " +
370.         " LIMIT 10 ";
371.     if (con == null) {
372.         throw new SQLException("Connection is null. Please connect to the
    database first.");
373.     }
374.
375.     Statement stmt = con.createStatement();
376.     return stmt.executeQuery(query);
377. }
378.
379.
380.
381. /**
382.  * Query returns the customer key and the total price a customer spent in
383.  * descending
384.  * order, for all urgent orders that are not failed for all customers who
    are
385.  * outside Europe belonging
386.  * to the highest market segment.

```

```

387.      *
388.      * @return
389.      *      ResultSet
390.      * @throws SQLException
391.      *      if an error occurs
392.      */
393.      public ResultSet query2() throws SQLException {
394.          System.out.println("Executing query #2.");
395.          String segmentQuery = "SELECT C_MKTSEGMENT " +
396.                                "FROM CUSTOMER " +
397.                                "GROUP BY C_MKTSEGMENT " +
398.                                "ORDER BY COUNT(C_CUSTKEY) DESC " +
399.                                "LIMIT 1";
400.
401.          Statement stmt = con.createStatement();
402.          ResultSet segmentResult = stmt.executeQuery(segmentQuery);
403.          String largestSegment = null;
404.          if (segmentResult.next()) {
405.              largestSegment = segmentResult.getString("C_MKTSEGMENT");
406.          }
407.          if (largestSegment != null) {
408.              String query = "WITH NonEuropeanCustomers AS ( " +
409.                              "    SELECT C.C_CUSTKEY " +
410.                              "    FROM CUSTOMER C " +
411.                              "    JOIN NATION N ON C.C_NATIONKEY = N.N_NATIONKEY
412.                              "    JOIN REGION R ON N.N_REGIONKEY = R.R_REGIONKEY
413.                              "    WHERE R.R_NAME != 'EUROPE' " +
414.                              "    ), " +
415.                              "FilteredCustomers AS ( " +
416.                              "    SELECT C.C_CUSTKEY " +
417.                              "    FROM CUSTOMER C " +
418.                              "    WHERE C.C_MKTSEGMENT = ? " +
419.                              "    AND C.C_CUSTKEY IN (SELECT C_CUSTKEY FROM
NonEuropeanCustomers) " +
420.                              "    ), " +
421.                              "UrgentOrders AS ( " +
422.                              "    SELECT O.O_CUSTKEY AS CustomerKey,
SUM(L.L_EXTENDEDPRI) AS TotalSpent " +
423.                              "    FROM ORDERS O " +
424.                              "    JOIN LINEITEM L ON O.O_ORDERKEY = L.L_ORDERKEY
425.                              "    WHERE O.O_ORDERPRIORITY = '1-URGENT' " +
426.                              "    AND O.O_ORDERSTATUS != 'F' " +
427.                              "    AND O.O_CUSTKEY IN (SELECT C_CUSTKEY FROM
FilteredCustomers) " +
428.                              "    GROUP BY O.O_CUSTKEY " +
429.                              "    )" +
430.                              "SELECT U.CustomerKey, U.TotalSpent " +
431.                              "FROM UrgentOrders U " +
432.                              "ORDER BY U.TotalSpent DESC";
433.
434.          PreparedStatement preparedStatement = con.prepareStatement(query);

```

```

435.         preparedStatement.setString(1, largestSegment); // Set the largest
market segment dynamically
436.         return preparedStatement.executeQuery();
437.     }
438.     System.out.println("No largest market segment found.");
439.     return null;
440. }
441.
442. /**
443.  * Query returns all the lineitems that was ordered within the six years
from
444.  * January 4th,
445.  * 1997 and the orderpriority in ascending order.
446.  *
447.  * @return
448.  *         ResultSet
449.  * @throws SQLException
450.  *         if an error occurs
451.  */
452. public ResultSet query3() throws SQLException {
453.     System.out.println("Executing query #3.");
454.     String query = "SELECT o.O_ORDERPRIORITY, COUNT(l.L_LINENUMBER) AS
lineitem_count " +
455.                   "FROM orders o " +
456.                   "JOIN lineitem l ON o.O_ORDERKEY = l.L_ORDERKEY " +
457.                   "WHERE o.O_ORDERDATE >= '1997-04-01' " +
458.                   "AND o.O_ORDERDATE < DATEADD(year, 6, '1997-04-01') " +
459.                   "GROUP BY o.O_ORDERPRIORITY " +
460.                   "ORDER BY o.O_ORDERPRIORITY ASC";
461.     Statement stmt = con.createStatement();
462.     ResultSet rs = stmt.executeQuery(query);
463.
464.     return rs;
465. }
466.
467.
468. /**
469.  * Do not change anything below here.
470.  */
471. /**
472.  * Converts a ResultSet to a string with a given number of rows displayed.
473.  * Total rows are determined but only the first few are put into a string.
474.  *
475.  * @param rst
476.  *         ResultSet
477.  * @param maxrows
478.  *         maximum number of rows to display
479.  * @return
480.  *         String form of results
481.  * @throws SQLException
482.  *         if a database error occurs
483.  */
484. public static String resultSetToString(ResultSet rst, int maxrows) throws
SQLException {

```

```

485.         StringBuffer buf = new StringBuffer(5000);
486.         int rowCount = 0;
487.         ResultSetMetaData meta = rst.getMetaData();
488.         buf.append("Total columns: " + meta.getColumnCount());
489.         buf.append('\n');
490.         if (meta.getColumnCount() > 0)
491.             buf.append(meta.getColumnName(1));
492.         for (int j = 2; j <= meta.getColumnCount(); j++)
493.             buf.append(", " + meta.getColumnName(j));
494.         buf.append('\n');
495.         while (rst.next()) {
496.             if (rowCount < maxrows) {
497.                 for (int j = 0; j < meta.getColumnCount(); j++) {
498.                     Object obj = rst.getObject(j + 1);
499.                     buf.append(obj);
500.                     if (j != meta.getColumnCount() - 1)
501.                         buf.append(", ");
502.                 }
503.                 buf.append('\n');
504.             }
505.             rowCount++;
506.         }
507.         buf.append("Total results: " + rowCount);
508.         return buf.toString();
509.     }
510.
511.     /**
512.      * Converts ResultSetMetaData into a string.
513.      *
514.      * @param meta
515.      *         ResultSetMetaData
516.      * @return
517.      *         string form of metadata
518.      * @throws SQLException
519.      *         if a database error occurs
520.      */
521.     public static String resultSetMetaDataToString(ResultSetMetaData meta)
522.         throws SQLException {
523.         StringBuffer buf = new StringBuffer(5000);
524.         buf.append(meta.getColumnName(1) + " (" + meta.getColumnLabel(1) + ", "
525.             + meta.getColumnType(1) + "-" + meta.getColumnTypeName(1) + ", "
526.             + meta.getColumnDisplaySize(1) + ", " + meta.getPrecision(1) +
527.             meta.getScale(1) + ")");
528.         for (int j = 2; j <= meta.getColumnCount(); j++) {
529.             buf.append(", " + meta.getColumnName(j) + " (" +
530.                 meta.getColumnLabel(j) + ", " +
531.                 meta.getColumnType(j) + "-" + meta.getColumnTypeName(j) +
532.                 meta.getColumnDisplaySize(j) + ", " + meta.getPrecision(j)
533.                 + meta.getScale(j) + ")");

```

```
532.     }  
533.     return buf.toString();  
534.   }  
535. }
```