Part 1: Multiple Choice (72 points - 3 points per question)

(C) 1. Which is used to extract and analyze useful business information from very large databases?
   (A) GIS (B) GPS (C) OLAP (D) none of above

(B) 2. Which is true?
   (A) A database system is a collection of related data. (B) E. F. Codd first proposed the relation model.
   (C) Database schema changes each time the database is updated. (D) none of above

(C) 3. Which is not a task of defining a database?
   (A) Specify the data types (B) Specify the data structures (C) Specify the authorized users (D) none of above

(A) 4. Which is a DBMS? (A) Access (B) Excel (C) Facebook (D) none of above

(D) 5. Who designs and implements database tools?
   (A) System analysts (B) Application programmers (C) Operators (D) none of above

(D) 6. Which is not an advantage of using the database approach?
   (A) Controlling redundancy (B) Restricting unauthorized access
   (C) Providing persistent storage (D) Reduce complex relationships among data

(C) 7. Which is the rule activated by updates to the table? (A) constraint (B) business rule (C) trigger (D) None of above

(A) 8. Which is the data in database at a particular moment in time?
   (A) database state (B) database constraint (C) database schema (D) database query

(A) 9. Which level of the schema describes structure of the whole database for a community of users?
   (A) conceptual (B) external (C) view (D) internal

(B) 10. Which data model describes how data is stored as files in the computer?
   (A) conceptual (B) physical (C) representational (D) none of above

(A) 11. Which is a capacity to change the schema at one level without changing the schema at the next higher level?
   (A) data independence (B) data entity (C) data flexibility (D) data robustness

(D) 12. Which of the following is true?
   (A) Cardinality is the number of attributes n of its relation schema (B) Degree is the total number of values in domain.
   (C) Relational model represents data as a collection of objects. (D) None of the above

(B) 13. Which is not a meaning for null values?
   (A) Attribute does not apply to this tuple. (B) The value is beyond the domain range.
   (C) Attribute value is unknown. (D) Value exists but is not available.

(B) 14. Which is true?
   (A) A super key is a key. (B) A relation schema may have more than one key
   (C) Candidate keys can be designated as unique keys. (D) None of the above

(C) 15. Which constraint is used to indicate no primary key value can be null?
   (A) Key constraint (B) Referential integrity (C) Entity integrity (D) Domain constraint

(B) 16. Which constraint may delete violate?
   (A) Domain constraint (B) Referential integrity (C) Key constraint (D) All of the above

(D) 17. In MySQL which command can show the schema of a table? (A) show (B) display (C) present (D) describe

(X) 18. Which integrity constraints can trigger a sequence of operations? (A) restrict (B) set default (C) set null (D) trigger

(C) 19. Which is a join condition in the following SQL commands?
   select name from painter, painting
   where painter_name = 'Pablo Picasso' and painter.painter_id = painting.painter_id;
   (A) select name from painter, painting (B) painter_name = 'Pablo Picasso'
   (C) painter.painter_id = painting.painter_id (D) None of the above

(D) 20. What result set will the following query return? select ticker from stock where price < 20;
   (A) The stocks of tickers whose price is less than 20. (B) The tickers of stocks whose ticker is less than 20.
   (C) The prices of stocks whose ticker is less than 20. (D) None of the above

(A) 21. Which SQL keyword is used to select only different values from a specific column in a table?
   (A) distinct (B) check (C) specific (D) unique

(B) 22. In MySQL which is used to execute a SQL script? (A) use (B) \ (C) \e (D) none of the above

(B) 23. Which SQL operator is used to search for a specified pattern in a column?
   (A) as (B) like (C) match (D) none of above

(A) 24. When you register at your Facebook account, which SQL command will be used?
   (A)insert (B) update (C) delete (D) select

Part 2: Questions and Answers (90 points)

1. (20 points) Briefly explain these terminologies. If they are acronyms, also write what they stand for.
(a) XML (b) DBA (c) DBMS (d) ODBC (e) data mining

(a) eXtensible Markup Language (XML) is a language for defining markup languages.

(b) A database administrator (DBA) is the person who takes overall responsibility for data, metadata, and policies about data use.

(c) A database management system (DBMS) is software system used to create, maintain, and provide controlled access to databases.

(d) Open Database Connectivity (ODBC) is an API for database access.

(e) The data mining can be defined in either one as shown in below:
   i. The discovery of new information in terms of patterns or rules from vast amounts of data.
   ii. The process of finding interesting structure in data.
   iii. The process of employing one or more computer learning techniques to automatically analyze and extract knowledge from data.

2. (a) (4 points) What is data model?
   (b) (3 points) Why are data models needed?
   (c) (3 points) What is a relational database?

(a) A data model is a set of concepts to describe the structure of a database, the operations for manipulating these structures, and certain constraints that the database should obey.

(b) Data models are needed to capture the nature of and relationships among data. Data models are fundamental for effectiveness and efficiency of a database.

(c) A relational database is a database that represents data as a collection of tables in which all data relationships are represented by common values in related tables.

3. (a) (3 points) Illustrate the three-tier client-server architecture.
   (b) (4 points) Explain the function for each tier in the three-tier architecture.
   (c) (3 points) Map the software in Appserv to corresponding tier.

(a)

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Client
    GUI, Web Interface
    Presentation Layer

Application Server or Web Server
    Application Programs, Web Pages
    Business Logic Layer
    Database Management System

Database Server
    Database Services Layer
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(b) • The first tier has the Web browser, which provides the user interface.
   • The middle tier has Web server and the applications that require database access.
   • The third tier has the database system and the database itself.

(c) Client: phpMyAdmin, Web server: Apache, PHP, Database server: MySQL.

4. A faculty relation has 5 attributes: employee_id, name, position, email, and department. No two faculty members have the same employee_id and email.

(a) (2 points) What is the difference between a superkey and a key?

(b) (6 points) List the superkey, key, candidate key, and primary key for the employee relation.

(c) (2 points) Explain the reason of choosing the primary key.

(a) • keys: employee_id, email
• **superkeys**: (Any three of the following is enough.)
  
  employee_id, email, 
  (employee_id, name), (employee_id, position), (employee_id, email), (employee_id, department), 
  (name, email), (position, email), (email, department) 
  (employee_id, name, position), (employee_id, name, email), (employee_id, name, department), 
  (employee_id, position, email), (employee_id, position, department), (name, email, position), 
  (name, email, department), (employee_id, name, position, email) 
  (employee_id, name, position, department), (employee_id, name, email, department), 
  (name, position, email, department) 
  (employee_id, name, position, email, department)

• **candidate keys**: employee_id, email

• **primary key**: employee_id

(b) The employee_id is chosen because it can uniquely identify each tuple in the employee relation and the email might have the null value.

5. (8 points) Consider the following relations for a database that keeps track of student, course, section, and grade report. Underline the primary key and draw the schema diagram.

 student(student_id, name, major)

 grade_report(student_id, section_id, score)

 section(section_id, course_id, semester, year, instructor)

 course(course_id, title, credit_hours, department)

 student: 

    | student_id | name     | major   |
    |------------|----------|---------|
    | A1001      | Vincent  | Van Gogh|
    | A2002      | Claude   | Monet   |
    | A3003      | Edouard  | Manet   |

 grade_report: 

    | student_id | section_id | score |
    |------------|------------|-------|
    | A1001      | P1001      | 1888  |
    | A2002      | P2002      | 1872  |
    | A3003      | P3003      | 1863  |

 section: 

    | section_id | course_id | semester | year | instructor |
    |------------|-----------|----------|------|------------|

 course: 

    | course_id | title                  | credit_hours | department |
    |-----------|------------------------|--------------|------------|
    | A1001     | Cafe Terrace at Night  | P1001        |            |
    | A2002     | Impression, Sunrise    | P2002        |            |
    | A3003     | The Luncheon on the Grass | P3003      |            |

where primary keys are underlined. artist_id and painting_id in the Completion table are foreign keys referring to the artist and painting table respectively.

(a) If the following operations are taken, check if domain constraints, key constraints, entity integrity, or referential integrity is violated. If there is any violation, explain it.

i. Insert ('A4004', 'Pablo', 'Picasso') into the Artist table.

ii. Remove the row with the artist name 'Claude Monet' from the Artist table.

iii. Change the value of completed_year from 1888 to 'one thousand and eight hundred and eighty-eight' in the Completion table.

iv. Change the value of artist_id from A3003 to A5005 in the Artist table.

(b) (14 points) Use SQL to answer the following questions based on the above database:

i. (3 points) Create the Artist table and set artist_id as the primary key.

ii. (2 points) Insert ('A6006', 'Pierre-auguste', 'Renoir') into the Artist table.

iii. (3 points) Update the Artist table and change the value of name from 'Edouard Manet' to 'Alfred Sisley'.

iv. (3 points) List all paintings by Vincent Van Gogh.

v. (3 points) Delete all paintings completed in 2007.

(a) i. It violates no constraint.
ii. It violates the referential integrity because the foreign key, artist_id 'A2002' in the Completion table will have no primary key to refer to in the Artist table.

iii. It violates domain constraint because completed_year should be an integer.

iv. It violates the referential integrity because the foreign key, artist_id 'A3003' in the Completion table will have no primary key to reference to in the Artist table.

(b) i. create table Artist ( 
    artist_id char(5) primary key not null, 
    firstname varchar(30), 
    lastname varchar(10)); 

ii. insert into Artist values ('A6006', 'Pierre-auguste', 'Renoir')

iii. update Artist set firstname = 'Alfred', lastname = 'Sisley' where firstname = 'Edouard' and lastname = 'Manet';

iv. select title from Artist, Completion, Painting 
    where Artist.artist_id = Completion.artist_id and 
    Completion.painting_id = Painting.painting_id and firstname = 'Vincent' and lastname = 'Van Gogh';

v. delete from Painting where painting_id in (select painting_id from Completion where completed_year = 2007);