Part 1: Multiple Choice (78 points - 3 points per question)

(B) 1. Which is the process of defining a set of subtypes of a supertype?
   (A) Generalization (B) Specialization (C) Aggregation (D) Identification

(D) 2. An attribute of the supertype that determines the target subtype(s) is called the:
   (A) subtype determinant (B) disjoint indicator (C) subtype identification (D) subtype discriminator

(B) 3. In the following EER diagram, which is true?
   (A) An account can be a checking and savings account.
   (B) An account must be one of checking, savings, and loan accounts.
   (C) There are some accounts that don’t belong to checking, savings, or loan accounts.
   (D) None of the above

(C) 4. Which of the following is not a property of relations?
   (A) Every row must be unique. (B) Each attribute has a unique name.
   (C) The order of the columns must be relevant. (D) Every attribute value must be atomic.

(B) 5. Which constraint may the delete operation violate?
   (A) Domain constraint (B) Entity constraint (C) Referential integrity (D) None of the above

(B) 6. Which is an approach to map a n-ary relationship type in the ER diagram to the relational schema?
   (A) Merged Key (B) A relationship relation and n foreign keys
   (C) Functional relation (D) relation Set of simple component attributes

(A) 7. The entity integrity rule states that:
   (A) primary key attributes cannot be null. (B) each entity must have a primary key.
   (C) referential integrity must be maintained across all entities. (D) none of the above

(B) 8. Which is a component of the relational data model?
   (A) Data logics (B) Data manipulation (C) Data consistency (D) none of the above

(A) 9. A domain definition consists of the following components EXCEPT:
   (A) integrity constraints. (B) size. (C) data type. (D) domain name.

(D) 10. Referring to the following figure, which of the following is true?
   (A) An item is a part of a component. (B) A component can be used in only one item.
   (C) An item can be be used in multiple components. (D) none of the above

(D) 11. A candidate key must satisfy all of the following conditions EXCEPT:
   (A) the key must uniquely identify the row. (B) each nonkey attribute is functionally dependent upon it.
   (C) the key must be nonredundant. (D) the key must indicate the row’s position in the table.

(C) 12. Which integrity constraints can trigger a sequence of operations?
   (A) restrict (B) set default (C) cascade (D) none of the above

(C) 13. Which statement about denormalization is false?
   (A) It can improve performance. (B) It waste storage spaces.
   (C) It increase data integrity. (D) It can be used in one-to-one relationship,

(B) 14. Which is a SQL DCL command? (A) delete (B) grant (C) update (D) none of the above

(C) 15. Which SQL command is used to remove all data in a table but not the table itself?
   (A) delete table (B) drop table (C) truncate table (D) none of the above
16. Which is used to sort a table in SQL? (A) order by (B) group by (C) sort by (D) having

17. To indicate an attribute as a key, which SQL command can be used?
(A) create unique (B) create index (C) create distinct (D) none of the above

18. Which constraint can be specified on referential integrity in SQL?
(A) set null (B) set rule (C) revoke (D) none of the above

19. Which is a join condition in the following SQL commands?
select name from student, department
where department.name = 'Computer Science' and student.department_no = department.department_no;
(A) department.name = 'Computer Science' (B) student.department_no = department.department_no
(C) select name from student, department (D) None of the above

20. What does the following SQL statement do? select name from student where city = 'Hsinchu';
(A) Retrieves the name of all students who live in Hsinchu.
(B) Retrieves all students whose name is Hsinchu from the student table.
(C) Retrieves all cities whose name is Hsinchu from the student table.
(D) None of the above

21. To eliminate duplicate rows in a query, which qualifier can be used in the SQL Select command?
(A) unique (B) check (C) distinct (D) specific

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

23. Which of the following is true?
(A) The SQL insert operation will not violate domain constraint.
(B) The SQL update operation will not violate entity integrity constraint.
(C) The SQL delete operation can remove a table from the database.
(D) None of the above

24. Which of the following represents all attributes of a table in a SQL statement?
(A) * (B) <> (C) = (D) &

25. Which of the following finds those groups meeting stated conditions?
(A) group by (B) using by (C) order by (D) none of the above

26. When you log into your Yahoo account? Which database operation will be involved?
(A) insert (B) select (C) delete (D) none of the above

Part 2: Questions and Answers (87 points)

1. (a) (3 points) What is functional dependency?
   (b) (3 points) What is a normal form?
   (c) (6 points) Explain 1NF, 2NF, and 3NF.

   (a) Functional dependency specifies that the value of one attribute (the determinant) determines the value of another attribute in the same table.
   (b) A normal form is a relation after the process of structuring relations by decomposing their attributes into smaller relations.
   (c) i. 1NF is the relation that has no composite attributes, multivalued attributes, and nested relations.
      ii. In 2NF, every non-prime attribute is fully functionally dependent on the primary key in the relation.
      Other possible answers:
      There are no two keys in the relation.
      There is no partial functional dependency in the relation.
   iii. Third normal form (3NF) is a normal form in which there is no transitive functional dependency in the relation.

2. (a) (4 points) What does SQL stand for? Explain it.
   (b) (6 points) Based on the functions how can SQL be classified into three categories?

   (a) Structured Query Language (SQL) is a standard language used to retrieve, update and delete data from relational database management systems (DBMS).
   (b) Data Definition Language (DDL) is used to define databases.
   Data Manipulation Language (DML) is used to manipulate databases.
   Data Control Language (DCL) is used to control databases.
3. (15 points) Consider the following partial tables in a database:

<table>
<thead>
<tr>
<th>Artist table</th>
<th>Release table</th>
<th>Album table</th>
</tr>
</thead>
<tbody>
<tr>
<td>artist_id</td>
<td>artist_id</td>
<td>album_id</td>
</tr>
<tr>
<td>firstname</td>
<td>album</td>
<td>released_year</td>
</tr>
<tr>
<td>lastname</td>
<td>id</td>
<td></td>
</tr>
<tr>
<td>A1001</td>
<td>Avril</td>
<td>A1001</td>
</tr>
<tr>
<td>A2002</td>
<td>Amy</td>
<td>A2002</td>
</tr>
<tr>
<td>A3003</td>
<td>Norah</td>
<td>A3003</td>
</tr>
</tbody>
</table>

where primary keys are underlined. artist_id and album_id in the release table are foreign keys referencing to the artist and album table respectively. 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.

(a) Insert ('A4004', 'Sarah', 'McLachlan') into the Artist table.
(b) Insert ('B3003', 'The Very Best of Lisa Loeb') into the Album table.
(c) Delete the row with the artist name 'Avril Lavigne' from the Artist table.
(d) Update the Artist table and change the value of name from 'Norah Jones' to 'Lisa Loeb'.
(e) Update the Artist table and change the value of artist_id from A3003 to A5005.

(a) It violates no constraint.
(b) It violates the key constraint because the album_id 'B3003' already existed.
(c) It violates the referential integrity because the foreign key, artist_id 'A1001' in the Release table will have no primary key to reference to in the Artist table.
(d) It violates no constraint.
(e) It violates the referential integrity because the foreign key, artist_id 'A3003' in the Release table will have no primary key to reference to in the Artist table.

4. (24 points) Use SQL to answer the following questions based on the above database:

(a) (3 points) Create the Artist table and set artist_id as the primary key.
(b) (3 points) Add an attribute genre into the Album table.
(c) (3 points) Specify a constraint release_year > 1900 in the Release table.
(d) (3 points) Insert ('A6006', 'Sarah', 'McLachlan') into the Artist table.
(e) (3 points) Update the Artist table and change the value of name from 'Norah Jones' to 'Lisa Loeb'.
(f) (3 points) Get the titles of albums released more than 1000000 copies.
(g) (3 points) Get all albums released by Amy Winehouse.
(h) (3 points) Delete all albums released in 2007.

(a) create table Artist (artist_id char(5) primary key not null, firstname varchar(30), lastname varchar(10));
(b) alter table Album add genre varchar(20);
(c) alter table Release add constraint year_constraint check (year > 1900)
(d) insert into Artist values ('A6006', 'Sarah', 'McLachlan')
(e) update course set firstname = 'Lisa', lastname = 'Loeb' where firstname = 'Norah' and lastname = 'Jones';
(f) select title from Album, Release where Album.album_id = Release.album_id and quantity > 1000000
(g) select title from Album, Release, Artist where Album.album_id = Release.album_id and Artist.artist_id = Release.artist_id and firstname = 'Amy' and lastname = 'Winehouse';
(h) delete from albums where exists (select album_id from Release where year = 2007);

5. (12 points) Consider a database in a library with the following functional dependencies:

library (member_id, name, address, phone, isbn, title, authors, checkout_date, due_date)
member_id → name, address, phone
isbn → title, authors
(member_id, isbn) → checkout_date, due_date.

(a) (4 points) Draw the functional dependency diagram.
(b) (2 points) Which normalization form of the relation belongs to?
(c) (6 points) Normalize the following tables of data to 3 NF and draw the relational schema diagram.
(a) 

| member_id | name    | address  | phone | isbn | title | author | publisher | year | checkout_date | due_date |

(b) 1NF because it has no composite attributes, multivalued attributes, and nested relations but non-prime attribute is not fully functionally dependent on one key. For example, name, address, and phone depends on member_id while title and authors are dependent on isbn.

(c) 

<table>
<thead>
<tr>
<th>member:</th>
<th>member_id</th>
<th>name</th>
<th>address</th>
<th>phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>checkout:</td>
<td>member_id</td>
<td>isbn</td>
<td>checkout_date</td>
<td>due_date</td>
</tr>
<tr>
<td>book:</td>
<td>isbn</td>
<td>title</td>
<td>author</td>
<td>publisher</td>
</tr>
</tbody>
</table>

6. (14 points) Consider the following relations for book adoption of a course.

course (course_no, course_title, credit)
book_adoption(course_no, semester, isbn)
book (isbn, title, author, publisher, year)

(a) (6 points) Please draw the ER diagram.

(b) (8 points) Please draw the relational schema diagram and indicate the primary keys and the referential constraints.

(a)

(b) 

<table>
<thead>
<tr>
<th>course:</th>
<th>course_no</th>
<th>course_title</th>
<th>credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>book_adoption:</td>
<td>course_no</td>
<td>isbn</td>
<td>semester</td>
</tr>
<tr>
<td>book:</td>
<td>isbn</td>
<td>title</td>
<td>author</td>
</tr>
</tbody>
</table>