Refer to the following relational schema and the current state of the relations for this quiz:

Employee(EmpID, Ename, Salary, DeptID)
Department(DeptID, Dname, MgrEmpID, Budget)
Project(ProjID, Pname, DeptID)
Works(ProjID, EmpID, Hours)

- DeptID is a foreign key in Employee and Project
- ProjID and EmpID are foreign keys in Works
- MgrEmpID is a foreign key in Department referencing the Employee relation
- Primary keys are underlined

Department

DeptID	Dname	MgrEmpID	Budget
1	Acme	101	100000
2	Ajax	104	200000
3	AAA	103	300000

Employee

EmpID	Ename	Salary	DeptID
101	Ron Blue	30000	1
102	Jennifer Pink	35000	2
103	Gary Green	40000	3
104	Robert Red	35000	2
105	Dan Black	40000	3

Works

ProjID	EmpID	Hours
40	101	20
10	102	40
30	103	30
20	102	20
20	104	10

Project

ProjID	Pname	DeptID
10	X	2
20	Y	2
30	Z	3
40	W	1

CS 4400 QUIZ 2
Summer 2005

1. What is the minimum number of keys that any relation with n attributes must have?
    (a) 0
    (b) 1
    (c) n
    (d) 2^n

2. Which of the following statements is true?
    (a) a key is a superkey
    (b) a candidate key is a superkey
    (c) a primary key is a superkey
    (d) all of the above

3. If we have a relation schema that has 4 attributes, 2 candidate keys, and its corresponding relation has 7 rows, then the degree of that relation is
    (a) 1
    (b) 2
    (c) 4
    (d) 7

4. Which of the following statements is true?
    (a) the attribute value in a tuple that makes up the primary key can be null
    (b) the attribute value in a tuple that makes up a foreign key can be null
    (c) a tuple in a relation can have a null value for each attribute
    (d) all of the above

5. Which of the following update operations may cause a violation of the primary key constraint?
    (a) a deletion of one tuple from the relation
    (b) an insertion of one tuple into the relation
    (c) an update of one tuple in the relation
    (d) both (b) and (c)

6. The definition of a tuple as a mapping, makes the ordering of the attribute values in a relation
    (a) unimportant
    (b) important

7. How many tuples will be returned by the following relational algebra query?

π_{Salary}(Employee)

(a) 2
(b) 3
(c) 4
(d) 5

8. What is the result of the following relational algebra query?

π_{EmpID}(Employee) $-$ π_{EmpID}(Works)

(a) a relation with one column and one tuple whose value is 105
(b) a relation with one column and four tuples whose values are 101, 102, 103 and 104
(c) a relation with one column and zero tuples
(d) none of the above

9. What is the number of tuples returned by the query

Department X Employee X Project

(a) 12
(b) 20
(c) 60
(d) 300

10. Which of the following relational algebra queries returns the employees (i.e., EmpID) who work more than 10 hours on project 20?

(a) $\pi_{EmpID}(\sigma_{Hours>10 \wedge ProjID=20}$ (Works))
(b) π_{EmpID}(Employee)
(c) $\pi_{EmpID}(\sigma_{Hours>10}$ (Works) $\cap$ $\sigma_{ProjID=20}$ (Works))
(d) both (a) and (c)

11. Which relational algebra query will return employees (i.e., EmpID) who work on all projects?

(a) π_{EmpID}(Works) $\cup$ π_{EmpID}(Employee)
(b) $\pi_{EmpID,ProjID}$(Works) $\div$ π_{ProjID}(Project)
(c) π_{EmpID}(Works) $\cap$ π_{EmpID}(Employee)
(d) none of the above

12. Which Employees (i.e., Ename) will be returned by the following query?

$\pi_{Ename}(\sigma_{EmpID = MgrEmpID}$ (Employee X Department))

(a) Ron Blue, Jennifer Pink, Gary Green, Robert Red and Dan Black
(b) Jennifer Pink and Dan Black
(c) Ron Blue, Gary Green and Robert Red
(d) Dan Black

13. Which of the following relational algebra queries returns only the largest salary?

   (a) π_{Salary}(Employee)
   (b) π_{Salary} ($\sigma_{Salary > Asalary}$($\pi_{Salary}$(Employee) X $\rho_{(Asalary)}$ (π_{Salary}(Employee))))
   (c) π_{Salary}(Employee) - (π_{Salary}($\sigma_{Salary < Asalary}$ (π_{Salary}(Employee) X $\rho_{(Asalary)}$ (π_{Salary}(Employee)))))
   (d) None of the above

14. What is the relationship between the following two relational algebra queries?

   A: π_{EmpID}(Employee)
   B: $\pi_{EmpID,DeptID}$(Employee)

   (a) query A will always return more tuples than query B
   (b) query A will always return less tuples than query B
   (c) query A will always return the same number of tuples as query B
   (d) query A will sometimes return less tuples than query B

15. How many tuples will appear in the result of the following query?

   Employee * Project * Department

   (a) 3
   (b) 4
   (c) 5
   (d) 7

16. What is the result of executing the following relational tuple calculus query?
   {t.Dname, s.Ename | Department (t) AND Employee(s) AND t.MgrEmpID = s.EmpID}

   (a)

Acme	Ron Blue
Ajax	Robert Red
AAA	Gary Green

   (b)

Ajax	Jennifer Pink

   (c)

Acme	Ron Blue

   (d)

Ajax	Jennifer Pink
AAA	Dan Black

17. What is the result of executing the following relational tuple calculus query

$\{t.Ename \mid Employee(t)\ AND\ (\forall s)\ (NOT(Employee(s))\ OR\ t.Salary \geq s.Salary)\}$

(a)

Ron Blue
Robert Red
Gary Green

(b)

Robert Red

(c)

Gary Green
Dan Black

(d)

Ron Blue

18. Which query produces the following result?

Ename	DeptID
Dan Black	3

(a) $\pi_{Ename,DeptID}\ (\sigma_{Salary\ =\ 40000}(Employee))$

(b) $\pi_{Ename,DeptID}\ (Employee\ *\ \sigma_{Budget\ =\ 300000}(Department))$

(c) $\pi_{Ename,DeptID}\ (\sigma_{Salary\ >\ 35000}(Employee)\ *\ \sigma_{Budget\ <\ 250000}(Department))$

(d) none of the above

19. Which query produces the following result?

2	1
3	2
3	1

(a) $\sigma_{D\ >\ C}\ (\rho_{(D)}(\pi_{DeptID}(Department))\ X\ \rho_{(C)}(\pi_{DeptID}(Employee)))$

(b) $(\pi_{DeptID}(\sigma_{DeptID\ >\ 1}(Department)))\ X\ (\pi_{DeptID}(\sigma_{DeptID\ <\ 3}(Department)))$

(c) $\{t.DeptID, s.DeptID \mid Department(t)\ AND\ Employee(s)\ AND\ t.DeptID > s.DeptID\}$

(d) Both (a) and (c)

20. The following two queries return the same set of tuples for the given state of the Department, Project and Employee relations.

π_{DeptID}(Department * Project)   and π_{DeptID}(Department * Employee)

If we insert the following tuple, <4, 'BBB', null, 100000>, in the Department relation will the results of the two queries still be the same?
   (a) Yes
   (b) No

21. Suppose we have a relation R with n tuples. If we do the natural join, R * R, then the resulting relation will consist of how many tuples?
   (a) n^2 tuples
   (b) n tuples
   (c) 2*n tuples
   (d) 0 tuples

22. Suppose we do the left outer join of R and S and call it T1 and we do the right outer join of R and S and call it T2. The intersection of T1 and T2 will be the same as which of the following?
   (a) T1 ∪ T2
   (b) T1 * T2
   (c) T1 – T2
   (d) T2 – T1

23. If we perform R ÷ S, then which of the following conditions must hold?
   (a) The attributes in R and S must be the same
   (b) The attributes in S must be a subset of the attributes in R
   (c) The attributes in R must be a subset of the attributes in S
   (d) Both (b) and (c)

24. Which of the following relational algebra operators require type compatibility?

   (a) Set difference
   (b) Cartesian product
   (c) Natural join
   (d) All of the above

25. Suppose we have a relation with only attributes A and B. The combination of A and B is a superkey but it is not a key. Is it necessary that both A is a key and B is a key for the relation?
   (a) Yes
   (b) No

KEY:

1	2	3	4	5	6	7	8	9	10
B	D	C	B	D	A	B	A	C	D

11	12	13	14	15	16	17	18	19	20
B	C	C	C	D	A	C	D	D	A

21	22	23	24	25
B	B	B	A	B