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Question **1**

Not answered

Marked out of 4

The language generated by the following grammar $G = (\{S, A\}, \{a, b, c\}, \{S \to aA, S \to b, A \to cA, A \to a\}, S)$

Select one or more:

- a.   contains the string $aaab$.
- b.   is not regular.
- c.   can be accepted by a finite automaton.
- d.   contains the string aca.

The correct answers are: can be accepted by a finite automaton., contains the string aca.

Question **2**

Not answered

Marked out of 6

Assume we have two nondeterministic finite automata $A1$ and $A2$. Which of the following are valid statements regarding the equivalence of these automata:

Select one or more:

- a.   If these automata have different numbers of final states, then they are not equivalent.
- b.   There exists an algorithm to decide their equivalence.
- c.   If a start (i.e. initial) state of automaton $A1$ is at the same time its final (i.e. accept) state, but no start state of automaton $A2$ is its final state, then $A1$ and $A2$ are not equivalent.
- d.   If these automata have different numbers of states, then they are not equivalent.

The correct answers are: There exists an algorithm to decide their equivalence., If a start (i.e. initial) state of automaton $A1$ is at the same time its final (i.e. accept) state, but no start state of automaton $A2$ is its final state, then $A1$ and $A2$ are not equivalent.

Question **3**

Not answered

Marked out of 4

The multiplicative inverse of 3 (mod 7) is

Select one:

○ a.   5

○ b.   2

○ c.   3

○ d.   does not exist

The correct answer is: 5

Question **4**

Not answered

Marked out of 6

Cryptographic hash functions are used

Select one or more:

☐ a.   as a part of digital signature.

☐ b.   to assure message integrity.

☐ c.   for authentication.

☐ d.   for a safe password management.

The correct answers are: as a part of digital signature., to assure message integrity., for a safe password management.

Question **5**

Not answered

Marked out of 4

The system catalog of a relational database contains

Select one or more:

☐ a.   information needed to assure transaction processing (commit, rollback).

☐ b.   information needed for system recovery after a failure.

☐ c.   information regarding database users and their access rights.

☐ d.   metadata - information about the database structure.

The correct answers are: metadata - information about the database structure., information regarding database users and their access rights.

Question **6**

Not answered

Marked out of 6

Which of the following are valid properties of a relation key in relational database:

Select one or more:

- a. its value uniquely identifies a table row
- b. transitive closure of its proper subset contains all relation attributes
- c. its transitive closure contains all relation attributes
- d. it appears exclusively on the left-hand side of functional dependence

The correct answers are: its value uniquely identifies a table row, its transitive closure contains all relation attributes

Question **7**

Not answered

Marked out of 4

What is the dimension of the vector space of matrices $\mathbb{R}^{m,n}$?

Select one:

- a. $m^2 + n^2$
- b. $m \cdot n$
- c. $m + n$
- d. None of the listed values is correct.

The correct answer is: $m \cdot n$

Question **8**

Not answered

Marked out of 6

The rank of a matrix is equal to:

Select one or more:

- a. the rank of its transposed matrix.
- b. the number of its non-zero rows.
- c. the number of its linearly dependent rows.
- d. the number of non-zero numbers on its diagonal.

The correct answer is: the rank of its transposed matrix.

Question **9**

Not answered

Marked out of 4

Simplify the following propositional logic formula $B \wedge (A \vee \neg(\neg B \vee A))$.

Select one:

- a. $B \wedge A$
- b. $B \wedge \neg A$
- c. B
- d. $B \vee \neg A$

The correct answer is: B

Question **10**

Not answered

Marked out of 6

Which of the following formulae are logical consequences of the formula $\neg(\forall x)p(x)$? ($p(x)$ is a unary predicate).

Select one or more:

- a. $(\exists y)\neg p(y)$
- b. $(\exists x)\neg p(x)$
- c. $(\forall x)\neg p(x)$
- d. $(\forall y)\neg p(y)$

The correct answers are: $(\exists x)\neg p(x)$, $(\exists y)\neg p(y)$

Question **11**

Not answered

Marked out of 4

Decide which of the following synchronization techniques are block based and can be used to synchronize processes or threads.

Select one or more:

- a. instruction TSL (Test-and-Set Lock)
- b. barriers
- c. the ostrich algorithm
- d. semaphores

The correct answers are: semaphores, barriers

Question **12**

Not answered

Marked out of 6

Assume there is a FAT file system on disk drive Z and directories occupy just one data block. Only the FAT table and the root directory are in main memory. How many disk access operations are needed as a minimum in order to read the first data block containing the data from file Z:\A\B\file.txt?

Select one:

- ○ a.   0
- ○ b.   2
- ○ c.   1
- ○ d.   3

The correct answer is: 3

Question **13**

Not answered

Marked out of 4

Consider the following procedure ff definition:

```
void ff(int x) {
  if (x > 0) ff(x-1) ;
  abc(x);
  if (x > 0) ff(x-1) ;
}
```

During the call ff(2) of the procedure ff defined above, how many times the procedure abc(x) was called?

Select one:

- ○ a.   8
- ○ b.   7
- ○ c.   5
- ○ d.   1

The correct answer is: 7

Question **14**

Not answered

Marked out of 6

Assume the SET abstract data type is implemented using a characteristic (bit) vector. Select the correct time complexities of the operations of membership test, element insertion, element deletion for a set of n elements.

Select one:

- ○ a. $\Theta(n), \Theta(n), \Theta(n)$
- ○ b. $\Theta(1), \Theta(n), \Theta(n)$
- ○ c. $\Theta(1), \Theta(1), \Theta(1)$
- ○ d. $\Theta(\log n), \Theta(n), \Theta(n)$

The correct answer is: $\Theta(1), \Theta(1), \Theta(1)$

Question **15**

Not answered

Marked out of 6

User Datagram Protocol (UDP) differs from the TCP network protocol (among other) by the fact that:

Select one or more:

☐ a.   it does not solve the problem of packet duplicity.

☐ b.   it closes both sides of the channel at once.

☐ c.   it has "hand shake" at connection opening.

☐ d.   it does not confirm packet delivery.

The correct answers are: it does not confirm packet delivery., it does not solve the problem of packet duplicity.

Question **16**

Not answered

Marked out of 4

In probability theory, for two disjoint events it holds that

Select one:

○ a.   they could be independent, only if at least one of the events is impossible.

○ b.   they are always independent.

○ c.   they can never be independent.

○ d.   none of the other answers is correct.

The correct answer is: they could be independent, only if at least one of the events is impossible.

Question **17**

Not answered

Marked out of 4

Determine all correct statements:

Select one or more:

☐ a.   Arithmetic right shift by one bit corresponds to multiplication by two.

☐ b.   Arithmetic left shift by one bit corresponds to multiplication by two.

☐ c.   Arithmetic right shift by one bit followed by arithmetic left shift by one bit return always the original value for any argument.

☐ d.   Arithmetic left shift by two bits corresponds to multiplication by four.

The correct answers are: Arithmetic left shift by one bit corresponds to multiplication by two., Arithmetic left shift by two bits corresponds to multiplication by four.

Question **18**

Not answered

Marked out of 6

Assume we are using an 8-bit binary adder for two's complement binary number encoding. Determine the result obtained when adding FF and 01 (in hexadecimal).

Select one:

- a. 256 (in decimal)
- b. 0 (in decimal)
- c. 100 (in hexadecimal)
- d. the result cannot be represented in 8 bits due to overflow

The correct answer is: 0 (in decimal)

Question **19**

Not answered

Marked out of 4

Let A, B, C be any sets. If possible, replace question mark by one of the operations offered so that the equality $A \setminus (B \setminus C) = (A \setminus B) \, ? \, C$ will hold (symbol $\setminus$ expresses the set difference operation).

Select one:

- a. $\cap$
- b. $\setminus$
- c. $\cup$
- d. the equality does not hold for any one of the operations offered

The correct answer is: the equality does not hold for any one of the operations offered

Question **20**

Not answered

Marked out of 6

Let us consider a binary relation $R = \{(a, b), (b, c), (c, a)\}$ on the set $X = \{a, b, c\}$. Determine which of the relations below is an equivalence on X (symbol Δ_X denotes the identity relation on X, symbol R^+ denotes the transitive closure of R).

Select one:

- a. $R \cup R^{-1}$
- b. none of the relations offered
- c. $R \cup \Delta_X$
- d. R^+

The correct answer is: \(R^+\)

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