

Instructions: This quiz has 27 questions. The use of calculators is forbidden. Click on the box with the right answer. To initialise the quiz you must click on “BEGIN QUIZ.” When you finish the quiz you click on “END QUIZ” in order to see your score.

Begin Quiz Answer each of the following.

There are two parts to this exam. A multiple-choice part and a true or false part.

Part I. Multiple Choice

1. What value is returned for s in the following algorithm?

Algorithm 0.1: MYSTERY(.)

```
s ← 1
for i ← 1 to 100
  do { if i mod 10 = 0
      then s ← i
  }
return (s)
```

10

550

551

5050

2. An urn contains 28 blue marbles, 20 red marbles, 12 white marbles, 10 yellow marbles, and 8 magenta marbles. How many marbles must be drawn from the urn in order to assure that there will be 15 marbles of the same color?

59

58

16

43

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3. Obtain a sum of products for the truth table

A	B	C	Z
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

$$Z = \bar{A} \cdot B \cdot \bar{C} + A \cdot B \cdot \bar{C} + A \cdot B \cdot C$$

$$Z = A \cdot B \cdot \bar{C} + \bar{A} \cdot B \cdot \bar{C} + A \cdot B \cdot \bar{C}$$

$$Z = \bar{A} \cdot B \cdot \bar{C} + ABC$$

$$Z = (\bar{A}) \cdot (\bar{B}) \cdot (\bar{C}) + \bar{A} \cdot B \cdot \bar{C} + A \cdot B \cdot \bar{C} + A \cdot B \cdot C$$

4. How many injective functions are there from the set $\{1, 2, 3\}$ to the set $\{1, 2, 3, 4\}$?

81 64 24 36

5. How many surjective functions are there from the set $\{1, 2, 3, 4\}$ to the set $\{1, 2, 3\}$?

81 64 24 36

6. How many integers in the set $\{100, 101, 102, \dots, 198, 199\}$ of 100 consecutive integers **are not** the sum of four consecutive integers?

76 75 74 73

7. Given that

$$1,000,002,000,001$$

has a prime factor greater than 9000, find it.

8887 8999 9901 9907

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14. Evaluate the sum

$$\binom{100}{0} - \binom{100}{1}2 + \binom{100}{2}2^2 - \binom{100}{3}2^3 + \cdots - \binom{100}{99}2^{99} + \binom{100}{100}2^{100}.$$

15. The numbers

$$1, 2, 3, \dots, 2003$$

are written on a blackboard, in increasing order. Then the first, the fourth, the seventh, etc. are erased, leaving the numbers

$$2, 3, 5, 6, 8, 9, 11, 12, 14, \dots$$

on the board. This process is repeated, leaving the numbers

$$3, 5, 8, 9, \dots$$

The process continues until one number remains on the board and is finally erased. What is the last number to be erased?

$$473 \qquad 710 \qquad 1065 \qquad 1598$$

16. How many binary relations on a set A of five elements are there which are both symmetric and reflexive?

$$512 \qquad 1024 \qquad 25 \qquad 100$$

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17. Consider the relation \sim on the non-zero real numbers given by

$$(x, y) \in (\mathbb{R} \setminus \{0\})^2, \quad x \sim y \iff xy < 0.$$

Which of the following statements is true?

- \sim is reflexive
- \sim is symmetric
- \sim is anti-symmetric
- \sim is transitive

Part II. True or False.

18. If P and Q are boolean propositions then $P \vee Q \vee (P \implies Q)$ is a tautology.
True False
19. For all $n \geq 3$, the complete graph on n vertices has an Euler tour.
True False
20. If a graph contains no odd-length cycle, then it is bipartite.
True False
21. Every non-bipartite graph contains a 3-cycle as a subgraph.
True False
22. Every graph with a Hamiltonian cycle also has an Euler tour.
True False
23. There exists a graph with 20 vertices, 10 edges, and 5 connected components.
True False
24. Every connected graph has a tree as a subgraph.
True False

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25. In every planar embedding of a connected planar graph, the number of vertices plus the number of faces is greater than the number of edges.

True

False

26. If every vertex in a graph has degree 3, then the graph is 4- colorable.

True

False

27. There exists a six-vertex graph with vertex degrees 0, 1, 2, 3, 4, and 5.

True

False

End Quiz

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