Name:                                                                             Number:

30 Multiple-choice questions each worth 1 point. Use the mark reader sheets.
Do not spend more than 50 minutes on the MCQ.

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1. Sieve of Eratosthenes is an algorithm to find
   a) The greatest common divisor d) The shortest path in a graph
   b) Prime numbers e) The inverse of a matrix
   c) The closest pair of points in plane

2. Pseudocode may be defined as
   a) Procedural solutions to problems
   b) A collection of connected geometric shapes containing a description of the algorithms steps
   c) A mixture of natural language and programming language like constructs
   d) A general approach to solving problems algorithmically
   e) Precise machine-readable description of an algorithm

3. Algorithms that require ____________ number of operations are practical for solving only problems of very small size.
   a) polynomial    b) constant    c) logarithmic    d) linear    e) exponential

4. The function $\log_2 n$ grows ________ when input $n$ is doubled in size
   a) twofold    b) 4 times    c) by 1    d) by constant factor    e) None of the above

5. Which of the following better captures an algorithm's behavior on typical or random inputs
   a) Best-case efficiency analysis d) Typical case efficiency analysis
   b) Worst-case efficiency analysis e) Amortized efficiency
   c) Average-case efficiency analysis

6. The efficiency analysis framework concentrates on ________ as the principal indicator of algorithm efficiency
   a) basic operation count d) amount of memory units used
   b) basic operation timing e) most expensive operation
   c) total run time on reference machine

7. A function $t(n)$ is said to be in $O(g(n))$ if $t(n)$
   a) is bounded above by $g(n)$ for all large $n$
   b) is bounded above by some constant multiple of $g(n)$ for all large $n$
   c) is bounded both above and below by some constant multiples of $g(n)$
   d) is bounded below by some constant multiple of $g(n)$ for all large $n$
   e) is bounded above by some function of $g(n)$

8. The limit as $n \to \infty$ of $t(n)/g(n) = $ some positive constant implies that
   a) $t(n)$ has a smaller order of growth than $g(n)$
   b) $t(n)$ has the same order of growth as $g(n)$
   c) $g(n)$ has a larger order of growth than $t(n)$
   d) $g(n)$ has a smaller order of growth than $t(n)$
   e) None of the above

9. Multiplicative constants are not considered in analysis of algorithm time efficiency because
   a) they can be overcome by faster machines
   b) they do not affect the actual run time of the algorithm
   c) they cancel out when computing efficiency functions
   d) constant functions grow very slowly with input size growth
   e) they have a small effect when input size is small

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Sunday, June 14, 2009
10. A sorting algorithms is considered **stable** if it
   a) preserves the relative order of any two equal elements in its input
   b) preserves the relative order of most two equal elements in its input
   c) perform its operations mostly in the same memory used by its input elements
   d) can change the relative order of equal elements in its input
   e) its worst case efficiency is in $n \log n$

11. Empirical analysis of an algorithm is the use of _________ to convey useful information about the algorithm
   a) still or animated images
   b) a program implementing the algorithm on sample inputs
   c) a combination of natural language and programming language like code
   d) Fibonacci numbers
   e) recurrence relations

12. Brute force strategy of designing algorithms relies (depends) on using
   a) the problem statements and definitions directly
   b) solution of a smaller instance of the same problem
   c) the combined solutions of smaller sub problems
   d) the solution to a simpler instance of the same problem
   e) the solution of an instance from a different problem

13. Which sort algorithm(s) have a quadratic worst case efficiency
   a) bubble sort    b) heap sort    c) quicksort    d) A and B    e) A and C

14. A **sentinel** is used in sequential search to
   a) improve the algorithm's time efficiency
d) improve the algorithm's memory usage
   b) improve the algorithm's run time
e) simplify its efficiency analysis
   c) make the algorithm more readable

15. An algorithm which finds the closest pair of points in the plane by computing the distance between all possible pairs is an example of
   a) reduce-and-conquer
d) change-and-conquer
   b) brute force
e) transform representation
   c) divide-and-conquer

16. A Hamiltonian circuit is
   a) a cycle that passes through all the vertices of a graph
   b) the shortest cycle through all vertices of a graph
   c) a cycle that passes through all the vertices of a graph exactly once
d) cycle through points which form the smallest polygon that contains all points of a set of points
e) the fastest cycle through distinct vertices of a graph

17. An algorithm that relies on pre sorting its element list input is an example of
   a) Decrease by variable size
d) Transform by simplification
   b) Decrease by constant factor
e) Decrease-and-conquer
   c) Representation change

18. The Johnson-Trotter algorithm is used to
   a) generate all subsets of a set of objects
   b) solving the topological sorting problem
c) generating permutations of set of objects in lexicographic order
d) compute the product of two matrices
e) None of the above

19. Using the determinant of a matrix to determine the position of a point relative to a line segment in the plane is an example of
   a) brute force
d) simplification
   b) representation change
e) decrease-and-conquer
   c) problem reduction

20. One of the following is not an **elementary operation** for Gaussian elimination:
   a) exchanging two equations
   b) replacing an equation with the sum of itself and some multiple of another
   c) replace an equation with its nonzero multiple
d) replacing an equation with the difference of itself and some multiple of another
e) replacing an equation by another
21. In the maximum key deletion operation on heaps, the first step involves
   a) exchanging the root's key with the last key of the heap
   b) deleting the first element of the heap
   c) exchanging the root's key with the last parent node in the heap
   d) deleting the last element of the heap
   e) reversing the order of elements of the heap

22. Which algorithm has the best worst-case performance
   a) Quicksort    b) Insertion sort    c) Mergesort    d) Selection sort    e) Bubble sort

23. The worst-case performance of interpolation search is
   a) $\log_2 n + 1$    b) $\log_2 \log_2 n + 1$    c) linear    d) quadratic    e) $\log_2 n$

24. Breadth-first search method of graph traversal can not be used to determine
   a) connectivity    b) acyclicity    c) tree edges    d) articulation points    e) cross edges

25. A DFS-based solution of the topological sorting problem relies (depends) on ___________ in the
digraph representation of item pre-requisites (dependencies)
   a) finding forward edges    b) deciding if cycles exist    c) finding vertices with no incoming edges
   d) finding minimum-edge paths    e) finding cross edges

26. Which algorithm design technique tends to be ideally suited for parallel computations
   a) Brute force    b) Divide-and-conquer    c) Decrease-and-conquer
   d) Transform-and conquer    e) None of the above

27. The height of an empty binary search tree is
   a) 0    b) 1    c) -1    d) -2    e) None of the above

28. The number of external nodes in a binary search tree of 4 nodes is:
   a) 3    b) 4    c) 5    d) 6    e) 7

29. Computing the factorial recursively is an example of
   a) Divide-and-conquer    b) Decrease-by-constant factor    c) Decrease-by-1
   d) Brute force    e) None of the above

30. Which one of the following permutations of \{1,2,3\} is in lexicographic order?
   a) 123 132 213 312 321    d) 123 132 213 231 321 312
   b) 123 132 312 231 213    e) None of the above
   c) 123 132 231 213 312

31. **[10 Points]** Find the median of the following list: 4,1,10,9,7,12,8,2,15 without pre-sorting. Show each
    iteration of your solution. (No points for final answer)

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