Part II. *Multiple Choice.* Choose the best answer from among the choices supplied. Record the answers on the scantron sheet provided. *(2 pts. each)*

1. Combinatorics is concerned, among others, with the study of this activity:

   a. arrangements and patterns
   b. designs and assignments
   c. schedules and connections
   d. configurations
   e. All of these are areas of concern

2. Of the three basic problems of combinatorics, this might be the most difficult, since it requires an additional element – a metric that is the basis of the calculated answer:

   a. existence problem
   b. counting problem
   c. optimization problem
   d. All are equally difficult.
   e. There is no valid basis for comparison.

3. The ***product*** rule for counting applies to events that are mutually exclusive. Assess the validity of this statement.

   a. It is a valid statement.
   b. It is non a valid statement.

4. The ***sum*** rule for counting applies only to events where the results are mutually exclusive, that is, we are counting results that cannot occur in both events. Assess the validity of this statement.

   a. It is a valid statement.
   b. It is non a valid statement.

5. In an n-set, there are this many duplicated elements.

   a. 0
   b. 1
   c. n
   d. $n-1$
   e. $n+1$

6. An n-set has this many permutations that begin with the number 1.

   a. 0
   b. 1
   c. $n!$
   d. $(n-1)!$
   e. $(n+1)!$

7. The value of $n!$ can be approximated by computing $s_n = \sqrt{2\pi n}\,(n/e)^n$. This is known as:

   a. Turing's approximation
   b. Gauss' approximation
   c. Stirling's approximation
   d. Lagrange's approximation
   e. Laplace's approximation

8. An r-permutation of an n-set is denoted in the textbook by $P(n,r)$. It supplies the number of ways one can arrange r elements from the n-*set* when order is important. The correct formula for $P(n,r)$ is:

   a. $n!r!$
   b. $(n+r)!$
   c. $r!/n!$
   d. $n!+r!$
   e. $n!/(n-r)!$

9. The number of subsets of the n-set is given by this formula:

   a. $n!$
   b. $(n-1)!$
   c. $n(n-1)/2$
   d. 2^n
   e. None of the above

10. An r-combination of an n-set is denoted in the textbook by $C(n,r)$. It supplies the number of r-element subsets of the n-set. The correct formula for $C(n,r)$ is:

    a. $n(n-r)/2$
    b. $(n-r)!$
    c. $n!/r!(n-r)!$
    d. $n!/(n+r)!$
    e. $n!/(n-r)!$

11. The relationship between $P(n,r)$ and $C(n,r)$ is:

    a. $P(n,r) = C(n,r)$
    b. $P(n,r) \geq C(n,r)$
    c. $P(n,r) \leq C(n,r)$
    d. $P(n,r) = C(n,r) \times P(r,r)$
    e. All of the above

12. $C(n,r)$ can be computed in a recursive manner. The double recurrence relation involving $C(n,r)$ is valid: $C(n,r) = C(n–1,r–1) + C(n–1,r)$
As with all recurrences, the basis case(s) must be defined. This is one of the basis cases –

a. $C(1,1) = 0$
b. $C(1,1) = 1$
c. $C(1,1) = 2$
d. $C(n,n) = 0$
e. $C(n,n) = n$

13. $P(n,r)$ can likewise be computed in a recursive manner. A recurrence equation involving $P(n,r)$ is given by:

a. $P(n,r) = P(n–1,r–1) + P(n–1,r)$
b. $P(n,r) = n\ P(n–1,r–1)$
c. $P(n,r) = P(n–1,r–1) / P(n–1,r)$
d. All of the above
e. None of the above

14. The number of r-permutations of an m-set where replacement or repetition is allowed is denoted in the textbook by $P^R(m,r)$. The correct formula for $P^R(m,r)$ is:

a. $P^R(m,r) = m\ P(m,r)$
b. $P^R(m,r) = r^m$
c. $P^R(m,r) = m^r$
d. $P^R(m,r) = P(m+r–1,r)$
e. There is no formula for this.

15. Similarly, the number of r-combinations of an m-set where replacement or repetition is allowed is denoted in the textbook by $C^R(m,r)$. The correct formula for $C^R(m,r)$ is:

a. $C^R(m,r) = m\ C(m,r)$
b. $C^R(m,r) = m^r$
c. $C^R(m,r) = r^m$
d. $C^R(m,r) = C(m+r–1,r)$
e. There is no formula for this.

16. According to the textbook, combinatorics is one of the fastest-growing areas of mathematics (and may we add thanks in part to the rise of computers). Assess the validity of this statement.

a. This is a valid statement.
b. This is not a valid statement.

17. The algorithms presented in Chapter 2 of the textbook generated this/these kind(s) of combinatorial objects:

a. permutations of the set $\{1,2,\ldots,n\}$
b. bit strings of length n
c. r-combinations of the set $\{1,2,\ldots,n\}$
d. All of these were generated.
e. None of these were generated.

18. There are these many binary functions on n variables: $\{0,1\}^n \rightarrow \{0,1\}$

a. n^2
b. $P(n,2) = n(n–1)$
c. $C(n,2) = n(n–1)/2$
d. 2^n
e. 2^{2^n}

19. Most, if not all, of the counting formulas in combinatorics are derived from the basic counting rules (product rule, sum rule). Assess the validity of this statement

a. This is a valid statement.
b. This is not a valid statement.

20. "And" and "or" are key words that usually indicate whether the sum rule or the product rule is appropriate. The word _______ suggests the ***product*** rule; the word _______ suggests the ***sum*** rule.

a. and/or
b. or/and
c. and/and
d. or/or
e. None of these is a valid answer.