1. (20 pts.) Circle T if the statement is true or F if the statement is false.

T  F  (R ∩ Q) ∪ Z = Z.
T  F  If P(A) is the Power Set of A and Ø is the Empty Set, then Ø ⊂ P(A) and Ø ∈ P(A).
T  F  The negation of the statement All students who take CMSC 203 and pass will get a Computer Science degree is the statement All students who take CMSC 203 and pass will not get a Computer Science Degree.
T  F  The statements If I pass CMSC 203, then I will get a good job and If I do not get a good job, then I did not pass CMSC 203 are logically equivalent.
T  F  If A = {x,y,z}, then (z,z,y) ∈ A × A.
T  F  If Σ = {x,y,z}, then (zz,y) ∈ Σ² × Σ.
T  F  The set of the integers is partitioned by the set of positive integers and the set of negative integers.
T  F  (Show work!) 

\[ \left( (33 \mod 6) - \left\lfloor \frac{126}{102} \right\rfloor \right) \left( -13.2 \right) + 6 \mod 5 = 2 \]

T  F  If n and d are positive integers, then n = d(n div d) + (n mod d).
T  F  If A is a set with 8 elements, and a ∈ A, then A has 128 subsets containing a.

2. (6 pts.) Given the statement All kids who run fast win races, its converse is ____________; its inverse is ___________; its contrapositive is ____________.

3. (10 pts.) Show, without using truth tables, that p → (q → r) ≡ (p ∧ q) → r.

4. (4 pts.) Write the negation of the universal statement: For all x ∈ Z, if x² = 9, then x = 3 or x = −3.

5. (10 pts.) Find the Truth Table and Boolean Polynomial representing a circuit of three switches controlling a light bulb in such a way that if the first and third switches are both ON or both OFF, the bulb is ON.

6. (10 pts.) Using the Properties of Sets, show that: \((A − B) − C = (A − C) − B\).

7. (40 pts.) Prove 2 of the 4 theorems:

Theorem 1: If every integer has a unique representation as the product of primes, then there are an infinite number of primes.

Theorem 2: If any integer n can be expressed as 3k, 3k + 1, or 3k + 2, then the product of three consecutive integers is divisible by 3.

Theorem 3: If q ∈ Q and r ∈ Q, then qr ∈ Q.

Theorem 4: For all integers a,b,c, and d, if a | (b + c) and a | d, then a | (b + c + d).