

Assignment 1 – Due 7/2/2017

**Part I. Exercise Set 2.1 [5(a-d), 10, 25-31, 52, 54]**

**5. Q: Indicate which of the following sentences are statements.**

A: See highlighted.

a) 1,024 is the smallest four-digit number that is a perfect square.

b) She is a mathematics major.

c)  $128 = 2^6$

d)  $x = 2^6$

**10. Q: Let  $p$  be the statement “DATAENDFLAG is off”.  $q$  the statement “ERROR equals 0,” And  $r$  the statement “SUM is less than 1,000”. Express the following sentences in symbolic notation.**

A: See highlighted.

a) DATAENDFLAG is off, ERROR equals 0, and SUM is less than 1,000.

$p \wedge q \wedge r$

b) DATAENDFLAG is off but ERROR is not equal to 0.

$p \wedge \sim q$

c) DATAENDFLAG is off; however, ERROR is not 0 or SUM is greater than or equal to 1,000.

$p \wedge (\sim q \vee \sim r)$

d) DATAENDFLAG is on and ERROR equals 0 but SUM is greater than or equal to 1,000.

$(\sim p \wedge q) \wedge \sim r$

e) Either DATAENDFLAG is on or it is the case that both ERROR equals 0 and SUM is less than 1,000.

$\sim p \vee (q \wedge r)$

**Use De Morgan’s laws to write negations for the statements in 25-31**

25. Q: Hal is a math major and Hal’s sister is a computer science major.

A: Hal is not a math major or Hal’s sister is not a computer science major.

26. Q: Sam is an orange belt and Kate is a red belt.

A: Sam is not an orange belt or Kate is not a red belt.

27. Q: The connector is loose or the machine is unplugged.

A: The connector is not loose and the machine is not unplugged.

28. Q: The units digit of  $4^{67}$  is 4 or it is 6.

A: The units digit of  $4^{67}$  is not 4 and it is not 6.

29. Q: This computer program has a logical error in the first ten lines or it is being run with an incomplete data set.

A: This computer program does not have a logical error in the first ten lines and it is not being run with an incomplete data set.

30. Q: The dollar is at an all-time high and the stock market is at a record low.

A: The dollar is not at an all-time high or the stock market is not at a record low.

31. Q: The train is late or my watch is fast.

A: The train is not late and my watch is not fast.

**Use Theorem 2.1.1 to verify the logical equivalences in 50-54. Supply a reason for each step.**

52.Q:  $\sim (p \vee \sim q) \vee (\sim p \wedge \sim q) \equiv \sim p$

A:  $\sim (p \vee \sim q) \vee (\sim p \wedge \sim q) \equiv (\sim p \wedge \sim(\sim q)) \vee (\sim p \wedge \sim q)$  //By De Morgan's Law

$\equiv (\sim p \wedge q) \vee (\sim p \wedge \sim q)$  //By Double Negative Law

$\equiv \sim p \wedge (q \vee \sim q)$  //By Distributive Laws

$\equiv \sim p \wedge t$  //By Negation Law

$\equiv \sim p$  //By Identity Law

54. Q:  $(p \wedge (\sim(\sim p \vee q))) \vee (p \wedge q) \equiv p$

A:  $(p \wedge (\sim(\sim p \vee q))) \vee (p \wedge q) \equiv (p \wedge (\sim(\sim p) \wedge \sim q)) \vee (p \wedge q)$  //By De Morgan's Law

$\equiv (p \wedge (p \wedge \sim q)) \vee (p \wedge q)$  //By Double Negative Law

$\equiv ((p \wedge p) \wedge \sim q) \vee (p \wedge q)$  //By Associative Law

$\equiv (p \wedge \sim q) \vee (p \wedge q)$  //By Idempotent Law

$\equiv p \wedge (\sim q \vee q)$  //By Distributive Laws

$\equiv p \wedge t$  //By Negation Law

$\equiv p$  //By Identity Law