Devin Gendron

Hw sec 2.1, #'s: 5, 10, (25-31), 52, 54

5. Indicate which of the following sentences are statements.

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

Ans: A) is a statement because it is a true proposition.

b. She is a mathematics major.

Ans: B) is not a statement because the pronoun is not clear without preceding information.

c. 128=26

Ans: C) is a statement even though it is false.

d. x =26

Ans: D) is a statement because the value for x will not change.

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

Ans: p ^ q ^ r

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

Ans: p ^ ~ q

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

Ans: p ^ (~ q v ~ r)

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

Ans: ~ p ^ q ^ ~ r

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

Ans: ~ p v (q ^ r)

Use De Morgan's laws to write negations for the statements in 25–31.

Using: $\sim(p \wedge q) \equiv \sim p \vee \sim q \quad \& \quad \sim(p \vee q) \equiv \sim p \wedge \sim q$

25. Hal is a math major and Hal's sister is a computer science major.

Ans: Hal is not a math major or Hal's sister is not a computer science major.

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

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

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

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

28. The units digit of 467 is 4 or it is 6.

Ans: The units digit of 467 is not 4 and it is not 6.

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

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

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

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

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

$\sim(p \vee \sim q) \vee (\sim p \wedge \sim q) \equiv (\sim p \wedge \sim(\sim q)) \vee (\sim p \wedge \sim q)$		**by De Morgan's Laws**
	$\equiv (\sim p \wedge q) \vee (\sim p \wedge \sim q)$	**by the double negative law**
	$\equiv \sim p \wedge (q \vee \sim q)$	**by the distributive law**
	$\equiv \sim p \wedge t$	**by the negation law**
	$\equiv \sim p$	**by the identity law**

54. (p ∧ (∼(∼p ∨ q))) ∨ (p ∧ q) ≡ p

(p∧(∼(∼p∨q)))∨(p∧q) ≡ (p∧(∼(∼p) ∧ ∼q)))∨(p∧q)	**by De Morgan's Laws**
≡ (p ∧ (p ∧ ∼q)) ∨ (p ∧ q)	**by the double negative law**
≡ (p ∧ p) ∧ (p ∧ ∼q) ∨ (p ∧ q)	**by the distributive law**
≡ p ∧ (p ∧ ∼q) ∨ (p ∧ q)	**by the idempotent law**
≡ p ∧ (p ∧ (∼q ∨ q))	**by the distributive law**
≡ p ∧ (p ∧ t)	**by the negation law**
≡ p ∧ p	**by the identity law**
≡ p	**by the idempotent law**