1.3: 1, 8, 10, 13, 16, 17

8. a. \((\exists x)(W(x) \land L(x) \land C(x))\)
   b. \((\forall x)[W(x) \rightarrow (L(x) \land C(x))]\)
   c. \((\exists x)[L(x) \land (\forall y)(A(x, y) \rightarrow J(y))] \lor (\exists x)(\forall y)[L(x) \land (A(x, y) \rightarrow J(y))]\)
   d. \((\forall x)[J(x) \rightarrow (\forall y)(A(x, y) \rightarrow J(y))] \lor (\forall x)(\forall y)[J(x) \rightarrow (A(x, y) \rightarrow J(y))]\)
   e. \((\forall x)(\forall y)[(J(y) \land A(x, y)) \rightarrow J(x)]\)
   f. \((\forall x)(W(x) \land L(x)) \rightarrow (\exists y)[J(y) \land A(x, y)]\) or \((\forall x)(\exists y)[W(x) \land L(x)] \rightarrow [J(y) \land A(x, y)]\)
   g. \((\exists x)(W(x) \land (\forall y)[L(y) \rightarrow (A(x, y))])\) or \((\exists x)(W(x) \land (\forall y)[A(x, y) \rightarrow (L(y))])\) or \((\exists x)(\forall y)(W(x) \land [L(y) \rightarrow (A(x, y))])\)

10. a. \((\forall x)[B(x) \rightarrow (\forall y)(F(y) \rightarrow L(x, y))] \lor (\forall x)(\forall y)[(B(x) \land F(y)) \rightarrow L(x, y)]\)
   b. \((\exists x)[B(x) \land (\forall y)(F(y) \rightarrow L(x, y))]\)
   c. \((\forall x)[B(x) \rightarrow (\exists y)(F(y) \land L(x, y))]\)
   d. \((\forall x)[B(x) \rightarrow (\forall y)((L(x, y) \lor F(y)) \rightarrow F(y)))]\)
   e. \((\forall y)[F(y) \rightarrow (\forall x)(L(x, y) \lor B(x))] \lor (\forall y)(\forall x)[(F(y) \land (L(x, y)) \rightarrow B(x)]\)
   f. \((\forall x)[B(x) \rightarrow (\forall y)(L(x, y) \lor F(y)))]\)
   g. \([(\exists x)[B(x) \land (\forall y)L(x, y) \rightarrow F(y)]\)]
   h. \((\exists x)[B(x) \land (\exists y)(F(y) \land L(x, y))] \lor (\exists x)(\exists y)[B(x) \land F(y) \land L(x, y)]\)
   i. \([(\exists x)[B(x) \land (\forall y)L(x, y) \rightarrow F(y)]\)]
   j. \((\forall x)[B(x) \rightarrow (\exists y)(F(y) \land L(x, y))]\)
   k. \((\forall x)[B(x) \rightarrow (\forall y)(F(y) \rightarrow (L(x, y)))] \lor (\forall x)(\forall y)[(B(x) \land F(y)) \rightarrow (L(x, y))]\)
   l. \([(\exists x)[B(x) \land (\forall y)(F(y) \rightarrow (L(x, y)))])\]

13. \(\neg a. \neg b. \neg c. \neg d.\)

16. \(\neg a.\) domain is the integers, A(x) is "x is even", B(x) is "x is odd"
   b. domain is the integers, P(x,y) is "x + y = 0"; for every x there is a y (y = -x) such that x + y = 0 but there is no single integer x that gives 0 when added to every integer y
   c. domain is the positive integers, P(x) is "x > 4", Q(x) is "x > 2". Then every positive integer greater than 4 is greater than 2, so \((\forall x)(P(x) \rightarrow Q(x))\) is true. There exists a positive integer greater than 4, but not all positive integers are greater than 2, so \((\exists x)P(x) \rightarrow (\forall x)Q(x)\) is false.
   d. domain is the integers, A(x) is "x is even". Then \((\forall x)(A(x))'\) is false - it is not the case that every integer is odd (not even) - but \((\forall x)(A(x))'\) is true since it is false that every integer is even.
17. a. valid: there is an x in the domain with property A says it is false that everything in the domain fails to have property A.
   b. not valid: domain is the integers, P(x) is "x is even", Q(x) is "x is prime". Because there are prime integers, (\exists x)Q(x) and therefore (\forall x)P(x) \lor (\exists x)Q(x) is true. But it is false that every integer is even or prime, so the implication is false.
   c. valid: A true for all objects in the domain means it is false that there is some object in the domain for which A is not true.
   d. valid: suppose that for every member of the domain, either P(x) or Q(x) is true. If there is some member of the domain for which Q is true, then (\exists y)Q(y) is true. Otherwise all members of the domain have property P and (\forall x)P(x) is true. In either case, (\forall x)P(x) \lor (\exists y)Q(y) is true.