ans are funny.   **9. a)** $\exists x(P(x) \wedge Q(x))$ **b)** $\exists x(P(x) \wedge \neg Q(x))$
c) $\forall x(P(x) \vee Q(x))$ **d)** $\forall x \neg(P(x) \vee Q(x))$ **11. a)** T **b)** T **c)** F

d) F **e)** T **f)** F **13. a)** T **b)** T **c)** T **d)** F **15. a)** T **b)** F

Russian."   **35. a)** $\exists x(x \leq 1)$ **b)** $\exists x(x > 2)$ **c)** $\forall x(x < 4)$
d) $\forall x(x \geq 0)$ **e)** $\exists x((x \geq -1) \wedge (x \leq 2))$ **f)** $\forall x((x \geq 4)$
$\wedge (x \leq 7))$ **37. a)** There is no counterexample. **b)** $x = 0$

about one given semester)   **41. a)** If there is a printer that is both out of service and busy, then some job has been lost. **b)** If every printer is busy, then there is a job in the queue. **c)** If there is a job that is both queued and lost, then some printer is out of service. **d)** If every printer is busy and every job is queued, then some job is lost.   **43. a)** $(\exists x\, F(x,\, 10)) \rightarrow$

`father(F,Y)`   **61. a)** $\forall x(P(x) \rightarrow \neg Q(x))$ **b)** $\forall x(Q(x) \rightarrow R(x))$ **c)** $\forall x(P(x) \rightarrow \neg R(x))$ **d)** The conclusion does not follow. There may be vain professors, because the premises do not rule out the possibility that there are other vain people besides ignorant ones. **63. a)** $\forall x(P(x) \rightarrow \neg Q(x))$ **b)** $\forall x(R(x) \rightarrow \neg S(x))$

ignorant ones. **63. a)** $\forall x(P(x) \rightarrow \neg Q(x))$ **b)** $\forall x(R(x) \rightarrow \neg S(x))$ **c)** $\forall x(\neg Q(x) \rightarrow S(x))$ **d)** $\forall x(P(x) \rightarrow \neg R(x))$ **e)** The conclusion follows. Suppose x is a baby. Then, by the first premise, x is illogical, so by the third premise, x is despised. The second premise says that if x could manage a crocodile, then x would not be despised. Therefore, x cannot manage a crocodile.