



Universe of discourse:

The large circle above and every figure contained within it.

Names:

- a, b, c, d, e, f

Predicates:

- S = star
- C = circle
- F = Face
- Q = square
- H = Heart
- A = completely above
- B = completely below
- L = completely left of
- R = completely right of
- K = Contains

Notes:

- a is name of largest circle
- d is name of largest star
- $\forall x \forall y \forall z ((Kxy \ \& \ Kyz) \rightarrow Kxz)$
- $\forall x (Fx \rightarrow Cx)$
- $\sim \exists x Kxx$

1. $\exists x(Sx \ \& \ Hx)$ **False: Nothing is S and H.**
2. $\forall x \sim Sx \rightarrow Sb$ **True: Antecedent always false, hence conditional true.**
3. $\forall x(\sim Sx \rightarrow Cb)$ **True: Since Cb is true, conditional always true.**
4. $\exists x \forall y (\sim Kxy \rightarrow Cx)$ **True: The only thing that satisfies the antecedent condition is d, which is a circle.**
5. $\exists x \exists y \exists z (Kyx \ \& \ Kxz)$ **True: e.g., Kad and Kdb**
6. $\forall x \forall y (\exists z (Kzx \ \& \ Kzy) \rightarrow Sz)$ **~wff, z in Sz not bound.**
7. $\exists x \exists y ((Cx \ \& \ Sy) \ \& \ (Lyx \ \& \ Ayx))$: **False: No star is to the left of and above a circle.**
8. $\forall x Cx \vee (\sim \exists y Sy \rightarrow \forall z Hz)$: **True: Second disjunct is true because antecedent condition is false.**
9. $\forall x (\exists z Rxz \vee \exists z Lzx)$ **False: There is nothing to the left of or the right of the big star or the big circle.**
10. $\forall x \forall y ((Axy \vee Bxy) \vee (Cx \vee Sx))$: **False: e.g., The square is neither above nor below the heart.**
11. $\sim Sd \rightarrow \sim He$: **True: Antecedent condition is false.**
12. $\forall x (Sx \rightarrow \exists y \exists z ((Fy \ \& \ Hz) \ \& \ (Ryx \ \& \ Ayz)))$: **False. There is no face and heart that is to the right of and above the large star.**
13. $\forall x \forall y ((Sx \ \& \ Kxy) \ \& \ \sim \exists z ((Kxz \ \& \ Ayz) \rightarrow Cy))$ **False: First conjunct says everything is a square that contains everything.**
14. $\forall y \forall x ((Kxy \vee Kyx) \rightarrow \sim \exists z (Kzx \vee Kzy))$ **False: Kdb and Kad makes the antecedent true and the consequent false.**
15. $\forall x (Qx \rightarrow \exists y (Lyx))$ **~wff, no parentheses go around Lyx.**