PART I: PROPOSITIONAL LOGIC

1. List the components and the sentential operators in the following sentence. Which of the sentential operators is truth-functional?

   "Either Jonathan Edwards believed that Princeton is better than Harvard, or Harvard didn't offer him a job."

2. Compute the truth value of the following statements, given that A and B are each true and X and Y are each false.

   a) $(A \& \sim Y) \rightarrow (X \vee \sim B)$

   b) $\sim(A \vee \sim B) \leftrightarrow (\sim X \rightarrow Y)$

3. Are the following true or false?

   a) If two statement forms are consistent, then they must both be true at once on every row of their joint truth table.

   b) $\sim(P \& Q)$ and $(\sim P \vee \sim Q)$ are logically equivalent statement forms.

   c) If a system of propositional logic is *complete*, then any argument form that can be proved with the rules of that system is valid. ("Valid" here is supposed to correspond to the definition in terms of truth tables.)

Translate sentences (4) – (6) into propositional logic.

4. China's abandoning communism is a necessary condition for Tibet's regaining freedom.

5. If cocaine is legalized, then its use may increase but criminal activity will decline.

6. Human life will not perish unless either we poison ourselves with pollution or a large asteroid collides with earth.

---

7. Use the full truth table method to determine whether the following argument form is valid or invalid. Show your work.

   $(P \& \sim Q) \rightarrow R, \sim P \leftrightarrow Q \ : \ R \vee \sim P$

8. What is wrong with the following "proof"? Explain in detail.

{1}	1.	P v Q	A
{2}	2.	P	A
{3}	3.	Q	A
{2,3}	4.	P & Q	2,3 &I
{2,3}	5.	P	4 &E
{1}	6.	P	1,2,2,3,5 vE

9. Construct a proof of the following argument. Use only primitive rules.

$(F \& \sim G) \rightarrow (\sim G \& H), F \rightarrow \sim H \; : \; F \rightarrow G$

PART II: QUANTIFIER LOGIC

Translate sentences (10) – (12) into quantifier logic. Use the dictionary provided below.

a = Andrew	Lx ≡ x is a letter
s = Sally	Axy ≡ x is addressed to y
j = Julia	Ix ≡ x is an invitation
Gxyz ≡ x gives y to z	Wxy ≡ x is written by y

10. Andrew gives at least two things to Sally.

11. No letter written by Julia is an invitation.

12. Some invitations are not addressed to someone.

---

13. Translate the following quantifier logic sentence into English.

$(\exists x)(\exists y)[\sim(x = y) \; \& \; (z)((z = x) \vee (z = y))]$

14. State the restrictions that apply to the rule *E-Elimination*.

15. State the rule =Introduction.

16. Construct a proof of the following argument.

$: \sim(\exists x)Fx \rightarrow [(x)(Gx \rightarrow Fx) \rightarrow (x)\sim Gx]$

17. Complete the following definitions.

a) A quantifier logic sentence is *consistent* if and only if ...

b) Two quantifier logic sentences are *logically equivalent* if and only if ...

18. Provide interpretations which show that the following argument forms are invalid.

a) $(x)Fx \rightarrow (x)Gx \;:\; (x)(Fx \rightarrow Gx)$

b) $(x)(Jx \rightarrow (\exists y)Kxy) \;:\; (\exists y)(x)(Jx \rightarrow Kxy)$