Worksheet Exercise 4.1.A. Name ______________________________

Symbolizing Quantified Sentences Class _______________ Date ___________

Part A. Symbolize the following sentences, using obvious letters for names and simple predicates. (Watch out for hidden negatives.)

1. George is not happy. ________________________
2. Carlos is smart, but he is not rich. ________________________
3. Everything is mixed up. ________________________
4. Somethings cannot be explained. ________________________
5. Not everything can be explained. ________________________
6. Nothing is greatest. ________________________
7. Not everything is immortal. ________________________
8. Expensive candy exists. ________________________
9. Inexpensive automobiles don't exist. ________________________
10. If there are unicorns, then somethings are magical. ________________________
11. If there are no ghosts, then Carlos is not a ghost. ________________________
12. Everything is spiritual, or everything is not spiritual. ________________________
13. Everything is either spiritual or not spiritual. ________________________
14. Something is smart, and something is a computer. ________________________
15. There are ghosts if and only if there is no matter. ________________________
16. Everything is red and sweet or not red and not sweet. ________________________

Worksheet Exercise 4.1.B. Name ______________________________

Symbolizing Quantified Sentences Class ______________ Date __________

Part B. Symbolize the following sentences, using obvious letters for names and simple predicates. These are harder. Use the available **Exercise Work Sheet** to submit your work.

1. George and Sue like to dance, but neither Liz nor George like to sing.

   ____

2. None of George, Sue, Liz, and Bill know how to paint.

   ____

3. Simple, sober, silly Sally sits and Sophie sings.

   ____

4. Some things don't like to sing, including George, but some things do like to sing, although not George.

   ____

5. Some things are costly and trendy, and some things like that are useful as well.

   ____

6. George is such that he is definitely not a person who is generally very capable but specifically not able to sing.

   ____

7. Either something is good and something is bad, or nothing is good and nothing is bad.

   ____

8. If nothing is both alive and made of gold, then either something is not alive, or everything is not made of gold.

   ____

9. It is definitely false that nothing is both not alive and not made of gold. [Keep all the negatives.]

   ____

10. If everything has value, and everything is unique, then, if George is an atom, then unique atoms with value exist.

    ____

Worksheet Exercise 4.2.A.	Name _______________________________
Symbolizing Complex Sentences	Class _______________ Date ___________

Part A. Symbolize the following sentences in the blanks provided. Be sure to symbolize each individual idea used in these sentences with a corresponding predicate letter, and symbolize each negative word.

1. Some problems are difficult. ____________________
2. All students are logical. ____________________
3. Some problems cannot be solved. ____________________
4. No student is omniscient. ____________________
5. Some easy problems can be solved. ____________________
6. All difficult problems can be solved. ____________________
7. No problem is unsolvable. ____________________
8. Some answers are difficult mathematical proofs. ____________________
9. Some unsolvable problems are incomprehensible. ____________________
10. No short answers are adequate solutions. ____________________
11. Not every person is a professional logician. ____________________
12. No person is a professional logician. ____________________
13. If difficult problems exist then logicians exist. ____________________
14. If all problems are difficult, all solutions are long. ____________________
15. Either problems exist, or no logicians have jobs. ____________________
16. Ella is a logician, but all problems are unsolvable. ____________________

Worksheet Exercise 4.2.B. Name ______________________________

Symbolizing Complex Sentences Class ______________ Date ___________

Part B. Symbolize the following sentences. These are harder, and you will want to consult the translation rules back in Chapter 3.

1. Only graduate students are enrolled in graduate programs.
   (G = graduate student, E = is enrolled in a graduate program)

   ____

2. A great many metaphysical problems are both complex and unsolvable.

   ____

3. Tired students can't study very well.

   ____

4. Every person is irrational, if he or she is very angry.

   ____

5. All and only students with high GPAs are eligble for the award.

   ____

6. Everything is tolerable, except the creepy insects, they are definitely not.

   ____

7. Broccoli and spinach are delicious and nutritious.

   ____

8. A hungry tiger will eat you, if it can. (E = will eat you, A = is able to eat you)

   ____

9. If someone is poisoned, then he/she must get an antidote. (G = gets an antidote)

   ____

10. If anyone here starts to sing, George will get upset and leave. So, everyone, please, don't. (S = starts to sing, A = is allowed to sing)

    ____

Worksheet Exercise 4.2.C. Name ______________________________

Symbolizing Complex Sentences Class _______________ Date ___________

Part B. Translate the following symbolic sentences into regular English sentences using the listed meanings for the predicate letters.

T = triangle,	F = figure,	C = circle,	E = three-sided,
S = square,	G = green,	U = four-sided,	B = blue,
M = matter,	O = solid,	t = Sears Tower,	c = Chicago

1. (∀x)(Tx ⊃ Fx) ______________________________

2. ~(∀x)(Fx ⊃ Tx) ______________________________

3. (∀x)(Cx ⊃ ~Ex) ______________________________

4. (∃x)~(Sx & Gx) ______________________________

5. (∃x)(~Sx & ~Gx) ______________________________

6. (∃x)[(Gx & Sx) & Ux] ______________________________

7. (∀x)(Gx & Sx & Ux) ______________________________

8. (∀x)[Tx ⊃ (Ex & Fx)] ______________________________

9. (∀x)[Tx ⊃ ~(Ux & Fx)] ______________________________

10. (∀x)[Tx ⊃ (~Ux & Fx)] ______________________________

11. ~(∃x)[(Ex & Fx) & Cx] ______________________________

12. (∀x)Mx V (∀x)~Mx ______________________________

13. (∀x)(Ox & Fx) & (∃x)~Mx ______________________________

14. Bt ⊃ (∃x)[(Ox & Fx) & Bx] ______________________________

15. (∀x)(Gx & Sx) ⊃ Sc ______________________________

16. (∃x)(Sx &~Fx) ⊃ (∀x)~Fx ______________________________

Worksheet Exercise 4.3.	Name ______________________________
Calculating Truth-values	Class _______________ Date ___________

Part A. Translate each of the following sentences into a regular English sentence, using the listed meanings for the symbols; and then, state their truth-value, **T** or **F**.

T = triangle, F = figure, C = circle, S = square,
U = four-sided, G = green, B = blue, c = Chicago

			truth-value
1.	(∀x)(Fx ⊃ Tx)	______________________________	________
2.	(∀x)(Cx ⊃ ~Sx)	______________________________	________
3.	(∃x)(Sx & Ux)	______________________________	________
4.	(∀x)(Sx & Gx)	______________________________	________
5.	(∃x)(~Sx & ~Cx)	______________________________	________
6.	(∀x)(Bx V Gx)	______________________________	________
7.	(∀x)(~Bx V ~Gx)	______________________________	________
8.	Tc	______________________________	________

Part B. In the spaces provided, calculate the truth-values of the following sentences, using the calculated truth-values from Part A. Use the Tree Method.

9. Tc ⊃ (∃x)(Sx & Ux)

10. (∀x)(Fx ⊃ Tx) V (∀x)(Bx V Gx)

11. (∃x)(Sx & Ux) ≡ (∃x)(~Sx & ~Cx)

12. ~[(∀x)(Bx V Gx) & Tc]

13. ~Tc V ~(∀x)(Cx ⊃ ~Sx)

14. ~(∀x)(Fx ⊃ Tx) ⊃ ~(∃x)(Sx & Ux)

>>Continued on back side >>

Ex. 4. 3. C. Name ____________________ / _______

Part C. In the spaces provided, calculate the truth-values of the following sentences. Use the Tree Method and the symbol meanings from Part A. You must first determine the values of the simple component sentences.

15. (∀x)(Fx ⊃ Sx) ≡ [(∀x)(Tx ⊃ Ux) V ~(Bc & Tc)]

16. (∃x)(Fx & Cx) & (∃x)(Fx & ~Cx) & ~(∃x)[Fx & (Cx & ~Cx)]

17. [(∀x)(Tx ⊃ Bx) V (∀x)(Tx ⊃ ~Bx)] & (∀x)[Tx ⊃ (Bx V ~Bx)]

18. (∀x)[(Sx & Bx) ⊃ (Fx & Ux & ~Gx)] ⊃ [(∃x)(Sx & Tx) V (∃x)(Bx & Gx)]

19. [(∀x)(Cx ⊃ Bx) & (∀x)(Bx ⊃ Cx)] ≡ (∀x)(Cx ≡ Bx)

20. {(∃x)[Fx & (Tx & ~Ux & ~Cx)] V (∃x)[Fx & (~Tx & Ux & ~Cx)]} ⊃ ~(∀x)Gx

Reference Sheet 4.4.
Rules of Quantificational Logic

In what follows, α/β indicates putting α for all occurrences of β, and α//β indicates putting α for some occurrences of β.

The Quantifier-Negation Laws

Q.N.	~(∀x) **F**x = (∃x) ~**F**x
Q.N.	~(∃x) **F**x = (∀x) ~**F**x
Cat.Q.N.	~(∀x)(**F**x ⊃ **G**x) = (∃x)(**F**x & ~**G**x)
Cat.Q.N.	~(∃x)(**F**x & **G**x) = (∀x)(**F**x ⊃ ~**G**x)

Universal Instantiation U.I.

(∀**x**)(… **x** …)
∴ (… **n**/**x** …)

No restrictions on the name **n**.

Existential Instantiation E.I.

(∃**x**)(… **x** …)
∴ select name **n**
∴ (… **n**/**x** …)

1. **n** is a name that has never been used before
2. **n** must first be introduced in a selection step

Existential Generalization E.G.

(… **n** …)
∴ (∃**x**)(… **x**/**n** …)

(… **n** …)
∴ (∃**x**)(… **x**//**n** …)

No restrictions on the name **n**.

Universal Generalization U.G.

:
select name **n**
:
:
(… **n** …)
∴ (∀**x**)(… **x**/**n** …)

1. The first line selects a name **n** never used before.
2. The last line is not un-representative.

Worksheet Exercise 4.4.A. Name ______________________________

Practicing the Rules Class ______________ Date ___________

Part A. For each of the following inferences, determine whether the conclusion may be derived by the rule listed. Answer YES or NO in the blanks provided. (Premiss "Ma" is listed only to make the name "a" already present in the deduction.)

1. Ma (∀x)(Fx V Gx) --------- ∴ Fb V Gb U.I. _____	2. Ma (∀x)(Fx V Gx) --------- ∴ Fa V Ga U.I. _____	3. Ma (∀x)(Fx V Gx) --------- ∴ Fa V Gb U.I. _____	4. Ma (∀x)Fx V (∀x)Gx --------- ∴ Fa V (∀x)Gx U.I. _____
5. Ma Fb & Gb --------- ∴ (∃x)(Fx & Gx) E.G. _____	6. Ma Fa & Ga --------- ∴ (∃x)(Fx & Gx) E.G. _____	7. Ma Fa & Gb --------- ∴ (∃x)(Fx & Gx) E.G. _____	8. Ma ~Fb --------- ∴ ~(∃x)Fx E.G. _____
9. Ma (∃x)Fx --------- ∴ Fb E.I. _____	10. Ma (∃x)Fx --------- ∴ select name a ∴ Fa E.I. _____	11. Ma (∃x)Fx --------- ∴ select name b ∴ Fb E.I. _____	12. Ma (∃x)Fx --------- ∴ select name b ∴ Fc E.I. _____
13. Ma ~(∃x)Fx --------- ∴ (∀x)~Fx Q.N. _____	14. Ma ~(∀x)Fx --------- ∴ (∀x)~Fx Q.N. _____	15. Ma (∃x)~Fx --------- ∴ ~(∀x)Fx Q.N. _____	16. Ma ~(∃x)~Fx --------- ∴ (∀x)~~Fx Q.N. _____
17. Ma Fa --------- ∴ (∀x)Fx U.G. _____	18. Fa & Ga ⌈ select name a ⌊ Fa Simp ---------- ∴ (∀x)Fx U.G. _____	19. Fa & Ga ⌈ select name b ⌊ Fa Simp ---------- ∴ (∀x)Fx U.G. _____	20. Ma (∀x)(Fx & Gx) ⌈ select name b | Fb & Gb U.I. ⌊ Fb Simp ∴ (∀x)Fx U.G. _____

Worksheet Exercise 4.4.B. Name ________________________________

Quantificational Deductions Class _______________ Date ___________

Part B, 1–5. Symbolize the following arguments in the spaces provided, and give deductions for them. Check the symbolization answers at the end.

(1) Everything is either green or red. Chicago is not green, but it is square. So, Chicago is red and square.

1. ________________________ Prem
2. ________________________ Prem

So, ____________________

3. ________________________ ________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________

(2) All things are human or matter. All matter is expendable. Data is a non-human machine. So, Data is expendable.

1. ________________________ Prem
2. ________________________ Prem
3. ________________________ Prem

So, ____________________

4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________

(3) All pink horses are rare. All rare horses are expensive. Allegro is a pink horse. So, Allegro is an expensive horse.

1. ________________________ Prem
2. ________________________ Prem
3. ________________________ Prem

So, ___________________

4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________

(4) Queen Elizabeth is an orator and funny too. All orators have had voice lessons. So, something funny had voice lessons.

1. ________________________ Prem
2. ________________________ Prem

So, ____________________

3. ________________________ ________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________

(5) Some people are smart and funny. All things are made of matter. So, some material things are smart funny persons.

1. ________________________ Prem
2. ________________________ Prem

So, ____________________

3. ________________________ ________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________

Some help: Here is how you symbolize these arguments. Of course, you have to give the deductions too.

(1) $(\forall x)(Gx \vee Rx)$, $\sim Gc \& Sc$ $/\therefore$ $Rc \& Sc$

(2) $(\forall x)(Hx \vee Mx)$, $(\forall x)(Mx \supset Ex)$, $\sim Hd \& Ad$ $/\therefore$ Ed

(3) $(\forall x)[(Px \& Hx) \supset Rx]$, $(\forall x)[(Rx \& Hx) \supset Ex]$, $Pa \& Ha$ $/\therefore$ Ea

(4) $Oe \& Fe$, $(\forall x)(Ox \supset Vx)$ $/\therefore$ $(\exists x)(Fx \& Vx)$

(5) $(\exists x)[Px \& (Sx \& Fx)]$, $(\forall x)Mx$ $/\therefore$ $(\exists x)[Mx \& (Sx \& Fx \& Px)]$

Worksheet Exercise 4.4.C.	Name ________________________________
Quantificational Deductions	Class _______________ Date ___________

Part C, 6–10. Symbolize the following arguments in the spaces provided, and give deductions for them. Check the symbolization answers at the end.

(6) Some pink horses are rare and expensive. So, expensive horses exist.

1. ________________________ Prem
So, ___________________
2. ________________________ ________
3. ________________________ ________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________

(7) All pink horses are rare. Some wild horses are pink. So, some horses are rare.

1. ________________________ Prem
2. ________________________ Prem
So, ___________________
3. ________________________ ________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________

(8) Every person in Chicago views the Lake and worries a lot. All Lake viewers enjoy nature. Beth is a person in Chicago. So, some worriers enjoy nature.

1. ________________________ Prem
2. ________________________ Prem
3. ________________________ Prem
So, ___________________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________
12. ________________________ ________
13. ________________________ ________

(9) Supply the missing steps and reasons

1. (∀x)(Fx & Gx) Prem
2. (∀x)(Ox & Px) Prem
3. ____________ __________
4. Fa & Ga __________
5. ____________ 2, U.I.
6. ____________ __________
7. ____________ __________
8. ____________ 6,7, Conj
9. (∀x)(Gx & Px) __________

(10) Supply the missing steps and reasons

1. (∀x)(Dx & Sx) Prem
2. [(∀x)Sx] ⊃ (Ra & Qb) Prem
3. ____________ __________
4. ____________ __________
5. ____________ __________
6. (∀x)Sx __________
7. _______________ __________
8. _______________ 7, Simp
9. (∃x)Rx __________

Some help: Here is how you symbolize these arguments. Of course, you have to give the deductions too.

(6) $(\exists x)[(Px \& Hx) \& (Rx \& Ex)]$ $/\therefore$ $(\exists x)(Ex \& Hx)$

(7) $(\forall x)[(Px \& Hx) \supset Rx]$, $(\exists x)[(Wx \& Hx) \& Px]$ $/\therefore$ $(\exists x)(Hx \& Rx)$

(8) $(\forall x)[(Px \& Cx) \supset (Lx \& Wx)]$, $(\forall x)(Lx \supset Ex)$, $Pb \& Cb$ $/\therefore$ $(\exists x)(Wx \& Ex)$

Worksheet Exercise 4.4.D. Name ______________________________

Quantificational Deductions Class _______________ Date ___________

Part D, 11-15. Symbolize the following arguments in the spaces provided, and give deductions for them. Check the symbolization answers at the end. These problems are more difficult—practice them first. Try to write a little smaller here to make things fit.

(11) Dogs are large animals suitable as pets. All large animals are potentially dangerous. So, dogs are potentially dangerous yet suitable as pets. (D, L, A, S, P)

1. ________________________ Prem
2. ________________________ Prem

/∴ ________________________

3. ________________________ ________
4. ________________________ ________
5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________
12. ________________________ ________
13. ________________________ ________

(12) If all dogs are potentially dangerous, then they all require insurance. Fido requires no insurance; but Fido does bark; and only dogs bark. So, some dogs are not potentially dangerous. (D, P, R, f, B)

1. ________________________ Prem
2. ________________________ Prem
3. ________________________ Prem
4. ________________________ Prem

/∴ ________________________

5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________
12. ________________________ ________
13. ________________________ ________
14. ________________________ ________

(13) Some dogs are whimpy; and, some cats are ferocious. Whimpy things don't put up a fight; and, ferocious things don't back down. So, both some dogs don't put up a fight, and some cats don't back down. (D, W, C, F, P, B)

1. ________________________ Prem
2. ________________________ Prem
3. ________________________ Prem
4. ________________________ Prem

/∴ ________________________

5. ________________________ ________
6. ________________________ ________
7. ________________________ ________
8. ________________________ ________
9. ________________________ ________
10. ________________________ ________
11. ________________________ ________
12. ________________________ ________
13. ________________________ ________
14. ________________________ ________
15. ________________________ ________
16. ________________________ ________
17. ________________________ ________
18. ________________________ ________
19. ________________________ ________
20. ________________________ ________
21. ________________________ ________

>> Continued on back side >>

Ex. 4. 4. D. Name ____________________ / _______

(14) Betsy can't sing. But some can sing and climb mountains too. Others can't climb mountains, but they can dance. Now, if both singers and dancers exist, then no non-dancing non-singers exist. So, Betsy can't sing, but she can certainly dance. (b, S, M, D)

1. ______________________ Prem
2. ______________________ Prem
3. ______________________ Prem
4. ______________________ Prem

____

/∴ ______________________

5. ______________________ ________
6. ______________________ ________
7. ______________________ ________
8. ______________________ ________
9. ______________________ ________
10. ______________________ ________
11. ______________________ ________
12. ______________________ ________
13. ______________________ ________
14. ______________________ ________
15. ______________________ ________
16. ______________________ ________
17. ______________________ ________
18. ______________________ ________
19. ______________________ ________
20. ______________________ ________
21. ______________________ ________
22. ______________________ ________

(15) All kittens are felines. All felines are whiskered animals. If all kittens are whiskered, then all felines are carnivors. All carnivorous animals are predators. So, all kittens are predators. (K, F, W, A, C, P)

1. ______________________ Prem
2. ______________________ Prem
3. ______________________ Prem
4. ______________________ Prem

/∴ ______________________

5. ______________________ ________
6. ______________________ ________
7. ______________________ ________
8. ______________________ ________
9. ______________________ ________
10. ______________________ ________
11. ______________________ ________
12. ______________________ ________
13. ______________________ ________
14. ______________________ ________
15. ______________________ ________
16. ______________________ ________
17. ______________________ ________
18. ______________________ ________
19. ______________________ ________
20. ______________________ ________
21. ______________________ ________
22. ______________________ ________

Some help: Here is how you symbolize these arguments. Of course, you have to give the deductions too.

(11) (∀x)[Dx ⊃ ((Lx & Ax) & Sx)] , (∀x)[(Lx & Ax) ⊃ Px] /∴ (∀x)[Dx ⊃ (Px & Sx)]

(12) (∀x)(Dx ⊃ Px) ⊃ (∀x)(Dx ⊃ Rx) , ~Rf , Bf , (∀x)(Bx ⊃ Dx)) /∴ (∃x)(Dx & ~Px)

(13) (∃x)(Dx & Wx) , (∃x)(Cx & Fx) , (∀x)(Wx ⊃ ~Px) , (∀x)(Fx ⊃ ~Bx)
/∴ (∃x)(Dx & ~Px) & (∃x)(Cx & ~Bx)

(14) (∃x)(Sx & Mx) , (∃x)(~Mx & Dx) ,
[(∃x)Sx & (∃x)Dx] ⊃ ~(∃x)(~Dx & ~Sx) /∴ ~Sb & Db

(15) (∀x)(Kx ⊃ Fx) , (∀x)[Fx ⊃ (Wx & Ax)] , (∀x)(Kx ⊃ Wx) ⊃ (∀x)(Fx ⊃ Cx) ,
(∀x)[(Cx & Ax) ⊃ Px] /∴ (∀x)(Kx ⊃ Px)

Worksheet Exercise 4.5.A.B. Name ________________________________

Deductions with C.P. and I.P. Class _______________ Date ___________

Part A. Use the rule I.P. to show that the following arguments are valid.

(#1)

1. ~(∃x)Ux Prem

∴ ~(∃x)(Mx & Ux) Concl

(#2)

1. (∃x)Ux V (Ub V Uc) Prem

∴ (∃x)Ux Concl

(#3)

1. (∀x)(Ax V Bx) Prem
2. (∀x)(Cx V ~Bx) Prem

∴ (∀x)(Ax V Cx) Concl

(#4)

1. (∀x)Ax V (∀x)Bx Prem

∴ (∀x)(Ax V Bx) Concl

>> Continued on back side >>

Ex. 4. 5. B. Name ____________________ / _______

Part B. Use the rule C.P. to show that the following arguments are valid.

(#5)

1. (∀x)(Ax ⊃ Bx)	Prem
∴ Ae ⊃ (∃x)Bx	Concl

(#6)

1. (∀x)(Ax ⊃ Bx)	Prem
2. (∀x)Mx	Prem
∴ Ab ⊃ (∃x)(Bx & Mx)	Concl

(#7)

1. (∃x)(Ax & Bx)	Prem
∴ (∀x)Mx ⊃ (∃x)(Bx & Mx)	Concl

(#8)

1. (∀x)(Mx ≡ Sx)	Prem
∴ (∀x)~Mx ⊃ (∀x)~Sx	Concl

Worksheet Exercise 4.5.C.	Name _______________________________
Deductions with C.P. and I.P.	Class _______________ Date ___________

Part C. Give deductions for the following arguments. These are more difficult.

(#9)

1. (∀x)[Ax ⊃ (Bx & Cx)] Prem
2. (∃x)Dx ⊃ (∃x)Ax Prem

∴ (∃x)(Cx & Dx) ⊃ (∃x)Bx Concl

(#10)

1. (∀x)[(Ax V Bx) ⊃ (Cx & Dx)] Prem
2. (∀x)Cx ⊃ (∀x)Ex Prem

∴ (∀x)Ax ⊃ (∀x)(Ax & Ex) Concl

(#11)

1. (∀x)Ax V (∀x)Bx Prem
2. (∀x)(Ax ⊃ Cx) Prem

∴ (∃x)(Ax & ~Bx) ⊃ (∀x)Cx Concl

(#12)

1. (∀x)[Ax ⊃ (Bx & Cx)] Prem
2. (∀x)[(Bx & Dx) ⊃ Ex] Prem

∴ (∀x)~Ex ⊃ [(∀x)Dx ⊃ (∀x)~Ax] Concl

>> Continued on back side >>

 Name ____________________ / _______

(#13)

1. (∀x)[Fx ⊃ (Gx & (∀y)Hy)] Prem
∴ (∀x)(∀y)[Fx ⊃ (Gx & Hy)] Concl

(#14)

1. (∀x)(Ax ⊃ Cx) Prem
2. (∀x)[(Cx & Dx) ⊃ Ex] Prem
∴ (∃y)(Ay & ~Dy) V (∀x)(Ax ⊃ Ex) Concl

(#15)

1. (∀x)(Ax ⊃ Bx) Prem
2. (∀x)(Bx ⊃ ~Cx) Prem
3. (∃y)By Prem
∴ ~(∃x)(∀y)[(Ax & Cx) V Cy] Concl

(#16)

1. (∀x)[(∃y)(Fx & Gy) ⊃ (Hx & (∀y)Jy)] Prem
∴ (∀x)(∀y)(∀z)[(Fx & Gy) ⊃ (Hx & Jz)] Cncl

Worksheet Exercise 4.6.A.B Name ______________________________

Demonstrating Invalidity Class _______________ Date ___________

Part A. Show that these arguments are invalid. In each case give an appropriate domain and state description. Use the indicated symbolic letters, as well as additional name letters as needed. Your answers should look similar to the answer for #1. *

1. Nothings is a red pig. So, somethings are not red. (R, P)

D = { a, b }

Ra	Pa	Rb	Pb
T	**F**	**T**	**F**

For this domain and description:
Are the premisses = T ? yes
Is the conclusion = F ? yes

2. George is smart. So, George is a smart person. (g, S, P)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

3. George is funny. So, some people are funny. (g, F, P)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

4. There are no funny people. So, George is not funny. (F, P, g)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

5. Some cats sing. Some cats dance. So, some cats sing and dance. (C, S, D)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

6. Some people are not singers. So, some singers are not people. (P, S)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

7. All cats have tails. So, all non-cats do not have tails. (C, T)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

8. All cats have tails. George has a tail. So, George is a cat. (C, T, g)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

9. All cats are smart. Some smarties are funny. So, some cats are funny. (C, S, F)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

10. All things are smart. All funny cats are smart. So, all cats are funny. (S, F, C)

D = { } ____________________ Are the premisses = T ? _______
Is the conclusion = F ? _______

* Throughout, many different answers are possible.

>> Continued on back side >>

Part B. Show that the following arguments are invalid. In each case give an appropriate domain and state description. Your answers should look similar to the answer for #1.

(Don't use the domain individuals "a" and "b" here. Use the individuals "d" and "e" instead. Otherwise, things may get too confusing.)

11. (∃x)Ax & (∃x)Bx /∴ (∃x)(Ax & Bx)

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

12. (∀x)(Ax V Bx) /∴ (∀x)Ax V (∀x)Bx

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

13. (∃x)~(Ax & Bx) /∴ (∃x)~Ax & (∃x)~Bx

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

14. (∀x)Ax ⊃ (∃x)Bx /∴ (∃x)Ax ⊃ (∀x)Bx

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

15. (∀x)Ax ⊃ (∀x)Bx /∴ (∃x)Ax ⊃ (∃x)Bx

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

16. (∀x)(Ax ⊃ Bx) /∴ (∀x)[(Ax V Cx) ⊃ Bx)

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

17. (∀x)(Ax V Bx) , (∀x)(Bx V Cx) /∴ (∀x)(Ax V Cx)

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

18. (∀x)(Ax V Cx) , (∃x)(Ax & Bx) /∴ (∃x)(Ax & Cx)

D = { } ____________________ Are the premisses = T ? ______
Is the conclusion = F ? ______

Worksheet Exercise 4.7.A. Name ________________________________

Symbolizing Relations Class _______________ Date ___________

Part A. Symbolize the following sentences in the blanks provided. Use the indicated predicate letters, relation letters, and name letters.

P = person , R = _ has read _ , s = Shakespeare ,
B = book , W = _ wrote _ , r = *Romeo and Juliet*

1. Shakespeare wrote *Romeo and Juliet*.

   ____

2. *Romeo and Juliet* is a book, written by Shakespeare.

   ____

3. Shakespeare wrote some books.

   ____

4. Some person wrote *Romeo and Juliet*.

   ____

5. *Romeo and Juliet* is a book, written by some person.

   ____

6. *Romeo and Juliet* has been read by every person.

   ____

7. Some people have not read *Romeo and Juliet*, a book written by Shakespeare.

   ____

8. *Romeo and Juliet* is a book that has been read by every person.

   ____

9. Something has written something.

   ____

10. Some person has written nothing.

    ____

11. Some person wrote some book.

    ____

12. Some person has read all books.

    ____

>> continued on back side >>

Ex. 4. 7. A. Name ____________________ / _______

13. No person has read all books.

____

14. Not any person wrote any book.

____

15. Some books have been read by every person.

____

16. Some books have been read by no person.

____

17. Some people have read whatever Shakespeare wrote.

____

18. Whatever a person has writen, he has also read.

____

Worksheet Exercise 4.7.B. Name ______________________________

Symbolizing Relations Class ______________ Date ___________

Part B. Symbolize the following arguments, using the indicated predicate letters, relation letters, and name letters.

1. There is something that caused everything. So, something has caused itself. (C)

____

____

2. Dumbo is bigger than any mouse. Mickey is a mouse. So, Dumbo is bigger than some mouse. (d, m, B)

____

____

____

3. Nothing can cause itself. So, nothing can cause everything. (C)

____

____

4. Bill the Barber shaves only those who pay him. Whoever pays someone has money. George has no money. So, Bill does not shave George. (b, P, S, M = has money, g)

____

____

____

____

5. Everything affects something important. But some things are not important. So, some important things are affected by some unimportant things. (A, I)

____

____

____

6. Nancy is a girl who loves all boys. Frank is a boy who hates all girls. So, some girl likes some boy who hates her. (n, G, L, B, f, H)

____

____

____

7. God can stop any event that is about to happen, provided he knows of it. God knows all events that are about to happen. So, God can stop all bad events that are about to happen. (g, E, A, K, S, B)

____

____

____

8. Whatever. So, Red things that have blue things are things that have things. (R, B, H)

____

____

9. Whatever is alive has some non-physical component. Whatever is non-physical is outside of time. Whatever is outside of time is eternal. So, whatever is alive has some eternal component. (A, P, C, O, E)

____

____

____

____

10. All spiritual things in the actual situation are spiritual in all possible situations. In all possible situations, all spiritual things are outside of time. So, all spiritual things in the actual situation are outside of time in all possible situations. (Px = x is a possible situation, a = the actual situation, xSy = x is spiritual in situation y, xOy = x is outside of time in situation y)

____

____

____

Worksheet Exercise 4.8.A. Name ______________________________

Deductions with Relations Class ______________ Date __________

Part A. These arguments have the English meanings specified in Ex. 4.7.B. Give deductions for these arguments. Some are more difficult, and some require use of the rule CP.

(1)

1.	(∃x)(∀y)(xCy)	Prem
	∴ (∃x)(xCx)	Concl

2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

(2)

1.	(∀x)(Mx ⊃ dBx)	Prem
2.	Mm	Prem
	∴ (∃x)(Mx & dBx)	Concl

3. ______________________________

(3)

1.	(∀x)~(xCx)	Prem
	∴ (∀x)~(∀y)(xCy)	Concl

(4)

1.	(∀x)(~xPb ⊃ ~bSx)	Prem
2.	(∀x)[(∃y)(xPy) ⊃ Mx]	Prem
3.	~Mg	Prem
	∴ ~bSg	Concl

(5)

1.	(∀x)(∃y)(Iy & xAy)	Prem
2.	(∃x)~Ix	Prem
	∴ (∃y)[Iy & (∃x)(~Ix & xAy)]	Concl

(6)

1.	Gn & (∀x)(Bx ⊃ nLx)	Prem
2.	Bf & (∀x)(Gx ⊃ fHx)	Prem
	∴ (∃x){Gx & (∃y)[(By & yHx) & xLy]}	Concl

>> Continued on back side >>

Ex. 4. 8. A. Name ____________________ / _______

(7)

1. $(\forall x)[(Ex \;\&\; Ax \;\&\; gKx) \supset gSx]$ Prem
2. $(\forall x)[(Ex \;\&\; Ax) \supset gKx]$ Prem

∴ $(\forall x)[(Ex \;\&\; Bx \;\&\; Ax) \supset gSx]$ Concl

(8)

1. p Prem

Concl

∴ $(\forall x)\{[Rx \;\&\; (\exists y)(By \& xHy)] \supset (\exists y)(xHy)\}$

(9)

1. $(\forall x)[Ax \supset (\exists y)({\sim}Py \;\&\; yCx)]$ Prem
2. $(\forall x)({\sim}Px \supset Ox)$ Prem
3. $(\forall x)(Ox \supset Ex)$ Prem

∴ $(\forall x)[Ax \supset (\exists y)(Ey \;\&\; yCx)]$ Concl

(10)

1. $(\forall x)[(xSa \;\&\; Pa) \supset (\forall y)(Py \supset xSy)]$ Prem
2. $(\forall y)[Py \supset (\forall x)(xSy \supset xOy)]$ Prem

∴ $(\forall x)[(xSa \;\&\; Pa) \supset (\forall y)(Py \supset xOy)]$ Concl

Worksheet Exercise 4.8.B. Name ________________________________

Deductions with Relations Class _______________ Date ___________

Part B. Symbolize, and give deductions for the following arguments. These are difficult. Check the symbolization answers given below.

1. People like to do what they are good at. People are also good at something if and only if they practice it. So, people like to do what they practice. (P = person, G = x is good at y, L = x likes to do y, R = x practices y)

1.

2.

∴

Symbolization answer. Here is the symbolization answer for problem 1, but do try to figure it out for yourself first, really.

(∀x)[Px ⊃ (∀y)(xGy ⊃ xLy)]
(∀x)[Px ⊃ (∀y)(xGy ≡ xPy)]
/∴ (∀x)[Px ⊃ (∀y)(xPy ⊃ xLy)]

>> Continued on back side >>

Ex. 4. 8. B. Name ____________________ / _______

2. *L'amour*. Everybody loves a lover. Well, George and Barb, and Cindy and Mike, are really nice people; but Barb just doesn't love George. So, that's how one figures out that Cindy does not love Mike. (P = person, N = really nice, L = x loves y, g = George, b = Barb, c = Cindy, m = Mike)

1.
2.
3.
∴

Symbolization answer. Here is the symbolization answer for problem 2, but do try to figure it out for yourself first.

(∀x){Px ⊃ (∀y)[(Py & (∃z)(Pz & yLz)) ⊃ xLy]}
Pg & Ng & Pb & Nb & Pc & Nc & Pm & Nm
~(bLg)
/∴ ~(cLm)

>> Continued on the next page >>

3. People do think with whatever heads they have, if they can. People can think with whatever heads they have, if those heads are not full. Many people have heads that are not full. So, many people have heads that they do think with. (P = person, H = head, H = x has y, T = x thinks with y, C = x can think with y, F = is full)

1.
2.
3.
∴

Symbolization answer. Here is the symbolization answer for problem 3, but do try to figure it out for yourself first.

(∀x){Px ⊃ (∀y)[(Hy & xHy) ⊃ (xCy ⊃ xTy)]}
(∀x)[Px ⊃ (∀y)((Hy & xHy & ~Fy) ⊃ xCy)]
(∃x)[Px & (∃y)(Hy & xHy & ~Fy)]
/∴ (∃x)[Px & (∃y)(Hy & xHy & xTy)]

>> Continued on back side >>

4. There are things that everybody wants to have. All those kinds of things are very hard to get. Whatever is very hard to get is very expensive. People who don't have a lot of money can't afford very expensive things. People who want things that they can't afford are always miserable. You are a person who does not have a lot of money, but you think you are content. People who think they are content but are actually miserable are deluding themselves. So, you are deluding yourself. (a = you, P = person, W = x wants to have y, H = very hard to get, E = very expensive, L = has lots of money, A = x can afford y, M = miserable, C = x thinks y is content, D = x deludes y)

1.
2.
3.
∴

Symbolization answer. Here is the symbolization answer for problem 4, but do try to figure it out for yourself first.

(∃y)(∀x)(Px ⊃ xWy) , (∀y)[(∀x)(Px ⊃ xWy) ⊃ Hy]
(∀y)(Hy ⊃ Ey) , (∀x)[(Px & ~Lx) ⊃ (∀y)(Ey ⊃ ~xAy)]
(∀x){[Px & (∃y)(xWy & ~xAy)] ⊃ Mx} , Pa & ~La & aCa
(∀x)[(Px & xCx & Mx) ⊃ xDx] /∴ aDa

Worksheet Exercise 4.9.A.	Name ________________________________
Symbolizing Identities	Class _______________ Date ___________

Part A. Symbolize the following sentences in the blanks provided. Use the indicated predicate letters, relation letters, and name letters.

S = skyscraper	I = _ is in _	s = The Sears Tower
E = expensive to live in	T = _ is taller than _	c = Chicago
B = very big	L = _ lives in _	n = New York

1. There is at least one skyscraper in Chicago, and it is very big.

   ____

2. There are at least two skyscrapers in Chicago.

   ____

3. There is at most one skyscraper in Chicago.

   ____

4. There is exactly one skyscraper in Chicago.

   ____

5. The Sears Tower is the only skyscraper in Chicago.

   ____

6. Every skyscraper except the Sears Tower is in Chicago.

   ____

7. The one and only skyscraper in Chicago is expensive to live in.

   ____

8. The Sears Tower is one of at least two skyscrapers in Chicago.

   ____

9. Some skyscraper in Chicago is taller than another skyscraper in New York.

   ____

10. No skyscraper in Chicago can be identical to some skyscraper in New York.

    ____

11. The Sears Tower is the tallest skyscraper there is.

    ____

12. Some skyscraper in Chicago has at least two occupants (they live there).

    ____

Worksheet Exercise 4.9.B. Name ________________________________

Symbolizing Identities Class _______________ Date ___________

Part B. Symbolize the following arguments in the blanks provided. Use the indicated predicate letters, relation letters, and name letters.

L = likes to dance	D = Dutchman	F = _ is a friend of _
H = hairdresser		A = _ admires _
P = person	g = George	T = _ talks to _
E = exhausted	s = Sally	K = _ knows _ (active voice)
T = is in town	h = Harry	F = _ is faster than _
S = skater	n = Sally's neighbor	outskated = some skater is faster

1. George is a friend of Sally and also of Harry. Sally likes to dance, but Harry does not. So, George has at least two different friends.

____ prem

____ prem

____ concl

2. Sally is a friend of all hairdressers but not of George, who is her neighbor. So, her neighbor is not a hairdresser.

____ prem

____ concl

3. Sally doesn't admire anything except herself. Sally sometimes talks to herself, but she has never talked to George. So, Sally does not admire George.

____ prem

____ prem

____ concl

4. Only Sally is known by Harry, and only Harry is known by Sally. Some people are known by both Harry and by Sally. Sally is exhausted. So, Harry is exhausted.

____ prem

____ prem

____ prem

____ prem

____ concl

5. Some people in town know Sally. At most one person knows Sally. So, no one outside of town knows Sally.

____ prem

____ prem

____ concl

6. The fastest skater is a Dutchman. So, any skater who is not a Dutchman can be outskated.

____ prem

____ concl

Worksheet Exercise 4.9.C. Name ______________________________

Deductions with Identities Class ______________ Date __________

Part C. Give deductions for these arguments.

(#1) 1. gFs & gFh Prem
2. Ds & ~Dh Prem /∴ (∃x)(∃y)[gFx & gFy & ~(x **=** y)]

(#2) 1. (∀x)(Hx ⊃ sFx) & ~sFg Prem
2. g **=** n Prem /∴ ~Hn

(#3) 1. (∀x)[~(x **=** s) ⊃ ~sAx] & sAs Prem
2. sTs & ~sTg Prem /∴ ~sAg

(#4) 1. (∀x)[~(x **=** s) ⊃ ~hKx] & hKs Prem
2. (∀x)[~(x **=** h) ⊃ ~sKx] & sKh Prem
3. (∃x)(Px & hKx & sKx) Prem
4. Es Prem /∴ Eh

>> Continued on back side >>

Ex. 4. 9. C. Name ____________________ / _______

(#5) 1. (∃x)(Px & Tx & xKs) Prem
2. (∀x)(∀y)[(Px & Py & xKs & yKs) ⊃ x = y] Prem /∴ (∀x)[(Px & ~Tx) ⊃ ~xKs]

(#6) 1. (∃x){ Dx & Sx & (∀y)[(Sy & ~(y = x)) ⊃ xFy] } Prem
∴ (∀y)[(Sy & ~Dy) ⊃ (∃x)(Sx & xFy)]