Worksheet Exercise 2.1.A.
Symbolizing Basic Sentences

Name _____
Class _____ Date _____

Part A. Symbolize the following sentences in the blanks provided. First, give a partial symbolization with capital letters and the original English operator expressions. Secondly, give a complete symbolization. Write the two results side by side for comparison.

	partial symb.	complete
1. If there is no noise, the parrot will bite.	if not N, B	~N ⊃ B
2. Although there was noise, the parrot bit.	although N, B	N & B
3. The parrot won't bite, if there is noise.		
4. The parrot will bite, or there will be noise.		
5. It is false that the parrot will not bite.		
6. Either there is noise, or there is no noise.		
7. There was noise, but the parrot didn't bite.		
8. The parrot didn't bite; yet, there was noise.		
9. There was noise, and the parrot did bite.		
10. There was no noise; the parrot did not bite.		
11. The parrot does not bite, if there is no noise.		
12. That the parrot didn't bite is definitely true.		
13. That the parrot did bite is definitely false.		
14. Not only was there noise, the parrot also bit.		
15. The parrot did bite, even though it didn't.		
16. It bites if and only if there is noise.		
17. If the parrot didn't bite, there was no noise.		
18. It doesn't bite if and only if there's no noise.		
19. The choices are noise and a biting parrot.		
20. Yay, though it noised, it bit thee not.		

Worksheet Exercise 2.1.B.
Symbolizing Basic Sentences

Name _____
Class _____ Date _____

Part B. Some symbolism practice. Each of the following expressions is intended to be a single, compound symbolic sentence, but some of them are incorrectly written. Figure out which of these is a well-formed sentence. Write "YES" or "NO." (Of course, don't worry about whether any of these are true or false.) There is also a space for you to make some optional comments. It may help here, if you try to read these in English, with the meanings:

A = Apples are red	C = Carrots are crunchy	M = Monkeys are funny
B = Bananas are yellow	K = Kangaroos are jumpy	P = Parrots are noisy

		Correct? YES/NO	Optional comment space
1.	A & ~M		
2.	~A ⊃ ~C		
3.	K (& ~M)		
4.	⊃ A, B		
5.	~ P & M		
6.	~A & B		
7.	A ⊃ B C		
8.	K V (~M)		
9.	A & B V C		
10.	(~A) & B		
11.	A, B, & C		
12.	~(A & B)		
13.	(~A)(& B)		
14.	(K V M) V ~P		
15.	K V (M V ~P)		
16.	M & (~P & ~M) V P		
17.	(M & ~P) & (~M V P)		
18.	~(~A) & ((~B) & (~C))		
19.	~(~(~M)) & ~~~P		
20.	~(B V ~C) ⊃ (~B & C)		

Worksheet Exercise 2.2.A. Name _____
Symbolizing Arguments Class _____ Date _____

Part A. Analyze each of the following arguments in two stages. (1) First, use the suggested capital letters to abbreviate the simple sentences of the argument. This results in a partial symbolization consisting of capital letters connected by English operator expressions. (2) Next, finish symbolizing the arguments by replacing the English operator expressions by the symbolic connectives. Write the two results side by side for comparison. (3) Optional: In your opinion, is the argument valid or invalid?

	English argument	partial	complete
1.	Either this painting is by Rembrandt or it is by VerMeer. It isn't by Rembrandt. So, it must be by VerMeer. (R, M) Argument is: valid	either R or M not R So, M	R V M ~R ∴ M
2.	Coffee and tea both contain the drug caffeine. So, tea contains the drug caffeine. (C, T) Argument is: _____		
3.	If the premium was paid, then the insurance is in force. But the premium was not paid. So, the insurance is not in force. (P, I) Argument is: _____		
4.	If people can live on Venus, then they can live on Mars. If they can live on Mars, then they can live on Jupiter. Therefore, if people can live on Venus, then they can live on Jupiter. (V, M, J) Argument is: _____		
5.	The house will be sold by August, or it won't be sold this year. It won't be sold by August. So, it won't be sold this year. (A, Y) Argument is: _____		
6.	If George is not late for the meeting, then he will introduce the speaker. But, George was late for the meeting. So, he did not introduce the speaker. (L, I) Argument is: _____		
7.	Rotterdam is in Holland or in Europe. Rotterdam is in Holland. So, Rotterdam is not in Europe. (H, E) Argument is: _____		
8.	The dog won't bark, if the child won't scare it. The child won't scare it. So, the dog won't bark. (D, C) Argument is: _____		

>> continued on back side >>

9. If it rains, then the streets are wet. If it freezes, then the streets are slippery. It is raining or freezing. So, the streets are wet or slippery. (R, W, F, S) Argument is: _____

10. If it rains and freezes, then the streets are wet and slippery. It is raining or freezing. So, the streets are wet or slippery. (R, F, W, S) Argument is: _____

Worksheet Exercise 2.2.B. Name _____
Symbolizing Arguments Class _____ Date _____

Part B. Analyze each of the following arguments in two stages. (1) First, use the suggested capital letters to abbreviate the simple sentences of the argument. This results in a partial symbolization consisting of capital letters connected by English operator expressions. (2) Next, finish symbolizing the arguments by replacing the English operator expressions by the symbolic connectives. Write the two results side by side for comparison. (3) Optional: In your opinion, is the argument valid or invalid?

	English argument	partial	complete
1.	If George or Liz went to the party, then Tom and Susan were upset. Liz, as it turned out, didn't go, but Tom and Susan were still upset. Therefore, George did indeed go to the party. (G, L, T, S) Argument is: _____		
2.	If Al isn't singing then Bo isn't dancing. Either Bo or Clyde is dancing. So, if Clyde is not dancing then Al is singing. (A, B, C) Argument is: _____		
3.	The orchestra won't play both Stravinski and Mozart tonight. They will, as we know, play Mozart tonight. We must conclude, therefore, that they will not play Stravinski tonight. (M, S) Argument is: _____		
4.	It is not true that both you can't go on the kiddie rides and also you can't go on the adult rides. You, naturally, can't go on the kiddie rides. Therefore, you can go on the adult rides. (K, A) Argument is: _____		
5.	His driving license won't have been revoked if he hasn't violated the law. But he must have violated the law, because his license has been revoked. (R, V) Argument is: _____ [Note: "because"]		
6.	If this school is to survive, it must increase its tuition (in order to offset expenses). But, if this school is to survive, it can't increase its tuition (so as to remain competitive). So, this school is definitely not going to survive. (S, I) Argument is: _____		
7.	If this creature doesn't have teeth, then it does not bite. Ouch! Well, it is not the case that it doesn't bite. So, it is not the case that it doesn't have teeth. (T, B) Argument is: _____		

>> continued on back side >>

8. They won the battle, and it is false that they did not win the war. So, they did win the war, and it is not true that they didn't win the battle. (B, W) Argument is: _____

9. If some number N is the largest possible number, then both N is the largest possible number (by hypothesis) and N is not the largest possible number (since you can add 1 to it). So, it's false that some number N is the largest possible number. (L) Argument is: _____

10. Paris, London, or Rome will host the Wine Convention this year. If Paris does, then French wines will win. If London does, then British wines will win. If Rome does, then Italian wines will win. British wines will not win this year. So, either French wines or Italian wines will win this year. (P, L, R, F, B, I) Argument is: _____

Reference Sheet 2.3.
Conditional Sentences

Statements of sufficient condition		
if <u>what?</u> then q if p, then q if p, q q, if p in the event that p, q in the case that p, q provided p, q (sometimes)	p is sufficient for q if p then q	p ⊃ q

Statements of requirement (a.k.a. statements of necessary condition)		
if p then <u>what?</u> p requires q if p then it must be that q not p unless q not p without q p only if q	q is necessary for p if not q then not p if p then q	~q ⊃ ~p p ⊃ q

Statements of equal condition (a.k.a. statements of necessary condition *and* sufficient condition)		
p if and only if q p if q, and p only if q if p then q, and if q then p p when and only when q p in case and only in case that q p just in the case that q p, provided q (sometimes) p, but only if q p equals q	p and q are equal conditions p is a nec. and suf. cond. for q p if and only if q	(p ⊃ q) & (q ⊃ p) p ≡ q

Statements qualifified by condition (here p is often affirmative)		
definitely p, unless q unless q, p p, except if q	if the qualification q does not occur, then p is true	~q ⊃ p

Worksheet Exercise 2.3.A. Name _____
Complex Symbolizations Class _____ Date _____

Part A. Analyze each of the following arguments in two stages. (1) First, use the suggested capital letters to abbreviate the simple sentences of the argument. This results in a partial symbolization consisting of capital letters connected by English operator expressions. (2) Next, finish symbolizing the arguments by replacing the English operator expressions by the symbolic connectives. Write the two results side by side for comparison. (3) Optional: In your opinion, is the argument valid or invalid?

	English argument	partial	complete
1.	Robert knows Latin if and only if he doesn't know Greek. He does know Greek. So, Robert doesn't know Latin. (L, G) Argument is: _____	L if and only if not G G So, not L	L ≡ ~G G ∴ ~L
2.	Beth will go, if James asks her. If Matthew asks her, Beth will go also. If James doesn't ask her, Matthew will. So, Beth will go. (B, J, M) Argument is: _____		
3.	The music isn't by Vivaldi unless the style is baroque. If the style is romantic then it is not baroque. So, if the music is by Vivaldi, then it is not romantic. (V, B, R) Argument is: _____		
4.	Matthew will have eaten, if Beth cooked. Matthew did not eat unless James ate too. So, James ate only if Beth cooked. (M, B, J) Argument is: _____		
5.	Laura will give the lecture unless no one shows up. Luckily, people did show up. So, she did give the lecture. (G, S) Argument is: _____		
6.	If the host knows the senator, then the senator will be invited. If the hostess likes the senator, then he will also be invited. But neither does the host know him nor does the hostess like him. So, the senator won't be invited. (K, I, L) Argument is: _____		
7.	They won't sell the house only if they can pay the mortgage. But they are selling the house. So, they can't pay the mortage. (S, P) Argument is: _____		
8.	Samantha will not run unless the weather isn't hot. Thus, that she will run while the weather is hot isn't going to happen. (R, H) Argument is: _____		

>> continued on back side >>

9. This cylinder is square only if it isn't round. But, even if the cylinder is square, it still has to be round. But any fool knows it can't be both round and not round. So, this cylinder can't be square. (S, R) Argument is: _____

10. If the demand for these products goes up, then the price will go up. Also, the demand for these products will go up only if employment goes up. However, the demand hasn't gone up at all. So, either the price or the employment is not going up. (D, P, E) Argument is: _____

11. Some employees must be let go, if the budget is reduced. There won't be a pay increase unless the budget is not frozen. The budget will be either reduced or frozen. So, some employees must be let go, or there won't be a pay increase. (L, R, P, F) Argument is: _____

12. Unless clubs were not led, I can take this trick. I have a good hand, if spades are trump. Either clubs were led or spades are trump. So, either I can take this trick, or I have a good hand. (C, T, G, S) Argument is: _____

13. If the pressure is too low, the engine won't run. And, if the pressure is too high, the engine won't run. So, if the engine runs, the presssure is neither too low nor too high. (L, R, H) Argument is: _____

14. The landlord may evict the tenant only if the tenant has not satisfied the terms of the lease. The tenant has not satisfied the terms of the lease unless the rent is paid. So, if the rent is not paid, the landlord may evict the tenant. (E, S, P) Argument is: _____

15. Provided Albert knows calculus, he knows algebra. But he doesn't know calculus if he doesn't know trigonometry. So, he doesn't know trigonometry unless he doesn't know algebra. (C, A, T) Argument is: _____

16. Joe does not know calculus, but he does know algebra. But, he doesn't know trigonometry without knowing calculus. So, Joe knows algebra, but he doesn't know trigonometry. (C, A, T) Argument is: _____

Worksheet Exercise 2.3.B. Name _____
Symbolizing Conditionals Class _____ Date _____

Part B. Symbolize the following sentences in the blanks provided. First, give a partial symbolization with capital letters and the original English operator expressions. Then, give a complete symbolization. Write the results side by side for comparison. Pay special attention to what symbolization recipe you use for each of the conditional sentences.

	English sentence	partial symb.	complete
1.	If this is a platypus, then it lays eggs.	if P, then E	P ⊃ E
2.	This doesn't lay eggs, if it is a platypus.	not E, if P	P ⊃ ~E
3.	If this is not a platypus, it doesn't lay eggs.		
4.	This is a platypus only if it lays eggs.		
5.	It isn't a platypus only if it doesn't lay eggs.		
6.	It lays eggs if and only if this isn't a platypus.		
7.	This is not a platypus unless it lays eggs.		
8.	This lays eggs unless it is not a platypus.		
9.	Unless it lays eggs, this is not a platypus.		
10.	Only if this is a platypus does it lay eggs.		
11.	It doesn't lay eggs without being a platypus.		
12.	This lays eggs without it being a platypus.		
13.	Without it laying eggs, it isn't a platypus.		
14.	Being a platypus requires that it lay eggs.		
15.	This is a platypus, but only if it lays egss.		
16.	Provided this lays eggs, it is not a platypus.		

Worksheet Exercise 2.3.C. Name _____
Various Symbolizations Class _____ Date _____

Part C. Symbolize the following constructions.

1. A, B, so C
2. A, since B and C
3. A, so B, since C
4. A and B
5. A but B
6. A but not B
7. A even thought not B
8. A or B
9. either A or B
10. not not A
11. that not A is not true
12. it is not false that not A
13. not both A and B
14. not both A and not B
15. both not A and not B
16. neither A nor B
17. not either A or B
18. either not A or not B
19. not either not A or not B
20. A, B, and C
21. A, B, or C
22. one of A, B, and C
23. not all of A, B, and C
24. not any of A, B, and C
25. not one of A, B, and C
26. if A then B
27. B, if A
28. if not A then not B
29. not B if not A
30. not A unless B
31. not A unless not B
32. A unless B
33. A unless not B
34. A only if B
35. not A only if B
36. A only if not B
37. not A without B
38. A without B
39. A if and only if B
40. A but only if B
41. Only if B, A
42. if and only if A, B
43. A exactly when B
44. if A and B then C
45. if A and if B then C
46. if A then if B then C
47. if A then both B and C
48. if A then either B or C
49. if A or B then C
50. not if A, then not B
51. unless B, not A

Worksheet Exercise 2.3.D. Name _____

Brain teasers Class _____ Date _____

Part D. These are difficult. Symbolize the following sentences. First of all, write a partial symbolization with capital letters that keeps the English operators as stated and that also adds parentheses as an additional tool for grouping. After that, symbolize completely. Throughout, use L, M, G, S, B, and A for the appropriate simple sentences.

(1) Unless Liz or Mandy goes, neither George nor Sam will go, provided Bill goes but Alice doesn't.

partial: _____

complete: _____

(2) Unless Liz or Mandy goes, not both George and Sam will go; but regardless, either Bill or Alice won't go.

partial: _____

complete: _____

(3) If either neither Liz nor Mandy goes or neither George nor Sam go, then Bill won't go only if Alice does go.

partial: _____

complete: _____

(4) If Bill and Alice go, then if George or Sam goes, and if Liz doesn't go, then Mandy will go without Liz going.

partial: _____

complete: _____

(5) While both Liz and Mandy won't go only if either George or Sam do go, that Bill and Alice will go while both Liz will and George won't, is not true.

partial: _____

complete: _____

(6) Either Bill will go and not both Liz and George will, or either Bill will go and both Sam and Mandy won't, or Alice will.

partial: _____

complete: _____

(7) Only if not both George and Sam won't go, will Liz and Mandy go, even though Bill and Alice will not go without George and Sam not going.

partial: _____

complete: _____

>> continued on back side >>

(8) It is false that both neither both Liz won't go and either George won't go or Mandy won't go, nor Sam won't go, and also Alice won't go.

partial:

complete:

(9) Unless Liz goes, unless George goes, Mandy goes, unless Sam goes; unless Alice goes, unless Bill goes. *****

partial:

complete:

(10) If and only if Liz goes is it true that if George goes, then, Mandy goes only if Alice goes, if Bill goes.

partial:

complete:

***** A very weird sentence! Some logic books rightly recommend treating "X unless Y" as "X or Y." That approach would work very nicely here. But replacing "unless X" by "if not X" works as well.

Worksheet Exercise 2.4.A.
Practice calculations

Name _____
Class _____ Date _____

Part A. This is just some practice to help you learn your **T's** and **F's**. You should know the results here without looking at the rules. So, learn the rules first. When you are done, fold the backside of this page over to match the answers printed there.

T & **F** = _____
F ∨ **T** = _____
F ≡ **F** = _____
F ⊃ **F** = _____

F ∨ **F** = _____
T & **T** = _____
F ⊃ **T** = _____
F ⊃ **F** = _____

F & **T** = _____
T ∨ **F** = _____
T ⊃ **F** = _____
F ≡ **T** = _____

T ∨ **T** = _____
T ≡ **T** = _____
F ⊃ **T** = _____
F ∨ **T** = _____

F ⊃ **F** = _____
F ≡ **F** = _____
F & **F** = _____
F ∨ **F** = _____

T ⊃ **T** = _____
F & **T** = _____
T ≡ **T** = _____
T & **F** = _____

T ∨ **F** = _____
F & **F** = _____
T ≡ **F** = _____
T ⊃ **F** = _____

Answers

__**F**____ = **T** & **F**
__**T**____ = **F** ∨ **T**
__**T**____ = **F** ≡ **F**
__**T**____ = **F** ⊃ **F**

__**F**____ = **F** ∨ **F**
__**T**____ = **T** & **T**
__**T**____ = **F** ⊃ **T**
__**T**____ = **F** ⊃ **F**

__**F**____ = **F** & **T**
__**T**____ = **T** ∨ **F**
__**F**____ = **T** ⊃ **F**
__**F**____ = **F** ≡ **T**

__**T**____ = **T** ∨ **T**
__**T**____ = **T** ≡ **T**
__**T**____ = **F** ⊃ **T**
__**T**____ = **F** ∨ **T**

__**T**____ = **F** ⊃ **F**
__**T**____ = **F** ≡ **F**
__**F**____ = **F** & **F**
__**F**____ = **F** ∨ **F**

__**T**____ = **T** ⊃ **T**
__**F**____ = **F** & **T**
__**T**____ = **T** ≡ **T**
__**F**____ = **T** & **F**

__**T**____ = **T** ∨ **F**
__**F**____ = **F** & **F**
__**F**____ = **T** ≡ **F**
__**F**____ = **T** ⊃ **F**

Worksheet Exercise 2.4.B.
Calculating truth-values

Name _____
Class _____ Date _____

Part B. Use the Tree Method to determine the values of the following compound sentences. Do not skip any steps: show your work for every sub-calculation that you make. You are not allowed to use any rules other than the rules for calculating truth-values. The capital letters have the indicated meanings and real-world values.

A = Amsterdam is a city
C = Cairo is a city
M = Morocco is a city
R = Russia is a city

A	C	M	R
T	T	F	F

1. ~A V M
2. R & ~M
3. C ≡ ~M
4. C & (A V R)
5. C ⊃ (R V M)
6. (A & R) ⊃ M
7. ~A V ~M
8. ~R ⊃ ~C
9. R ≡ ~(~C)
10. (M ⊃ ~R) & A
11. A V (M & ~R)
12. (C V R) ≡ ~M
13. (M & A) V (C V ~R)
14. (A ⊃ R) V (A ⊃ ~R)
15. ~(A & R) ⊃ (C & M)
16. ~A V [(M ⊃ C) V R]
17. (~A V ~R) ⊃ (A V ~M)
18. ~{A V [M ⊃ (C V R)]}

>> continued on back side >>

Ex. 2. 4. B. Name _____ / _____

19. ~((A ≡ ~A) & C) ⊃ (~M & ~(M & R))

20. ((~A ⊃ M) ⊃ (A ⊃ R)) ⊃ ((C ≡ M) ⊃ ~C)

21. ~(~A & ~(~M & ~C)) ≡ (A V (M V C))

22. (((C ≡ M) ≡ R) ≡ ~R) ≡ (C ≡ ~M)

Worksheet Exercise 2.5.A.
Truth-tables for Validity

Name _____
Class _____ Date _____

Part A. Give complete truth-tables for these arguments to determine whether they are valid. Label the columns as "aux," "prem," or "concl."

1.

~(A & B)
~A

∴ B

A	B		

argument is: _____

2.

K V M
~M

∴ ~M

K	M		

argument is: _____

3.

~R V ~S
~R V S

∴ ~R

R	S		

argument is: _____

4.

G ⊃ (G & H)
~G

∴ ~H

G	H		

argument is: _____

5.

A V W
~A V ~W

∴ ~W ≡ A

A	W		

argument is: _____

>> continued on back side >>

Ex. 2. 5. A. Name _____ / _____

6.

~(Q & ~P)
Q

∴ Q & P

Q P

argument is:
_____

7.

~D ⊃ ~T
D ⊃ T

∴ T V D

D T

argument is:
_____

8.

F ⊃ (G & A)
~G

∴ ~F

F G A

argument is:
_____

9.

F ⊃ (G V A)
~G

∴ ~F

F G A

argument is:
_____

10.

S ≡ ~K
K
~B ⊃ S

∴ ~B V S

S K B

argument is:
_____

Worksheet Exercise 2.5.B.
Demonstrating Laws of Logic

Name _____
Class _____ Date _____

Part B. These are the laws of logic that we discussed above. Give complete truth-tables for them to show that they are valid. Label the columns as "aux," "prem," or "concl."

1.

p ⊃ q
p

∴ q

p q

the argument pattern is:
_____

2.

p ⊃q
~q

∴ ~p

p q

the argument pattern is:
_____

3.

p ⊃ q
q ⊃ r

∴ p ⊃ r

p q r

the argument pattern is:
_____

4.

p & q

∴ p

p q

the argument pattern is:
_____

5.

p
q

∴ p & q

p q

the argument pattern is:
_____

6.

p V q
~p

∴ q

p q

the argument pattern is:
_____

>> continued on back side >>

Ex. 2. 5. B. Name _____ / _____

7.

p

∴ p V q

p q

the argument pattern is:

_____

8.

p ⊃ q
p ⊃ ~q

∴ ~p

p q

the argument pattern is:

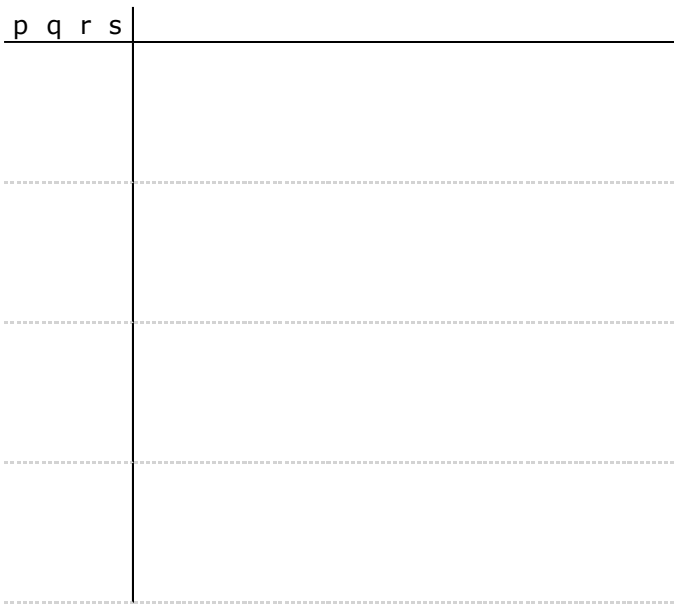
_____

9.

p V q
p ⊃ r
q ⊃ s

∴ r V s

p q r s



the argument pattern is:

_____

10.

p ≡ q

(p⊃q)&(q⊃p)

p q

the argument pattern is:

_____

11.

p ⊃ (q & r)

(p⊃q)&(p⊃r)

p q r

the argument pattern is:

_____

Worksheet Exercise 2.5.C.
Truth-tables for Validity

Name _____
Class _____ Date _____

Part C. Give complete truth-tables for the following arguments to determine whether they are valid. Label the columns as "aux," "prem," or "concl."

1.

A ⊃ (B & C)
~C ⊃ ~B
~A
∴ ~B

arg is _____

A	B	C	

2.

E V ~P
U V ~E
~U V ~E
∴ ~(P & E)

arg is _____

E	P	U	

3.

~(A ≡ B)
B ≡ ~C
∴ ~(A ≡ C)

arg is _____

A	B	C	

4.

A ≡ (B & C)
~(A V ~C)
∴ ~B

arg is _____

A	B	C	

Ex. 2. 5. C. Name _____ / _____

5.

P ⊃ T
~T ⊃ ~Q
~(~P & ~Q)

∴ T

arg is _____

P	T	Q	

6.

(AV~B)≡(C&B)
C ⊃ ~A

∴ ~A & B

arg is _____

A	B	C	

7.

F ⊃ (G & A)
~G V M

∴ M V ~F

arg is _____

F	G	A	M	

For problem #8, write one row of the table in which all the premisses are T and in which the conclusion is F.

8. (M ⊃ S) ⊃ (N & O) , ~S , O ⊃ S /∴ ~M

M	S	N	O	

The argument is _____.

Worksheet Exercise 2.6.A.
Truth-tables for Equivalence

Name _____
Class _____ Date _____

Part A. Use complete truth tables to determine whether the following sentence pairs are equivalent. Be sure to label the columns as "sent 1," "sent 2," or "aux." Use the space on these two pages efficiently.

1. ~(~(~p)) , ~p
2. p V ~q , ~p V q
3. p ⊃ ~q , ~p ⊃ q
4. p ⊃ ~q , q ⊃ ~p
5. ~(p & q) , ~p & ~q
6. ~(p & q) , p ⊃ ~q
7. ~(p V q) , ~p & ~q
8. p V q , ~p ⊃ q
9. p ≡ q , ~p ≡ ~q
10. p ≡ q , (p ⊃ q) & (~p ⊃ q)
11. p ⊃ (q V r) , (p ⊃ q) V (p ⊃ r)
12. (p & q) ⊃ r , (p ⊃ r) & (q ⊃ r)
13. (p V q) ⊃ r , (p ⊃ r) & (q ⊃ r)
14. p , (p & q & r) V (p & ~q) V (p & ~r)

Ex. 2. 6. A. Name _____ / _____

Worksheet Exercise 2.6.B. Name _____

Truth-tables for Sentence Status Class _____ Date _____

Part B. Use complete truth-tables to determine the logical status of the following sentence forms. Be sure to label the columns as "main sent," or "aux." Use the space on these two pages efficiently.

1. p V ~p
2. ~(p & q) V p
3. ~p V (p & q)
4. (p & q) & ~p
5. p ⊃ (q ⊃ q)
6. (p ⊃ p) ⊃ (q & ~q)
7. (p & q) V (~p & ~q)
8. (p V q) V (p V ~q)
9. (p & q) & (p & ~q)
10. (p & q) ⊃ q
11. (p ≡ q) ≡ (~p ≡ ~q)
12. [p & (~p V q)] ⊃ (q V r)
13. ((p ⊃ q) & (r ⊃ q)) V (p V r)
14. ((p ⊃ q) & (q ⊃ r)) & (p & (r ⊃ ~p))

Ex. 2. 6. B. Name _____ / _____

Worksheet Exercise 2.6.C.
Truth-tables for Consistency

Name _____
Class _____ Date _____

Part C. Use complete truth-tables to determine whether the following sets of sentence forms are consistent. Be sure to label the columns as "sentence," or "aux." Use the space on these two pages efficiently.

1. p , p ⊃ q , ~q
2. ~p , p ⊃ q , q
3. ~p , p V q , p ≡ q
4. p , p & ~q , q V p
5. p ≡ q, p ≡ ~q
6. p & ~q , (p & r) ≡ q , p V r
7. ~(p & q) , ~(q & r) , ~(p & r)
8. ~(p V q) , ~(q V r) , ~(p V r)
9. ~(p ≡ q) , ~(q ≡ r) , ~(p ≡ r)
10. ((p & q) & ~(q & r)) & (p ⊃ r)

Ex. 2. 6. C. Name _____ / _____

Worksheet Exercise 2.6.D. Name _____

Demonstrating the Laws of Logic Class _____ Date _____

Part D. These are the laws of logic we discussed above. Give complete truth-tables for these pairs of sentence forms to show that they are equivalent. Be sure to label the columns as "sent 1," "sent 2," or "aux." Use the space on these two pages efficiently.

1.	~(~p)	=	p	Double Negation
2a.	~(p & q)	=	~p V ~q	De Morgan's Laws
2b.	~(p V q)	=	~p & ~q	De Morgan's Laws
3.	p ⊃ q	=	~q ⊃ ~p	Contraposition
4.	p ⊃ q	=	~p V q	Conditional Relation
5.	p ≡ q	=	(p ⊃ q) & (q ⊃ p)	Bicondition
6.	(p & q) ⊃ r	=	p ⊃ (q ⊃ r)	Exportation
7a.	p & p	=	p	Duplication
7b.	p V p	=	p	Duplication
8a.	p & q	=	q & p	Commutation
8b.	p V q	=	q V p	Commutation
9a.	p & (q & r)	=	(p & q) & r	Association
9b.	p V (q V r)	=	(p V q) V r	Association
10a.	p & (q v r)	=	(p & q) V (p & r)	Distribution
10b.	p V (q & r)	=	(p V q) & (p V r)	Distribution

Ex. 2. 6. D. Name _____ / _____

Reference Sheet 2.7.
Rules of Propositional Logic

I. BASIC ARGUMENT FORMS

M.P.

p ⊃ q
p
———
∴ q

M.T.

p ⊃ q
~q
———
∴ ~p

Hyp. Syll.

p ⊃ q
q ⊃ r
———
∴ p ⊃ r

Dilem.

p V q
p ⊃ r
q ⊃ r
———
∴ r

p V q
p ⊃ r
q ⊃ s
———
∴ r V s

Simp.

p & q
———
∴ p
∴ q

Conj.

p
q
———
∴ p & q

Disj. Syll.

p V q
~p
———
∴ q

p V q
~q
———
∴ p

Disj. Add.

p
———
∴ p V q
∴ q V p

D.Thens

p ⊃ (q & r)
———
∴ p ⊃ q
∴ p ⊃ r

p ⊃ q
p ⊃ r
———
∴ p ⊃ (q & r)

Bicond.

p ≡ q
———
∴ p ⊃ q
∴ q ⊃ p

p ⊃ q
q ⊃ p
———
∴ p ≡ q

R.A.A.

p ⊃ q
p ⊃ ~q
———
∴ ~p

II. BASIC EQUIVALENCE FORMS

D.Neg.	p = ~ (~p)
DeMorg.	~(p & q) = ~p V ~q
DeMorg.	~(p V q) = ~p & ~q
Contrap.	p ⊃ q = ~q ⊃ ~p
Cond.	p ⊃ q = ~p V q
Bicond.	p ≡ q = (p ⊃ q) & (q ⊃ p)
D.Ifs	(p & q) ⊃ r = p ⊃ (q ⊃ r)
Dupl.	p & p = p
Dupl.	p V p = p
Comm.	p & q = q & p
Comm.	p V q = q V p
Assoc.	(p & q) & r = p & (q & r)
Assoc.	(p V q) V r = p V (q V r)
Dist.	p & (q V r) = (p & q) V (p & r)
Dist.	p V (q & r) = (p V q) & (p V r)

III. Logical Truths

(Taut.)

- p V ~p
- ~(p & ~p)
- p ⊃ p
- (p & q) ⊃ p
- (p & q) ⊃ q
- p ⊃ (p V q)
- p ⊃ (q V p)

IV. Assumption Rules (§ 2.10)

p assmp : q	p assmp : q & ~q
∴ p ⊃ q **C.P.**	∴ ~p **I.P.**

Worksheet Exercise 2.7.A.
Practicing the rules

Name _____
Class _____ Date _____

Part A. For each of the following inferences, determine whether the conclusion follows from the premiss by the rule listed. Answer YES or NO in the blanks provided.

1. ~J ⊃ (A V S)
   ~J
   ———
   ∴ (A V S)

   M.P. YES

2. (A V S) ⊃~J
   ~J
   ———
   ∴ (A V S)

   M.P. _____

3. (A V S) ⊃ J
   ~J
   ———
   ∴ ~(A V S)

   M.T. _____

4. J ⊃ (A V S)
   ~J
   ———
   ∴ ~(A V S)

   M.T. _____

5. A ⊃ ~C
   ~B & ~C
   ———
   ∴ ~C

   Simp _____

6. T V ~E
   ~T
   ———
   ∴ ~E

   Disj Syll _____

7. H V ~I
   H ⊃ ~P
   ~A ⊃ ~I
   ———
   ∴ ~P V ~A

   Dilem. _____

8. ~B ⊃ ~C
   ~B ⊃ A
   ———
   ∴ ~C ⊃ A

   Hyp Syll _____

9. (T & B) V ~E
   ~(~E)
   ———
   ∴ T & B

   Disj Syll _____

10. ~T V ~E
    ~T
    ———
    ∴ ~E

    Disj Syll _____

11. A ⊃ Q
    ~C ≡ B
    ———
    ∴ ~C ⊃ B

    Bicond _____

12. ~E
    ———
    ∴ ~E V (M & S)

    Disj Add _____

13. B ⊃ ~C
    ~A ⊃ B
    ———
    ∴ ~A ⊃ ~C

    Hyp Syll _____

14. H V ~I
    H ⊃ ~P
    ~I ⊃ ~J
    ———
    ∴ ~P V ~J

    Dilem. _____

15. L ⊃ (B & E)
    L ⊃ ~(B & E)
    ———
    ∴ ~L

    R.A.A. _____

16. (B & E) ⊃ ~C
    ~A ⊃ (B & E)
    ———
    ∴ ~A ⊃ ~C

    Hyp Syll _____

17. ~(A V B) ⊃ C
    ———
    ∴ (A V B) ⊃~C

    Contrap _____

18. ~(A V B) ⊃ C
    ———
    ∴ ~C ⊃ (A V B)

    Contrap _____

19. ~(A V B)
    ———
    ∴ ~A V ~B

    DeMorg _____

20. ~(S & E)
    ———
    ∴ ~S V ~E

    DeMorg _____

21. ~A V ~B
    ———
    ∴ A ⊃ ~B

    Cond _____

22. (Q & P) ⊃ A
    ———
    ∴ (~Q&~P)V A

    Cond _____

23. L ⊃ ((B & E) & A)
    ———
    ∴ L ⊃ (B & E)

    D.Thens _____

24. L ⊃ (B & E)
    ———
    ∴ L ⊃ (~B V L)

    Taut _____

Worksheet Exercise 2.7.B.
Practicing the rules

Name _____
Class _____ Date _____

Part B. Each of the following inferences uses one of the allowed rules. In each case, supply the abbreviated name of the rule that was used.

---

1. ~(A V ~B)

   ∴ ~A & ~(~B)

   rule: _____

2. (A V S) ⊃ J
   ~J

   ∴ ~(A V S)

   rule: _____

3. ~(A V B) ⊃ C

   ∴ ~C ⊃ (A V B)

   rule: _____

4. (A V S) ⊃ ~J
   (A V S)

   ∴ ~J

   rule: _____

---

5. H V ~I
   H ⊃ ~P
   ~I ⊃ ~J

   ∴ ~P V ~J

   rule: _____

6. J ⊃ (A V S)
   ~(A V S)

   ∴ ~J

   rule: _____

7. ~S & ~E

   ∴ ~(S V E)

   rule: _____

8. T V ~E
   ~T

   ∴ ~E

   rule: _____

---

9. ~H ⊃ Q
   ~H V I
   I ⊃ M

   ∴ Q V M

   rule: _____

10. (T & B) V ~E
    ~(~E)

    ∴ T & B

    rule: _____

11. ~T V ~E
    ~T

    ∴ ~T & (~T V ~E)

    rule: _____

12. A ⊃ B
    ~C ≡ B

    ∴ ~C ⊃ B

    rule: _____

---

13. L ⊃ (B & E)

    ∴ (B & E) ⊃ B

    rule: _____

14. ~E

    ∴ ~E V (M & S)

    rule: _____

15. Q ⊃ ((B & E) & A)

    ∴ Q ⊃ (B & E)

    rule: _____

16. B ⊃ ~C
    ~A ⊃ B

    ∴ ~A ⊃ ~C

    rule: _____

---

17. ~J ⊃ (A & S)
    ~J

    ∴ (A & S)

    rule: _____

18. ~(Q & P) V A

    ∴ (Q & P) ⊃ A

    rule: _____

19. A ⊃ ~C
    ~B & ~C

    ∴ ~C

    rule: _____

20. (B & E) ⊃ ~C
    ~A ⊃ (B & E)

    ∴ ~A ⊃ ~C

    rule _____

---

21. (A V B) ⊃ C

    ∴ ~(A V B) V C

    rule: _____

22. A V ~B
    D

    ∴ D & (A V ~B)

    rule: _____

23. (B ⊃ ~C) &
    (~B ⊃ A)

    ∴ ~B ⊃ A

    rule: _____

24. L ⊃ (~B & ~E)

    ∴ L ⊃ ~E

    rule: _____

Worksheet Exercise 2.8.A.
Deductions, Supply reasons

Name _____
Class _____ Date _____

Part A. Supply the missing reasons in the following deductions. Use the standard method of annotating deductions, as in problem #1. Always cite the line numbers used, and cite the abbreviated name of the rule used. In all these problems lines 1 and 2 are premisses, and they are annotated as "Prem".

1)

1. A ⊃ B	Prem	
2. B ⊃ C	Prem	
3. A ⊃ C	1,2, Hyp Syll	
4. ~C ⊃ ~A	3, Contrap	

2)

1. T V (D & ~E)	Prem
2. ~T	Prem
3. D & ~E	_____
4. ~E	_____

3)

1. (A V B) ⊃ C	Prem
2. (A V B) & F	Prem
3. A V B	_____
4. C	_____

4)

1. ~(Q V S)	Prem
2. B	Prem
3. ~Q & ~S	_____
4. B & (~Q & ~S)	_____

5)

1. ~B & A	Prem
2. (K & ~E) ⊃ B	Prem
3. ~B	_____
4. ~(K & ~E)	_____
5. ~K V ~(~E)	_____

6)

1. ~J ⊃ ~I	Prem
2. (H ⊃ P) & (H V ~J)	Prem
3. H ⊃ P	_____
4. H V ~J	_____
5. P V ~I	_____

7)

1. L ⊃ (B & E)	Prem
2. E ⊃ S	Prem
3. L ⊃ B	_____
4. L ⊃ E	_____
5. L ⊃ S	_____

8)

1. L ⊃ (B & E)	Prem
2. ~E	Prem
3. (B & E) ⊃ E	_____
4. ~(B & E)	_____
5. ~L	_____

9)

1. A ≡ ~B	Prem
2. C ≡ ~B	Prem
3. A ⊃ ~B	_____
4. ~B ⊃ C	_____
5. A ⊃ C	_____
6. ~C ⊃ ~A	_____

10)

1. (~S V Y) V ~A	Prem
2. ~Y	Prem
3. (Y V ~S) V ~A	_____
4. Y V (~S V ~A)	_____
5. ~S V ~A	_____
6. ~(S & A)	_____

Worksheet Exercise 2.8.B. Name _____
Deductions, Supply reasons Class _____ Date _____

Part B. Supply the missing reasons in the following deductions. Use the standard method of annotating deductions, always citing both the line numbers used, and the abbreviated name of the rule used, in that order. In each deduction, the steps above the horizontal line are the premisses, and they are cited as "Prem".

1)
1. F ≡ G _____
2. E ⊃ (F V G) _____
3. ~G & (A V B) _____
4. (B ⊃ E) & H _____

---

5. ~G _____
6. A V B _____
7. B ⊃ E _____
8. F ⊃ G _____
9. ~F _____
10. ~F & ~G _____
11. ~(F V G) _____
12. ~E _____
13. ~B _____
14. A _____

2)
1. A V (N V W) _____
2. W ⊃ ~(~B) _____
3. K & ~S _____
4. (N ⊃ L) & ~A _____
5. (~S V M) ⊃ Q _____

---

6. ~S _____
7. ~S V M _____
8. Q _____
9. ~A _____
10. N V W _____
11. N ⊃ L _____
12. W ⊃ B _____
13. L V B _____
14. Q & (L V B) _____

3)
1. M ⊃ (~P V T) _____
2. ~M ⊃ Q _____
3. (P V A) & (~Q & ~A) _____

---

4. P V A _____
5. ~Q & ~A _____
6. ~Q _____
7. ~(~M) _____
8. M _____
9. ~P V T _____
10. ~A _____
11. P _____
12. ~(~P) _____
13. T _____
14. ~S V T _____

4)
1. A ⊃ (B ⊃ C) _____
2. D ⊃ (E & F) _____
3. (B ⊃ C) ⊃ (A ⊃ D) _____
4. (~A V E) ⊃ (B ⊃ C) _____
5. ~C _____

---

6. A ⊃ (A ⊃ D) _____
7. (A & A) ⊃ D _____
8. A ⊃ D _____
9. A ⊃ (E & F) _____
10. A ⊃ E _____
11. ~A V E _____
12. B ⊃ C _____
13. ~B _____
14. ~B & ~C _____

Worksheet 2.9.
Practice the Twenty Sample Deductions

Practice these problems, and compare your answers to the solutions given above.

1.
1. D ⊃ E	prem	
2. E ⊃ F	prem	
3. F ⊃ G	prem ∴ D ⊃ G	
4. _____	_____	
5. _____	_____	

2.
1. E V F	prem	
2. E ⊃ G	prem	
3. ~F	prem ∴ G	
4. _____	_____	
5. _____	_____	

3.
1. G V ~F	prem	
2. H ⊃ F	prem	
3. ~G	prem ∴ ~H	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	

4.
1. (~E V P) V U	prem	
2. (~E V P) ⊃ A	prem	
3. U ⊃ B	prem	
4. ~A	prem ∴ B	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	

5.
1. ~R ⊃ (A ⊃ M)	prem	
2. ~R	prem	
3. ~M	prem ∴ ~A&~M	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	

6.
1. ~M V ~O	Prem	
2. O V N	Prem	
3. M	prem ∴ N	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	

7.
1. A ⊃ (B & C)	Prem	
2. ~B & E	Prem ∴ ~A	
3. _____	_____	
4. _____	_____	
5. _____	_____	
6. _____	_____	

8.
1. A ⊃ (B & C)	Prem	
2. ~B	Prem ∴ ~A	
3. _____	_____	
4. _____	_____	
5. _____	_____	
6. _____	_____	

9.
1. (A & B) ⊃ C	Prem	
2. A & D	Prem	
3. B	Prem ∴ B & C	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	

10.
1. B ⊃ [C V (D & E)]	Prem	
2. B & ~C	Prem ∴ E	
3. _____	_____	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	

11.
1. ~M ⊃ O	Prem	
2. U ⊃ ~M	Prem	
3. S & ~O	prem ∴ ~U&~O	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	

12.
1. (A V B) ⊃ K	Prem	
2. C ⊃ (A V B)	Prem	
3. D ≡ C	prem ∴ ~K⊃~D	
4. _____	_____	
5. _____	_____	
6. _____	_____	
7. _____	_____	
8. _____	_____	

Ex. 2. 9. 20 Problems Name _____ / _____

13. 1. ~(A & ~H) Prem
2. ~H V ~E Prem
3. N & A Prem ∴ S V ~E
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____

14. 1. U ⊃ C Prem
2. L V U Prem
3. (M & H) ⊃ ~L Prem∴ (M&H)⊃C
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____

15. 1. ~B & ~U Prem
2. ~U ⊃ (W V S) Prem
3. (W ⊃ Q)&(S ⊃ A) prem ∴ Q V A
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____

16. 1. (A V B) ⊃ K Prem
2. C ⊃ (A V B) Prem
3. ~C ⊃ ~D prem ∴ D ⊃ K
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____

17. 1. A ≡ (B & C) Prem
2. ~(A V ~C) Prem ∴ ~B
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____

18. 1. (M V S)⊃(N & O) Prem
2. ~S Prem
3. O ⊃ S Prem ∴ ~M
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____

19. 1. (~A ⊃ D)&(A ⊃ I) Prem
2. (D ⊃ S) & (I ⊃ Q) Prem ∴ Q V S
3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____

20. 1. E ⊃ (U ⊃ D) Prem
2. E ⊃ U Prem
3. ~D Prem∴ ~(E V D)
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____

Worksheet Exercise 2.9.A. Name _____
Deductions, full blast Class _____ Date _____

Part A. Give deductions for the following arguments, use as many blanks as you need. These are easy.

(1)

1. ~A	Prem
2. ~B	Prem
3. B V C	Prem
4. A V D	Prem ∴ C & D
---	
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____

(2)

1. ~A & ~B	Prem
2. B V C	Prem ∴ C & ~A
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

(3)

1. A ⊃ B	Prem
2. ~P ⊃ ~T	Prem
3. B ⊃ ~P	Prem ∴ A ⊃ ~T
---	
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

(4)

1. G V ~H	Prem
2. ~G	Prem
3. I ⊃ H	Prem ∴ ~I
---	
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

(5)

1. (A & B) V (Q & R)	Prem
2. ~Q V ~R	Prem ∴ B
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

(6)

1. C ⊃ (A & S)	Prem ∴ ~S ⊃ ~C
---	
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

(7)

1. M ≡ ~O	Prem ∴ ~M ⊃ O
---	
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

(8)

1. F ⊃ (G V A)	Prem
2. ~G	Prem
3. ~A	Prem ∴ ~F
---	
4. _____	_____
5. _____	_____
6. _____	_____

Worksheet Exercise 2.9.B. Name _____
Deductions, full blast Class _____ Date _____

Part B. Give deductions for the following arguments, use as many blanks as you need. These are a bit harder.

(1)

1. ~(A & B)	Prem
2. A	Prem
3. ~B ⊃ D	Prem ∴ D
---	
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

(2)

1. ~(G & ~(~H))	Prem
2. ~H ⊃ D	Prem ∴ G ⊃ D
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

(3)

1. ~L	Prem
2. ~N	Prem
	∴ ~(L V N) V Q
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

(4)

1. K V M	Prem
2. ~M	Prem
	∴ ~(~K V M)
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

(5)

1. ~R V ~S	Prem
2. ~R V S	Prem ∴ ~R
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

(6)

1. F ⊃ (G & A)	Prem
2. (~G) & M	Prem ∴ ~F
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

(7)

1. F ⊃ A	Prem
2. G & ~A	Prem ∴ ~F V X
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

(8)

1. S ⊃ ~M	Prem
2. M V T	Prem
3. S ⊃ ~T	Prem ∴ ~S
---	
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

Worksheet Exercise 2.9.C. Name _____
Deductions, full blast Class _____ Date _____

Part C. Give deductions for the following arguments, use as many blanks as you need. These are a bit harder yet.

(1)

1. A V W	Prem
2. ~A V ~W	Prem ∴ ~W ≡ A
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____

(2)

1. S ≡ ~K	Prem
2. K	Prem
3. ~B ⊃ S	Prem ∴ B & K
---	
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10._____	_____

(3)

1. (S V ~S) ⊃ ~B	Prem
2. (A & P) ⊃ B	Prem ∴ ~A V ~P
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____

(4)

1. (A & B) & ~(~C)	Prem
2. (D V D) & M	Prem ∴ (C & B) & D
---	
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____

(5)

1. U ⊃ R	Prem
2. ~N ⊃ ~F	Prem
3. N ⊃ J	Prem
4. ~U ⊃ ~J	Prem ∴ F ⊃ R
---	
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10._____	_____

(6)

1. P ⊃ T	Prem
2. ~T ⊃ ~Q	Prem
3. ~(~P & ~Q)	Prem ∴ T
---	
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10._____	_____

>> continued on back side >>

Ex. 2. 9. C. Name _____ / _____

(7)

1. ~Q ⊃ E	Prem
2. ~A ⊃ E	Prem
3. ~E	Prem
	∴ (A & Q) V (A & E)

---

4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10._____	_____

(8)

1. A V (B & C)	Prem
2. A ⊃ M	Prem
3. M ⊃ D	Prem ∴ D V B

---

4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____

Worksheet Exercise 2.9.D. Name _____

Deductions, full blast Class _____ Date _____

Part D. Give deductions for the following arguments, use as many blanks as you need. These are difficult. The rule of Tautology may be useful here. You may want to practice these first on a separate sheet.

(1)

1. A ⊃ (B V C) Prem
2. C ≡ B Prem ∴ A ⊃ B

3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____

(2)

1. ~(A & B) Prem
2. (A V B) & (A V ~B) Prem ∴ A & ~B

3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____

(3)

1. A ⊃ B Prem
2. C ⊃ D Prem ∴ (A V C) ⊃ (B V D)

3. _____ _____
4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____

(4)

1. P ⊃ (Q & R) Prem
2. (Q V R) ⊃ S Prem
3. P V S Prem ∴ S

4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____

1. (A V B) ⊃ (A ⊃ ~B) Prem **(#5)**
2. (B & ~C) ⊃ (A & B) Prem
3. ~A ⊃ B Prem ∴ A V C

4. _____ _____
5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____

>> continued on back side >>

Ex. 2. 9. D. Name _____ / _____

1. ~(T & R) Prem **(#6)**
2. (P ⊃ Q) & (R ⊃ S) Prem
3. T & (P V R) Prem
4. ~Q ≡ S Prem ∴ ~R & ~S

5. _____ _____
6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____
17. _____ _____
18. _____ _____
19. _____ _____

1. G ⊃ F Prem **(#7)**
2. (D ⊃ A) & (E ⊃ B) Prem
3. G V (D V E) Prem
4. ~(F V C) Prem
5. B ⊃ C Prem ∴ A

6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____
11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____
17. _____ _____
18. _____ _____
19. _____ _____

1. (E V R) ≡ D Prem **(#8)**
2. (K ⊃ L) & (G ⊃ H) Prem
3. (~E V L) ⊃ (D V G) Prem
4. ~(D V L) Prem ∴ E V H

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

1. (N & E) V (N & H) Prem **(#9)**
2. (B V P) ≡ ~(B & K) Prem
3. (E V P) ⊃ ~N Prem
4. H ⊃ B Prem ∴ ~K

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

1. (K & L) ⊃ ~M Prem **(#10)**
2. S ⊃ (M & P) Prem
3. T ⊃ (Q & R) Prem
4. L & (S V T) Prem
5. K ≡ L Prem ∴ Q V ~L

6. _____ _____
7. _____ _____
8. _____ _____
9. _____ _____
10. _____ _____

11. _____ _____
12. _____ _____
13. _____ _____
14. _____ _____
15. _____ _____
16. _____ _____
17. _____ _____
18. _____ _____
19. _____ _____
20. _____ _____
21. _____ _____

Worksheet Exercise 2.10.A. Name _____

The rules C.P. and I.P. Class _____ Date _____

Part A. Give deductions for the following arguments, using the rules C.P. and I.P.

(1)

1. (A V B)⊃(C & D) Prem ∴ A ⊃ D

(2)

1. (A V B) ⊃ (A & B) Prem ∴ A ≡ B

(3)

1. A V (B & C) Prem
2. A ⊃ D Prem
3. D ⊃ E Prem ∴ ~E ⊃ B

(4)

1. C ⊃ [A V (B & C)] Prem
2. ~B Prem ∴ C ⊃(A V D)

(5)

1. A ⊃ (B & C) Prem
2. (D & C) ⊃ (E & F) Prem ∴ (A & D) ⊃ E

Ex. 2. 10. A. Name _____ / _____

(6)

1. (A & ~B) ⊃ C	Prem	
2. B ⊃ C	Prem	
3. ~(~A & ~B)	Prem	∴ C

(7)

1. A ⊃ ~B	Prem	
2. C ⊃ (D ⊃ B)	Prem	
	∴ D ⊃ (~A V ~C)	

(8)

1. E ⊃ (A ⊃ B)	Prem	
	∴ E ⊃ [(A V B) ⊃ B]	

(9)

1. (A & B) ⊃ C	Prem	
2. (A & ~B) ⊃ E	Prem	∴ A ⊃ (C V E)

(10)

1. (A ⊃ B) V (A ⊃ C)	Prem	
2. B ⊃ D	Prem	
3. C ⊃ D	Prem	∴ A ⊃ D

Worksheet Exercise 2.10.B.
The rules C.P. and I.P.

Name _____
Class _____ Date _____

Part B. Give deductions for the following arguments, using the rules C.P. and I.P. These are more difficult.

1. (P V Q) ⊃ ~R — Prem **(#1)**
2. S ⊃ (~U & ~W) — Prem
3. M ⊃ (R & U) — Prem
∴ (P V S) ⊃ ~M

1. ~[A & (B V C)] — Prem **(#2)**
2. D ⊃ B — Prem
3. E ⊃ C — Prem
∴ ~[A & (D V E)]

1. (P V Q) ⊃ (R & S) — Prem **(#3)**
2. (T V U) ⊃ (U & W) — Prem
∴ (P V T) ⊃ (R V W)

1. A V B — Prem **(#4)**
2. ~A V ~B — Prem ∴ ~(A ≡ B)

>> continued on back side >>

Ex. 2. 10. B. Name _____ / _____

1. (A & B) ⊃ C Prem **(#5)**
2. A ⊃ B Prem
3. (A V C) V ~D Prem ∴ D ⊃ C

1. (A & B) ⊃ (C V D) Prem **(#6)**
2. (~A V C) ⊃ D Prem ∴ B ⊃ D

1. (B V C) ⊃ ~A Prem **(#7)**
2. (D & ~E) ⊃ B Prem
3. A ⊃ ~E Prem ∴ A ⊃ ~D

1. A ⊃ [B ⊃ (C V D)] Prem **(#8)**
2. (Q & ~C) ⊃ B Prem
∴ ~C ⊃[A ⊃(Q ⊃D)]

Worksheet Exercise 2.11.A.
Demonstrating equivalences

Name _____
Class _____ Date _____

Part A. Give pairs of deductions to show that the following listed pairs of sentences are equivalent. Use the space on these two pages efficiently. For each pair of deductions, write the one in the left column and the other one next to it in the right side column.

1. ~(D & H) , D ⊃ ~H
2. S , (A V ~A) ⊃ S
3. M , [(M V ~~M) & M] V M
4. ~Q & E , ~Q & (Q V E)
5. A V (B & C) , (~B ⊃ A) & (~C ⊃ A)
6. F ⊃ ~(G V H) , (F ⊃ ~G) & (F ⊃ ~H)
7. (P V Q) ⊃ S , (P ⊃ S) & (Q ⊃ S)
8. ~(W V K) , ~K & [W ⊃ (H & ~H)]

Ex. 2. 11. A. Name _____ / _____

Worksheet Exercise 2.11.B.
Demonstrating Logical Truths

Name _____
Class _____ Date _____

Part B. Give deductions to show that the following sentences are truths of Logic, i.e., tautologies. Use the space on these two pages efficiently.

1. (B V S) ⊃ (~B ⊃ S)
2. P V (P ⊃ Q)
3. (A & (B & C)) V [A ⊃ (~B V ~C)]
4. (S & ~M) ⊃ (S V M)
5. (A & B & C) ⊃ (B V Q)
6. [(Q ⊃ U) & ~U] ⊃ ~Q
7. [(P V Q) & (P ⊃ R)] ⊃ (R V Q)
8. (A & B) V (A & ~B) V (~A & B) V (~A & ~B)

Ex. 2. 11. B. Name _____ / _____

Worksheet Exercise 2.11.C.
Demonstrating Contradictions

Name _____
Class _____ Date _____

Part B. Give deductions to show that the following sentences are contradictions. Use the space on these two pages efficiently.

1. (B V S) & (~B & ~S)
2. (F ⊃ G) & (F & ~G)
3. (S & ~M) & ~(S V M)
4. ~[P V (P ⊃ Q)]
5. ~[(A V B) V (~A V C)]
6. A ≡ ~A
7. O & (O ⊃ P) & (P ⊃ R) & ~R
8. (A V B) & (~A V C) & (~B & ~C)

Ex. 2. 11. C. Name _____ / _____

Worksheet Exercise 2.11.D.
Demonstrating Inconsistencies

Name _____
Class _____ Date _____

Part B. Give deductions to show that the following sets of sentences are inconsistent. Use the space on these two pages efficiently.

1. M ⊃ D , (D V ~M) ⊃ S , ~S
2. A V B , ~A V C , ~B & ~C
3. W ≡ P , ~P , (A V ~A) ⊃ W
4. ~(R & S) , ~(S & T) , S & (R V T)
5. (A & B) , [(A & ~B) V (B & ~A)]
6. (A V B) V C , A ⊃ C , C ⊃ ~C , B ≡ C
7. M ≡ ~N , N ≡ ~O , ~M ≡ O
8. (A ⊃ B) ⊃ A , (B ⊃ A) ⊃ ~A

Ex. 2. 11. D. Name _____ / _____