Name: _____

Exam 2 – MAD 2104H

Directions: Make sure to show any necessary work to receive full credit. If you need extra space please use the extra sheet with appropriate labeling. **TW** means the FOL of Tarski's World

(1) Determine whether the following argument is valid or not. If it is, supply a Fitch proof. If it is not valid, supply appropriate sentences and a model in **TW**. You may use **Taut Con** but only to establish an instance of the Law of Excluded Middle.

1. $\neg(A \rightarrow B)$

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21. $A \wedge \neg B$

(2) Determine whether the following argument is valid or not. If it is, supply a Fitch proof. If it is not valid, supply appropriate sentences and a model in **TW**. You may use **Taut Con** but only to establish an instance of the Law of Excluded Middle.

1. $A \to (B \to C)$

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8. $(A \wedge B) \to C$

(3) Determine whether the following argument is valid or not. If it is, supply a Fitch proof. If it is not valid, supply appropriate sentences and a model in **TW**. You may use **Taut Con** but only to establish an instance of the Law of Excluded Middle.

1. Cube(a) $\vee$ Cube(b)

2. $\neg$ (Cube(c) $\wedge$ Cube(b))

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8. $\neg$ Cube(c)

(4) Evaluate the following argument's validity. If it is valid, construct a Fitch proof to show this. If you need to use **Ana Con**, use it only to derive $\perp$ from atomic sentences. You may use Taut Con but only cite at most two sentences at a time. If the argument is invalid, you should construct a counterexample world in the space provided.

1. $\mathbf{Medium}(b) \vee \mathbf{Large}(c)$

2. $\mathbf{Medium}(b) \rightarrow \mathbf{FrontOf}(a, b)$

3. $\mathbf{Large}(c) \rightarrow \mathbf{Tet}(c)$

4.

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9.

10. $\neg\mathbf{Tet}(c) \rightarrow \mathbf{FrontOf}(a, b)$

(5) Given the conditional $P \rightarrow Q$ fill in the blanks to the following:

Inverse :

Converse:

Contrapositive:

What can be said about a conditional statement and its contrapositive? Be as specific as possible.

(6) The following problem presents a formal argument. Determine if the argument is valid. If the argument is valid, supply a Fitch proof in the space provided. If the argument is not valid, supply a counterexample world using Tarski's World. You may use **Ana Con** but cite exactly two atomic sentences in support of an introduction of $\bot$. You may use **Taut Con** but only to justify an instance of the Law of Excluded Middle.

1. **Dodec**(b) $\vee$ **Cube**(b)

2. **Small**(b) $\vee$ **Medium**(b)

3. $\neg$(**Small**(b) $\wedge$ **Cube**(b))

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21. **Medium**(b) $\wedge$ **Dodec**(b)

(7) Supply a Fitch proof for the following argument without premises. You may not use **Ana Con**. You may use **Taut Con** but only to establish a Law of Excluded Middle.

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24. $(\neg \mathbf{P} \wedge \neg \mathbf{Q}) \leftrightarrow \neg(\mathbf{P} \vee \mathbf{Q})$

(8) Supply a Fitch proof. However, you may not use $\perp$ Elim nor **Taut Con**.

1. P

2. $\neg P$

3.

4.

5.

6.

7. Q

(9) Supply a counterexample to the following argument.

1. **Cube**(b) $\leftrightarrow$ (**Cube**(a) $\leftrightarrow$ **Cube**(c))

2. **Dodec**(b) $\rightarrow$ a $\neq b$