PHIL 220g: Introduction to Logic
Midterm (Fall 2026)

Name: TA:

Instructions

Two of the given arguments are **propositionally valid** and two are **propositionally invalid**. For each given argument:

1. state it in **premise-conclusion form**
2. **translate** it into **propositional logic**
3. **determine** whether the argument is **valid** or **invalid**:
    - if **valid**, build a **proof** of the conclusion from its premises.
    - if **invalid**, give an **assignment** on which the premises are true and the conclusion false.

Over Please

A

If the motion detector was triggered or the display case was opened, then the alarm sounded. The alarm did not sound. The display case was not opened. Therefore, the motion detector was not triggered.

PREMISE-CONCLUSION FORM

1. If the motion detector was triggered or the display case was opened, then the alarm sounded.
2. The alarm did not sound.
3. The display case was not opened.
4. The motion detector was not triggered.

TRANSLATION INTO PROPOSITIONAL LOGIC

translation key

p: The motion detector was triggered.
q: The display case was opened.
r: The alarm sounded.

1. $(p \vee q) \rightarrow r$
2. $\neg r$
3. $\neg q$
4. $\neg p$

VALIDITY

Here is a proof of the conclusion from the premises:

1	$(p \vee q) \rightarrow r$	assumption
2	$\neg r$	assumption
3	$\neg q$	assumption
4	$\quad p$	assumption
5	$\quad p \vee q$	I$\vee$, 4
6	$\quad r$	E$\rightarrow$, 1, 5
7	$\quad \bot$	E$\neg$, 2, 6
8	$\neg p$	I$\neg$, 4–7

OVER PLEASE

B

If you have submitted your application, then the application will be reviewed if you have paid the application fee. Your application will not be reviewed unless you have paid the application fee. Therefore, you have submitted your application.

PREMISE-CONCLUSION FORM

1. If you have submitted your application, then the application will be reviewed if you have paid the application fee.
2. Your application will not be reviewed unless you have paid the application fee.
3. You have submitted your application.

TRANSLATION INTO PROPOSITIONAL LOGIC

translation key

p: You have submitted your application.
q: Your application will be reviewed.
r: You have paid the application fee.

1. $p \to (r \to q)$
2. $\neg r \to \neg q$
3. p

VALIDITY

Here is an assignment on which the premises are true and the conclusion is false:

p	q	r	$p \to (r \to q)$	$\neg r \to \neg q$	p
F	T	T	T	T	F

OVER PLEASE

C

If the lab wins the grant and hires a statistician, then the study will be completed. If the lab wins the grant, then it will buy new equipment and hire a statistician. Therefore, if the lab wins the grant, then the study will be completed.

PREMISE-CONCLUSION FORM

1. If the lab wins the grant and hires a statistician, then the study will be completed.
2. If the lab wins the grant, then it will buy new equipment and hire a statistician.
3. If the lab wins the grant, then the study will be completed.

TRANSLATION INTO PROPOSITIONAL LOGIC

translation key

p: The lab wins the grant.
q: The lab hires a statistician.
r: The study will be completed.
s: The lab buys new equipment.

1. $(p \wedge q) \rightarrow r$
2. $p \rightarrow (q \wedge s)$
3. $p \rightarrow r$

VALIDITY

Here is a proof of the conclusion from the premises:

1	$(p \wedge q) \rightarrow r$	assumption
2	$p \rightarrow (q \wedge s)$	assumption
3	$\quad p$	assumption
4	$\quad q \wedge s$	E$\rightarrow$, 2, 3
5	$\quad q$	E$\wedge$, 4
6	$\quad p \wedge q$	I$\wedge$, 3, 5
7	$\quad r$	E$\rightarrow$, 1, 6
8	$p \rightarrow r$	I$\rightarrow$, 3–7

OVER PLEASE

D

If the proposed transportation plan is adopted, then the city will expand the subway or add new express bus routes. If the city expands the subway, then traffic congestion will decrease. If the city adds new express bus routes, then commuting times will decrease. Therefore, traffic congestion or commuting times will decrease.

PREMISE-CONCLUSION FORM

1. If the proposed transportation plan is adopted, then the city will expand the subway or add new express bus routes.
2. If the city expands the subway, then traffic congestion will decrease.
3. If the city adds new express bus routes, then commuting times will decrease.
4. Traffic congestion or commuting times will decrease.

TRANSLATION INTO PROPOSITIONAL LOGIC

translation key

p: The proposed transportation plan is adopted.
q: The city will expand the subway.
r: The city will add new express bus routes.
s: Traffic congestion will decrease.
t: Commuting times will decrease

1. $p \to (q \vee r)$
2. $q \to s$
3. $r \to t$
4. $s \vee t$

VALIDITY

Here is an assignment on which the premises are true and the conclusion is false:

p	q	r	s	t	$p \to (q \vee r)$	$q \to s$	$r \to t$	$s \vee t$
F	F	F	F	F	T	T	T	F