1. **(2 points)** `Library/SDSU/Discrete/Logic/formallogicB21.pg`
Negate the following statement:

$$\text{If } \mathbf{a} = \mathbf{1} \text{ and } \mathbf{b} = \mathbf{2}\text{, then } \mathbf{a} + \mathbf{b} = \mathbf{3}.$$

Choose the correct statement:

- A. $a \neq 1$ or $b \neq 2$ and $a+b \neq 3$
- B. $a \neq 1$ or $b \neq 2$ or $a+b \neq 3$
- C. $a = 1$ and $b = 2$ and $a+b \neq 3$
- D. $a = 1$ and $b = 2$ or $a+b \neq 3$

2. **(2 points)** `Library/SDSU/Discrete/Logic/formallogicB10.pg`
Convert the following statement using an "or" structure.

if a is irrational and b is rational, then $a \cdot b$ is irrational.

Choose the correct statement:

- A. a is irrational, or b is rational, or $a \cdot b$ is irrational
- B. a is rational, or b is irrational, or $a \cdot b$ is irrational
- C. a is irrational, or b is rational, and $a \cdot b$ is irrational
- D. a is rational and b is rational, or $a \cdot b$ is irrational

3. **(8 points)** `Library/MontanaState/Misc.Logic/1.5A33Logic1.pg`

Are the two sentences logically equivalent?
If John and Fred will go, Jess will go.
If John will go, Jess will go, and if Fred will go, Jess will go.

- A. Yes
- B. No

Are the two sentences logically equivalent?
If James will go, Jack and Melinda will go.
If James will go, Jack will go, and if James will go, Melinda will go.

- A. Yes
- B. No

Are the two sentences logically equivalent?
If Chris or Michael will go, Jess will go.
If Chris will go, Jess will go, and if Michael will go, Jess will go.

- A. Yes
- B. No

Are the two sentences logically equivalent?
If Sam or Bobby will go, Karen will go.
If Sam will go, Karen will go, or if Bobby will go, Karen will go.

- A. Yes
- B. No

4. **(8 points)** `Library/MontanaState/Misc.Logic/1.5B3Logic.pg`

Suppose you have four cards, each of which has an integer on one side and a letter on the other. Someone tells you that
if the letter is a vowel, the number is even.
Right now you can see the following cards: 4, B, E, 7. To check if the assertion is true, you may need to flip over some cards. Which cards?

Do you need to flip over this card?
4

- A. Yes
- B. No

Do you need to flip over this card?
B

- A. Yes
- B. No

Do you need to flip over this card?
E

- A. Yes
- B. No

Do you need to flip over this card?
7

- A. Yes
- B. No

5. **(5 points)** `Library/MontanaState/Misc.Logic/1.6B13Logic4.pg`
Suppose this is true: All widgets are gadgets.

Which is the correct conditional form of the sentence?

- A. If it's a widget, then it's a gadget
- B. If it's a gadget, then it's a widget

What can be deduced from that and this additional fact?
It's a gadget

- A. It is not a gadget
- B. It's a widget
- C. It is not a widget
- D. It's a gadget

- E. Nothing

What can be deduced from that and this additional fact?
It's not a widget

- A. It is not a gadget
- B. It's a widget
- C. It is not a widget
- D. It's a gadget
- E. Nothing

What can be deduced from that and this additional fact?
It's not a gadget

- A. It's a widget
- B. It is not a gadget
- C. It's a gadget
- D. It is not a widget
- E. Nothing

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6. **(4 points)** `Library/Rochester/setDiscrete8Reasoning/ur_dis_8_1.pg`

Which rule of inference is used in each of the following arguments? Check the correct answers.
1. Alice is a mathematics major. Therefore, Alice is either a mathematics major or a computer science major.

- A. Hypothetical syllogism.
- B. Modus ponens.
- C. Simplification.
- D. Addition.
- E. Conjunction.
- F. Modus tollens.
- G. Disjunctive syllogism.

2. Colleen is a cat. Colleen is gray. Therefore Colleen is a gray cat.

- A. Addition.
- B. Conjuction.
- C. Disjunctive syllogism.
- D. Hypothetical syllogism.
- E. Simplification.
- F. Modus tollens.
- G. Modus ponens.

3. Steve will work at a computer company this summer. Therefore, this summer Steve will work at a computer company or be a beach bum.

- A. Conjuction.
- B. Disjunctive syllogism.
- C. Modus ponens.
- D. Addition.
- E. Modus tollens.
- F. Simplication.
- G. Hypothetical syllogism.

4. Kangaroos live in Australia and are marsupials. Therefore, kangaroos are marsupials.

- A. Addition.
- B. Disjunctive syllogism.
- C. Hypothetical syllogism.
- D. Simplification.
- E. Conjuction.
- F. Modus ponens.
- G. Modus tollens.

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7. **(8 points)** `Library/SUNYSB/contradiction.pg`

For the following **proof by contradiction** provide the justifications at each step, using the following equivalences and inference rules. Use the following keys:

a	Idempotent Law
b	Double Negation
c	De Morgan's Law
d	Commutative Properties
e	Associative Properties
f	Distributive Properties
g	Equivalence of Contrapositive
h	Definition of Implication
i	Definition of Equivalence
j	Identity Laws $(p \vee F = p \wedge T = p)$
k	Tautology $(p \vee \neg p = T)$
l	Contradiction $(p \wedge \neg p = F)$
m	Negation of the goal to prove
n	Modus Ponens
o	Modus Tollens
p	Transitivity of Implication
q	Conjunctive Simplification
r	Conjunctive Addition
s	Disjunctive Addition

We want to prove s by a proof by contradiction from the following propositions.

$p \to b$
$r \to b$
$\neg b$
$\neg(s \wedge T) \to p$

$\neg s$ by ___
$\neg p$ by ___ between $p \to b$ and $\neg b$
$s \wedge T$ by ___ between $\neg(s \wedge T) \to p$ and $\neg p$ previously deduced.
s by ___ of $s \wedge T$
We have s and $\neg s$ true, therefore we have a contradiction.

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8. **(6 points)** `Library/SUNYSB/proofReasons1.pg`

For the following proof (of equivalence of 2 formulae) provide the justifications at each step, using the following equivalences. Use the following key:

a	Idempotent Law
b	Double Negation
c	De Morgan's Law
d	Commutative Properties
e	Associative Properties
f	Distributive Properties
g	Equivalence of Contrapositive
h	Definition of Implication
i	Definition of Equivalence
j	Identity Laws ($p \vee F \equiv p \wedge T \equiv p$)
k	Tautology ($p \vee \neg p \equiv T$)
l	Contradiction ($p \wedge \neg p \equiv F$)

$p \to (p \wedge q) \equiv$
$\neg p \vee (p \wedge q)$ by ___ $\equiv (\neg p \vee p) \wedge (\neg p \vee q)$ by ___ $\equiv (p \vee \neg p) \wedge (\neg p \vee q)$ by ___ $\equiv T \wedge (\neg p \vee q)$ by ___ $\equiv (\neg p \vee q) \wedge T$ by ___ $\equiv \neg p \vee q$ by ___