1. Consider the following argument:

   In my logic class, I learned that some deductively valid arguments are not sound. This led me to see that it's possible for deductively valid arguments to have false conclusions, since any argument that is not sound will have a false conclusion.

a) Extract the argument from this passage and put it in standard form.

Some deductively valid arguments are not sound.
Any argument that is not sound will have a false conclusion.
∴ It's possible for deductively valid arguments to have false conclusions.

b) Is the argument valid? YES

c) Is it sound? NO

It is valid since it is impossible for the premises to be true and the conclusion false. But it is not sound since premise 2 is false

2. Are the following in official notation; informal notation or not well-formed (circle correct answer). If well-formed, indicate the main connective (circle, use an arrow, etc.) If not well-formed, indicate the problem (circle, use an arrow, etc.)

a) $(P \leftrightarrow (R \vee {\sim}{\sim}{\sim}S \rightarrow Z)) \wedge P \wedge Q$

$\uparrow$

Official

Informal

Not well-formed

b) ${\sim}({\sim}({\sim}P \rightarrow Q) \leftrightarrow {\sim}\,\big(\,{\sim}(R \wedge S)\big))$

$\uparrow \quad \uparrow$

Incorrect parentheses

Official If circled this, ½ pt. for ↔

Informal

$\boxed{\text{Not well-formed}}$

3. Can a deductively sound argument be made invalid by adding more premises? Can it be made unsound by adding more premises? Briefly explain.

No, a deductively sound argument cannot be made invalid by adding more premises. If it is deductively sound, then it is deductively valid. Thus, it is impossible the conclusion to be false if all the premises are true. If the conclusion is true whenever all the premises are true, then that won't change if more premises are added.

It can be made unsound by adding more premises – if any of the added premises are false.

P: John wins the poker hand.	S: Sara wins the poker hand.	W: Sara gets a straight flush.
Q: John has two queens.	T: Tom wins the poker hand.	X: Tom gets a straight flush.
R: John gets a full house	U: John has three tens.	Y: John gets a straight flush.

4. Using the abbreviation scheme above, symbolize the following:

a) Only provided that Tom doesn't get a straight flush, will John win the poker hand if he gets a full house.

$(R \rightarrow P) \rightarrow \sim X$

b) Neither Sara nor Tom wins the poker hand unless John fails to get a full house, in which case Sara will win.

$((\sim S \wedge \sim T) \vee \sim R) \wedge (\sim R \rightarrow S)$ (or, the first part can be $(R \rightarrow (\sim S \wedge \sim T))$ or $(\sim(\sim S \wedge \sim T) \rightarrow \sim R)$

$(\sim(S \vee T) \vee \sim R) \wedge (\sim R \rightarrow S)$ (or, the first part can be $((S \vee T) \rightarrow \sim R)$ or $(R \rightarrow \sim(S \vee T))$

c) John's having two queens and three tens is sufficient for him to get a full house, but in order for him to win the poker hand it is necessary that he get a straight flush.

\ $((Q \wedge U) \rightarrow R) \wedge (P \rightarrow Y)$

d) No more than two of them (John, Sara and Tom) get a straight flush.

$\sim(W \wedge X \wedge Y)$

$\sim W \vee \sim X \vee \sim Y$

$(\sim W \wedge \sim X \wedge \sim Y) \vee (\sim W \wedge \sim X \wedge Y) \vee (W \wedge \sim X \wedge \sim Y) \vee (\sim W \wedge X \wedge \sim Y) \vee$
$(\sim W \wedge X \wedge Y) \vee (W \wedge \sim X \wedge Y) \vee (W \wedge X \wedge \sim Y)$

5. Using the abbreviation scheme above, provide an idiomatic English sentence for the following:

$$(W \vee X \vee Y) \wedge \sim((W \wedge X) \vee (X \wedge Y) \vee (Y \wedge W)) \rightarrow ((S \vee T) \wedge \sim(S \wedge T))$$

If exactly one of the players (John Sara and Tom) gets a straight flush, then either Sara or Tom, but not both, will win the poker hand.

6. Show that the following argument is a valid theorem is true using **ONLY** the 10 basic rules: **MP, MT, DN, R, ADJ, S, ADD, MTP, BC, CB**

$(W \to V) \leftrightarrow (X \vee P)$. $T \wedge \sim Q \to W$. $(V \leftrightarrow W) \to Z$. $P \vee Q$. $Q \to \sim R$. $R \wedge T$.
$\therefore Z$

1	~~Show~~ Z		
2		R	pr6 sl
3		T	pr6 sr
4		~~R	2 dn
5		~Q	4 pr5 mt
6		$T \wedge \sim Q$	3 5 adj
7		W	6 pr 2 mp
8		P	5 pr4 mtp
9		$X \vee P$	8 add
10		$(X \vee P) \to (W \to V)$	pr1 bc
11		$W \to V$	9 10 mp
12		~~show~~ $V \to W$	
13		V	ass cd
14		W	7 r
15			14 cd
16		$V \leftrightarrow W$	11 12 cb
17		Z	16 pr3 mp
18			17 dd

7. Show that the following theorem is valid using **ONLY** the 10 basic rules:
MP, MT, DN, R, ADJ, S, ADD, MTP, BC, CB

$$(\sim P \to (Q \vee T)) \to [((Q \to R) \wedge \sim (P \vee R)) \to (S \vee T)]$$

1	~~Show~~ $(\sim P\to Q\vee T)\to((Q\to R)\wedge\sim(P\vee R)\to S\vee T)$	"show conc"
2	$\sim P\to Q\vee T$	ass cd
3	~~Show~~ $(Q\to R)\wedge\sim(P\vee R)\to S\vee T$	"show cons"
4	$(Q\to R)\wedge\sim(P\vee R)$	ass cd
5	~~Show~~ $S\vee T$	"show cons"
6	$Q\to R$	4 sl
7	$\sim(P\vee R)$	4 sr
8	~~Show~~ $\sim P$	
9	P	ass id
10	$P\vee R$	9 add
11	$\sim(P\vee R)$	7 r
12		10 11 id
13	$Q\vee T$	2 8 mp
14	~~Show~~ T	
15	$\sim T$	ass id
16	Q	13 15 mtp
17	R	6 16 mp
18	$P\vee R$	17 add
19	$\sim(P\vee R)$	7 r
20		19 18 id
21	$S\vee T$	14 add
22		21 dd
23		5 cd
24		3 cd
25		

8. Provide a derivation to show that the following is a valid argument. Use any of the rules.

$\sim(Z \leftrightarrow Q)$. $\sim(Z \rightarrow P) \rightarrow \sim(W \wedge X)$. $\sim(R \rightarrow \sim X)$. $\sim W \rightarrow \sim R$. $\therefore$ $\sim(P \vee Q) \rightarrow S$

1	~~Show~~ $\sim(P \vee Q) \rightarrow S$	
2	$\sim(P \vee Q)$	ass cd
3	~~Show~~ S	
4	$\sim P \wedge \sim Q$	2 dm
5	$\sim P$	4 s
6	$\sim Q$	4 s
7	$R \wedge \sim\sim X$	pr3 nc
8	R	7 s
9	$\sim\sim X$	7 s
10	X	9 dn
11	$\sim\sim R$	8 dn
12	W	11 pr4 mt, dn
13	$W \wedge X$	10 12 adj
14	$\sim\sim(Z \rightarrow P)$	12 dn, pr2 mt
15	$Z \rightarrow P$	14 dn
16	$\sim Z$	5 15 mt
17	$Z \leftrightarrow \sim Q$	pr1 nb
18	$\sim Q \rightarrow Z$	17 bc
19	$\sim\sim Q$	16 18 mt, 6 id
20		3 cd

1	~~Show~~ $\sim(P \vee Q) \rightarrow S$	
2	$\sim(P \vee Q)$	ass cd
3	$\sim P \wedge \sim Q$	2 dm
4	$\sim P$	3 s
5	$\sim Q$	3 s
6	$Z \leftrightarrow \sim Q$	pr1 nb
7	$\sim Q \rightarrow Z$	6 bc
8	Z	5 7 mp
9	$Z \wedge \sim P$	4 8 adj
10	$\sim(Z \rightarrow P)$	9 nc
11	$\sim(W \wedge X)$	10 pr1 dm
12	$\sim W \vee \sim X$	11 dm
13	$R \wedge \sim\sim X$	pr3 nc
14	$\sim\sim X$	13 s
15	$\sim W$	11 14 mtp
16	$\sim R$	15 pr4 mp
17	R	13 s
18		16 17 id
19		
20		