Translate into syllogistic logic and say whether valid or invalid.

6 points each

You must be the criminal. I'm sure of this, because you walk with a slight limp. We all know that the criminal walks with a slight limp.

All who use Macintosh computers are irresponsible artistic rebels.
No one who uses a Macintosh computer likes IBM computers.
All who like IBM computers are unthinking conformists.
∴ No irresponsible artistic rebels are unthinking conformists.

Only what is based on sense experience can be known. Hence no mathematical truths can be known – since surely no mathematical truths are based on sense experience.

Gensler is a teacher who puts music on homework disks.
All teachers who put music on homework disks are incompetent.
All incompetent teachers ought to be fired.
∴ Gensler ought to be fired.

All who major in biology are in the biology club. Not all pre-med students major in biology. Pre-med students get good grades. So at least some in the biology club don't get good grades.

Translate into syllogistic wffs. 4 points each

Not all snakes are poisonous.

Only fools wear Ohio State shirts to Gensler's logic class.

Troy is the starting Dallas quarterback.

No one is a Cubs fan unless they are a masochist.

Whoever has used LogiCola has seen the bicycle in the introductory screen.

Logicians are wonderful people.

At least one logician is brilliant.

Test using Venn diagrams (following the format in the book) and say whether valid or invalid. 6 points each

all A is B
some C is B
∴ some C is A

no G is H
some I is H
∴ some I is not G

Write a conclusion in English **(not in wffs)** which follows validly from and uses **all** the premises. Leave blank if no such conclusion validly follows.

6 points each

All ice cream is healthy.
No healthy food tastes good.

Gensler is a logician.
Gensler has a great sense of humor.

No one who plays Tetris continually will pass logic.
Some who do LogiCola do not pass logic.

Some philosophers are logical positivists.
No logical positivists believe in God.
All Catholics believe in God.

All successful horse thieves are rich.
Some rich people pay taxes.

Answers to page 1

1. Invalid (W not starred)

   u is W
   c is W
∴ u* is c*

2. Invalid (M & L starred twice, I & U not starred)

   all M* is I
   no M* is L*
   all L* is U
∴ no I is U

3. Valid

   all K* is B
   no M* is B*
∴ no M is K

4. Valid

   g is P
   all P* is I
   all I* is F
∴ g* is F*

5. Invalid (M starred twice, G not starred)

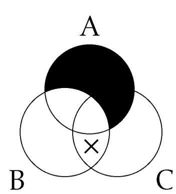
   all M* is C
   some P is not M*
   all P* is G
∴ some C* is not G

Answers to page 2

1. some S is not P
2. all W is F
3. t is q
4. all C is M
5. all U is S
6. all L is W
7. some L is B

1. Invalid

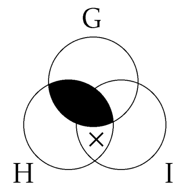
   all A is B
   some C is B
∴ some C is A



We can draw the premises without drawing the conclusion.

2. Valid

   no G is H
   some I is H
∴ some I is not G



We can't draw the premises without drawing the conclusion.

Answers to page 3

1. No ice cream tastes good. (OR: Nothing that tastes good is ice cream.)

   all I* is H
   no H* is G*
∴ no I is G

2. Some logicians have a great sense of humor. (OR: Some who have a great sense of humor are logicians.)

   g is L
   g is S
∴ some L* is S*

3. No conclusion (L starred twice, two right-hand stars)

   no T* is L*
   some D is not L*
∴

4. Some philosophers are not Catholics.

   some P is L
   no L* is B*
   all C* is B
∴ some P* is not C

5. No conclusion (R not starred)

   all S* is R
   some R is P
∴

Translate into propositional logic and say whether valid or invalid.

6 points each

We'll be able to have class, only if either there's chalk in the room or else Gensler brought chalk. There's no chalk in the room. So we won't be able to have class. I say this, of course, because Gensler didn't bring chalk.

If Gensler is healthy and there's snow, then Gensler is skiing.
Gensler is healthy.
Gensler isn't skiing.
∴ There's no snow.

I'll do poorly in logic. I'm sure of this because of the following facts. First, I don't do LogiCola. Second, I don't read the book. Third, I spend my time playing Tetris. Assuming that I spend my time playing Tetris and I don't do LogiCola, then, of course, if I don't read the book then I'll do poorly in logic.

If you either remain silent or tell the truth, then the murderer will know that your friend is hiding upstairs.
You won't tell the truth.
∴ The murderer won't know that your friend is hiding upstairs.

My tent will get wet and my food sack will get wet, assuming that it rains. My tent will get wet. So my food sack will also get wet.

Either I will stay home and it will be sunny, or I will go backpacking and it will rain.
I won't go backpacking.
∴ It will be sunny.

Valid or invalid? — 3 points each

((W • F) ≡ ~G)
G
~F
∴ ~W

(C ⊃ (W ∨ F))
~W
~F
∴ ~C

(W ⊃ (F ∨ N))
~N
∴ ~W

((W • ~F) ⊃ ~N)
N
∴ F

((S ∨ L) ⊃ (P • H))
~S
∴ ~P

((D • W) ∨ (B • M))
~D
∴ M

What letters (or negations of letters) follow? Leave blank if nothing follows. — 2 points each

~(U • ~J) ______

(~G ⊃ ~L) ______

~(Q ∨ L) ______

(~Z ∨ J) ______

(~Z • ~L) ______

~(P ⊃ ~Z) ______

~(G • H)
~G ______

(~H ∨ ~O)
O ______

~(F • ~I)
~I ______

(O ⊃ ~H)
H ______

(U ∨ ~D)
~D ______

(~F ⊃ K)
K ______

Translate into propositional logic wffs. — 2 points each

A is true only if B is true.

If not either A or B, then C but not D.

If A then B, or C.

A or B, but not both.

A is true, unless B and C are both true.

Do a truth table for this formula.

4 points

(~A ⊃ ~(B ∨ C))

Test by the truth table method and say whether valid or invalid.

4 points each

(~A ⊃ (~B ⊃ C))
A
~C
∴ ~B

(A ≡ (A • B))
∴ (A ⊃ B)

ANSWERS TO PAGE 5

1. $(A^1 \supset (R^o \vee G^o)) \neq 1$ **Valid**
   $\sim R^o = 1$
   $\sim G^o = 1$
   $\therefore \sim A^1 = 0$

2. $((H^1 \cdot S^1) \supset K^o) \neq 1$ **Valid**
   $H^1 = 1$
   $\sim K^o = 1$
   $\therefore \sim S^1 = 0$

3. $\sim L^o = 1$
   $\sim W^o = 1$
   $T^1 = 1$
   $((T^1 \cdot \sim L^o) \supset (\sim W^o \supset P^o)) \neq 1$ **Valid**
   $\therefore P^o = 0$

4. $((S^? \vee T^o) \supset K^1) = 1$ **Invalid**
   $\sim T^o = 1$
   $\therefore \sim K^1 = 0$

5. $(R^o \supset (T^1 \cdot F^o)) = 1$ **Invalid**
   $T^1 = 1$
   $\therefore F^o = 0$

We let R=0 to make the first premise true.

6. $((H^? \cdot S^o) \vee (B^o \cdot R^?)) \neq 1$ **Valid**
   $\sim B^o = 1$
   $\therefore S^o = 0$

ANSWERS TO PAGE 6

1. $((W^1 \cdot F^o) \equiv \sim G^1) = 1$ **Invalid**
   $G^1 = 1$
   $\sim F^o = 1$
   $\therefore \sim W^1 = 0$

2. $(C^1 \supset (W^o \vee F^o)) \neq 1$ **Valid**
   $\sim W^o = 1$
   $\sim F^o = 1$
   $\therefore \sim C^1 = 0$

3. $(W^1 \supset (F^1 \vee N^o)) = 1$ **Invalid**
   $\sim N^o = 1$
   $\therefore \sim W^1 = 0$

We let F=1 to make the first premise true.

4. $((W^o \cdot \sim F^o) \supset \sim N^1) = 1$ **Invalid**
   $N^1 = 1$
   $\therefore F^o = 0$

We let W=0 to make the first premise true.

5. $((S^o \vee L^o) \supset (P^1 \cdot H^1)) = 1$ **Invalid**
   $\sim S^o = 1$
   $\therefore \sim P^1 = 0$

We let L=0 or H=1 to make the first premise true.

6. $((D^o \cdot W^?) \vee (B^? \cdot M^o)) \neq 1$ **Valid**
   $\sim D^o = 1$
   $\therefore M^o = 0$

S-Rules: nil || nil || ~Q, ~L || nil || ~Z, ~L || P, Z

I-Rules: nil || ~H || ~F || ~O || nil || nil

1. $(A \supset B)$
2. $(\sim(A \vee B) \supset (C \cdot \sim D))$
3. $((A \supset B) \vee C)$
4. $((A \vee B) \cdot \sim(A \cdot B))$
5. $(A \vee (B \cdot C))$

ANSWERS TO PAGE 7

A	B	C	(~A ⊃ ~(B ∨ C))
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

A	B	C	(~A ⊃ (~B ⊃ C)),	A,	~C ∴	~B	
0	0	0	0	0	1	1	
0	0	1	1	0	0	1	
0	1	0	1	0	1	0	
0	1	1	1	0	0	0	
1	0	0	1	1	1	1	
1	0	1	1	1	0	1	
1	1	0	1	1	1	0	←
1	1	1	1	1	0	0	

Invalid – we can have true premises and a false conclusion.

A	B	(A ≡ (A · B)) ∴	(A ⊃ B)
0	0	1	1
0	1	1	1
1	0	0	0
1	1	1	1

Valid – we can't have true premises and a false conclusion.

Translate into propositional logic. Say whether VALID (then give a formal proof) or INVALID (then give a refutation).

15 points each

If smoke in the office is a problem, then there's bad ventilation.

If there's bad ventilation, then there'd be further problems even without cigarettes and banning smoking wouldn't solve the problem of bad air.

∴ If smoke in the office is a problem, then banning smoking wouldn't solve the problem of bad air.

(P V F S)

If emotions can rest on factual errors and factual errors can be criticized, then we can criticize emotions.

If we can criticize emotions and moral judgments are based on emotions, then beliefs about morality can be criticized and morality isn't entirely irrational.

∴ If morality is entirely irrational, then emotions can't rest on factual errors.

(E F W M B I)

Translate into propositional logic. Say whether VALID (then give a formal proof) or INVALID (then give a refutation).

15 points (English) or 10 points (symbolic)

If Socrates didn't approve of the laws of Athens, then he'd have left Athens or tried to change the laws.
If Socrates didn't leave Athens and didn't try to change the laws, then he agreed to obey the laws.
Socrates didn't try to change the laws.
∴ If Socrates didn't leave Athens, then he approved of the laws and agreed to obey them.

(A L C O)

A
((A • B) ⊃ C)
(D ∨ B)
∴ (D ∨ C)

(A ⊃ B)
(B ⊃ C)
(D ⊃ ~B)
(E ⊃ ~C)
∴ (E ⊃ (D • ~A))

Translate into propositional logic. Say whether VALID (then give a formal proof) or INVALID (then give a refutation).

15 points (English) or 10 points (symbolic)

If belief in God is irrational, then it has no scientific backing.
No experiment could decide the issue of whether there is a God.
If belief in God has scientific backing, then some experiment could decide the issue of whether there is a God.
∴ Belief in God is irrational.

(I S E)

((A ⊃ (B • C)) ⊃ (D ⊃ (E • F)))
D
C
∴ (B ∨ E)

(A ⊃ (B • ~C))
(A ∨ (D • ~E))
∴ ~(C • E)

ANSWERS TO PAGE 9

* 1 (P ⊃ V) **Valid**
* 2 (V ⊃ (F • ~S))
[∴ (P ⊃ ~S)
* 3 asm: ~(P ⊃ ~S)
4 ∴ P {from 3}
5 ∴ S {from 3}
6 ∴ V {from 1 & 4}
* 7 ∴ (F • ~S) {from 2 & 6}
8 ∴ F {from 7}
9 ∴ ~S {from 7}
10 ∴ (P ⊃ ~S) {from 3; 5 contradicts 9}

1 $((E^1 \cdot F^0) \supset W^0) = 1$ **Invalid**
2 $((W^0 \cdot M^?) \supset (B^? \cdot \sim I^1)) = 1$
[∴ $(I^1 \supset \sim E^1) = 0$
* 3 asm: ~(I ⊃ ~E)
4 ∴ I {from 3}
5 ∴ E {from 3}
** 6 asm: ~(E • F) {break up 1}
7 ∴ ~F {from 5 & 6}
8 asm: ~(W • M) {break up 2}
9 asm: ~W {break up 8}

I, E, ~F, ~W

Without "~W," the second premise is ? (unknown).

ANSWERS TO PAGE 10

* 1 (~A ⊃ (L ∨ C)) **Valid**
2 ((~L • ~C) ⊃ O)
3 ~C
[∴ (~L ⊃ (A • O))
* 4 asm: ~(~L ⊃ (A • O))
5 ∴ ~L {from 4}
6 ∴ ~(A • O) {from 4}
7 asm: A {break up 1}
8 ∴ ~O {from 6 & 7}
9 ∴ ~(~L • ~C) {from 2 & 8}
10 ∴ C {from 5 & 9}
11 ∴ ~A {from 7; 3 contradicts 10}
* 12 ∴ (L ∨ C) {from 1 & 11}
13 ∴ L {from 3 & 12}
14 ∴ (~L ⊃ (A • O)) {from 4; 5 contradicts 13}

1 A **Valid**
* 2 ((A • B) ⊃ C)
* 3 (D ∨ B)
[∴ (D ∨ C)
* 4 asm: ~(D ∨ C)
5 ∴ ~D {from 4}
6 ∴ ~C {from 4}
7 ∴ B {from 3 & 5}
* 8 ∴ ~(A • B) {from 2 & 6}
9 ∴ ~B {from 1 & 8}
10 ∴ (D ∨ C) {from 4; 7 contradicts 9}

* 1 $(A^0 \supset B^0) = 1$ **Invalid**
* 2 $(B^0 \supset C^0) = 1$
3 $(D^0 \supset \sim B^0) = 1$
* 4 $(E^1 \supset \sim C^0) = 1$
[∴ $(E^1 \supset (D^0 \cdot \sim A^0)) = 0$
* 5 asm: ~(E ⊃ (D • ~A))
6 ∴ E {from 5}
* 7 ∴ ~(D • ~A) {from 5}
8 ∴ ~C {from 4 & 6}
9 ∴ ~B {from 2 & 8}
10 ∴ ~A {from 1 & 9}
11 ∴ ~D {from 7 & 10}

E, ~A, ~B, ~C, ~D

ANSWERS TO PAGE 11

1 $(I^0 \supset \sim S^0) = 1$ **Invalid**
2 $\sim E^0 = 1$
* 3 $(S^0 \supset E^0) = 1$
[∴ $I^0 = 0$
5 asm: ~I
6 ∴ ~S {from 2 & 3}

~E, ~I, ~S

1 $((A^1 \supset (B^0 \cdot C^1)) \supset (D^1 \supset (E^0 \cdot F^?))) = 1$ **Invalid**
2 $D^1 = 1$
3 $C^1 = 1$
[∴ $(B^0 \vee E^0) = 0$
* 4 asm: ~(B ∨ E)
5 ∴ ~B {from 4}
6 ∴ ~E {from 4}
** 7 asm: ~(A ⊃ (B • C)) {break up 1}
8 ∴ A {from 7}
9 ∴ ~(B • C) {from 7}

A, C, D, ~B, ~E

* 1 (A ⊃ (B • ~C)) **Valid**
2 (A ∨ (D • ~E))
[∴ ~(C • E)
* 3 asm: (C • E)
4 ∴ C {from 3}
5 ∴ E {from 3}
6 asm: ~A {break up 1}
7 ∴ (D • ~E) {from 2 & 6}
8 ∴ D {from 7}
9 ∴ ~E {from 7}
10 ∴ A {from 6; 5 contradicts 9}
* 11 ∴ (B • ~C) {from 1 & 10}
12 ∴ B {from 11}
13 ∴ ~C {from 11}
14 ∴ ~(C • E) {from 3; 4 contradicts 13}

Translate into modal logic. Say whether VALID (then give a formal proof) or INVALID (then give a refutation). Work out ambiguous ones both ways.

12 points (English) or
20 points (ambiguous English)
or 8 points (symbolic)

If you know the answer, then you couldn't do this one incorrectly.
You could do this one incorrectly.
∴ You don't know the answer.

(K I)

~(◇~Y • ~☐G)
∴ ☐(Y ∨ G)

~D
~◇(~D • ~E)
∴ ☐E

Translate into modal logic. Say whether VALID (then give a formal proof) or INVALID (then give a refutation). Work out ambiguous ones both ways.

12 points (English) or 20 points (ambiguous English) or 8 points (symbolic)

"I did what I chose to do" is consistent with "My action was determined."
"I did what I chose to do" logically entails "My action was free."
∴ "My action was free" is consistent with "My action was determined."

(C D F)

Translate into modal wffs, using the letters given. Translate ambiguous ones both ways.

4 points each (8 for ambiguous)

If n is a number, then either it's necessary that n is prime or it's necessary that n is composite. (N P C)

"I acted freely" doesn't entail "My act wasn't determined." (F D)

If you know that this act is virtuous, then it's necessary that you will do it. (K D)

"Michigan will win the national championship" is a contingent truth. (M)

If it's impossible to have snow, then it's impossible for Gensler to ski. (S G)

Translate into modal logic. Say whether VALID (then give a formal proof) or INVALID (then give a refutation). Work out ambiguous ones both ways.

12 points (English) or
20 points (ambiguous English)
or 8 points (symbolic)

Necessarily, if Michigan and Florida both lose then Notre Dame will move up in the standings.
It's possible for Michigan to lose.
It's possible for Florida to lose.
∴ It's possible for Notre Dame to move up in the standings.

(M F N)

$\sim\Box X$
∴ $\sim\Diamond(\sim Y \cdot X)$

$\sim\Diamond(E \cdot D)$
$\Box(H \vee D)$
∴ $\Box(E \supset H)$

ANSWERS TO PAGE 13

The first argument is ambiguous; so we work it out both ways. If we take premise 1 as "(K ⊃ □~I)" [or equivalently "(K ⊃ ~◇I)"], then it's valid. If we take it as "□(K ⊃ ~I)," then it's invalid.

* 1 (K ⊃ □~I) **Valid**
* 2 ◇I
[∴ ~K
3 asm: K
4 ∴ □~I {from 1 & 3}
5 W ∴ I {from 2}
6 W ∴ ~I {from 4, contradicting 5}
7 ∴ ~K {from 3, 5, & 6}

1 □(K ⊃ ~I) = 1 **Invalid**
* 2 ◇I = 1
[∴ ~K = 0
3 asm: K
4 W ∴ I {from 2}
* 5 W ∴ (K ⊃ ~I) {from 1}
* 6 ∴ (K ⊃ ~I) {from 1}
7 W ∴ ~K {from 4 & 5}
8 ∴ ~I {from 3 & 6}

	K, ~I
W	I, ~K

* 1 ~(◇~Y • ~□G) **Valid**
[∴ □(Y ∨ G)
* 2 asm: ~□(Y ∨ G)
* 3 ∴ ◇~(Y ∨ G) {from 2}
* 4 W ∴ ~(Y ∨ G) {from 3}
5 W ∴ ~Y {from 4}
6 W ∴ ~G {from 4}
7 asm: ~◇~Y {break up 1}
8 ∴ □Y {from 7}
9 W ∴ Y {from 8, contradicting 5}
10 ∴ ◇~Y {from 7, 5, & 9}
11 ∴ □G {from 1 & 10}
12 W ∴ G {from 11, contradicting 6}
13 ∴ □(Y ∨ G) {from 2, 6, & 12}

1 ~D = 1 **Invalid**
* 2 ~◇(~D • ~E) = 1
[∴ □E = 0
* 3 asm: ~□E
* 4 ∴ ◇~E {from 3}
5 ∴ □~(~D • ~E) {from 2}
6 W ∴ ~E {from 4}
* 7 W ∴ ~(~D • ~E) {from 5}
* 8 ∴ ~(~D • ~E) {from 5}
9 W ∴ D {from 6 & 7}
10 ∴ E {from 1 & 8}

	E, ~D
W	D, ~E

ANSWERS TO PAGE 14

* 1 ◇(C • D) **Valid**
2 □(C ⊃ F)
[∴ ◇(F • D)
* 3 asm: ~◇(F • D)
4 ∴ □~(F • D) {from 3}
* 5 W ∴ (C • D) {from 1}
* 6 W ∴ (C ⊃ F) {from 2}
* 7 W ∴ ~(F • D) {from 4}
8 W ∴ C {from 5}
9 W ∴ D {from 5}
10 W ∴ F {from 6 & 8}
11 W ∴ ~D {from 7 & 10, contradicting 9}
12 ∴ ◇(F • D) {from 3, 9, & 11}

1. (N ⊃ (□P ∨ □C))
2. ~□(F ⊃ ~D)
3. (K ⊃ □D) or □(K ⊃ D) – ambiguous
4. (M • ◇~M)
5. (~◇S ⊃ ~◇G)

ANSWERS TO PAGE 15

1 □((M • F) ⊃ N) = 1 **Invalid**
* 2 ◇M = 1
* 3 ◇F = 1
[∴ ◇N = 0
* 4 asm: ~◇N
5 ∴ □~N {from 4}
6 W ∴ M {from 2}
7 WW ∴ F {from 3}
* 8 W ∴ ((M • F) ⊃ N) {from 1}
* 9 WW ∴ ((M • F) ⊃ N) {from 1}
10 W ∴ ~N {from 5}
11 WW ∴ ~N {from 5}
* 12 W ∴ ~(M • F) {from 8 & 10}
* 13 WW ∴ ~(M • F) {from 9 & 11}
14 W ∴ ~F {from 6 & 12}
15 WW ∴ ~M {from 7 & 13}

W	M, ~F, ~N
WW	F, ~M, ~N

* 1 ~□X = 1 **Invalid**
[∴ ~◇(~Y • X) = 0
* 2 asm: ◇(~Y • X)
* 3 ∴ ◇~X {from 1}
4 W ∴ ~X {from 3}
* 5 WW ∴ (~Y • X) {from 2}
6 WW ∴ ~Y {from 5}
7 WW ∴ X {from 5}

W	~X
WW	X, ~Y

* 1 ~◇(E • D) **Valid**
2 □(H ∨ D)
[∴ □(E ⊃ H)
* 3 asm: ~□(E ⊃ H)
4 ∴ □~(E • D) {from 1}
* 5 ∴ ◇~(E ⊃ H) {from 3}
* 6 W ∴ ~(E ⊃ H) {from 5}
* 7 W ∴ (H ∨ D) {from 2}
* 8 W ∴ ~(E • D) {from 4}
9 W ∴ E {from 6}
10 W ∴ ~H {from 6}
11 W ∴ ~D {from 8 & 9}
12 W ∴ D {from 7 & 10, contradicting 11}
13 ∴ □(E ⊃ H) {from 3, 11, & 12}