

1.1 HW 2, 4, 6, 8 P 11/12

2 a) Imperative

- b.) declarative, statement, F
- c.) declarative, statement, F when $x \neq 2$
- d.) interrogative
- e.) exclamatory
- f.) declarative, statement, T

4

a.) $n < 3+2 = \boxed{n \leq 5}$

b.) $2n^2 - 5n + 2 = 0 \quad n=2$

c.) $n > 0$

d.) $n \in \{1, 2\}$

e.) $n = 0$

f.) $n = \{0, 2\}$

6

a. $n = 2$

b. $n = 0$

8

$x \geq 0, y = 1$

1.2 HW

25, 4, 6, 8, 10, 12, 14, 16, 18, 20
p. 23-25

2. $a) \sqrt{3} \leq 1.7$

b) The integer 0 is not even

c) The number 7 is a root of the equation $x^2 - 7 = 0$ conjunction: $P = \text{false} \wedge Q = \text{True}$ $P \wedge Q = \text{False}$ disjunction: $P = \text{False} \vee Q = \text{True}$ $P \vee Q = \text{True}$ P is false $\wedge Q$ is true

6. a.) $n=1$

b.) $n=2$ F T

c.) yes $n=4$ F T

8. a.) $\sim P$ | Q | $\sim P \vee Q$ b.) P | $\sim Q$ | $P \wedge (\sim Q)$

F	T	T	T	F	F
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F	F	F	T	T	T
---	---	---	---	---	---

T	T	T	F	F	F
---	---	---	---	---	---

T	F	F	F	T	F
---	---	---	---	---	---

c.) $\sim P$ | $P \wedge (\sim Q)$ | $\sim P \vee (P \wedge (\sim Q))$

F	F	F
---	---	---

F	T	T
---	---	---

T	F	T
---	---	---

T	F	T
---	---	---

10. $P = 2$ is even $Q = 7$ is odd

P | Q | $P \oplus Q$ | $Q \oplus P$

because $2 \oplus 7$ is true

T	T	F	F
---	---	---	---

In both cases

T	F	T	T
---	---	---	---

F	T	T	F
---	---	---	---

F	F	F	F
---	---	---	---

AND

$$1. \sim(P \vee Q) \equiv (\sim P) \wedge (\sim Q)$$

OR

$$2. \sim(P \wedge Q) \equiv (\sim P) \vee (\sim Q)$$

De Morgan's laws

12 a. $\sim(x < -3 \vee x > 3) \equiv (\sim(x < -3)) \wedge (\sim(x > 3))$
 $(x \geq -3) \wedge (x \leq 3)$

P	Q	$\sim P$	$\sim Q$	$P \vee Q$	$\sim(P \vee Q)$
T	T	F	F	T	F
T	F	F	T	F	T
F	T	T	F	T	F
F	F	T	T	F	T

$$\sim(P \vee Q) \equiv (\sim P) \wedge (\sim Q) \quad \checkmark$$

b $\sim(a \text{ is odd} \wedge b \text{ is even}) \equiv (\sim(a \text{ is odd})) \vee (\sim(b \text{ is even}))$
 $(a \text{ is not odd}) \vee (b \text{ is not even})$

P	Q	$\sim P$	$\sim Q$	$P \wedge Q$	$\sim P \wedge Q$	$\sim P \vee \sim Q$
T	T	F	F	T	F	F
T	F	F	T	F	T	T
F	T	T	F	F	T	T
F	F	T	T	F	T	T

P	Q	$\sim P$	$\sim Q$	$P \vee Q$	$\sim(P \vee Q)$	$(\sim P) \vee (\sim Q)$
T	T	F	F	T	F	F
T	F	F	T	T	F	T
F	T	T	F	T	F	T
F	F	T	T	F	T	T

P	Q	$\sim P$	$\sim Q$	$P \wedge Q$	$\sim(P \wedge Q)$	$(\sim P) \wedge (\sim Q)$
T	T	F	F	T	F	F
T	F	F	T	F	T	F
F	T	T	F	F	T	F
F	F	T	T	F	T	T

16 a.

P	Q	R	$Q \vee R$	$P \vee (Q \vee R)$	$P \vee Q$	$(P \vee Q) \vee R$
T	T	T	T	T	T	T
T	F	T	T	T	T	T
T	T	F	T	T	T	T
T	F	F	F	T	T	T
F	T	T	T	T	T	T
F	F	T	T	T	F	T
F	T	F	T	T	T	T
F	F	F	F	F	F	F

b. \equiv

P	Q	R	$Q \wedge R$	$P \wedge (Q \wedge R)$	$P \wedge Q$	$(P \wedge Q) \wedge R$
T	T	T	T	T	T	T
T	F	T	F	F	F	F
T	T	F	F	F	T	F
T	F	F	F	F	F	F
F	T	T	T	F	F	F
F	F	T	F	F	F	F
F	T	F	F	F	F	F
F	F	F	F	F	F	F

C.	P	Q	R	$Q \wedge R$	$P \vee (Q \wedge R)$	$P \vee Q$	$P \vee R$	$(P \vee Q) \wedge (P \vee R)$
	T	T	T	T	T	T	T	T
	T	F	T	F	T	T	T	T
	T	T	F	F	T	T	T	T
	T	F	F	F	T	T	T	T
	F	T	T	T	T	T	T	T
	F	F	T	F	F	F	T	F
	F	T	F	F	F	T	F	F
	F	F	F	F	F	F	F	F

d.	P	$G \mid R$	$Q \vee R$	$P \wedge (Q \vee R)$	$P \wedge Q$	$P \wedge R$	$(P \wedge Q) \vee (P \wedge R)$
	T	T	T	T	T	T	T
	T	F	T	T	F	T	T
	T	T	F	T	T	F	T
	T	F	F	F	F	F	F
	F	T	T	F	F	F	F
	F	F	T	F	F	F	F
	F	T	F	F	F	F	F
	F	F	F	F	F	F	F

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	P	Q	R	$Q \oplus R$	$P \oplus (Q \oplus R)$	$P \oplus Q$	$(P \oplus Q) \oplus R$
	T	T	T	F	T	F	T
	T	F	T	T	F	T	F
	T	T	F	T	F	F	F
	T	F	F	F	T	T	T
	F	T	T	F	F	T	F
	F	F	T	T	T	F	T
	F	T	F	T	T	T	T
	F	F	F	F	F	F	F

True

20

	P	Q	R	$Q \oplus R$	$P \vee (Q \oplus R)$	$P \vee Q$	$P \vee R$	$(P \vee Q) \oplus (P \vee R)$
	T	T	T	F	T	T	T	F
	T	F	T	T	T	T	T	F
	T	T	F	T	T	T	T	F
	T	F	F	F	T	T	T	F
	F	T	T	F	F	T	T	F
	F	F	T	T	T	F	T	T
	F	T	F	T	T	T	F	T
	F	F	F	F	F	F	F	F

false



2, 8, 10, 12, 16, 18, 20, 22, 24, 26

1.3

2 a. If $x^2 = x$ then $(x+1)^2 = 0$

b - 1

c 3

4

- 1 - F F \boxed{F} T
- 2 - T F \boxed{F} F
- 3 - T T \boxed{T} T

10 a. If 7 is an even integer then 0 is a positive integer
 - F. T True

b. If 0 is a positive integer then 7 is an even integer
 - T F False

12

converse : if 110 is even, then 101 is even

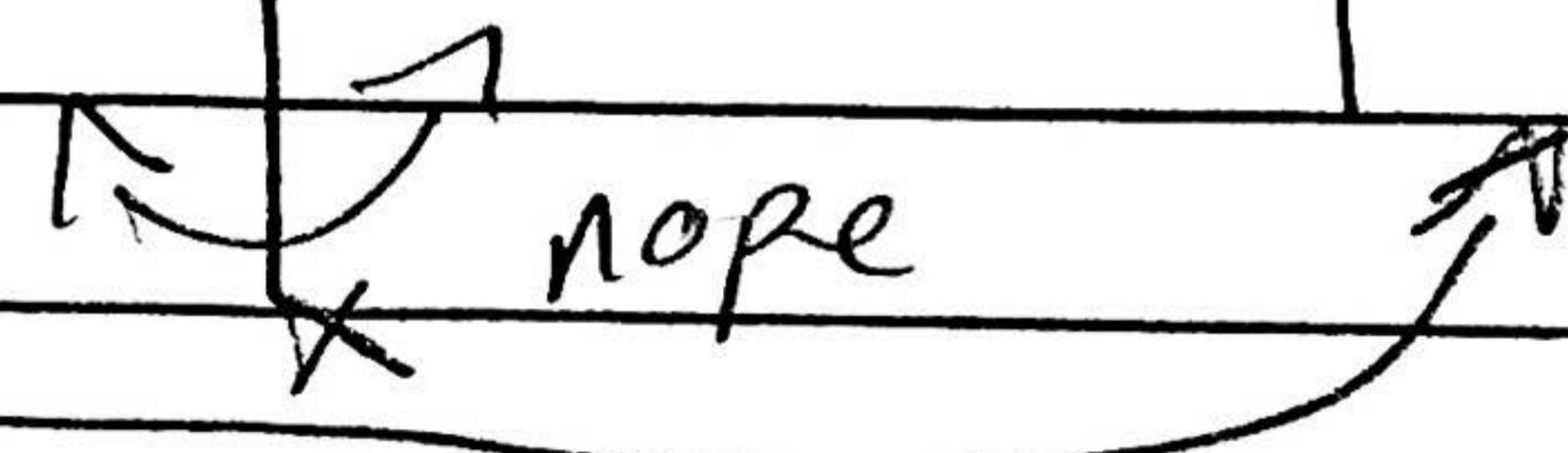
contrapositive: if 110 is not even, then 101 is not even

16

P	Q	$\sim P$	$Q \Rightarrow (\sim P)$	$P \wedge (Q \Rightarrow (\sim P))$
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T	T	F	F	F
T	F	F	T	T
T	T	F	F	F
F	F	E	T	T
F	T	T	T	F
F	F	T	T	F
F	T	T	T	F
F	F	T	T	F

P	Q	$\sim P$	$\sim Q$	$P \Rightarrow Q$	$(\sim P) \Rightarrow (\sim Q)$	$(\sim Q) \Rightarrow (\sim P)$
T	T	F	F	T	T	T
T	F	F	T	F	T	F
F	T	T	F	T	F	T
F	F	T	T	T	T	T

b. $(\sim Q) \Rightarrow (\sim P)$ ————— 

- 20 a. if today is saturday or sunday then I do not have class today
- b. if I have class today then it is not sat or sunday
- c. Today is not sat or sunday or I do not have class today
- d. if I do not have class today then it is sat or sunday
- e. I have class today or it is saturday or sunday
- f. if today is not sat or sunday then I have class today

22 $P = A \text{ on Final}$ $Q = A \text{ in class}$

$$P \Rightarrow Q$$

$$T \Rightarrow ? \equiv T$$

- a. Yes
- b. not necessarily
- c. again not directly

26

ZY	P	Q	R	$P \Rightarrow Q$	$P \Rightarrow R$	$(P \Rightarrow Q) \wedge (P \Rightarrow R)$	$Q \wedge R$	$P \Rightarrow (Q \wedge R)$
A.	T	T	T	T	T	T	T	T
	T	F	T	F	T	F	F	F
	T	T	F	T	F	F	F	F
	T	F	F	F	F	F	F	F
	F	T	T	T	T	T	T	T
	F	F	T	F	T	F	F	T
	F	T	F	T	T	T	F	T
	F	F	F	T	T	T	F	T

b.

$P \Rightarrow R$	$Q \Rightarrow R$	$(P \Rightarrow R) \wedge (Q \Rightarrow R)$	$P \vee Q$	$(P \vee Q) \Rightarrow R$
T	T	T	T	T
T	T	T	T	T
F	F	F	T	F
F	T	F	T	F
T	T	T	T	T
T	T	T	F	T
T	F	F	T	F
T	T	T	F	T

$$c. (P \Rightarrow Q) \vee (P \Rightarrow R) \quad Q \vee R \quad P \Rightarrow (Q \vee R)$$

T	T	T
T	T	T
T	T	T
F	F	F
T	T	T
T	T	T
T	T	T
T	F	T

$$d. (P \Rightarrow R) \vee (Q \Rightarrow R) \quad P \wedge Q \quad (P \wedge Q) \Rightarrow R$$

T	T	T
T	F	T
F	T	F
T	F	T
T	F	T
T	F	T
T	F	T
T	F	T

$$e. (P \Rightarrow Q) \wedge (Q \Rightarrow R) \quad P \Rightarrow R$$

T	T
F	T
F	F
F	F
T	T
F	T
F	T
T	T

$$\sim(P \Rightarrow Q) \equiv P \wedge (\sim Q)$$

26 a if n is odd then n is not the sum of two even integers

b. It is not the case that n is odd since n is the sum of two even integers

c. n is odd and is the sum of two even integers

1.4

~~Z, 4, 6, 8, 10, 12~~ P. 39/40

$-1^2 > 0 \Rightarrow 1 > 0$	$f(5) = 6^2 - 1 = 35 = 35$
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$P \Leftrightarrow Q$ is true

4) n is odd iff n^2 is odd

n^2 is odd if n is odd

n is odd is necessary & sufficient for n^2 is odd

n^2 is odd is necessary + sufficient for n is odd

True

6 $5^n + 7$ is even if and only if n is odd and
 n is odd if and only if $5^n + 7$ is even

$$g \quad | \quad 9. \quad a=1 \quad b=2$$

$$b. \quad a = 0 \quad b = 2$$

10 | $P(i) \Rightarrow Q(i)$ odd odd True

$P(z) \Rightarrow Q(z)$ odd even False

12 a. $P \vee Q$ | $\neg P$ | $\neg Q$ | $P(\neg)Q$ | $(\neg P) \Leftrightarrow (\neg Q)$

T	T	F	F	T			T
T	F	F	T		F		F
F	T	T	F		F		F
F	F	T	T	T		J	T

$$b. (P \wedge Q) | (\neg P) \wedge (\neg Q) | (P \wedge Q) \vee (\neg P) \wedge (\neg Q)$$

T	F	T
F	T	F
F	F	F
F	T	T

$\sim(P \leftrightarrow Q)$	$P \leftrightarrow (\sim Q)$
F	F
T	T
T	T
F	F

1.5 7, 4, 6, 8

2.	a.	P	Q	$P \wedge Q$	$(P \wedge Q) \Rightarrow P$
		T	T	T	T
		T	F	F	T
		F	T	F	T
		F	F	F	T

b.	$P \vee Q$	$P \Rightarrow P \vee Q$	c. $(P \wedge Q) \Rightarrow (P \vee Q)$
	T	T	T
	T	T	T
	T	T	T
	F	T	T

4. a. $\neg P$ $P \Rightarrow Q$ $(\neg P) \Rightarrow (P \Rightarrow Q)$

F	T	T
F	F	T
T	T	T
T	F	T

b. $(P \wedge Q) \Rightarrow (P \Rightarrow Q)$

T

T

T

T

6

	$P \mid Q$	$\sim Q$	$P \wedge (\sim Q)$	$P \wedge Q$	$(P \wedge (\sim Q)) \wedge (P \wedge Q)$
T	T	F	F	T	F
T	F	T	T	F	F
F	T	F	F	F	F
F	F	T	F	F	F

8 $P \vee Q \mid (P \wedge (\sim Q)) \Rightarrow (P \vee Q)$

T T

Tautology

T F

T T

F T