Exercise 23C: Solutions

1 a Your eyes are not blue.

b The sky is not grey.

c This integer is even.

d I do not live in Switzerland.

e $x \leq 2$

f This number is greater than or equal to 100.

2 a It is dark or it is cold.

b It is dark and cold.

c It is light and cold.

d It is light or hot.

e It is good or light.

f It is light and hard.

g It is dark or hard.

3 a $B \wedge A$

b $D \vee C$

c $\neg C \wedge D$

d $\neg A \wedge \neg B$

e $\neg D \wedge \neg C$

f $B \vee A$

4 a It is wet or rough.

b It is wet and rough.

c It is dry and rough.

d It is dry or smooth.

e It is difficult or dry.

f It is dry and inexpensive.

g It is wet or inexpensive.

5 a x is a prime number or an even number.

b x is divisible by 6.

c x is 2.

d x is an even number greater than 2.

e x is not 2.

f x is not prime.

g x is neither prime nor divisible by 6.

h x is not divisible by 6.

6 a

A	B	$\neg(A \vee B)$	$\neg A \wedge \neg B$
T	T	F	F
T	F	F	F
F	T	F	F
F	F	T	T

b

A	$\neg(\neg A)$
T	T
F	F

c

A	$A \vee A$
T	T
F	F

d

A	B	$A \vee B$	$\neg(\neg A \wedge \neg B)$
T	T	T	T
T	F	T	T
F	T	T	T
F	F	F	F

e

A	B	$A \wedge B$	$\neg(\neg A \vee \neg B)$
T	T	T	T
T	F	F	F
F	T	F	F
F	F	F	F

f

A	B	$A \wedge \neg B$	$\neg(\neg A \vee B)$
T	T	F	F
T	F	T	T
F	T	F	F
F	F	F	F

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A	B	$\neg B$	$(A \wedge B)$	$(A \wedge B) \wedge \neg B$
T	T	F	T	F
T	F	T	F	F
F	T	F	F	F
F	F	T	F	F

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A	B	$\neg A$	$(\neg A \wedge B)$	$(\neg A \wedge B) \wedge A$
T	T	F	F	F
T	F	F	F	F
F	T	T	T	F
F	F	T	F	F

9

A	B	$\neg A$	$\neg B$	$(\neg A \wedge \neg B)$	$(\neg A \wedge \neg B) \vee A \vee B$
T	T	F	F	F	T
T	F	F	T	F	T
F	T	T	F	F	T
F	F	T	T	T	T

10a

A	B	$A \wedge B$	$(A \wedge B) \Rightarrow A$
T	T	T	T
T	F	F	T
F	T	F	T
F	F	F	T

b

A	B	$A \vee B$	$(A \vee B) \Rightarrow A$
T	T	T	T
T	F	T	T
F	T	T	F
F	F	F	T

c

A	B	$\neg A$	$\neg B$	$C{:}\neg B \vee \neg A$	$C \Rightarrow A$
T	T	F	F	F	T
T	F	F	T	T	T
F	T	T	F	T	F
F	F	T	T	T	F

d

A	B	$\neg B$	$\neg B \wedge A$	$(\neg B \wedge A) \Rightarrow A$
T	T	F	F	T
T	F	T	T	T
F	T	F	F	T
F	F	T	F	T

e

A	B	$\neg A$	$B \vee \neg A$	$(B \vee \neg A) \Rightarrow \neg A$
T	T	F	T	F
T	F	F	F	T
F	T	T	T	T
F	F	T	T	T

f

A	B	C:$\neg B \vee \neg A$	D:$\neg B \wedge A$	$C \Rightarrow D$
T	T	F	F	T
T	F	T	T	T
F	T	T	F	F
F	F	T	F	F

g

A	B	C:$\neg B \vee A$	D:$\neg(B \wedge A)$	$C \Rightarrow D$
T	T	T	F	F
T	F	T	T	T
F	T	F	T	T
F	F	T	T	T

h

A	B	$\neg B$	$\neg B \Rightarrow A$	$\neg B \wedge (\neg B \Rightarrow A)$
T	T	F	T	F
T	F	T	T	T
F	T	F	T	F
F	F	T	F	F

11a

A	B	$A \wedge B$
T	T	T
T	F	F
F	T	F
F	F	F

A	B	$\neg B$	$A \Rightarrow \neg B$	$\neg(A \Rightarrow \neg B)$
T	T	F	F	T
T	F	T	T	F
F	T	F	T	F
F	F	T	T	F

b

A	B	$A \vee B$
T	T	T
T	F	T
F	T	T
F	F	F

A	B	$\neg A$	$\neg A \Rightarrow B$
T	T	F	T
T	F	F	T
F	T	T	T
F	F	T	F

c Truth tables are the same.

12a All values of truth tables are true

b All values of truth tables are true

c All values of truth tables are true

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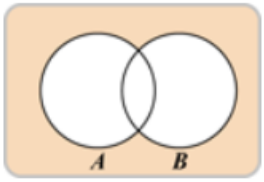

$(A \cup B)' = A' \cap B'$

14a

A	B	$A \downarrow B$	$B \downarrow A$
T	T	F	F
T	F	F	F
F	T	F	F
F	F	T	T

b

A	$A \downarrow A$	$\neg A$
T	F	F
F	T	T

c **Note:** $A \downarrow A$ is equivalent to $\neg A$ by part b

A	B	$\neg A \downarrow \neg B$	$A \wedge B$
T	T	T	T
T	F	F	F
F	T	F	F
F	F	F	F

d

A	B	$\neg(A \downarrow B)$	$A \vee B$
T	T	T	T
T	F	T	T
F	T	T	T
F	F	F	F

15a **i** If x is an even integer, then $x = 6$.

ii If x is not an even integer, then $x \neq 6$.

b **i** If public transport improves, then I was elected.

ii If public transport does not improve, then I was not elected.

c **i** If I qualify as an actuary, then I passed the exam.

ii If I do not qualify as an actuary, then I failed the exam.