Solution [Logics]

[1]a) Sharks have not been spotted near the shore.

b) Swimming at the New Jersey shore is allowed, and sharks have been spotted near the shore.

c) Swimming at the New Jersey shore is not allowed, or sharks have been spotted near the shore.

d) If swimming at the New Jersey shore is allowed, then sharks have not been spotted near the shore.

e) If sharks have not been spotted near the shore, then swimming at the New Jersey shore is allowed.

f) If swimming at the New Jersey shore is not allowed, then sharks have not been spotted near the shore.

g) Swimming at the New Jersey shore is allowed if and only if sharks have not been spotted near the shore.

h) Swimming at the New Jersey shore is not allowed, and either swimming at the New Jersey shore is allowed or sharks have not been spotted near the shore. Note that we were able to incorporate the parentheses by using the word "either" in the second half of the sentence.

[2] a) "But" is a logical synonym for "and" (although it often suggests that the second part of the sentence is
likely to be unexpected). So this is *r* A --.*p*.

b) Because of the agreement about precedence, we do not need parentheses in this expression: --.*p* A *q* A *r*.

c) The outermost structure here is the conditional statement, and the conclusion part of the conditional
statement is itself a biconditional: *r* -> (*q* f-+ --.*p)* .

d) This is similar to part **(b):** --.*q* A --.*p* A *r*.

e) This one is a little tricky. The statement that the condition is necessary is a conditional statement in one
direction, and the statement that this condition is not sufficient is the negation of the conditional statement in
the other direction. Thus we have the structure (safe -> conditions) A--.(conditions -> safe). Fleshing this out
gives our answer: (*q* -> *(--.r* A --.*p))* A --.(*(--.r* A --.*p)* -> *q).* There are some logically equivalent correct answers
as well.

f) We just need to remember that "whenever" means "if" in logic: *(p* A *r)* -> --.*q*.

[3] for part a [column 3]and for pat b [column 4]

p	$\neg p$	$p \wedge \neg p$	$p \vee \neg p$
T	F	F	T
F	T	F	T

[3]

For part c

p	q	$\neg q$	$p \vee \neg q$	$(p \vee \neg q) \rightarrow q$
T	T	F	T	T
T	F	T	T	F
F	T	F	F	T
F	F	T	T	F

For part d

p	q	$p \vee q$	$p \wedge q$	$(p \vee q) \rightarrow (p \wedge q)$
T	T	T	T	T
T	F	T	F	F
F	T	T	F	F
F	F	F	F	T

Part (e)

p	q	$p \rightarrow q$	$\neg q \rightarrow \neg p$	$(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$
T	T	T	T	T
T	F	F	F	T
F	T	T	T	T
F	F	T	T	T

p	q	$p \rightarrow q$	$q \rightarrow p$	$(p \rightarrow q) \rightarrow (q \rightarrow p)$
T	T	T	T	T
T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

For part f

[4] "whenever" means "if," we have q→ p.
b) but" means "and," we have q /\ (not)P.
c) This sentence is saying the same thing as the sentence in part (a), so the answer is the same: q→ p.
d) Again, we recall that "when" means "if" in logic: (not)q→(not)p.

[5] Let s be "The router can send packets to the edge system"; let a be "The router supports the new address space"; let r be "The latest software release is installed." Then we are told s → a, a -→ r, r -→ s, and (not)a. Since a is false, the first conditional statement tells us that s must be false. From that we deduce from the third conditional statement that r must be false. If indeed all three propositions are false, then all four specifications are true, so they are consistent.

[6] Let's use the letters B, C, G, and H for the statements that the butler, cook, gardner, and handyman are telling the truth, respectively. We can then write each fact as a true proposition:

$B \to C$; $\neg(C \wedge G)$, which is equivalent to $\neg C \vee \neg G$; $\neg(\neg G \wedge \neg H)$, equivalent to $G \vee H$; and $H \to \neg C$. Suppose that B is true. Then it follows from the first of our propositions that C must also be true. This tells us (using the second proposition) that G must be false, whence the third proposition makes H true. But now the fourth proposition is violated. Therefore we conclude that B cannot be true. If fact, the argument we have just given also proves that C cannot be true. Therefore we know that the butler and the cook are lying. This much already makes the first, second, and fourth propositions true, regardless of the truth of G or H. Thus either the Gardner or the handyman could be lying or telling the truth; all we know (from the third proposition) is that at least one of them is telling the truth.

[7]

We construct a truth table for each conditional statement and note that the relevant column contains only T's. For parts **(a)** and **(b)** we have the following table (column four for part **(a)**, column six for part **(b)**).

p	q	$p \wedge q$	$(p \wedge q) \to p$	$p \vee q$	$p \to (p \vee q)$
T	T	T	T	T	T
T	F	F	T	T	T
F	T	F	T	T	T
F	F	F	T	F	T

For parts **(c)** and **(d)** we have the following table (columns five and seven, respectively).

p	q	$\neg p$	$p \to q$	$\neg p \to (p \to q)$	$p \wedge q$	$(p \wedge q) \to (p \to q)$
T	T	F	T	T	T	T
T	F	F	F	T	F	T
F	T	T	T	T	F	T
F	F	T	T	T	F	T

For parts **(e)** and **(f)** we have the following table. Column five shows the answer for part **(e)**, and column seven shows the answer for part **(f)**.

p	q	$p \to q$	$\neg(p \to q)$	$\neg(p \to q) \to p$	$\neg q$	$\neg(p \to q) \to \neg q$
T	T	T	F	T	F	T
T	F	F	T	T	T	T
F	T	T	F	T	F	T
F	F	T	F	T	T	T

[8]

a) Let $H(x)$ be "x can speak Hindi." Then we have $\exists x\, H(x)$ the first way, or $\exists x(C(x) \wedge H(x))$ the second way.

b) Let $F(x)$ be "x is friendly." Then we have $\forall x\, F(x)$ the first way, or $\forall x(C(x) \to F(x))$ the second way.

c) Let $B(x)$ be "x was born in California." Then we have $\exists x\, \neg B(x)$ the first way, or $\exists x(C(x) \wedge \neg B(x))$ the second way.

d) Let $M(x)$ be "x has been in a movie." Then we have $\exists x\, M(x)$ the first way, or $\exists x(C(x) \wedge M(x))$ the second way.

e) This is saying that everyone has failed to take the course. So the answer here is $\forall x\, \neg L(x)$ the first way, or $\forall x(C(x) \to \neg L(x))$ the second way, where $L(x)$ is "x has taken a course in logic programming."

[9] a) Abdallah Hussein does not like Japanese cuisine.
b) Note that this is the conjunction of two separate quantified statements. Some student at your school likes
Korean cuisine, and everyone at your school likes Mexican cuisine.
c) There is some cuisine that either Monique Arsenault or Jay Johnson likes.
d) Formally this says that for every x and z, there exists a y such that if x and z are not equal, then it is not the case that both x and z like y. In simple English, this says that for every pair of distinct students at your school, there is some cuisine that at least one them does not like.
e) There are two students at your school who have exactly the same tastes (i.e., they like exactly the same cuisines).
f) For every pair of students at your school, there is some cuisine about which they have the same opinion (either they both like it or they both do not like it).

[10] Let w be the proposition "Aandy works hard," let d be the proposition "Aandy is a dull boy," and let j be the proposition "Aandy will get the job." We are given premises w, $w \to d$, and $d \to \neg j$. We want to conclude $\neg j$.

Step	Reason
1. w	Hypothesis
2. $w \to d$	Hypothesis
3. d	Modus ponens using (2) and (3)
4. $d \to \neg j$	Hypothesis
5. $\neg j$	Modus ponens using (3) and (4)