1.

a) This is not a proposition because it does not have a set truth value.

b) This is a proposition. Let:
$P = \pi$ is a rational number $\rightarrow$ False
This statement can then be written symbolically as:
$\sim (\sim P) \equiv \sim (\sim F) \equiv \sim T \equiv F$
So this statement is false.

c) This is not a proposition, since the truth value depends on what set x is an element of, which is undefined here.

d) This is not a proposition, again because of the undefined nature of x.

e) This is a proposition. Let:
P = π is rational $\rightarrow$ False
Q = 17 is prime $\rightarrow$ True
R = $7 < 13 \rightarrow$ True
S = 81 is a perfect square $\rightarrow$ True
So, this statement can be written symbolically as:
$(P \wedge Q) \vee (R \wedge S) \equiv (T \wedge F) \vee (T \wedge T) \equiv F \vee T \equiv T$
So this statement is true.

f) This is a proposition. Let:
P = 2 is rational $\rightarrow$ True
Q = π is irrational $\rightarrow$ True
R = 2π is rational $\rightarrow$ False
So, this statement can be written symbolically as:
$(P \wedge Q) \vee R \equiv (T \wedge T) \vee F \equiv T \vee F \equiv T$
So this statement is true.

g) This is a proposition. Let:
P = 5π is rational $\rightarrow$ False
Q = 4.9 is rational $\rightarrow$ True
R = There are exactly four primes less than 10 $\rightarrow$ True
So, this statement can be written symbolically as:
$(P \wedge Q) \vee R \equiv (F \wedge T) \vee T \equiv F \vee T \equiv T$
So this statement is true.

h) This is a proposition. Let:
P = -3.7 is rational → True
Q = $3\pi < 10$ → True
R = $3\pi > 15$ → False
So, this statement can be written symbolically as:
$P \wedge (Q \vee R) \equiv T \wedge (T \vee F) \equiv T \wedge T \equiv T$
So this statement is true.

i) This is a proposition. Let:
P = 39 is prime → False
Q = 64 is a power of 2 → True
So, this statement can be written symbolically as:
$\sim P \vee Q \equiv \sim F \vee T \equiv T \vee T \equiv T$
So this statement is true.

j) This statement is not a proposition, since there are more than three false statements in the book but the truth of the last part of the statement changes the truth of the entire statement in a contradictory manner.

10.

a)

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

The output varies for different values for P and Q, so it is neither a tautology nor a contradiction.

b)

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

This is a tautology since it evaluates to true for all possible values of P

c)

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

This is a tautology since it evaluates to true for all possible combinations of values of P and Q.

d)

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

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

This is a tautology since it evaluates to true for all possible combinations of values of P and Q.

e)

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

The output varies for different values for P, Q, and R, so it is neither a tautology nor a contradiction.

f)

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

The output varies for different values for P, Q, and R, so it is neither a tautology nor a contradiction.