On my honor, I have not given, nor received, nor witnessed any unauthorized assistance on this work.

Print name and sign: _____

Question:	1	2	3	4	5	6	Total
Points:	6	5	8	4	5	2	30
Score:							

1. Given the statement "If there is a hurricane, then it is raining" find the following:
   (a) (2 points) Give the original statement in formal propositional notation (i.e. define p, q, and the appropriate logical connectives).

   (b) (2 points) The converse of the statement in propositional logic and English

   (c) (2 points) The contrapositive of the statement in propositional logic and English.

2. (5 points) Show (via truth tables) that $(p \leftrightarrow q) \rightarrow (p \rightarrow q)$ is a tautology.

3. Let $A = \{w, x, y, z\}$ and $B = \{a, y\}$.
   (a) (1 point) Is $x \in A$? _____
   (b) (1 point) Is $\{a\} \in B$? _____
   (c) (1 point) Is $y \subseteq B$? _____
   (d) (1 point) Is $\{z\} \subseteq A$? _____
   (e) (2 points) Give the power set of B.

   (f) (2 points) Show $A \times B$.

4. Conversions:
   (a) (2 points) Convert 42 (base 10) to 8-bit binary (base 2).

(b) (2 points) Convert 10011101 (8-bit binary, base 2) to hexadecimal (base 16)

5. Let $A = \{0, 2, 4, 6, 8, 10\} B = \{0, 1, 2, 3, 4, 5, 6\}$ and $C = \{4, 5, 6, 7, 8, 9, 10\}$. Find:

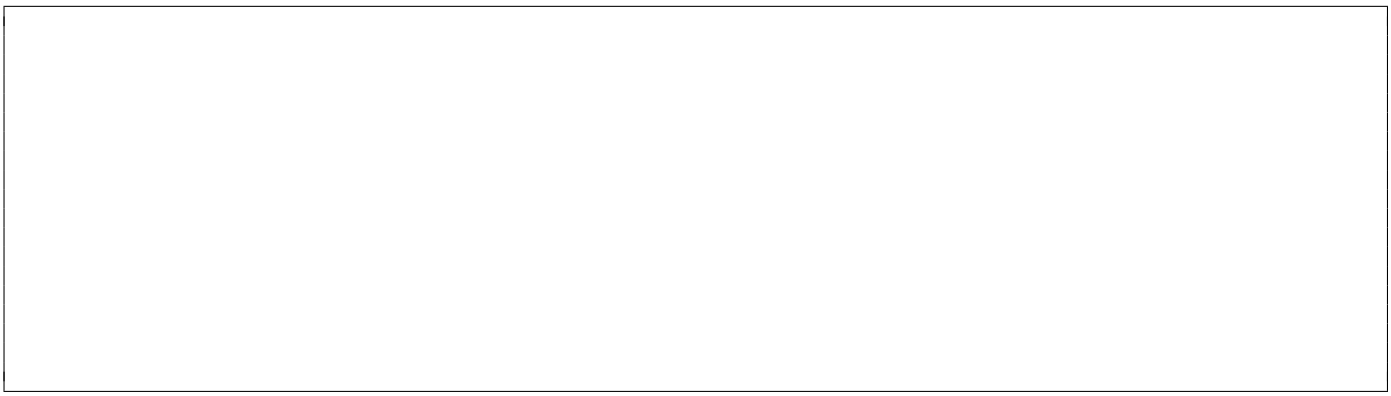
(a) (2 points) $(A \cup B) \cap C$

(b) (3 points) Draw a Venn diagram representing the three sets.

6. (2 points) You are given the code:

```
if(x > 4) {
    x = 0;
}
```

Represent this code as formal propositional logic – that is, define propositions and the connectives to represent the above code.



Standard Sets:

- $\mathbb{R}$: set of real numbers
- $\mathbb{Q}$: set of rational numbers $\{a/b : a \in \mathbb{Z} \text{ and } b \in \mathbb{Z} \text{ and } b \neq 0\}$
- $\mathbb{N}$: set of natural numbers $\{0, 1, 2, 3\}$
- $\mathbb{Z}$: set of all integers $\{..., -3, -2, -1, 0, 1, 2, 3, ...\}$
- $\mathbb{Z}+$: set of positive integers $\{1, 2, 3, ...\}$

Set Symbols:

- $\subseteq$: "is a subset of"
- $\subset$: "is a proper subset of"
- $\in$: "is an element of"

Identity Laws:	$p \wedge T \equiv p$ $p \vee F \equiv p$
Domination Laws:	$p \vee T \equiv T$ $p \wedge F \equiv F$
Idempotent Laws:	$p \vee p \equiv p$ $p \wedge p \equiv p$
Double negation Law:	$\neg(\neg p) \equiv p$
Commutative Laws:	$p \vee q \equiv q \vee p$ $p \wedge q \equiv q \wedge p$
Associative Laws:	$(p \vee q) \vee r \equiv p \vee (q \vee r)$ $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$
Distributive Laws:	$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$ $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
DeMorgan's Laws:	$\neg(p \wedge q) \equiv \neg p \vee \neg q$ $\neg(p \vee q) \equiv \neg p \wedge \neg q$
Absorption Laws:	$p \vee (p \wedge q) \equiv p$ $p \wedge (p \vee q) \equiv p$
Negation Laws:	$p \vee \neg p \equiv T$ $p \wedge \neg p \equiv F$