1a p = cat position (inside or outside box)
q = box position (open or closed)
r = cats morality
$(p \wedge q \rightarrow r) \vee ((\neg p \vee \neg q) \rightarrow \neg r)$

1b p = hash table has empty space
q = hash table has full space
r = hash collision
s = new element insertion

i $\neg q \rightarrow r \wedge s$
ii $\neg p \rightarrow r \wedge \neg s$
iii $(p \wedge q) \wedge \neg r \rightarrow s$

1c p = child-age (above 8)
q = child height (above 4 feet 9 inch)
r = belt system
q = child restraint system

i $p \vee q \rightarrow r$
ii $\neg q \wedge \neg p \rightarrow q$

2a p = late days used (<3)
q = talk with Kevin
r = late work accepted
$r \rightarrow p \vee q$

2b $\neg p \wedge \neg q \rightarrow \neg r$

2c if more than 3 late days have been used, & you have not talked with Kevin, your late work will not be accepted

2d yes, because they are contrapositives of each other

3 The E card must be flipped because it is a vowel, & vowel cards must have an even number on the other side so a flip is necessary to verify.
The 3 card must be flipped because it is unknown if the letter on the other side is a constant (following rule) or a vowel (not following rule)
K is not a vowel & does not need to be checked
8 can have any letter behind it & still follow the rule, does not need to be checked

4

if _ secure	a	b	c
a	not secure	secure	not secure
b	secure	not secure	secure
c	not secure	secure	secure

when A is true B is secure

5a

a	b	c	d	a∨b	¬a∨¬b	b∨d	a∨¬d	E
T	T	T	T	T	F	T	T	F
T	T	T	F	T	F	T	T	F
T	T	F	T	T	F	T	T	F
T	T	F	F	T	F	T	T	F
T	F	T	T	T	T	T	T	T
T	F	T	F	T	T	F	T	F
T	F	F	T	T	T	T	T	T
T	F	F	F	T	T	F	T	F
F	T	T	T	T	T	T	F	F
F	T	T	F	T	T	T	T	T
F	T	F	T	T	T	T	F	F
F	T	F	F	T	T	T	T	T
F	F	T	T	F	T	T	F	F
F	F	T	F	F	T	F	T	F
F	F	F	T	F	T	T	F	F
F	F	F	F	F	T	F	T	F

5b $(a \wedge \neg b \wedge c \wedge d) \vee (a \wedge \neg b \wedge \neg c \wedge d) \vee (\neg a \wedge b \wedge c \wedge d) \vee$

$(\neg a \wedge b \wedge \neg c \wedge \neg d)$

5c
```
if(a&& !b && c&&d)
    return true;
if(a&& !b&& !c&&d)
    return true;
if(!a&&b&& c&& !d)
    return true;
return !a&&b&& !c&& !d;
```

6a

a_r	a_g	a_b	possible?	6b
T	T	T	F	$\neg a_r \vee \neg a_g \vee \neg a_b$
T	T	F	F	$\neg a_r \vee \neg a_g \vee a_b$
T	F	T	F	$\neg a_r \vee a_g \vee \neg a_b$
T	F	F	T	
F	T	T	F	$a_r \vee \neg a_g \vee \neg a_b$
F	T	F	T	
F	F	T	T	
F	F	F	F	$a_r \vee a_g \vee a_b$

6c

a_r	c_r	possible?	6b
T	T	F	$\neg a_r \vee \neg c_r$
T	F	T	
F	T	T	
F	F	T	

6e $(\neg a_r \vee \neg c_r) \wedge (\neg a_g \vee \neg c_g) \wedge (\neg a_b \vee \neg c_b)$

6f Pos 15 %

-1 -2 -3 0

1 -2 -3 0

-1 2 -3 0

-1 -2 3 0

1 2 3 0

```
6f  -4 -5 -6 0
     4 -5 -6 0
    -4  5 -6 0
    -4 -5  6 0
     4  5  6 0
    -7 -8 -9 0
     7 -8 -9 0
    -7  8 -9 0
    -7 -8  9 0
     7  8  9 0
   -10 -11 -12 0
    10 -11 -12 0
   -10  11 -12 0
   -10 -11  12 0
    10  11  12 0
   -13 -14 -15 0
    13 -14 -15 0
   -13  14 -15 0
   -13 -14  15 0
    13  14  15 0
    -1  -4  0
    -2  -5  0
    -3  -6  0
    -4  -7  0
    -5  -8  0
    -6  -9  0
    -7 -10  0
    -8 -11  0
    -9 -12  0
   -10 -13  0
   -11 -14  0
   -12 -15  0
    -1  -7  0
    -2  -8  0
    -3  -9  0
    -1 -13  0
    -2 -14  0
    -3 -15  0
    -4 -13  0
    -5 -14  0
    -6 -15  0
```

Output:

-1, -2, 3, 4, -5, -6, -7, 8, -9, 10, -11, -12, -3, 14, 15

Alex wears blue

Bobby wears red

Chris wears green

Dylan wears red

Erin wears green