KMAPS

A Karnaugh map (K-map) is a pictorial method used *to minimize Boolean expressions without* having to use Boolean algebra theorems and equation manipulations.

Increment Decoder:

Without using Don't cares

Z	Y	X	W	D	C	B	A
0	0	0	0	0	0	0	1
0	0	0	1	0	0	1	0
0	0	1	0	0	0	1	1
0	0	1	1	0	1	0	0
0	1	0	0	0	1	0	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	1	1
0	1	1	1	1	0	0	0
1	0	0	0	1	0	0	1

Expressions:

A = !W!X!Y!Z + !WX!Y!Z + !W!XY!Z + !WXY!Z + !W!X!YZ

B = W!X!Y!Z + !WX!Y!Z + W!XY!Z + !WXY!Z

C = WX!Y!Z + !W!XY!Z + W!XY!Z + !WXY!Z

D = WXY!Z + W!X!Y!Z

for A:

A = !W!Y + !WY!Z

for B:

yz

wx	00	01	11	10
	1			1
	1			1

$$B = !WX!Z + W!X!Z$$

for   C:

yz

wx	00	01	11	10
				1
				1
	1			
				1

$$C = WX!Y!Z + !XY!Z + !WY!Z$$

For D:

yz

wx	00	01	11	10
		1		
				1

$$D = WXY!Z + !W!X!YZ$$

 Code:

```
//Declaring all variables as integers
int Z=0,Y=0,X=1,W=1;  // int Z,Y,X,W
int D,C,B,A;

//Code released under GNU GPL.  Free to use for anything.
void disp_7447(int D, int C, int B, int A)
{
 digitalWrite(2, A); //LSB
 digitalWrite(3, B);
 digitalWrite(4, C);
 digitalWrite(5, D); //MSB
```

```
}
// the setup function runs once when you press reset or power the board
void setup() {
   pinMode(2, OUTPUT);
   pinMode(3, OUTPUT);
   pinMode(4, OUTPUT);
   pinMode(5, OUTPUT);
   //pinMode(6,OUTPUT);
   //pinMode(7,OUTPUT);
   //pinMode(8,OUTPUT);
   //pinMode(9,OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
 //W = digitalWrite(6);
 //X = digitalWrite(7);
 //Y = digitalWrite(8);
 //Z = digitalWrite(9);
 A=(!W&&!Y || !W&&Y&&!Z);
 B=(!W&&X&&!Z || W&&!X&&!Z);
 C=(W&&X&&!Y&&!Z || !X&&Y&&!Z || !W&&Y&&!Z);
 D=(W&&X&&Y&&!Z || !W&&!X&&!Y&&Z);

disp_7447(D,C,B,A);
}
```

OUTPUT:
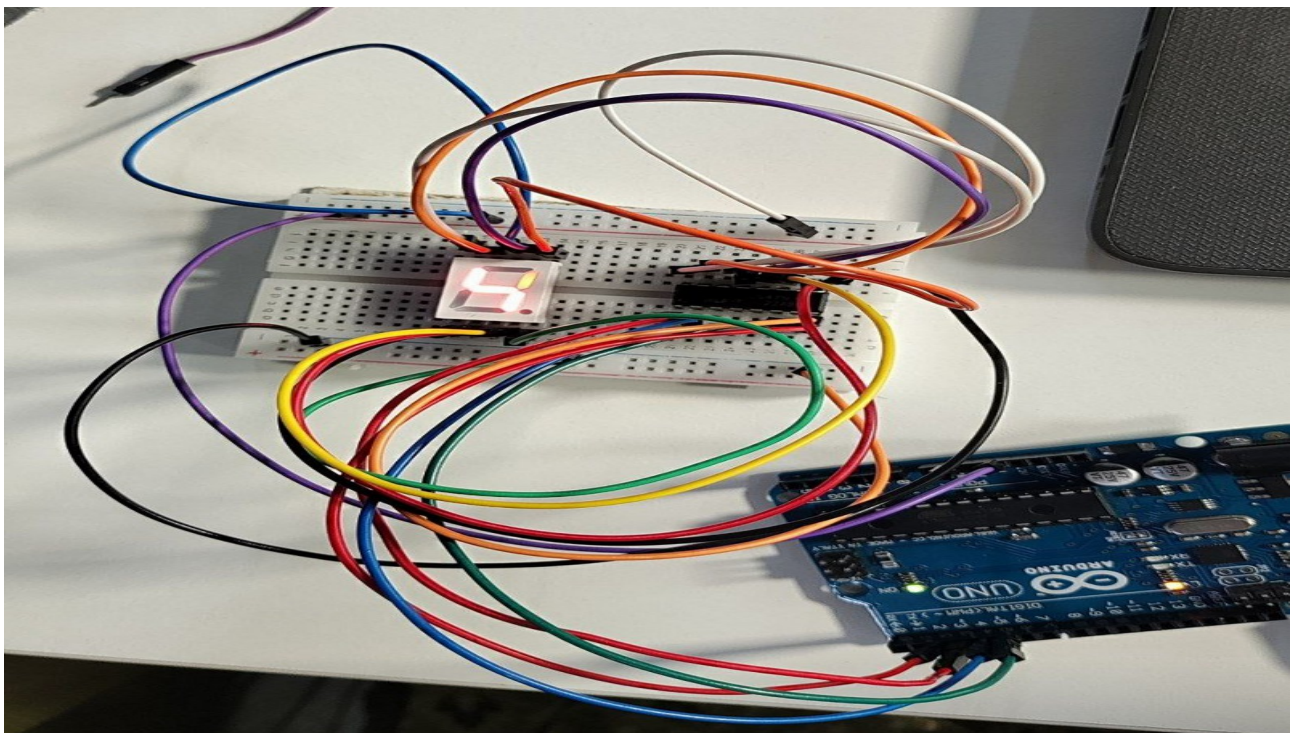
With Don't care Conditions:

Z	Y	X	W	D	C	B	A
0	0	0	0	0	0	0	1
0	0	0	1	0	0	1	0
0	0	1	0	0	0	1	1
0	0	1	1	0	1	0	0
0	1	0	0	0	1	0	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	1	1
0	1	1	1	1	0	0	0
1	0	0	0	1	0	0	1
1	0	0	1	x	x	x	x
1	0	1	0	x	x	x	x
1	0	1	1	x	x	x	x
1	1	0	0	x	x	x	x
1	1	0	1	x	x	x	x
1	1	1	0	x	x	x	x
1	1	1	1	x	x	x	x

for A:

yz

wx

	00	01	11	10
	1	1	X	1
	1	1	X	1
		X	X	
		X	X	

A = !W

for B:

yz

wx

	00	01	11	10
			X	
	1		X	1
		X	X	
	1	X	X	1

B = !WX!Z + W!X

for C:

yz

wx	00	01	11	10
			X	1
			X	1
	1	X	X	
		X	X	1

C = WX!Y!Z + !XY + !WY

For D:

yz

wx	00	01	11	10
		1	X	
			X	
		X	X	1
		X	X	

D = WXY+ !XZ

code:

```
//Declaring all variables as integers
int Z=0,Y=0,X=0,W=0;  // int Z,Y,X,W
int D,C,B,A;

//Code released under GNU GPL.  Free to use for anything.
void disp_7447(int D, int C, int B, int A)
{
 digitalWrite(2, A); //LSB
 digitalWrite(3, B);
 digitalWrite(4, C);
 digitalWrite(5, D); //MSB

}
// the setup function runs once when you press reset or power the board
void setup() {
  pinMode(2, OUTPUT);
  pinMode(3, OUTPUT);
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  //pinMode(6,OUTPUT);
  //pinMode(7,OUTPUT);
  //pinMode(8,OUTPUT);
  //pinMode(9,OUTPUT);
}
```

```
// the loop function runs over and over again forever
void loop() {
 //W = digitalWrite(6);
 //X = digitalWrite(7);
 //Y = digitalWrite(8);
 //Z = digitalWrite(9);
 A=(!W);
 B=(!W&&X&&!Z || W&&!X);
 C=(W&&X&&!Y&&!Z || !X&&Y || !W&&Y);
 D=(W&&X&&Y || !X&&Z);

disp_7447(D,C,B,A);
}
```

Output: