7. P = ((NOT A) OR B) AND C

8. P = NOT((NOT A) AND B)

9. P = (A OR B) AND (C OR D)

10. P = NOT((A OR B) AND C)

11. P = A OR B OR C OR D

12. P = (A AND B) AND NOT C

Your name:

Binary Logic

Activity 1: How many values?

How many different ways can we arrange four bits in one nibble?

0	0	0	0
1	1	1	1

Activity 2: Representing small numbers in binary

The denary number 13 in binary is written 1101

13 = | 8 | 4 | 2 | 1 |
|---|---|---|---|
| 1 | 1 | 0 | 1 |

= 1 1 0 1

Use the place value tables below to write the following numbers in binary.

9 = | 8 | 4 | 2 | 1 |
|---|---|---|---|
| | | | |

= _____

14 = | 8 | 4 | 2 | 1 |
|---|---|---|---|
| | | | |

= _____

Without place value tables:

11 = _____ 7 = _____

5 = _____ 8 = _____

___ = 0 1 1 0 ___ = 1 1 0 0

What about this one?

23 = _____

Activity 7 Logic Charts

Draw logic charts for the following logic statements. You will need to use a maximum of three logic gates (OR, AND, NOT) for each question.

1. P = NOT A

2. P = A AND B

3. P = A OR B

4. P = NOT (A AND B)

5. P = (A AND B) OR C

6. P = NOT (A OR B) AND C

Nightclub Doorman Checks Activity 6

You have been asked by "the management" of Horbury Gardens to write a set of rules that must be checked when the doormen are letting customers into the nightclub.

1. **Write some rules that the customers must have when they come in**

    a. Rule 1_____

    b. Rule 2 _____

    c. Rule 3 _____

2. There are two ways in which customers could still be allowed into the nightclub even if they didn't follow the rules. What are they?

    a. Exception 1 _____

    b. Exception 2 _____

If two rules both HAVE to be followed, we can add them together for example at Horbury Academy, you need your planner AND your five a day.

Sometimes we can make exceptions, for example you must have your tie on OR a uniform note in your planner.

Using the words "AND" and "OR", can you group the nightclub rules together to make one single rule that the bouncers could use?

Activity 3: Representing larger numbers in binary

Each individual digit in a binary number is a binary digit or "bit" for short. A bit can only have the values 0 or 1.

Usually bits are grouped by eight, and called a "byte". When we represent numbers in binary we shall usually use whole bytes.

Fill in this place value table, with the place values for 8 bits.

Use these place values to do the following conversions between binary and denary.

47 = | | | | | | | | | = _____

___ = | | | | | | | | | = 01100100

Try these without the place value table.

Denary → Binary		Denary ← Binary		
135 =	_____	_____	=	10000011
73 =	_____	_____	=	01010111
245 =	_____	_____	=	11100101

What are the largest and smallest numbers you can represent in a byte?

To make a byte easier to read, it is usually divided into groups of 4, called nibbles e.g. 1110 0101.

What is the meaning of the following terms?

- kilobyte (kB)
- megabyte (MB)
- gigabyte (GB)
- terabyte (TB)

Activity 4: Adding binary numbers

We can add binary numbers by columns.

If the total for a column is two (in binary 10) we write down 0 and "carry 1" to the next column.

If the total for a column is three (in binary, 11) we write down 1 and carry 1.

Try these:

```
   1 0 1 0 1 0 0 1    (169)
+  0 0 1 0 1 0 1 0    (42)
-------------------
```

```
   0 1 0 1 1 0 1 1    (91)
+  0 0 1 1 1 0 0 1    (57)
-------------------
```

What about this one?

```
   1 1 0 1 1 0 1 0
+  0 0 1 1 0 0 1 1
-------------------
```

This is a special case which results in an "overflow", which is technically an error when we use eight bit bytes.

Activity 5 Binary Logic

	1	1	0	1	1	0	1	0
AND	0	0	1	1	0	0	1	1

	1	1	0	1	1	0	1	0
OR	0	0	1	1	0	0	1	1

	1	1	0	0	1	1	1	0
AND	1	0	0	1	0	1	1	1

	1	1	0	0	1	1	1	0
OR	1	0	0	1	0	1	1	1

	1	1	1	1	1	1	1	1
AND	1	0	1	0	1	0	1	0

	1	1	1	1	1	1	1	1
OR	1	0	1	0	1	0	1	0