Solutions to Mid-Term Exam

Question 1

The program contains one loop which computes values of `i` starting at 4 and ending at 7. The first two statements inside the loop compute the bitwise AND of `i` and the value 2 (binary `10`). The results are shown in the following table:

`i` (dec.)	`i` (bin.)	`2` (bin.)	`i & 2` (bin.)	`i & 2` (dec.)
4	100	010	000	0
5	101	010	000	0
6	110	010	010	2
7	111	010	010	2

Thus the function would print:

```
0
0
2
2
```

Marks: 2 for printing 4 numbers, 4 for the correct values of `i`*, 4 for the correct values printed.*

Question 2

The function must compute and print the powers of 3 until the value computed is greater than `max`. We use a loop control variable that starts at 1, is multiplied by 3 each time through the loop and terminate the loop when the value is greater than `max`. The function must then return the last value printed. Since the value of the loop variable will now be a factor of 3 larger than the last value printed, we can either return the value divided by 3 or add an extra statement to keep track of the last value printed (as in the example below). The following function is one solution:

```
int powers3(int max)
{
   int i, last ;
   i = 1 ;
   while ( i <= max ) {
        printf ( "%d\n", i ) ;
        last = i ;
        i = i * 3 ;
   }
   return last ;
}
```

Marks: 2 for the function declaration, 1 for the variable declaration(s), 2 for the loop control expression, 2 for including statements to compute and print in the loop, 1 for correct powers computed, 1 for correct powers printed, 1 for returning the correct value.

Question 3

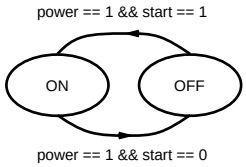
As stated in the question, the inputs are `power` and `start` and the output is `run`.

Since the controller is required to turn the motor on and off, the output will have two values the minimum number of states required is 2. Let's call the two states `ON` and `OFF`.

A table showing the values of the output for the two states is:

state	`run`
ON	1
OFF	0

Using the description in the problem the state transition diagram is as follows:



The state transition table is as follows:

current state	input conditions		next state
	`power`	`start`	
ON	0	0	ON
ON	0	1	ON
ON	1	0	OFF
ON	1	1	ON
OFF	0	0	OFF
OFF	0	1	OFF
OFF	1	0	OFF
OFF	1	1	ON

Marks: 1 mark for listing the inputs and outputs (many people omitted this), 1 for listing the states (also omitted by many people), 2 marks for a table showing the output value for each state, 2 marks for the state transition diagram, 4 marks for the state transition table.