MCU Practice Sheet #1 - 2012

Part 1. Answer the following questions by marking the best answer among the choices given:

1. Using a 3.3V microcontroller, a GPIO pin can provide high current output using …
    a. A push-pull output mode
    b. An open-drain output mode with internal weak pull-ups
    c. An open-drain output mode with external pull-ups.

2. Using a 3.3V microcontroller, one can make a GPIO work as an input pin using …
    a. An open-drain output mode and a pull-up resistor
    b. A push-pull output mode and an amplifier at the output of the pin
    c. A push-pull output mode and an internal weak pull-up

3. We can toggle bit 3 of P1 by the following C instruction …
    a. P1= P1 ^ 008H
    b. P1= P1 & 0F7H
    c. P1.3= ~P1.3

4. GPIO pins can be used for bidirectional data transfer when they are configured as …
    a. Open-drain mode with internal weak pull-ups
    b. Open-drain mode with external pull-ups
    c. Push-pull mode

5. When the external crystal oscillator is invalid for a long period of time, the microcontroller …
    a. Switches automatically to internal oscillator
    b. Can be configured to reset
    c. Causes a flag to be raised for the program to repair the problem

6. C8051F020 has a … architecture.
    a. Harvard
    b. Von Neumann
    c. Mixed

7. For a microcontroller application in which timing accuracy is important, a system clock based on … is used.
    a. RC oscillator
    b. Crystal oscillator
    c. Internal oscillator

8. Microcontroller watchdog timer can be used to …
    a. Schedule periodic check on the status of a process
    b. Reset the microcontroller when it runs out of control
    c. Measure the number of particular events of interest

9. Using a 3.3V microcontroller, a GPIO pin can provide high current output using …
    a. A push-pull output mode
    b. An open-drain output mode with internal weak pull-ups
    c. An open-drain output mode with external pull-ups.

10. For human interface devices based on C8051F020 applications, a system clock based on … is used.
    a. RC oscillator
    b. Crystal oscillator
    c. The microcontroller's own internal oscillator

11. Watchdog timer must be … in order for the program to not use it.
    a. Restarted
    b. Disabled
    c. Checked

Part 2. Mark the following statement as either True (T) or False (F):

12. C8051F020 is a mixed-signal microcontroller because it can handle analog and digital data.
13. Microcontroller external clock configuration must perform a check on the external clock validity.
14. Using `bit` to declare a bit variable is valid only for global variables.
15. 8-bit MCUs are well-suited for low-power applications that use batteries.
16. One can declare a bit-addressable variable in C language programming for microcontrollers
17. The operands of a logical operation must be Boolean.
18. The size of the bit-addressable region of the data memory allows for 256 bit variables.
19. 8-bit microcontrollers are sufficient and cost-effective for many embedded applications.
20. All data memory locations are bit addressable.
21. For internal crystal oscillators, only certain values can be programmed with C8051F020.
22. The C8051F020 must start with an internal oscillator upon reset.
23. Logical instructions perform Boolean operations on a bit-by-bit basis.

Part 3. Compute the output of the following operations in a C Language program for a C8051F020 device:

```
24.     0x24 > 0xA1
25.     !(0x24 | 0x01)
26.     (0xF0 & 0x80) >= 0
27.     0x021 % 0x02
28.     1>>2
29.     0xF0 + 0x0A
30.     !(0x51 & 1)
31.     (0xF0 – 0x80) == 0
32.     (0xA0 & 0x55)
33.     (0x90 – 0x80) | 0x0F
34.     0xF0 / 0x4
35.     0x0F<<4
36.     (0xFE20 || 0x80)
37.     0xAA && 0x55
38.     (0xF0 ^ 0x0A)&& 0x11
```

```
39.      ~(0xAA)
40.      (0xF0 ^ 0xA0)
41.      0xFF | 0x11
42.      0xA3 % 0x8
43.      0x40>>2
```

Part 4. Solve the following design problem:

Consider the simple C8051F020 microcontroller-based temperature control shown below. The user selects the value of the temperature and puts it as an 8-bit INPUT that is connected to PORT 1 while the temperature measured is converted to an 8-bit digital value and connected to PORT 2. The microcontroller can turn the heater ON by setting pin P2.3 and OFF by resetting the same pin. Design a project that would enable the ON/OFF control of the heater to adjust the temperature to exactly the value read by INPUT. Control should work as follows:

1. Read INPUT
2. Read ADC
3. Compare INPUT to ADC
4. Turn Heater ON if INPUT > ADC and wait for 1 s
5. Turn Heater OFF if INPUT < ADC