Problem Set #1

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

1. Relative addressing mode is useful in …
a) Jump or branching instructions
b) Data transfer instructions
c) Arithmetic instuctions.

2. For a microcontroller application in which timing accuracy is not important, a system clock based on … is used.
a) RC oscillator
b) Crystal oscillator
c) The microcontroller's own internal oscillator

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

4. 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.

5. The following assembly code requires … clock cycles to execute.

```
mov WDTCN, #0ADh
mov XBR2, #40h
orl P1MDIN, #40h
clr P1.6
```

a) 12
b) 11
c) 10

6. C8051F020 microcontroller memory location 0F0H when accessed using indirect addressing mode refers to a …
a) Special function register
b) General purpose RAM location
c) Far address

7. For reliable timing in C8051F020 applications, one should use a system clock based on …
a) RC oscillator
b) Crystal oscillator
c) The microcontroller's own internal oscillator

8. Watchdog timer must be periodically … in order for the program using it to run correctly.
a) Restarted
b) Disabled
c) Checked

9. Using a 3.3V microcontroller, one can make a GPIO pin provide high current output 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.

10. Lowest cost clock source for C8051F020 is based on …
a) RC oscillator
b) CMOS clock
c) Internal clock

11. Accessing C8051F020 memory location 0F0H using indirect addressing mode refers to …
a) Special function register
b) memory address
c) Immediate value

12. For low-cost microcontroller applications, one should use a system clock based on …
a) RC oscillator
b) Crystal oscillator
c) The microcontroller's own internal oscillator

13. Using a 3.3V microcontroller, a GPIO pin can provide TTL-compatible output with levels using …
a) A push-pull output mode
b) A push-pull output mode with internal weak pull-ups
c) An open-drain output mode

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

14. Indirect addressing is not useful in C8051F020 assembly language programming
15. Not all GPIO ports are bit addressable
16. For external crystal oscillators, only certain values are can be used with C8051F020
17. Microcontrollers can be programmed using either assembly or C languages
18. The C8051F020 can be configured to start using an external crystal oscillator upon reset.
19. The output from logical operations is always a Boolean value.
20. The memory locations above 080H can only be accessed using indirect addressing.
21. Any C8051F020 microcontroller program must run at least a short while with a clock speed of 2MHz.

22. C8051F020 is a mixed-signal microcontroller because it can accommodate different logic levels.
23. The C8051F020 instruction `MOV` can be used to move 16 bit data from its source to its destination. .
24. Microcontroller clock configuration must perform a check on the internal clock validity

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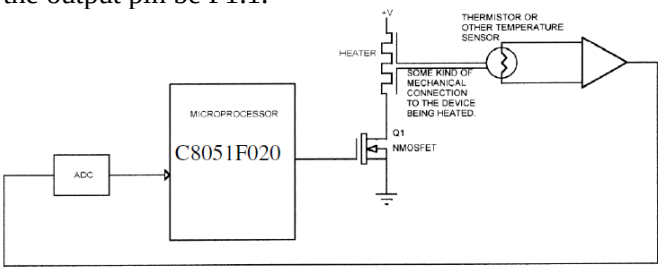
Part III. Denote the following C8051F020 microcontroller instructions as either being True (T) or False (F) assembly instructions:

25. `CLR P4.2`
26. `CPL C`
27. `JZ @R7`
28. `DIV A,B`
29. `SUBB R2, F0H`
30. `ANL C, /P1.0`
31. `XCH A, 040H`
32. `INC @R0`
33. `CPL A`
34. `DJNZ R6, 70H`
35. `ADD A, F0H`

```
36. MOV 70H, 060H
37. MOV @R0, A
38. ADD A, #300H
39. RLC R0
40. DJNZ #30H, 70H
41. CPL P2.4
42. COUNT EQU R3
43. PUSH A
44. XCH A, 05AH
45. SUBB R2, F0H
46. XRL 70H, A
47. MOV 40H , #FFH
48. ADD A, #30H
49. DA R1
50. DJNZ R6, 70H
51. CPL P1.6
52. SETB C
53. INC @R7
54. DIV AB
```

Part IV. Consider a microcontroller-controlled heater shown below. Design a C8051F020 project that would enable the ON/OFF control of the heater to adjust the temperature to within a predefined range Tmin and Tmax. The desired control is such that the heater is turned on whenever the temperature drops below Tmin and turned off when the temperature is above Tmax. Assume that the ADC used is of 8-bit FLASH type connected to GPIO port P0 (i.e., requires no clock and its digital reading corresponds to the temperature value whenever it is read). Assume also that the control of the heater is such that when the microcontroller pin is 1 the heater is ON and when it is 0 the heater is OFF. Let the ADC reading port be the entire P0 and the output pin be P1.1.



Part V. [5 points] In a microcontroller application, it is desired to have a periodic control signal of period 1 minute and duty cycle of 50% from pin P1.6. Provide the programming sequence of a microcontroller timer to generate such periodic signal. Make sure to include all parts of the code including the initialization.

Part VI. [10 points] Write a C8051F020 assembly code part that configures the clock source to be an external crystal clock source with frequency 22.1184 MHz.

Part IV. [8 Points] Write C8051F020 assembly code lines to do the following tasks:

a. Delay of 5 clock cycles.
b. Configuration of P4.3 to be an open-drain with internal weak pull-up.
c. Configuration of internal oscillator to generate a frequency of 8 MHz.