

**ALL QUESTIONS ARE TO BE ANSWERED AND CARRY EQUAL MARKS.
USE COMPUTER MARK SENSE SHEETS TO ENTER YOUR ANSWERS.
THERE IS ONLY ONE CORRECT ANSWER FOR EACH QUESTION.
INCORRECTLY MARKED ANSWERS WILL RECEIVE NO CREDIT.**

QUESTION 1

Which of the following best describes an automotive engine control system?

- (a) Soft real-time and embedded
- (b) Hard real-time and embedded
- (c) Soft real-time but not embedded
- (d) Hard real-time but not embedded
- (e) None of the above

QUESTION 2

Which of the following is NOT a typical feature of a micro-controller?

- a) On-chip peripherals
- b) Multiple serial communication ports
- c) Non-volatile memory
- d) Low interrupt latency
- e) None of the above

QUESTION 3

NONE of the registers of the Rabbit 4000 microcontroller is

- a) 8 bit
- b) An extended program counter
- c) 64 bit
- d) An Alternate CPU register useful in context switching
- e) Read Only

QUESTION 4

Which of the following best describes fixed point arithmetic capability on the RCM 4000 and Dynamic C platform used in the laboratory

- (a) A math library is available but limited to 16.16 arithmetic
- (b) A set of routines can be user written utilizing floating point operations
- (c) A set of routines can be user written utilizing integer arithmetic operations
- (d) A math library is available but it does not have a multiply operation
- (e) None of the above

QUESTION 5

The program counter register (PC) of the Rabbit 4000 microcontroller stores information about

- (a) The length of the executing program in bytes
- (b) The address of the next instruction
- (c) The number of programs that have executed on the system
- (d) The number of cosates in the executing program
- (e) None of the above

QUESTION 6

C as a programming language for embedded systems has the drawback that it

- a) Cannot represent or operate on complex numbers
- b) Cannot provide low level access
- c) Cannot describe hardware communication
- d) Does not allow recursive functions
- e) None of the above

QUESTION 7

The hardware interface between a Testing station and an RCM4000 core module in the laboratory for your problem based learning assignment

- (a) Used parallel ports C and D on the RCM4000
- (b) used parallel ports A and B on the RCM4000
- (c) had one serial clock line
- (d) did not perform any voltage level conversions
- (e) None of the above

QUESTION 8

```
#asm
InitValues::
c  start_time = 0;
c  counter = 256;
    ret
#endasm
```

In the code segment from a Dynamic C program for Rabbit 4000, there are

- (a) assembler label with global scope and comments
- (b) assembler label with local scope and comments
- (c) assembler label with global scope and C language statements
- (d) assembler label with local scope and C language statements
- (e) None of the above

QUESTION 9

LD A, XPC is a chained-atomic instruction of the Rabbit 4000. This implies that

- (a) The contents are fetched from consecutive locations in extended memory
- (b) The accumulator will be loaded with a link to access extended memory
- (c) No interrupt can take effect between this instruction and the next
- (d) No flags will be updated by this instruction
- (e) This instruction is associated with a semaphore operation

QUESTION 10

It is preferable to place frequently accessed functions in root RAM rather than in extended memory because

- a) They need not be re-loaded on power up
- b) Access to root RAM takes fewer clock cycles
- c) The life of extended memory is only 10,000 to 100,000 writes
- d) They will be closer to BIOS functions
- e) None of the above

QUESTION 11

The extended memory segment in the Rabbit 4000 covers the logical address space range

- a) 0x0000 to 0xA000
- b) 0x0000 to 0xFFFF
- c) 0xE000 to 0xEFFF
- d) 0xE000 to 0xFFFF
- e) None of the above

QUESTION 12

The RS232 library with Dynamic C and RCM4000 provides two types of serial port functions that are

- (a) For polled and interrupt driven transfers
- (b) For buffered and non-buffered transfers
- (c) Multi-thread and single thread
- (d) Blocking and non-blocking
- (e) None of the above

QUESTION 13

In foreground/background software architecture for an embedded application without multi-tasking, most work is done by

- (a) The main program in the background
- (b) A single task
- (c) Interrupt service routines
- (d) The kernel
- (e) None of the above

QUESTION 14

A Dynamic C program calls a stand-alone assembly function that takes one argument and returns an integer. The return value is put by the assembly function before returning in

- (a) the stack at the top
- (b) the A register
- (c) the HL register
- (d) root data memory at a pre-determined location
- (e) None of the above

QUESTION 15

The register IX on Rabbit 4000 can be used to create stack frames when assembly language segments call C functions. Stack frames are useful for consistent parameter referencing when function calls may be nested. The contents of a stack frame do NOT include

- (a) the return address
- (b) the old value of IX
- (c) auto variables
- (d) parameters passed
- (e) static variables

QUESTION 16

The addition of two 16.16 fixed point real numbers on the Rabbit 4000

- a) requires an algorithm and a few integer instructions
- b) requires one integer instruction
- c) cannot be done
- d) requires an addition with carry and can only be done in assembly
- e) requires the math library MATH.LIB from Dynamic C

QUESTION 17

In co-operative multi-tasking using Dynamic C, the currently running thread can relinquish the processor and later return to itself when it encounters the following statement

- (a) switch
- (b) exit
- (c) return
- (d) yield
- (e) All of the above

QUESTION 18

A re-entrant function will NOT make use of

- (a) The stack
- (b) Auto variables
- (c) Global variables
- (d) Conditional statements
- (e) None of the above

QUESTION 19

Which of the following is NOT a typical characteristic of a low-end microcontroller such as the Rabbit 4000?

- f) Low interrupt latency
- g) On-chip peripheral such as a PWM generator
- h) Fairly large number of input-output ports
- i) Floating point arithmetic co-processor
- j) Low power consumption

QUESTION 20

The multiply operation of Rabbit 4000, MUL, uses

- a) Specified registers of length 16 bits for operands
- b) The register A and another specified register of length 16 bits for operands
- c) Implicitly defined registers as operands
- d) Stack pointer and register A as operands
- e) Stack pointer contents from the top four bytes as the operands

QUESTION 21

Which of the following statements is NOT TRUE of asynchronous serial communication?

- a) The receiver and the transmitter have nearly the same clock frequency
- b) Start or stop bits may be used
- c) Polling may be used to check for device ready status
- d) Data transfer may be interrupt driven
- e) Pad characters must be transmitted when the line is idle

QUESTION 22

In a serial ISR Receive routine, the interrupt is cleared by

- a) Writing to the status register
- b) Reading the data register
- c) Writing to the interrupt control register
- d) Reading the shadow port register
- e) None of the above

QUESTION 23

The segment that gets re-mapped most frequently by applications is

- a) The root segment
- b) The data segment
- c) The stack segment
- d) The extended memory segment
- e) None of the above

QUESTION 24

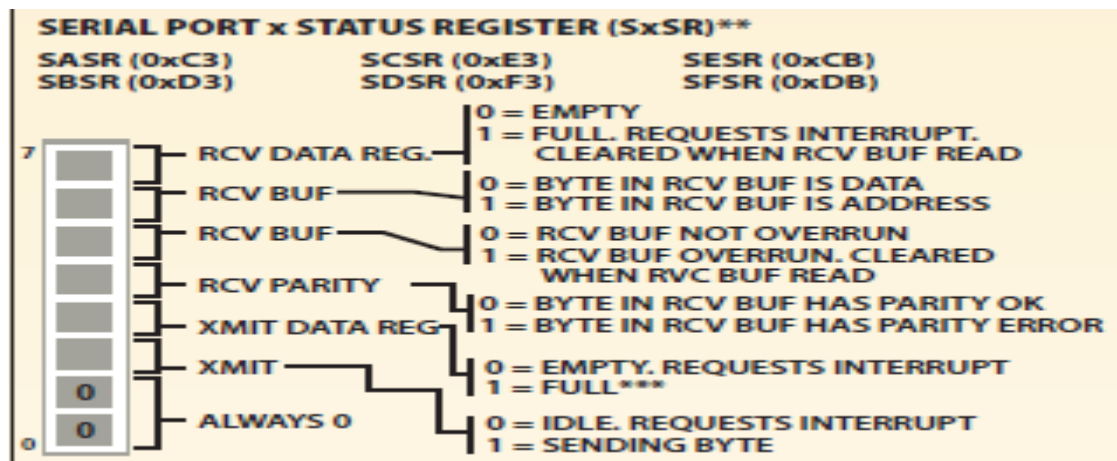
The data transfer rate in interrupt driven serial communication is MOST dependent on?

- f) The interrupt latency
- g) The hardware response time to interrupt
- h) The time from the interrupt service routine entry to the I/O data transfer instruction
- i) The time to complete the interrupt service routine
- j) None of the above

QUESTION 28

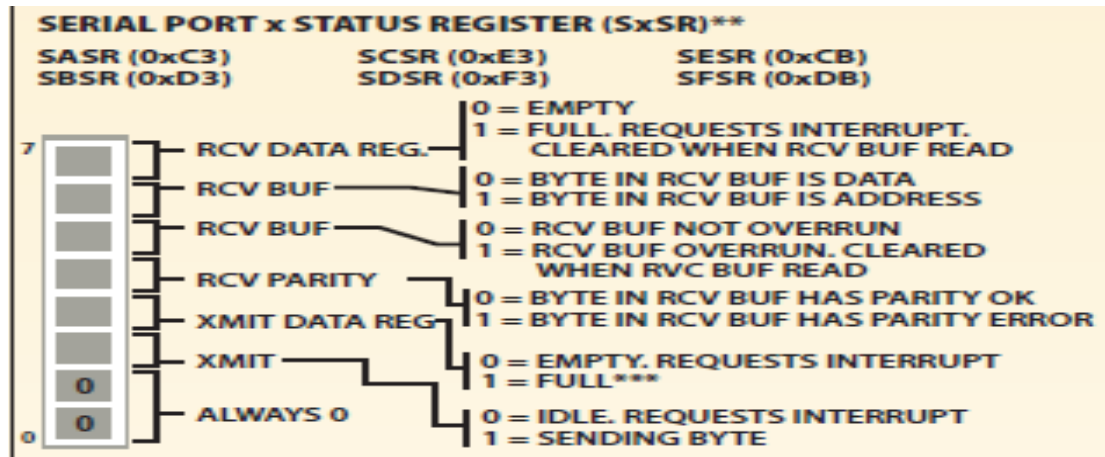
Compared to polled serial transfers, interrupt driven serial transfers usually are

- a) Faster but have unpredictable worst case latency
- b) Slower and have unpredictable worst case latency
- c) Faster and have predictable worst case latency
- d) Slower but have predictable worst case latency
- e) None of the above

QUESTION 29

Based on the information above, to check when data is available, a polled serial input routine should monitor bit _____ (note: bit 7 is on top and bit 0 at the bottom as indicated)

- a) 2
- b) 5
- c) 6
- d) 7
- e) None of the above

QUESTION 30

Based on the information above, to check when data is available, a serial port interrupt service routine can check bit 7 to (note: bit 7 is on top and bit 0 at the bottom as indicated)

- (a) Clear the interrupt
- (b) Determine the nature of the interrupt – transmit or receive
- (c) Fetch the data to be transmitted
- (d) Generate the next interrupt
- (e) None of the above

QUESTION 31

Which of the following statements about critical sections is NOT TRUE?

- (a) They are sections of code
- (b) Their correct execution is based on the assumption that the task has exclusive access to a shared resource
- (c) They must be protected against pre-emption by other code manipulating the same resource
- (d) No interrupts should occur while a task is within them
- (e) None of the above

QUESTION 32

Which of the following is NOT part of Dynamic C support for multitasking (without an add-on real-time kernel or RTOS)?

- (a) The *slice* statement
- (b) The *yield* statement
- (c) Task prioritization
- (d) Library functions to delay tasks
- (e) Library functions for a real time clock

QUESTION 33

Which of the following statements about co-operative multitasking is NOT TRUE?

- a) Context switching takes place under program control
- b) The programmer inserts yield statements where context switches may take place
- c) Yield statements must be used infrequently or sparingly to avoid poor response
- d) Worst case latency cannot be easily predicted
- e) None of the above

QUESTION 34

Which of the following statements about pre-emptive multitasking is NOT TRUE?

- a) A task may be forced to give up the CPU after a time slice
- b) The programmer does not need to insert yield statements
- c) Interrupts must be masked to improve context switching
- d) System response time is improved
- e) None of the above

QUESTION 35

Which of the following statements about pre-emptive multitasking is TRUE?

- a) Task switching is unpredictable and response times are non-deterministic
- b) Task switching is unpredictable but response times are deterministic
- c) Task switching is predictable and response times are deterministic
- d) Task switching is predictable but response times are non-deterministic
- e) None of the above

QUESTION 36

For the following code segment in Dynamic C in the context of your class assignment which of the statements is NOT TRUE

```
xmem int SenseBit(int bitnum)
{
    return BitRdPortI(PADR, bitnum);
}
```

- (a) It will read a bit from the Port A data register
- (b) It will be placed in extended memory
- (c) It returns an argument of type integer
- (d) It uses an RS232.LIB function to read the port
- (e) None of the above

QUESTION 37

In a foreground / background software architecture for embedded systems, most work is done by

- a) Interrupt service routines
- b) Background task
- c) Worker tasks
- d) Real time kernel
- e) None of the above

QUESTION 38

In co-operative multi-tasking using Dynamic C, the currently running thread can relinquish the processor and later return to itself when it encounters the following statement

- a) switch
- b) exit
- c) return
- d) yield
- e) All of the above

QUESTION 39

A Dynamic C program calls a stand-alone assembly function that takes one argument and returns a **long** . The return value is put by the assembly function before returning in

- a) the stack at the top
- b) the BC register
- c) the HL register
- d) the BC:DE register pair
- e) root data memory at a pre-determined location

QUESTION 40

Which of the following statements about segments of the logical address space with reference to Rabbit 4000 and Dynamic C is NOT TRUE?

- a) There are 4 segments
- b) The root segment typically holds code and constants
- c) The stack segment typically holds the system stack
- d) The size of the data segment is fixed at 8K
- e) None of the above

QUESTION 41

Which of the following statements about Semaphores implemented in Micro C OS/II is NOT TRUE?

- a) They are created using OSSemCreate() and specifying the initial count
- b) They have a count field of 16 bits
- c) A list of waiting tasks is associated with each of them
- d) OSSemPend() allows the specification of a timeout
- e) Semaphore services are always enabled

QUESTION 42

The height sensor output from the Testing station in your problem learning assignment was connected to the RCM4000 as an input to

- a) Parallel port B
- b) Serial port C
- c) A/D convertor
- d) Input Capture Module
- e) None of the above

QUESTION 43

The slice statement in Dynamic C is used for

- a) Co-operative multitasking
- b) Pre-emptive multitasking
- c) Deadline driven scheduling
- d) Memory management
- e) None of the above

QUESTION 44

Which of the following statements about counting semaphores is NOT TRUE?

- a) P (pend) and V (post) operations must be atomic
- b) The count field is decremented by a P operation
- c) If the P operation finds the count to be zero the calling task is made to wait in a queue
- d) If the V operation finds the count to be zero it does not release a task from the queue
- e) None of the above

QUESTION 45

The schedulable bound of the rate monotonic algorithm for a large number of tasks is roughly

- (a) 100%
- (b) 83%
- (c) 78%
- (d) 69%
- (e) None of the above

QUESTION 46

Which of the following statements about unbounded priority inversion is NOT TRUE?

- (a) A high priority task is made to wait for a long time
- (b) A low priority task holds the resource needed by a high priority task
- (c) There must be at least 3 tasks
- (d) The low priority task runs for a long time
- (e) None of the above

QUESTION 47

Which of the following statements about the Priority Inheritance Protocol is NOT TRUE?

- (a) Priorities of tasks are dynamically changed
- (b) A task entering a critical section inherits the priority of the highest priority task in the ready list
- (c) A task leaving the critical section has its priority restored
- (d) Priority inheritance is transitive
- (e) None of the above

QUESTION 48

Which of the following statements about the immediate Priority Ceiling Protocol is NOT TRUE?

- (a) Each resource is associated with a priority
- (b) A task can be prevented from entering a critical section even if the resource is available
- (c) A task entering a critical section has its priority set to the priority ceiling of that resource
- (d) Priority ceiling is the priority of the highest priority task that uses the resource
- (e) None of the above

QUESTION 49

Deadlock can be a problem when tasks share resources. A method by which it can be prevented is

- (a) Disabling of interrupts
- (b) Using a watchdog timer
- (c) Ordering of resources and allocation of all resources above the lowest one needed
- (d) Using a spin lock
- (e) None of the above

QUESTION 50

The Mutex implementation in Micro C OS/II is designed to?

- a) Facilitate prevention of deadlock
- b) Facilitate prevention of priority inversion
- c) Turn off the system speaker
- d) Turn off multitasking
- e) None of the above

END OF PAPER