1. Explain why a semaphore S would be initialized to each of the following values:
   a) S = 0
   b) S = 1
   c) S = n, where n > 1   (15%)

2. Consider an operating system which uses a round-robin scheduling algorithm with a quantum of Q. Empirical data indicate that, on the average, a process executes for time T before blocking due to an I/O operation. Furthermore, the time required by the operating system to block one process and restart another (i.e. the context switching time), is found to be S. Note that the time spent performing context switches is essentially wasted, since no useful computations are performed during this time. Give a mathematical expression for the efficiency of the CPU for each of the following situations:

   a) Q > T
   b) S = Q << T (T is much greater than Q)
   c) Q --> 0 (approach to zero)   (10%)

3. Consider the following resource allocation state for a system that contains eight processes P0, P1, ..., P7 and four resources A, B, C, D.

   AVAILABLE

A	B	C	D
5	2	3	2

   ALLOCATION

	A	B	C	D
P0:	2	1	0	1
P1:	3	1	0	0
P2:	0	0	0	0
P3:	0	0	1	0
P4:	1	0	0	0
P5:	0	0	1	1
P6:	1	0	0	0
P7:	1	0	1	0

   NEED

	A	B	C	D
P0:	2	1	4	2
P1:	7	1	6	3
P2:	9	1	6	3
P3:	3	0	2	0
P4:	3	3	1	2
P5:	0	1	3	1
P6:	10	0	1	2
P7:	5	3	5	2

   Is the system in a safe state? If so, show a safe sequence of processes.
                                                                   (10%)

4. In a demand-paged virtual memory system, the size of a page frame can have a large impact on overall performance. One processor, for example, might be configured with a page size of 512 bytes, while another might use page of size 8192 bytes. Assume, for this problem, that the total memory sizes (in bytes) are equal for the two machines.

   a) Which of the two schemes is better in terms of the amount of memory required for the page table for a given program? Explain.

   b) Which of the two schemes is better in terms of utilization of physical memory

   c) Which of the two schemes is better in terms of the page fault rate for a given program? Explain.

                                                                   (10%)

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5.
  a) Draw the phase structure of a compiler and describe the input/output and functions of each phase.

  b) The term pass is usually mentioned while writing a compiler or an assembler.
     (i) What is the meaning of pass?
     (ii) What is the criteria to decide the number of pass?
     (iii) What is the main difference in writing one pass assembler and two pass assembler?
                                                    (10%)

6. Given a grammer G:

       E --> E + E | E * E | (E) | id

  a) Which of the two following sentences can be accepted by G ? Draw the parse tree for that sentence.
     (i) id * (id + id)
     (ii) id = id * id

  b) Which method, bottom-up or top-down, are you based on to draw above parse tree?

  c) Based on the method of b), if you want to generate the postfix intermediate code, please show the semantic action routine for each production.
                                                    (15%)

7. Loader can be categorized into absolute, relocate, and dynamic loader.

  a) Show the advantages and disadvantages of using them respectively.

  b) The file that a loader can accept is called object code. Except the machine code, what should be involved in the file accepted by each of above three loaders?
                                                    (10%)

8. The macro fuction is provided in the programming language assembly and C.

  a) What is the macro? (Using an example to illustrate it)

  b) Describe the differences of parameters used in a macro and in a fuction or subroutine.

  c) While doing expansion for a macro, how can the labels and parameters within the macro be managed?

  d) How can the macro processor complete the expansion for a macro with nesting (recursive) definition.
                                                    (10%)

9.
  a) What is the linking of a program ?

  b) How do you link several individual compiled files? (Note: if you design a linker, what kind of file format must be provided by the designer of the compiler or assembler for you to implement the linker.)

  c) There is an important feature for a Data Base Management System (DBMS). The feature is that no matter what a language used to implement the application program, the application program can always access the data inside the data base. (i.e. The programmer needs not to know how the data are stored in the data base.)

     Please illustrate how a DBMS achieve this feature.   (10%)