

1. (10%) Consider a computer that does not have a TEST AND SET LOCK instruction but does have an instruction to swap the contents of a register and a memory word in a single indivisible action. Can that be used to write a routine enter region such as the one found in Fig. 2-12.

Ans : 可以

```

ENTER_REGION:
    MOVE REGISTER, #1
    SWAP REGISTER, MEMORYWORD(LOCK)
    CMP REGISTER, #0
    JNE ENTER_REGION
    RET

```

2. (20%) Measurements of a certain system have shown that the average process runs for a time T before blocking on I/O. A process switch requires a time S , which is effectively wasted (overhead). For round robin scheduling with quantum Q , give a formula for the CPU efficiency (i.e., the useful CPU time divided by the total CPU time) for each of the following:

(a) $Q = \infty$

$\frac{T}{T+S}$, If S is small compared to T , then utilization is almost 100%.

(b) $Q > T$

$\frac{T}{T+S}$, same as (a).

(c) $S < Q < T$

$$\text{Total cpu time} = T + \frac{T}{Q} \times S$$

$$\text{utilization} = \frac{T}{T + \frac{T}{Q} \times S} = \frac{1}{1 + \frac{S}{Q}} = \frac{Q}{Q+S}$$

(d) $Q = S$

$$\frac{Q}{Q+S} = \frac{Q}{Q+Q} = 50\%$$

(e) Q nearly 0

$$\frac{Q}{Q+S} = \frac{0}{0+S} = 0\%$$

3. (10%) Consider the interprocess-communication scheme where mailboxes are used. Suppose a process P wants to wait for two messages, one from mailbox A and one from mailbox B . What sequence of send and receive should it execute so that the messages can be received in any order?

建立 2 個 threads，分別去 receive mailbox A 及 mailbox B 的 send，透過此方法則可以同時進行。

4. (10%) Consider the following program that uses the Pthreads API. What would be the output of the program? (Note that the line numbers are for references only.)

A = 1

B = 1

C = 2

D = 2

由於 `fork()` 後是交由 scheduler 進行排程，所以順序不一定，共有 $4!$ 種可能。