Question 1: A computer has a monoprogramming operating system. If the size of memory is 64 MB and the memory reserved part for the operating system is 4 MB, what is the maximum size of program that can be run by this computer?

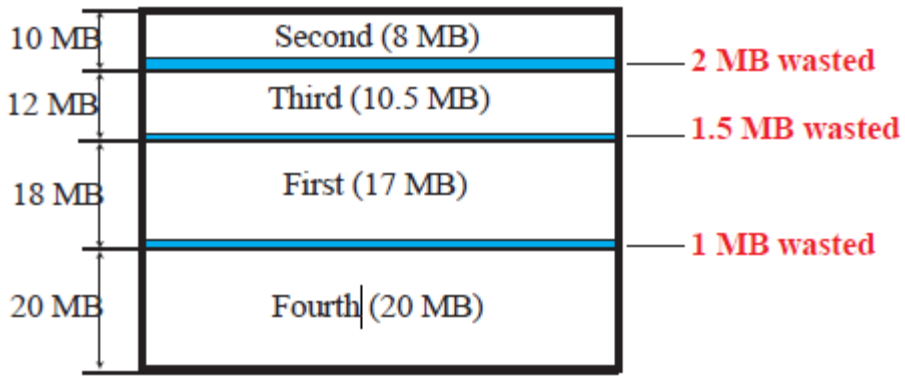
64 – 4 = 60 MB

Question 2: Monoprogramming operating system runs programs that on average need 10 microseconds access to the CPU and 70 microseconds access to the I/O devices. What percentage of time is the CPU idle?

70 / (70 + 10) × 100 = 87.5%

Question 3: A multiprogramming operating system divides a 60 MB of memory into 4 partitions as follows: the first partition is 10 MB, the second is 12 MB, the third is 18 MB and the fourth is 20 MB. The first program needs 17 MB to be run and occupies the third partition, the second program needs 8 MB and occupies the first partition, the third program needs 10.5 MB and occupies the second partition. Finally, the fourth program needs 20 MB and occupies the fourth partition.

The following figure shows the partitions and memory used by each program.



a) **What is the total memory used? 8+10.5+17+20 = 55.5 MB**
b) **What is the total memory allocated? 10+12+18+20= 60**
c) **What is the total memory wasted? 60 – 55.5 = 4.5 MB**
Or 2+1.5+1=4.5 MB

d) **What percentage of memory is wasted? Percent memory wasted = 4.5 / 60 × 100 = 7.5%**

Question 4: A multiprogramming operating system uses paging. The available memory is 60 MB divided into 15 frames, each of 4 MB. The first program needs 13 MB, the second program needs 12 MB, and the third program needs 27 MB.

a) **How many frames are used by the first / second / third program?**

P1 = 13/4= 3.4 = 4 frames

P2 = 12 / 4 = 3 frames

P3 = 27 / 4 = 6.75 = 7 frames

b) **How many frames are un-used?**

The used frames are 4 + 3 + 7 = 14 = 15- 14= 1 so the un-used frame is only one

c) **What is the total memory used?**

13+12+27= 52MB

d) **What percentage of memory is used?**

(52/ 60) × 100 = 86.67%