Worksheet 8.1: Main Memory

Q1. Choose the right answer. There is only **<u>one</u>** correct answer.

1. What's the relationship between page size and fragmentation?
   a. A larger page size decreases internal fragmentation.
   b. A larger page size increases internal fragmentation.
   c. A larger page size decreases external fragmentation.
   d. A larger page size increases external fragmentation.
   e. Both a and c are correct. f. Both b and d are correct. g. None of the above is correct.

2. A logical address space of a process has 512 pages with an 8-KB page size. How many bits are needed in the logical address?
   a. 8 b. 12 c. 16 d. 20 **e. 22** f. 24 g. 40 h. 64

   $512 = 2^9$ -> 9 bits for the base
   $8K = 2^3 \times 2^{10} = 2^{13}$ -> 13 bits for the offset
   Total number of bits = 9 + 13 = 22 bits

3. If 32 bits are used to represent a logical address, and the page size is 16 KB, what's the maximum number of pages that a process can have in its logical address space?
   a. 1M b. 512K **c. 256K** d. 128K e. 64K f. 32K g. 16K h. 8K i. 4K

   $16K = 2^{14}$ -> 14 bits for offset
   Bits left for the base = 32 – 14 = 18 bits
   $2^{18} = 256$ K

4. If a process uses 1100B of memory in a system with a page size of 512B, what's the size of internal fragmentation?
   a. 24B b. 76B c. 100B d. 412B **e. 436B** f. 0B

   What's the minimum number of pages needed?
   2 pages: 2 x 512 = 1024 not enough
   3 pages: 3 x 512 = 1536 enough

   Internal fragmentation = 1536 – 1100 = 436 B

5. Which of the following is (are) true about paging and segmentation?
   a. **Paging divides memory into equal blocks, but segmentation may divide it into unequal blocks**.
   b. Segmentation divides memory into equal blocks, but paging may divide it into unequal blocks.
   c. Paging requires hardware support but segmentation does not.
   d. Segmentation requires hardware support but paging does not.
   e. In both segmentation and paging, the address space of a process must be contiguous.
   f. Both a and c are correct. g. Both a and e are correct. h. Both d and e are correct.

6. Which of the following is (are) true about static linking and dynamic linking?
   a. Static linking results in a larger executable.
   b. Dynamic linking results in a larger executable.
   c. Static linking makes it possible for multiple processes to share libraries at run time.
   d. Dynamic linking makes it possible for multiple processes to share libraries at run time.
   e. Both a and c are true. **f. Both a and d are true**. g. Both c and d are true.

Q2. A system has a Table-Lookaside Buffer (TLB) with a negligibly small access time compared to the memory access time. Calculate the TLB hit ratio that will keep the Effective Access Time (EAT) within 10% of the ideal EAT (ideal EAT is EAT with no TLB misses). Show your work **clearly**.

Ideally, all accesses will hit in the TLB. So, there will be one TLB access and one memory access
Let memory-access time be M
TLB access is negligible

EAT = hM + (1-h) 2M

1.1 M = hM + 2 (1-h) M

1.1 = h + 2 (1-h)

Solve for h:

1.1 = h + 2 -2h
h = 2 – 1.1 = 0.9