Exercise 1

1.1) Correct statement(s): a, b

(Note that statement (b) is about a part of the lectures on caches that was not covered in this year's course.)

1.2) Correct statement(s): a, c

1.3) Correct statement(s): b, c

1.4) Correct statement(s): d

1.5) Correct statement(s): a, c

Question 2.1

There are several possible scenarios. For example:

- `malloc(16)` ==> requires 20 bytes (including header)
- `malloc(30)` ==> requires 34 bytes (including header)
- `malloc(52)` ==> requires 56 bytes (including header) [This last step will fail when using a first-fit policy]

Question 4.2.b)

Range 1: Associated to PDE #2 (for details, see answer of question 4.2.a studied in class).

Range 2: `[0x00B00000 ; 0x04FFFFFF]`

`0x00B00000` in binary notation is:
`0000 0000 10|11 0000 0000 | 0000 0000 0000` ==> This address falls within PDE 0x2 (in binary `00 0000 0010`)

`0x04FFFFFF` in binary notation is:
`0000 0100 11|11 1111 1111 | 1111 1111 1111` ==> This address falls within PDE 0x13 (in binary `00 0001 0011`)

So Range 2 spans 0x11 (= 17 in decimal) adjacent PDEs (PDE #0x2 to PDE #0x13). Note that a part of Range 2 uses the same PDE (# 0x2) as Range 1, which means that they have a PT instance in common. (However, note that Range 1 and Range 2 use non overlapping

PTEs within that PT.)

Range 3: `[0x64000000 ; 0x70FFFFFF]`

`0x64000000` in binary notation is:
`0110 0100 00|00 0000 0000 | 0000 0000 0000` ==> This address falls within PDE 0x190 (in binary `01 1001 0000`)

`0x70FFFFFF` in binary notation is:
`0111 0000 11|11 1111 1111 | 1111 1111 1111` ==> This address falls within PDE 0x1C3 (in binary `01 1100 0011`)

So Range 3 spans 0x11 (= 17 in decimal) adjacent PDEs (PDE #0x2 to PDE #0x13).

Wrap-up: In total, for the complete paging structure we need:

- 1 PD
- + (0x13 - 0x2 + 1) PTs (for Range 1 and Range 2)
- + (0x1C3 - 0x190 + 1) PTs (for Range 3)

which is equal to:

- 1 PD
- + 0x12 PTs (for Range 1 and Range 2)
- + 0x34 PTs (for Range 3)

which is equal to (in decimal notation):

- 1 PD
- + 18 PTs (for Range 1 and Range 2)
- + 52 PTs (for Range 3)

which is equal to:

1 PD + 70 PTs

which amounts to 71 pages (because each PD and PT instance has a size of 1 page) = 71 * 4 kB = 284 kB