CS241 SP15 Exam 8: Solution Key

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A VERSION OF THESE QUESTIONS MAY APPEAR IN A FUTURE QUIZ

1. (1 point.) Which of the following is NOT stored as part of the inode in a standard ext2 linux filesystem?

(A) reference count

(B) filename

(C) file length

(D) pointers to direct blocks, indirect blocks, double indirect block and triple indirect block

(E) created time

Correct answer: B.
Your answer: B.
1 out of **1** point received

2. (1 point.) Complete the following code to return 1 if the given path corresponds to a valid directory

```
int isdir(char* path) {
  struct stat s;
  return  _____;
}
```

(A) `dstat(&path, *s) ==1`

(B) `S_ISDIR( lstat(&path, *s) )`

(C) `0==stat(path, &s ) && 0 != S_ISDIR(s.st_mode)`

(D) `E_ISDIR==open(path,"d")`

(E) `0==fstat(path, &s ) && 0 != S_ISDIR(s)`

Correct answer: C.
Your answer: C.
1 out of **1** point received

Solution. Note `stat` returns 0 if successful

3. (1 point.) Which one of the following is true for `mmap` where 4KB of memory is mapped but the data file is truncated to 0KB?

```
int fd = open("data",O_RDWR | O_CREAT | O_TRUNC, 0600); // data is truncated (empty)
char* addr = mmap (0, 4096, PROT_READ | PROT_WRITE, MAP_SHARED, fd, 0);
addr[1024] = '!'; // Write to the 1025-th byte
munmap(addr,4096);
```

(A) Writing to `addr[1024]` is allowed but changes will not be written back to the file

(B) No errors will be reported until `munmap` is called

(C) Writing to `addr[1024]` will cause a bus error; the file must be lengthened first

(D) Attempting to write to `addr[1024]` will extend the file by one byte

(E) The `mmap` call will fail and `errno` will be set

Correct answer: C.
Your answer: C.
1 out of **1** point received

4

4. (1 point.) Solve my riddle. I'm a settable bit you can set on directories. If you set me then users can see each other's sub-directories but they cannot delete or directly overwrite them. I'm typically set on world-writable directories (such as `/tmp`)

(A) The setuid bit!

(B) The sticky bit!

(C) The www bit!

(D) The temp bit!

(E) The shared bit!

Correct answer: B.
Your answer: B.
1 out of **1** point received

5. (1 point.) Solve my riddle! I increase the chances of keeping your data safe from drive failure by storing redundant information- a parity bit for every set of bits written to the other disks. For performance, and to reduce stress on any one single drive, the parity bit is distributed across the disk array. You can replace any single failed drive with a new drive and recalculate the drive's contents. However if two drives fail (e.g. another drive fails during the rebuild process) - well... I hope you had recent backup using alternative storage!

(A) Reed-solomon coding

(B) RAID 0

(C) Mirror

(D) RAID 5

(E) RAID 1

Correct answer: D.
Your answer: E.
0 out of **1** point received

6. (1 point.) Before creating a new directory, the umask is changed to 077. What affect, if any, will this make on creating a new directory?

```
umask 077
mkdir newdir
```

(A) The directory contents can now be publicly read and modified by other users

(B) New directories are unaffected by `umask`

(C) The directory contents is not readable by the user who created it

(D) The directory contents is not modifiable by the user who created it

(E) The directory contents cannot be listed or used by other users

Correct answer: E.
Your answer: E.
1 out of **1** point received

7. (1 point.) Which one of the following is true for the shell command `touch abc` ?

(A) Truncates the file `abc` to zero bytes and removes any hard links to the original file

(B) Converts a symbolic link of the file `abc` to a physical file by coping the contents of the file

(C) Creates an empty file if `abc` does not exist. Updates the last modified time to the current time

(D) Updates the user and group information of the file `abc` to be the same as the shell process

(E) Creates a hard link to the file `abc` in the same directory

Correct answer: C.
Your answer: C.
1 out of **1** point received

8. (1 point.) What is the role of `__LINE __` ?

(A) The line number of the source code currently being compiled

(B) The total number of output lines printed by the process to stdout and stderr

(C) The line number of the last kernel call

(D) The number of output lines printed by the process to standard out

(E) The line number of the input file currently being read

Correct answer: A.
Your answer: A.
1 out of **1** point received

9. (1 point.) Which of the following is impossible with `mmap`?

(A) Execute the bytes of an existing library file

(B) Share virtual memory between a parent and child

(C) Create a private copy of an existing file and not write any changes back to the file

(D) Read virtual memory of a process on a remote machine

Correct answer: D.
Your answer: D.
1 out of **1** point received

Solution. The protection bits are READ,WRITE and EXECUTE. Example: The C library (libc) is opened as file descriptor and then mmap'd into the address space of the process.

10. (1 point.) I want to create a link in my home directory to directory containing my favorite movies, what kind of link(s) is/are most reasonable for a non-root user?

(A) Neither symbolic nor hard links are good choices for this task

(B) A symbolic link is a good choice but a hard link is not

(C) Both a symbolic link and hard link are good choices for this task

(D) A hard link is a good choice but a symbolic link is not a good choice

(E) A hard link is appropriate only if the movie directory has its execute bit set

Correct answer: B.
Your answer: B.
1 out of **1** point received

11. (1 point.) I create a directory with permissions 500. Which response is a reasonable output of the `ls` command below?

```
mkdir -m 500 stuff
ls -ldi stuff
```

(A) 12435 d------r-x. 2 angrave angrave 4096 Nov 16 20:51 stuff

(B) 12435 dr-x------. 2 angrave angrave 4096 Nov 16 20:51 stuff

(C) 12435 dr-xr-xr-x. 2 angrave angrave 4096 Nov 16 20:51 stuff

(D) 12435 dr-sr-sr-s. 2 angrave angrave 4096 Nov 16 20:51 stuff

(E) 12435 dr--r-----. 2 angrave angrave 4096 Nov 16 20:51 stuff

Correct answer: B.
Your answer: B.
1 out of **1** point received

12. (1 point.) Before modifying an existing file, the umask is changed to 777. What affect, if any, will this have on the existing file? A reminder that `>` redirects standard output to a file and `>>` appends standard output to a file.

```
echo "Hello" > story.txt
umask 777
echo "Again" >> story.txt
```

(A) The story.txt contents can be read and modified by other users

(B) Existing files and directories are unaffected by the umask value

(C) The story.txt contents is not readable by the user who created it

(D) The story.txt contents is not modifiable by the user who created it

(E) The story.txt contents cannot be modified or read by other users

Correct answer: B.
Your answer: B.
1 out of **1** point received

13. (1 point.) Solve my riddle! I am a virtual file in a virtual filesystem. I provide a source of random values also based on entropy of the system however I never block and will always return pseudo-random values even when there is little entropy in the system.

(A) /dev/noise

(B) /random/noise

(C) /dev/rnd

(D) /dev/source

(E) /dev/urandom

Correct answer: E.
Your answer: E.
1 out of **1** point received

14. (1 point.) How many lines will be printed by this program and what is the content of each line? Assume all system calls complete successfully.

```
int main(int argc, char**argv) {
  mkdir("dir1",0755);
  mkdir("dir1/dir2",0755);
  symlink("dir1/dir2","dir1/sym");
  struct dirent* dp;
  DIR* dirp = opendir("dir1");
  while ((dp = readdir(dirp)) != NULL) {
      puts(dp->d_name);
  }
  closedir(dirp);
  return 0;
}
```

(A) 3 lines are printed: "." "dir2" and "sym"

(B) 4 lines are printed: "." ".." "dir2" and "sym"

(C) 3 lines are printed: "." ".." and "dir2"

(D) 2 lines are printed: "dir2" and "sym"

(E) 3 lines are printed: ".." "dir2" and "sym"

Correct answer: B.
Your answer: B.
1 out of **1** point received

15. (1 point.) Complete the following to create shared memory between a parent and child process that is NOT backed by a file. The shared memory must be large enough to hold one integer and be usable for IPC (Interprocess communication)

```
int* addr = _____;
*addr=42;
pid_t child = fork();
```

(A) `mmap (0, sizeof(int), PROT_READ | PROT_WRITE, MAP_SHARED | MAP_ANON, -1, 0)`

(B) `smem(1, S_CHILD)`

(C) `mmap (0, 1, 0, MAP_SHARED , -1, 0)`

(D) `openmem(sizeof(int), S_PARENT|S_CHILD, -1)`

(E) `mmap (0, sizeof(int), PROT_READ , MAP_SHARED , -1, 0)`

Correct answer: A.
Your answer: A.
1 out of **1** point received

16. (1 point.) Which one of the following creates a file named `data` in my home directory of size 1MB of random bytes ?

(A) `dd if=/dev/urandom of=~/data bs=1024 count=1024`

(B) `cp --random ~/data -m1024*1024`

(C) `dd -count=1MB /dev/rnd home/data`

(D) `cp /dev/rnd ~/data --maxsize=1MB`

(E) `cat /dev/noise | /home/data`

Correct answer: A.
Your answer: A.
1 out of **1** point received

17. (1 point.) I execute `rm abc` to successfully delete my regular file. The file contents however are still accessible under a different filename in a different directory! What is the best explanation?

(A) The file must have been created in the `/etc` `/var` or `/tmp` directory

(B) The file must have had its setuid bit set

(C) A symbolic link to the file must have been created before it was deleted

(D) The file must have had its sticky bit set

(E) A hard link to the file must have been created before it was deleted

Correct answer: E.
Your answer: E.
1 out of **1** point received

18. (1 point.) Choose the best fitting description to complete the following: A directory disk consists of an inode and data blocks. The directory's data blocks contain ...

(A) Only filenames of the directory entries

(B) Filenames and inode numbers of the directory entries

(C) Only filenames and permissions of the directory entries

(D) Only inode numbers of the directory entries

(E) Only filenames and hard-link entries

Correct answer: B.
Your answer: B.
1 out of **1** point received

19. (1 point.) Which one of the following is NOT true when mounting filesystems using Linux's `mount` shell command?

(A) `mount` can be used to mount virtual and real filesystems

(B) `mount` requires admin (root) privileges to mount an arbitrary filesystem in an arbitrary directory

(C) `mount` can mount loop-ed filesystems stored as a single file on an existing filesystem

(D) Only read-only filesystems can be mounted

(E) File access permissions and ownership can be configured as part of the mounting process

Correct answer: D.
Your answer: D.
1 out of **1** point received

20. (1 point.) I create a symbolic link,

`ln -s /var/file1.c  file2.c`

What must be true?

(A) None of the other responses are correct

(B) `file1.c` must already exist before the link was created

(C) `file1.c` must be on the same filesystem as `file2.c`

(D) `file2.c` must be in the same directory as `file1.c`

(E) `file1.c` must be a named pipe

Correct answer: A.
Your answer: A.
1 out of **1** point received

21. (1 point.) My old harddisk has a seek time of 10ms and transfer rate of 50 MB/s. I perform the following benchmark on my system which takes 20 seconds to complete

```
dd if=/dev/zero of=/dev/null bs=1M count=123456
```

I now replace my hard disk with a solid state drive (SSD) that can execute 50,000 I/O 4KB block requests per second and a transfer rate of 250 MB/s. What is the expected completion time now for the above benchmark?

(A) 10-99 ms

(B) Less than 9ms

(C) 10-30 seconds

(D) 1-9.9 seconds

(E) 100-999 ms

Correct answer: C.
Your answer: C.
1 out of **1** point received

Solution. The benchmark should run in approximately the same amount of time: The above dd command is reading bytes from a virtual file `/dev/zero` and writing to a virtual file `/dev/null` from the virtual `/dev` file system - there are no bytes being read or written to a physical disk during the approx. 12GB transfer!

22. (1 point.) Which one of the following shell commands has the "setuid bit" set?

(A) sudo

(B) touch

(C) dd

(D) rm

(E) mkdir

Correct answer: A.
Your answer: A.
1 out of **1** point received

23. (1 point.) Which response best describes the purpose of /sys and /proc virtual filesystems?

(A) To provide a filesystem view of kernel objects and resources currently used by the kernel and user processes

(B) To provide networked filesystem control

(C) None of the other responses are correct

(D) To provide standard area to mount temporary devices such as USB keys and DVDs

(E) To provide thread and synchronization control of kernel tasks

Correct answer: A.
Your answer: A.
1 out of **1** point received

24. (1 point.) Choose the best explanation. The probability of a second disk failure during RAID rebuild is approximately $MTTR(N-1)/(MTTF_1)$ where N is the number of disks, $MTTR$ is the mean time to repair and $MTTF_1$ is the mean time to failure for one disk. In real production systems, the probability is significantly higher because...

(A) Disk failure is expected in production systems

(B) None of the other answers are appropriate

(C) RAID is not used in production systems

(D) Disk failure is correlated for disks from the same manufacturing batch

(E) The number of disks N is too small for this formula to be accurate

Correct answer: D.
Your answer: B.
0 out of **1** point received

25. (1 point.) Which of the following describes how Google manages its distributed file system "Colossus"?

```
1 Multiple copies in different geographic regions
2 Reed-solomon encoded data-blocks to recover from single bit and multiple-bit errors
3 Resilient to sudden failure of individual disks, servers, racks of servers, and entire data-centers
4 Pro-active warning when free space is under 1 petabyte
```

(A) (4) only

(B) None of the other responses are correct

(C) (1) (2) (3) (4)

(D) (1) + (2) only

(E) (3) + (4) only

Correct answer: C.
Your answer: C.
1 out of **1** point received

26. (1 point.) I will use `mmap` for IPC between a parent and child process, the bytes will be generated from a computation by the child. A reasonable options flag value is

(A) MAP_SHARED — MAP_ANONYMOUS

(B) None of the options are appropriate

(C) MAP_PRIVATE — MAP _FILE

(D) MAP_PRIVATE

(E) 0

Correct answer: A.

Your answer: A.

1 out of **1** point received

27. (1 point.) The following code creates one file, one hard link and one symbolic link. What will be the output of the last line? Hint `>>` implies redirect standard output to append-to-the file and `echo -n` means print the arguments but do not print a trailing newline. You can assume none of these files existed before.

```
touch 1.txt
ln 1.txt hard.txt
ln -s hard.txt sym.txt
echo -n "1" >> 1.txt
echo -n "2" >> hard.txt
echo -n "3" >> sym.txt
rm hard.txt
echo -n "4" >> 1.txt
echo -n "5" >> hard.txt
echo -n "6" >> sym.txt
cat 1.txt
```

(A) 123456

(B) 1245

(C) 123

(D) 1456

(E) 1234

Correct answer: E.
Your answer: E.
1 out of **1** point received

Summary of answers:

Question	Correct Answer	Your Answer	Points
1	B	B	1
2	C	C	1
3	C	C	1
4	B	B	1
5	D	E	0
6	E	E	1
7	C	C	1
8	A	A	1
9	D	D	1
10	B	B	1
11	B	B	1
12	B	B	1
13	E	E	1
14	B	B	1
15	A	A	1
16	A	A	1
17	E	E	1
18	B	B	1
19	D	D	1
20	A	A	1
21	C	C	1
22	A	A	1
23	A	A	1
24	D	B	0
25	C	C	1
26	A	A	1
27	E	E	1
Total			25