1- **Using Loop devices, create 4 PVs**

```
vboxuser@ubonto:~$ dd if=/dev/zero of=disk1.disk bs=1024 count=10000
10000+0 records in
10000+0 records out
10240000 bytes (10 MB, 9.8 MiB) copied, 0.117392 s, 87.2 MB/s
vboxuser@ubonto:~$ dd if=/dev/zero of=disk2.disk bs=1024 count=10000
10000+0 records in
10000+0 records out
10240000 bytes (10 MB, 9.8 MiB) copied, 0.117689 s, 87.0 MB/s
vboxuser@ubonto:~$ dd if=/dev/zero of=disk3.disk bs=1024 count=10000
10000+0 records in
10000+0 records out
10240000 bytes (10 MB, 9.8 MiB) copied, 0.11962 s, 85.6 MB/s
vboxuser@ubonto:~$ dd if=/dev/zero of=disk4.disk bs=1024 count=10000
10000+0 records in
10000+0 records out
10240000 bytes (10 MB, 9.8 MiB) copied, 0.121731 s, 84.1 MB/s
vboxuser@ubonto:~$ sudo losetup -f
[sudo] password for vboxuser:
/dev/loop23
vboxuser@ubonto:~$ sudo losetup /dev/loop23 disk1.disk
vboxuser@ubonto:~$ sudo losetup /dev/loop24 disk2.disk
vboxuser@ubonto:~$ sudo losetup /dev/loop25 disk3.disk
vboxuser@ubonto:~$ sudo losetup /dev/loop26 disk4.disk
```

2- **create VG and add 3 on PVs to it**

```
vboxuser@ubonto:~$ sudo pvcreate /dev/loop23 /dev/loop24 /dev/loop25
  Physical volume "/dev/loop23" successfully created.
  Physical volume "/dev/loop24" successfully created.
  Physical volume "/dev/loop25" successfully created.
vboxuser@ubonto:~$ sudo pvscab
sudo: pvscab: command not found
vboxuser@ubonto:~$ sudo pvscan
  PV /dev/loop23                     lvm2 [<9.77 MiB]
  PV /dev/loop24                     lvm2 [<9.77 MiB]
  PV /dev/loop25                     lvm2 [<9.77 MiB]
  Total: 3 [<29.30 MiB] / in use: 0 [0   ] / in no VG: 3 [<29.30 MiB]
vboxuser@ubonto:~$
```

3- **create LV which has size of 250M**

```
vboxuser@ubonto:~$ sudo lvcreate -L 20M -n lv1 vg1
  Logical volume "lv1" created.
```

4- **format LV using ext4**

```
vboxuser@ubonto:~$ sudo mkfs.ext4 /dev/vg1/lv1
mke2fs 1.45.5 (07-Jan-2020)
Discarding device blocks: done
Creating filesystem with 5120 4k blocks and 5120 inodes

Allocating group tables: done
Writing inode tables: done
Creating journal (1024 blocks): done
Writing superblocks and filesystem accounting information: done
```

5- **mount LV into /mnt directory**

```
vboxuser@ubonto:~$ sudo mkdir /mnt/lv
vboxuser@ubonto:~$ sudo mount /dev/vg1/lv1 /mnt/lv
```

6- **extend VG with the remaining PV**

```
vboxuser@ubonto:~$ sudo vgextend vg1 /dev/loop37
  Physical volume "/dev/loop37" successfully created.
  Volume group "vg1" successfully extended
```

7- **extend LV with +50M**

```
vboxuser@ubonto:~$ sudo lvextend /dev/vg1/lv1 -L +5M
  Rounding size to boundary between physical extents: 8.00 MiB.
  Size of logical volume vg1/lv1 changed from 20.00 MiB (5 extents) to 28.00 MiB
 (7 extents).
  Logical volume vg1/lv1 successfully resized.
```

8- **resize2fs LV with the 50M extra**

```
vboxuser@ubonto:~$ e2fsck -f /dev/vg1/lv1
e2fsck 1.45.5 (07-Jan-2020)
e2fsck: Permission denied while trying to open /dev/vg1/lv1
You must have r/w access to the filesystem or be root
vboxuser@ubonto:~$ sudo e2fsck -f /dev/vg1/lv1
e2fsck 1.45.5 (07-Jan-2020)
Pass 1: Checking inodes, blocks, and sizes
Pass 2: Checking directory structure
Pass 3: Checking directory connectivity
Pass 4: Checking reference counts
Pass 5: Checking group summary information
/dev/vg1/lv1: 11/5120 files (9.1% non-contiguous), 1196/5120 blocks
vboxuser@ubonto:~$ sudo resize2fs /dev/vg1/lv1 +50M
resize2fs 1.45.5 (07-Jan-2020)
The containing partition (or device) is only 7168 (4k) blocks.
You requested a new size of 12800 blocks.
```

********************Network********************

1- Display the network interface information using `ip` command

```
derbird Mail bonto:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defaul
t qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP gr
oup default qlen 1000
    link/ether 08:00:27:34:b4:88 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 74734sec preferred_lft 74734sec
    inet6 fe80::495:b0f:dd14:5126/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

2- Display currently active TCP connections on your OS using `netstat`command

```
vboxuser@ubonto:~$ netstat -t
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 10.0.2.15:59020         kazooie.canonical.:http TIME_WAIT
tcp        0      0 10.0.2.15:38710         ec2-35-163-38-240:https ESTABLISHED
tcp        0      0 10.0.2.15:54590         239.237.117.34.bc:https ESTABLISHED
vboxuser@ubonto:~$
```

3- Display currently open ports on your system using `nmap` command (install it using apt)

```
vboxuser@ubonto:~$ netstat -a -n | grep ESTABLISHED
tcp        0      0 10.0.2.15:38710         35.163.38.240:443       ESTABLISHED
udp        0      0 10.0.2.15:68            10.0.2.2:67             ESTABLISHED
vboxuser@ubonto:~$
```