

TestOut[®]

TestOut Linux Pro – English 5.0.x

Objective Mappings:

TestOut Linux Pro

CompTIA XK0-004

Contents

This document contains four objective mappings.

LabSim Section to Linux Pro Objective.....	3
Linux Pro Objective to LabSim Section.....	13
LabSim Section to XK0-004 Objective	16
XK0-004 Objectives to LabSim Section	65

LabSim Section to Linux Pro Objective

The Linux Pro course covers the following TestOut Linux Pro exam objectives:

Section	Title	Objectives
0.0	Linux Pro Introduction	
0.1	Course Introduction	2.2 Manage the file system View information about directories and files in the file system Create, copy, move, and delete files in the file system
0.2	The TestOut Lab Simulator	
1.0	Linux Overview	
1.1	Linux Introduction	
2.0	Using Linux	
2.1	The Linux Shell	1.2 Configure and use Linux shell environments View available shells
2.2	Linux Help	1.1 Use command-line utilities Get help with Linux command-line utilities
2.3	Text Editors	2.2 Manage the file system

		Create, copy, move, and delete files in the file system
2.4	Aliases	
2.5	Environment Variables	1.2 Configure and use Linux shell environments Manage environment variables
2.6	Shell Configuration Files	
2.7	Redirection, Piping and Command Substitution	
2.8	Directories	2.2 Manage the file system View information about directories and files in the file system Create, copy, move, and delete directories in the file system
2.9	Files	2.2 Manage the file system View information about directories and files in the file system Create, copy, move, and delete directories in the file system Create, copy, move, and delete files in the file system
2.10	Links	2.2 Manage the file system Create and manage hard and symbolic link files
2.11	Filesystem Hierarchy Standard (FHS)	
2.12	Locating and Searching Files	
2.13	Text Stream Processing	

3.0	Installation and Localization	
3.1	Linux System Design	
3.2	Linux Installation	
3.3	Localization	
4.0	Boot and Shutdown	
4.1	Linux Boot Process	
4.2	Bootloaders	1.3 Manage system startup and shutdown Manage bootloader configurations
4.3	systemd Boot Targets	1.3 Manage system startup and shutdown Manage bootloader configurations View and manage runlevels or boot targets for system services Set the default system runlevel or boot target
4.4	System Services	1.4 Manage system processes Start, stop, and restart system services Monitor and manage running processes
4.5	System Shutdown	1.3 Manage system startup and shutdown Shut down and restart the system
5.0	Graphical User Interfaces and Desktops	
5.1	Graphical User Interfaces	

5.2	Linux Desktops	
5.3	Remote Desktop	
5.4	Accessibility	
6.0	Software Installation	
6.1	Red Hat Package Manager (RPM)	1.5 Use package management Install, remove, and update packages with the RPM command
6.2	Online Package Installation	1.5 Use package management Install, remove, and update packages with the RPM command Install, remove, and update RPM packages with DNF
6.3	Debian Package Manager (dpkg)	
6.4	Shared Libraries	
7.0	Users and Groups	
7.1	User and Group Overview	4.1 Manage users and groups Create and manage groups Create and manage user accounts Manage user passwords Manage user access
7.2	User Management	4.1 Manage users and groups Create and manage user accounts Manage user passwords

		Manage user access
7.3	Group Management	4.1 Manage users and groups Create and manage groups
8.0	Disk and File System Management	
8.1	MBR Disk Partitions	2.1 Manage storage devices Create and manage disk partitions Create and manage swap partitions
8.2	GUID Partitions	2.1 Manage storage devices Create and manage disk partitions
8.3	Logical Volume Manager	2.1 Manage storage devices Configure Logical Volume management
8.4	File Systems	2.1 Manage storage devices Create and manage disk partitions Create and manage disk file systems Create and manage swap partitions
8.5	Mounting File Systems	2.1 Manage storage devices Mount and unmount devices in the file system

8.6	File System Maintenance	
8.7	Disk Quotas	2.2 Manage the file system Implement disk quotas
8.8	Ownership	4.2 Manage user and group access Manage directory and file ownership for users and groups
8.9	Permissions	4.2 Manage user and group access Manage directory and file permissions for users and groups
8.10	The umask Command	4.2 Manage user and group access Configure umask values
8.11	Special Permissions	4.2 Manage user and group access Use special permissions
8.12	Archive and Backup	2.2 Manage the file system Create and manage archives and backups
9.0	Hardware Installation	
9.1	Device Drivers	2.2 Manage the file system

		View disk space usage statistics
9.2	Kernel Module Management	1.4 Manage system processes Manage kernel modules
9.3	Hotplug and Coldplug Devices	
10.0	Processes and System Services	
10.1	Processes	1.4 Manage system processes Monitor and manage running processes
10.2	Process Management	1.4 Manage system processes Monitor and manage running processes
10.3	Task Management	1.4 Manage system processes Configure scheduled tasks
10.4	Print Management	3.1 Configure networking and printing Configure and manage print jobs
10.5	System Time Configuration	
11.0	System Monitoring	
11.1	System Logging	4.3 Monitor and manage system access

		Monitor logging
11.2	Resource Monitoring	4.3 Monitor and manage system access Monitor logging
12.0	Networking	
12.1	IPv4 Overview	
12.2	Network Interface Configuration	3.1 Configure networking and printing Enable or disable network interfaces Configure IP addresses Troubleshoot IP configuration
12.3	IPv6 Overview	
12.4	Routing Configuration	
12.5	Hostname and DNS Configuration	
12.6	Linux Firewalls	4.3 Monitor and manage system access Manage host firewall
12.7	Network Troubleshooting	3.1 Configure networking and printing Troubleshoot IP configuration
13.0	Cloud and Virtualization	
13.1	Cloud and Virtualization Overview	
13.2	Virtual Machines	

13.3	Virtual Networking	
14.0	Scripting and Automation	
14.1	Bash Shell Scripting	
14.2	Shell Environments, Bash Variables and Parameters	
14.3	Bash Scripting Logic	
14.4	Version Control Using Git	
14.5	Orchestration Processes and Concepts	
15.0	Security	
15.1	Root Usage	4.1 Manage users and groups Manage user access Switch users for access and elevated privilege
15.2	User Security and Restriction	
15.3	Login Blocking	
15.4	Network Security	1.5 Use package management Install, remove, and update packages with the RPM command Install, remove, and update RPM packages with DNF
15.5	The xinetd Super Daemon	
15.6	OpenSSH	4.3 Monitor and manage system access Manage remote connections
15.7	SSH Port Tunneling	

15.8	Security-Enhanced Linux (SELinux)	
15.9	Application Armor (AppArmor)	
15.10	Public Key Authentication	4.3 Monitor and manage system access Manage remote connections
15.11	VPN Access and Authentication	
15.12	Security Best Practices	
A.0	TestOut Linux Pro Practice Exams	
A.1	Preparing for Certification	
A.2	TestOut Linux Pro Domain Practice	
B.0	CompTIA Linux+ Practice Exams	
B.1	Preparing for Certification	
B.2	CompTIA Linux+ XK0-004 Domain Practice (20 Random Questions)	
B.3	CompTIA Linux+ XK0-004 Domain Practice (All Questions)	

Linux Pro Objective to LabSim Section

The Linux Pro course and certification exam cover the following TestOut Linux Pro objectives:

#	Domain	Module.Section
1.0	System Administration and Configuration	
1.1	Use command-line utilities Get help with Linux command-line utilities View the contents of text files	2.2
1.2	Configure and use Linux shell environments Manage environment variables View available shells	2.1, 2.5
1.3	Manage system startup and shutdown Manage bootloader configurations View and manage runlevels or boot targets for system services Set the default system runlevel or boot target Shut down and restart the system	4.2, 4.3, 4.5
1.4	Manage system processes Start, stop, and restart system services Monitor and manage running processes Manage kernel modules	4.4 9.2 10.1, 10.2, 10.3

	Configure scheduled tasks	
1.5	Use package management Install, remove, and update packages with the RPM command Install, remove, and update RPM packages with DNF	6.1, 6.2 15.4
2.0	Storage and File System Management	
2.1	Manage storage devices Create and manage disk partitions Create and manage disk file systems Mount and unmount devices in the file system Create and manage swap partitions Configure Logical Volume management	8.1, 8.2, 8.3, 8.4, 8.5
2.2	Manage the file system View information about directories and files in the file system Use the Linux Filesystem Hierarchy Standard Create, copy, move, and delete directories in the file system Create, copy, move, and delete files in the file system Create and manage hard and symbolic link files View disk space usage statistics Implement disk quotas Create and manage archives and backups	0.1 2.3, 2.8, 2.9, 2.10 8.7, 8.12 9.1
3.0	Networking and Printing	
3.1	Configure networking and printing Enable or disable network interfaces Configure IP addresses	10.4 12.2, 12.7

	Troubleshoot IP configuration Configure and manage print jobs	
4.0	Security and Access Control	
4.1	Manage users and groups Create and manage groups Create and manage user accounts Manage user passwords Manage user access Switch users for access and elevated privilege	7.1, 7.2, 7.3 15.1
4.2	Manage user and group access Manage directory and file ownership for users and groups Manage directory and file permissions for users and groups Configure umask values Use special permissions	8.8, 8.9, 8.10, 8.11
4.3	Monitor and manage system access Monitor logging Manage host firewall Manage remote connections	11.1, 11.2 12.6 15.6, 15.10

LabSim Section to XK0-004 Objective

Section	Title	Objectives
0.0	Linux Pro Introduction	
0.1	Course Introduction	
0.2	The TestOut Lab Simulator	
1.0	Linux Overview	
1.1	Linux Introduction	<p>2.5 Summarize and explain server roles.</p> <ul style="list-style-type: none"> NTP SSH Web Certificate authority Name server DHCP SNMP File servers Authentication server Proxy Logging Containers VPN Monitoring Database Print server Mail server Load balancer Clustering

2.0	Using Linux	
2.1	The Linux Shell	
2.2	Linux Help	
2.3	Text Editors	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>Text editors</p> <p>nano vi</p>
2.4	Aliases	<p>2.2 Given a scenario, manage users and groups.</p> <p>Profiles</p> <p>Bash parameters: User entries: .bashrc Bash parameters: User entries: .bash_profile Bash parameters: User entries: .profile Bash parameters: Global entries: /etc/profile.d/ Bash parameters: Global entries: /etc/profile</p>
2.5	Environment Variables	<p>2.2 Given a scenario, manage users and groups.</p> <p>Profiles</p> <p>Bash parameters: User entries: .bashrc Bash parameters: User entries: .bash_profile Bash parameters: User entries: .profile Bash parameters: Global entries: /etc/bashrc Bash parameters: Global entries: /etc/profile.d/</p>

		<p>Bash parameters: Global entries: /etc/profile</p> <p>5.1 Given a scenario, deploy and execute basic BASH scripts.</p> <p>Shell environments and shell variables</p> <p>PATH Global Local export env set printenv echo</p>
2.6	Shell Configuration Files	<p>2.2 Given a scenario, manage users and groups.</p> <p>Profiles</p> <p>Bash parameters: User entries: .bashrc Bash parameters: User entries: .bash_profile Bash parameters: User entries: .profile Bash parameters: Global entries: /etc/bashrc Bash parameters: Global entries: /etc/profile.d/ Bash parameters: Global entries: /etc/profile</p>
2.7	Redirection, Piping and Command Substitution	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>Output redirection</p> <p>< > << >></p>

		<p>2> &> stdin stdout stderr /dev/null /dev/tty xargs tee Here documents</p> <p>5.1 Given a scenario, deploy and execute basic BASH scripts.</p> <p>Shell expansions</p> <p>\$(,`</p> <p>Redirection and piping</p>
2.8	Directories	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File and directory operations</p> <p>mv cp rm ls mkdir rmdir</p>
2.9	Files	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File readers</p>

		<p>cat tail head less more</p> <p>File and directory operations</p> <p>touch mv cp rm</p>
2.10	Links	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File and directory operations</p> <p>In: Symbolic (soft) In: Hard unlink inodes</p>
2.11	Filesystem Hierarchy Standard (FHS)	
2.12	Locating and Searching Files	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File readers</p> <p>grep</p> <p>Text processing</p> <p>grep</p>

		<p>egrep</p> <p>File and directory operations</p> <p>find locate grep which whereis diff</p>
2.13	Text Stream Processing	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>Text processing</p> <p>tr sort awk sed cut wc paste</p>
3.0	Installation and Localization	
3.1	Linux System Design	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <p>Basic partitions File system types</p>
3.2	Linux Installation	

3.3	Localization	<p>1.6 Given a scenario, configure localization options.</p> <p>Commands</p> <p>locaectl</p> <p>Environment variables</p> <p>LC_* LC_ALL LANG</p> <p>Character sets</p> <p>UTF-8 ASCII Unicode</p>
4.0	Boot and Shutdown	
4.1	Linux Boot Process	<p>1.1 Explain Linux boot process concepts.</p> <p>Boot loaders</p> <p>GRUB GRUB2</p> <p>Boot options</p> <p>UEFI/EFI PXE NFS Boot from ISO</p>

		<p>Boot from HTTP/FTP</p> <p>File locations</p> <p>/boot/efi</p> <p>Boot modules and files</p> <p>Commands: mkinitrd Commands: dracut initramfs efi files vmlinuz vmlinux</p>
4.2	Bootloaders	<p>1.1 Explain Linux boot process concepts.</p> <p>Boot loaders</p> <p>GRUB GRUB2</p> <p>Boot options</p> <p>UEFI/EFI</p> <p>File locations</p> <p>/etc/default/grub /etc/grub2.cfg /boot /boot/grub /boot/grub2</p>

		<p>Boot modules and files</p> <p>Commands: mkinitrd Commands: grub2-install Commands: grub2-mkconfig</p>
4.3	systemd Boot Targets	<p>2.4 Given a scenario, manage services.</p> <p>Systemd management</p> <p>Systemd-analyze blame Unit files: Directory locations Unit files: Environment parameters Unit files: Targets Unit files: Hostnamectl Unit files: Automount</p>
4.4	System Services	<p>2.4 Given a scenario, manage services.</p> <p>Systemd management</p> <p>Systemctl: Enabled Systemctl: Disabled Systemctl: Start Systemctl: Stop Systemctl: Mask Systemctl: Restart Systemctl: Status Systemctl: Daemon-reload</p> <p>SysVinit</p> <p>chkconfig: on chkconfig: off chkconfig: level</p>

		Runlevels: Definitions of 0–6 Runlevels: /etc/init.d Runlevels: /etc/rc.d Runlevels: /etc/rc.local Runlevels: /etc/inittab Runlevels: Commands: runlevel Runlevels: Commands: telinit Service: Restart Service: Status Service: Stop Service: Start Service: Reload
4.5	System Shutdown	
5.0	Graphical User Interfaces and Desktops	
5.1	Graphical User Interfaces	2.8 Compare and contrast Linux graphical user interfaces. Servers Wayland X11
5.2	Linux Desktops	2.8 Compare and contrast Linux graphical user interfaces. GUI Gnome Unity Cinnamon MATE KDE

5.3	Remote Desktop	<p>2.8 Compare and contrast Linux graphical user interfaces.</p> <p>Remote desktop</p> <p>VNC XRDP NX Spice</p>
5.4	Accessibility	<p>2.8 Compare and contrast Linux graphical user interfaces.</p> <p>Accessibility</p>
6.0	Software Installation	
6.1	Red Hat Package Manager (RPM)	<p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Package types</p> <p>.rpm</p> <p>Installation tools</p> <p>RPM</p>
6.2	Online Package Installation	<p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Package types</p> <p>.rpm</p>

		<p>Installation tools</p> <p>YUM DNF Zypper</p>
6.3	Debian Package Manager (dpkg)	<p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Package types</p> <p>.deb</p> <p>Installation tools</p> <p>Dpkg APT</p>
6.4	Shared Libraries	<p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Build tools</p> <p>Commands: make Commands: make install Commands: ldd Compilers Shared libraries</p> <p>Repositories</p> <p>Configuration Creation Syncing</p>

		<p>Locations</p> <p>Acquisition commands</p> <p>wget curl</p>
7.0	Users and Groups	
7.1	User and Group Overview	<p>2.2 Given a scenario, manage users and groups.</p> <p>Creation Queries</p> <p>id</p> <p>Important files and file contents</p> <p>/etc/passwd /etc/group /etc/shadow</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>Permission</p> <p>Service accounts</p>
7.2	User Management	<p>2.2 Given a scenario, manage users and groups.</p> <p>Creation</p>

		<p>useradd</p> <p>Modification</p> <p>usermod passwd</p> <p>Deletion</p> <p>userdel</p> <p>Profiles</p> <p>Bash parameters: User entries: .bashrc Bash parameters: Global entries: /etc/skel</p> <p>Important files and file contents</p> <p>/etc/passwd /etc/group /etc/shadow</p>
7.3	Group Management	<p>2.2 Given a scenario, manage users and groups.</p> <p>Creation</p> <p>groupadd</p> <p>Modification</p> <p>usermod groupmod</p>

		<p>Deletion</p> <p>groupdel</p> <p>Important files and file contents</p> <p>/etc/group</p>
8.0	Disk and File System Management	
8.1	MBR Disk Partitions	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <p>Basic partitions</p> <p>Raw devices MBR</p> <p>Tools</p> <p>Commands: fdisk Commands: lsblk Commands: blkid</p> <p>Location</p> <p>/dev/ /proc/partitions</p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Storage monitoring and configuration</p> <p>partprobe</p>

8.2	GUID Partitions	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <ul style="list-style-type: none"> Basic partitions GPT Tools Commands: parted
8.3	Logical Volume Manager	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <ul style="list-style-type: none"> Device mapper LVM <ul style="list-style-type: none"> mdadm Multipath Tools LVM tools Location <ul style="list-style-type: none"> /dev/mapper /dev/disk/by-id /dev/disk/by-uuid /dev/disk/by-path /dev/disk/by-multipath
8.4	File Systems	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <ul style="list-style-type: none"> Tools

		<p>Commands: mkfs</p> <p>File system types</p> <p>ext3 ext4 xfs ntfs</p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Memory monitoring and configuration</p> <p>swapon swapoff mkswap</p>
8.5	Mounting File Systems	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <p>Device mapper</p> <p>LVM</p> <p>Tools</p> <p>LVM tools Commands: df Commands: mount Commands: umount</p> <p>Location</p> <p>/etc/fstab /dev/ /etc/mtab</p>

		<p>/proc/mounts</p> <p>File system types</p> <p>ext3 ext4</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>Storage</p> <p>Degraded storage Missing devices Missing volumes Missing mount point Performance issues Resource exhaustion Adapters: SCSI Adapters: RAID Adapters: SATA Adapters: HBA: /sys/class/scsi_host/host#/scan Storage integrity: Bad blocks</p>
8.6	File System Maintenance	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <p>Tools</p> <p>Commands: df Commands: du Commands: dumpe2fs Commands: fsck Commands: tune2fs</p> <p>Location</p>

		<p><code>/etc/fstab</code></p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Storage monitoring and configuration</p> <p><code>iostat</code> <code>ioping</code> IO scheduling: <code>cfq</code> IO scheduling: <code>noop</code> IO scheduling: <code>deadline</code> <code>du</code> <code>df</code> <code>fsck</code></p> <p>4.2 Given a scenario, analyze system processes in order to optimize performance.</p> <p>Process management</p> <p>Commands: <code>lsdf</code></p>
8.7	Disk Quotas	<p>1.4 Given a scenario, manage storage in a Linux environment.</p> <p>Location</p> <p><code>/etc/fstab</code></p> <p>2.2 Given a scenario, manage users and groups.</p> <p>Quotas</p> <p>User quota Group quota</p>

		<p>4.3 Given a scenario, analyze and troubleshoot user issues.</p> <p>File creation</p> <p>Quotas</p>
8.8	Ownership	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File and directory operations</p> <p>ls</p> <p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>File and directory permissions</p> <p>Read, write, execute</p> <p>Utilities: chown</p> <p>Utilities: chgrp</p> <p>Utilities: chage</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>Permission</p> <p>Ownership</p>
8.9	Permissions	<p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>File and directory permissions</p> <p>Read, write, execute</p>

		<p>User, group, other Utilities: chmod Utilities: chown Utilities: getfacl Utilities: setfacl Utilities: ls</p> <p>4.3 Given a scenario, analyze and troubleshoot user issues.</p> <p>Permissions</p> <p>File Directory</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>Permission</p> <p>Ownership Executables</p>
<p>8.10</p>	<p>The umask Command</p>	<p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>File and directory permissions</p> <p>umask</p> <p>4.3 Given a scenario, analyze and troubleshoot user issues.</p> <p>Permissions</p> <p>File Directory</p>

8.11	Special Permissions	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File and directory operations</p> <p>ls</p> <p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>File and directory permissions</p> <p>SUID Sticky bit Utilities: chmod Utilities: ls</p> <p>4.3 Given a scenario, analyze and troubleshoot user issues.</p> <p>Permissions</p> <p>File Directory</p> <p>5.1 Given a scenario, deploy and execute basic BASH scripts.</p> <p>Directory and file permissions</p> <p>chmod</p>
8.12	Archive and Backup	<p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Package types</p>

		<p>.tar</p> <p>3.6 Given a scenario, backup, restore, and compress files.</p> <p>Archive and restore utilities</p> <p>tar cpio dd</p> <p>Compression</p> <p>gzip xz bzip2 zip</p> <p>Backup types</p> <p>Incremental Full Snapshot clones Differential Image</p>
9.0	Hardware Installation	
9.1	Device Drivers	<p>1.2 Given a scenario, install, configure, and monitor kernel modules.</p> <p>Locations</p> <p>/usr/lib/modules/[kernelversion] /usr/lib/modules</p>

		<p>2.7 Explain the use and operation of Linux devices.</p> <p>Types of devices</p> <p>Client devices</p> <p>Bluetooth</p> <p>WiFi</p> <p>USB</p> <p>Monitors</p> <p>GPIO</p> <p>Network adapters</p> <p>PCI</p> <p>HBA</p> <p>SATA</p> <p>SCSI</p> <p>Printers</p> <p>Video</p> <p>Audio</p> <p>Monitoring and configuration tools</p> <p>lsdev</p> <p>lsusb</p> <p>lspci</p> <p>File locations</p> <p>/proc</p> <p>/sys</p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>CPU monitoring and configuration</p> <p>/proc/cpuinfo</p>
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9.2	Kernel Module Management	<p>1.2 Given a scenario, install, configure, and monitor kernel modules.</p> <p>Commands</p> <p>lsmod insmod modprobe modinfo rmmod depmod</p> <p>Locations</p> <p>/usr/lib/modules/[kernelversion] /usr/lib/modules /etc/modprobe.conf /etc/modprobe.d/</p>
9.3	Hotplug and Coldplug Devices	<p>2.7 Explain the use and operation of Linux devices.</p> <p>Types of devices</p> <p>USB PCI</p> <p>Monitoring and configuration tools</p> <p>udevadm: add udevadm: reload-rules udevadm: control udevadm: trigger</p> <p>File locations</p>

		<p>/dev</p> <p>Hot pluggable devices</p> <p>/etc/udev/rules.d</p>
10.0	Processes and System Services	
10.1	Processes	<p>4.2 Given a scenario, analyze system processes in order to optimize performance.</p> <p>Process management</p> <p>Process states: Zombie</p> <p>Process states: Uninterruptible sleep</p> <p>Process states: Interruptible sleep</p> <p>Process states: Running</p> <p>Priorities</p> <p>Commands: top</p> <p>Commands: ps</p> <p>Commands: pgrep</p> <p>PIDs</p>
10.2	Process Management	<p>2.6 Given a scenario, automate and schedule jobs.</p> <p>fg</p> <p>bg</p> <p>&</p> <p>kill</p> <p>Ctrl+c</p> <p>Ctrl+z</p> <p>nohup</p>

		<p>4.2 Given a scenario, analyze system processes in order to optimize performance.</p> <p>Process management</p> <p>Priorities Kill signals Commands: nice Commands: renice Commands: pkill PIDs</p>
10.3	Task Management	<p>2.4 Given a scenario, manage services.</p> <p>SysVinit</p> <p>Runlevels: /etc/init.d Runlevels: /etc/rc.d</p> <p>2.6 Given a scenario, automate and schedule jobs.</p> <p>cron at crontab</p> <p>3.3 Summarize security best practices in a Linux environment.</p> <p>Restrict cron access</p>
10.4	Print Management	<p>2.7 Explain the use and operation of Linux devices.</p> <p>Monitoring and configuration tools</p> <p>lpr</p>

		lpq CUPS
10.5	System Time Configuration	<p>1.6 Given a scenario, configure localization options.</p> <p>File locations</p> <p>/etc/timezone /usr/share/zoneinfo</p> <p>Commands</p> <p>timedatectl date hwclock</p> <p>Environment variables</p> <p>TZ</p> <p>2.5 Summarize and explain server roles.</p> <p>NTP</p>
11.0	System Monitoring	
11.1	System Logging	<p>1.2 Given a scenario, install, configure, and monitor kernel modules.</p> <p>Commands</p> <p>dmesg</p>

		<p>3.4 Given a scenario, implement logging services.</p> <p>Key file locations</p> <p><code>/var/log/secure</code> <code>/var/log/messages</code> <code>/var/log/[application]</code> <code>/var/log/kern.log</code></p> <p>Log management</p> <p><code>logrotate</code> <code>/etc/rsyslog.conf</code> <code>journalctl</code></p> <p><code>lastb</code></p>
11.2	Resource Monitoring	<p>2.7 Explain the use and operation of Linux devices.</p> <p>Monitoring and configuration tools</p> <p><code>abrt</code></p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Network monitoring and configuration</p> <p>Commands: <code>netstat</code></p> <p>Storage monitoring and configuration</p> <p><code>iostat</code></p>

		<p>CPU monitoring and configuration</p> <p>/proc/cpuinfo uptime loadaverage sar sysctl</p> <p>Memory monitoring and configuration</p> <p>vmstat Out of memory killer free /proc/meminfo Buffer cache output</p> <p>4.2 Given a scenario, analyze system processes in order to optimize performance.</p> <p>Process management</p> <p>Commands: top Commands: lsof</p>
12.0	Networking	
12.1	IPv4 Overview	<p>1.5 Compare and contrast cloud and virtualization concepts and technologies.</p> <p>Network considerations</p> <p>NAT</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p>

		<p>Troubleshooting additional hardware issues</p> <p>Communications ports</p>
12.2	Network Interface Configuration	<p>1.3 Given a scenario, configure and verify network connection parameters.</p> <p>Diagnostic tools</p> <p>ip</p> <p>Configuration files</p> <p>/etc/sysconfig/network-scripts/ /etc/sysconfig/network /etc/netplan /etc/dhcp/dhclient.conf</p> <p>Bonding</p> <p>Aggregation Active/passive Load balancing</p>
12.3	IPv6 Overview	
12.4	Routing Configuration	<p>1.3 Given a scenario, configure and verify network connection parameters.</p> <p>Diagnostic tools</p> <p>route ip</p>

		<p>Configuration files</p> <p><code>/etc/sysconfig/network-scripts/</code> <code>/etc/sysconfig/network</code></p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Network monitoring and configuration</p> <p>Routing Commands: route</p>
<p>12.5</p>	<p>Hostname and DNS Configuration</p>	<p>1.3 Given a scenario, configure and verify network connection parameters.</p> <p>Diagnostic tools</p> <p>nslookup dig host</p> <p>Configuration files</p> <p><code>/etc/sysconfig/network-scripts/</code> <code>/etc/hosts</code> <code>/etc/nsswitch.conf</code> <code>/etc/resolv.conf</code></p> <p>2.5 Summarize and explain server roles.</p> <p>Name server</p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p>

		<p>Network monitoring and configuration</p> <p>Name resolution Commands: nslookup Commands: dig Commands: host</p>
12.6	Linux Firewalls	<p>3.5 Given a scenario, implement and configure Linux firewalls.</p> <p>Access control lists</p> <p>Source Destination Ports Protocol Logging Stateful vs. stateless Accept Reject Drop Log</p> <p>Technologies</p> <p>firewalld: Zones firewalld: Run time iptables: Persistency iptables: Chains ufw: /etc/default/ufw ufw: /etc/ufw/ Netfilter</p> <p>IP forwarding</p> <p>/proc/sys/net/ipv4/ip_forward</p>

		<p><code>/proc/sys/net/ipv6/ip_forward</code></p> <p>Dynamic rule sets</p> <p>DenyHosts Fail2ban IPset</p> <p>Common application firewall configurations</p> <p><code>/etc/services</code> Privileged ports</p>
<p>12.7</p>	<p>Network Troubleshooting</p>	<p>1.3 Given a scenario, configure and verify network connection parameters.</p> <p>Diagnostics tools</p> <p>ping netstat nslookup dig ss nmcli nmtui</p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Network monitoring and configuration</p> <p>Commands: netstat Commands: iftop Commands: iperf Commands: tcpdump Commands: ipset Commands: Wireshark: tshark</p>

		Commands: netcat Commands: traceroute Commands: mtr Commands: arp Commands: dig Commands: whois Commands: ping
13.0	Cloud and Virtualization	
13.1	Cloud and Virtualization Overview	1.5 Compare and contrast cloud and virtualization concepts and technologies. Storage Blob Block Types of hypervisors Tools libvirt
13.2	Virtual Machines	1.5 Compare and contrast cloud and virtualization concepts and technologies. Templates VM OVA OVF JSON YAML Container images

		<p>Bootstrapping</p> <p>Cloud-init Anaconda Kickstart</p> <p>Storage</p> <p>Thin vs. thick provisioning Persistent volumes</p> <p>Network considerations</p> <p>Bridging NAT</p> <p>Tools</p> <p>libvirt virsh vmm</p>
13.3	Virtual Networking	<p>1.5 Compare and contrast cloud and virtualization concepts and technologies.</p> <p>Network considerations</p> <p>Bridging Overlay networks NAT Local Dual-homed</p>
14.0	Scripting and Automation	

14.1	Bash Shell Scripting	<p>5.1 Given a scenario, deploy and execute basic BASH scripts.</p> <p>Shell environments and shell variables</p> <p>PATH Global Local</p> <p>#!/bin/bash Sourcing scripts Commenting</p> <p>#</p> <p>Exit codes</p>
14.2	Shell Environments, Bash Variables and Parameters	<p>5.1 Given a scenario, deploy and execute basic BASH scripts.</p> <p>Shell environments and shell variables</p> <p>Local export env set printenv echo</p> <p>Shell expansions</p> <p>\${ \$(,`</p> <p>Positional parameters</p>

14.3	Bash Scripting Logic	<p>5.1 Given a scenario, deploy and execute basic BASH scripts.</p> <p>Exit codes Looping constructs</p> <p>while for until</p> <p>Conditional statements</p> <p>if case</p>
14.4	Version Control Using Git	<p>5.2 Given a scenario, carry out version control using Git.</p> <p>Arguments</p> <p>clone push pull commit merge branch log init config</p> <p>Files</p> <p>.gitignore .git/</p>

14.5	Orchestration Processes and Concepts	<p>5.3 Summarize orchestration processes and concepts.</p> <ul style="list-style-type: none"> Agent Agentless Procedures Attributes Infrastructure automation Infrastructure as code Inventory Automated configuration management Build automation
15.0	Security	
15.1	Root Usage	<p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <ul style="list-style-type: none"> Privilege escalation <ul style="list-style-type: none"> su sudo wheel visudo sudoedit User types <ul style="list-style-type: none"> Root Standard
15.2	User Security and Restriction	<p>2.2 Given a scenario, manage users and groups.</p> <ul style="list-style-type: none"> Modification

		<p>passwd</p> <p>Queries</p> <p>who last</p> <p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File and directory operations</p> <p>find</p> <p>2.6 Given a scenario, automate and schedule jobs.</p> <p>crontab</p> <p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>File and directory permissions</p> <p>Utilities: chgrp Utilities: ulimit Utilities: chage</p> <p>3.2 Given a scenario, configure and implement appropriate access and authentication methods.</p> <p>PAM</p> <p>Password policies LDAP integration User lockouts Required, allowed, or sufficient</p>
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		<p>/etc/pam.d/ pam_tally2+B708 faillock</p> <p>TTYs</p> <p>/etc/securetty /dev/tty#</p> <p>PTYs</p> <p>3.3 Summarize security best practices in a Linux environment.</p> <p>Importance of disabling or uninstalling unused and unsecure services</p> <p>Finger</p>
15.3	Login Blocking	<p>2.2 Given a scenario, manage users and groups.</p> <p>Queries</p> <p>w</p> <p>2.6 Given a scenario, automate and schedule jobs.</p> <p>kill</p> <p>3.2 Given a scenario, configure and implement appropriate access and authentication methods.</p> <p>PAM</p> <p>User lockouts</p>

		<p><code>/etc/pam.d/</code></p> <p>4.2 Given a scenario, analyze system processes in order to optimize performance.</p> <p>Process management</p> <p>Commands: <code>pkill</code></p>
15.4	Network Security	<p>1.3 Given a scenario, configure and verify network connection parameters.</p> <p>Configuration files</p> <p><code>/etc/sysctl.conf</code></p> <p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Installation tools</p> <p>RPM Dpkg YUM DNF Zypper</p> <p>2.4 Given a scenario, manage services.</p> <p>SysVinit</p> <p><code>chkconfig: on</code> <code>chkconfig: off</code> <code>chkconfig: level</code></p>

		<p>3.5 Given a scenario, implement and configure Linux firewalls.</p> <p>Technologies</p> <p>firewalld: Zones</p> <p>4.1 Given a scenario, analyze system properties and remediate accordingly.</p> <p>Network monitoring and configuration</p> <p>Commands: nmap Commands: netstat</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>Firewall</p> <p>Restrictive ACLs Blocked ports Blocked protocols</p> <p>Troubleshooting additional hardware issues</p> <p>Communications ports</p>
15.5	The xinetd Super Daemon	<p>2.1 Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Installation tools</p> <p>RPM Dpkg APT DNF</p>

		<p>Zypper</p> <p>3.2 Given a scenario, configure and implement appropriate access and authentication methods.</p> <p>SSH</p> <p>TCP wrappers</p>
15.6	OpenSSH	<p>2.3 Given a scenario, create, modify, and redirect files.</p> <p>File and directory operations</p> <p>scp</p> <p>2.5 Summarize and explain server roles.</p> <p>SSH</p> <p>3.2 Given a scenario, configure and implement appropriate access and authentication methods.</p> <p>SSH</p> <p>~/.ssh/: known_hosts ~/.ssh/: config</p> <p>PKI</p> <p>Private keys Public keys</p> <p>3.6 Given a scenario, backup, restore, and compress files.</p>

		<p>Off-site/off-system storage</p> <p>SFTP SCP</p>
15.7	SSH Port Tunneling	<p>2.8 Compare and contrast Linux graphical user interfaces.</p> <p>Console redirection</p> <p>SSH port forwarding: X11 forwarding</p>
15.8	Security-Enhanced Linux (SELinux)	<p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>Context-based permissions</p> <p>SELinux configurations: disabled SELinux configurations: permissive SELinux configurations: enforcing SELinux policy: targeted SELinux tools: setenforce SELinux tools: getenforce SELinux tools: sestatus SELinux tools: setsebool SELinux tools: getsebool SELinux tools: chcon SELinux tools: restorecon SELinux tools: ls -Z SELinux tools: ps -Z</p> <p>4.4 Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>SELinux context violations</p>

15.9	Application Armor (AppArmor)	<p>3.1 Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>Context-based permissions</p> <p>AppArmor: aa-disable AppArmor: aa-complain AppArmor: aa-unconfined AppArmor: /etc/apparmor.d/ AppArmor: /etc/apparmor.d/tunables</p>
15.10	Public Key Authentication	<p>3.2 Given a scenario, configure and implement appropriate access and authentication methods.</p> <p>SSH</p> <p>~/.ssh/: authorized_keys ~/.ssh/: config ~/.ssh/: id_rsa ~/.ssh/: id_rsa.pub User-specific access /etc/ssh/: sshd.conf ssh-copy-id ssh-keygen ssh-add</p> <p>PKI</p> <p>Self-signed Private keys Public keys Hashing Digital signatures Message digest</p>

		<p>3.6 Given a scenario, backup, restore, and compress files.</p> <ul style="list-style-type: none"> Off-site/off-system storage SCP Integrity checks MD5
15.11	VPN Access and Authentication	<p>3.2 Given a scenario, configure and implement appropriate access and authentication methods.</p> <ul style="list-style-type: none"> VPN as a client SSL/TLS <ul style="list-style-type: none"> Transport mode Tunnel mode IPSec DTLS
15.12	Security Best Practices	<p>3.3 Summarize security best practices in a Linux environment.</p> <ul style="list-style-type: none"> Boot security <ul style="list-style-type: none"> Boot loader password UEFI/BIOS password Additional authentication methods <ul style="list-style-type: none"> Multifactor authentication: Tokens: Hardware Multifactor authentication: Tokens: Software Multifactor authentication: OTP Multifactor authentication: Biometrics

		<p>RADIUS TACACS+ LDAP Kerberos: kinit Kerberos: klist</p> <p>Importance of disabling root login via SSH Password-less login</p> <p>Enforce use of PKI</p> <p>Chroot jail services No shared IDs Importance of denying hosts Separation of OS data from application data</p> <p>Disk partition to maximize system availability</p> <p>Change default ports Importance of disabling or uninstalling unused and unsecure services</p> <p>FTP Telnet Finger Sendmail Postfix</p> <p>Importance of enabling SSL/TLS Importance of enabling auditd CVE monitoring Discouraging use of USB devices Disk encryption</p> <p>LUKS</p> <p>Restrict cron access</p>
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		Disable Ctrl+Alt+Del Add banner MOTD
A.0	TestOut Linux Pro Practice Exams	
A.1	Preparing for Certification	
A.2	TestOut Linux Pro Domain Practice	
B.0	CompTIA Linux+ Practice Exams	
B.1	Preparing for Certification	
B.2	CompTIA Linux+ XK0-004 Domain Practice (20 Random Questions)	
B.3	CompTIA Linux+ XK0-004 Domain Practice (All Questions)	

XK0-004 Objectives to LabSim Section

#	Domain	Section
1.0	Hardware and System Configuration	
1.1	<p>Explain Linux boot process concepts.</p> <ul style="list-style-type: none"> Boot loaders <ul style="list-style-type: none"> ○ GRUB ○ GRUB2 Boot options <ul style="list-style-type: none"> ○ UEFI/EFI ○ PXE ○ NFS ○ Boot from ISO ○ Boot from HTTP/FTP File locations <ul style="list-style-type: none"> ○ /etc/default/grub ○ /etc/grub2.cfg ○ /boot ○ /boot/grub ○ /boot/grub2 ○ /boot/efi Boot modules and files <ul style="list-style-type: none"> ○ Commands: mkinitrd ○ Commands: dracut ○ Commands: grub2-install ○ Commands: grub2-mkconfig ○ initramfs ○ efi files ○ vmlinuz ○ vmlinux Kernel panic 	4.1, 4.2

1.2	<p>Given a scenario, install, configure, and monitor kernel modules.</p> <p>Commands</p> <ul style="list-style-type: none"> ○ lsmod ○ insmod ○ modprobe ○ modinfo ○ dmesg ○ rmmod ○ depmod <p>Locations</p> <ul style="list-style-type: none"> ○ /usr/lib/modules/[kernelversion] ○ /usr/lib/modules ○ /etc/modprobe.conf ○ /etc/modprobe.d/ 	9.1, 9.2, 11.1
1.3	<p>Given a scenario, configure and verify network connection parameters.</p> <p>Diagnostic tools</p> <ul style="list-style-type: none"> ○ ping ○ netstat ○ nslookup ○ dig ○ host ○ route ○ ip ○ ethtool ○ ss ○ iwconfig ○ nmcli ○ brctl ○ nmtui <p>Configuration files</p> <ul style="list-style-type: none"> ○ /etc/sysconfig/network-scripts/ ○ /etc/sysconfig/network ○ /etc/hosts ○ /etc/network 	12.2, 12.4, 12.5, 12.7, 15.4

	<ul style="list-style-type: none"> ○ /etc/nsswitch.conf ○ /etc/resolv.conf ○ /etc/netplan ○ /etc/sysctl.conf ○ /etc/dhcp/dhclient.conf <p>Bonding</p> <ul style="list-style-type: none"> ○ Aggregation ○ Active/passive ○ Load balancing 	
1.4	<p>Given a scenario, manage storage in a Linux environment.</p> <p>Basic partitions</p> <ul style="list-style-type: none"> ○ Raw devices ○ GPT ○ MBR <p>File system hierarchy</p> <ul style="list-style-type: none"> ○ Real file systems ○ Virtual file systems ○ Relative paths ○ Absolute paths <p>Device mapper</p> <ul style="list-style-type: none"> ○ LVM ○ mdadm ○ Multipath <p>Tools</p> <ul style="list-style-type: none"> ○ XFS tools ○ LVM tools ○ EXT tools ○ Commands: mdadm ○ Commands: fdisk ○ Commands: parted ○ Commands: mkfs ○ Commands: iostat ○ Commands: df ○ Commands: du ○ Commands: mount 	3.1, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7

	<ul style="list-style-type: none"> ○ Commands: umount ○ Commands: lsblk ○ Commands: blkid ○ Commands: dumpe2fs ○ Commands: resize2fs ○ Commands: fsck ○ Commands: tune2fs ○ Commands: e2label <p>Location</p> <ul style="list-style-type: none"> ○ /etc/fstab ○ /etc/crypttab ○ /dev/ ○ /dev/mapper ○ /dev/disk/by-id ○ /dev/disk/by-uuid ○ /dev/disk/by-path ○ /dev/disk/by-multipath ○ /etc/mtab ○ /sys/block ○ /proc/partitions ○ /proc/mounts <p>File system types</p> <ul style="list-style-type: none"> ○ ext3 ○ ext4 ○ xfs ○ nfs ○ smb ○ cifs ○ ntfs 	
1.5	<p>Compare and contrast cloud and virtualization concepts and technologies.</p> <p>Templates</p> <ul style="list-style-type: none"> ○ VM ○ OVA ○ OVF ○ JSON 	12.1, 13.1, 13.2, 13.3

	<ul style="list-style-type: none"> ○ YAML ○ Container images <p>Bootstrapping</p> <ul style="list-style-type: none"> ○ Cloud-init ○ Anaconda ○ Kickstart <p>Storage</p> <ul style="list-style-type: none"> ○ Thin vs. thick provisioning ○ Persistent volumes ○ Blob ○ Block <p>Network considerations</p> <ul style="list-style-type: none"> ○ Bridging ○ Overlay networks ○ NAT ○ Local ○ Dual-homed <p>Types of hypervisors</p> <p>Tools</p> <ul style="list-style-type: none"> ○ libvirt ○ virsh ○ vmm 	
1.6	<p>Given a scenario, configure localization options.</p> <p>File locations</p> <ul style="list-style-type: none"> ○ /etc/timezone ○ /usr/share/zoneinfo <p>Commands</p> <ul style="list-style-type: none"> ○ localectl ○ timedatectl ○ date ○ hwclock ○ time <p>Environment variables</p> <ul style="list-style-type: none"> ○ LC_* ○ LC_ALL 	3.3, 10.5

	<ul style="list-style-type: none"> ○ LANG ○ TZ <p>Character sets</p> <ul style="list-style-type: none"> ○ UTF-8 ○ ASCII ○ Unicode 	
2.0	Systems Operation and Maintenance	
2.1	<p>Given a scenario, conduct software installations, configurations, updates, and removals.</p> <p>Package types</p> <ul style="list-style-type: none"> ○ .rpm ○ .deb ○ .tar ○ .tgz ○ .gz <p>Installation tools</p> <ul style="list-style-type: none"> ○ RPM ○ Dpkg ○ APT ○ YUM ○ DNF ○ Zypper <p>Build tools</p> <ul style="list-style-type: none"> ○ Commands: make ○ Commands: make install ○ Commands: ldd ○ Compilers ○ Shared libraries <p>Repositories</p> <ul style="list-style-type: none"> ○ Configuration ○ Creation ○ Syncing ○ Locations <p>Acquisition commands</p>	6.1, 6.2, 6.3, 6.4, 8.12, 15.4, 15.5

	<ul style="list-style-type: none"> ○ wget ○ curl 	
2.2	<p>Given a scenario, manage users and groups.</p> <p>Creation</p> <ul style="list-style-type: none"> ○ useradd ○ groupadd <p>Modification</p> <ul style="list-style-type: none"> ○ usermod ○ groupmod ○ passwd ○ chage <p>Deletion</p> <ul style="list-style-type: none"> ○ userdel ○ groupdel <p>Queries</p> <ul style="list-style-type: none"> ○ id ○ whoami ○ who ○ w ○ last <p>Quotas</p> <ul style="list-style-type: none"> ○ User quota ○ Group quota <p>Profiles</p> <ul style="list-style-type: none"> ○ Bash parameters: User entries: .bashrc ○ Bash parameters: User entries: .bash_profile ○ Bash parameters: User entries: .profile ○ Bash parameters: Global entries: /etc/bashrc ○ Bash parameters: Global entries: /etc/profile.d/ ○ Bash parameters: Global entries: /etc/skel ○ Bash parameters: Global entries: /etc/profile <p>Important files and file contents</p> <ul style="list-style-type: none"> ○ /etc/passwd ○ /etc/group 	<p>2.4, 2.5, 2.6 7.1, 7.2, 7.3, 8.7, 15.2, 15.3</p>

	<ul style="list-style-type: none"> ○ /etc/shadow 	
2.3	<p>Given a scenario, create, modify, and redirect files.</p> <p>Text editors</p> <ul style="list-style-type: none"> ○ nano ○ vi <p>File readers</p> <ul style="list-style-type: none"> ○ grep ○ cat ○ tail ○ head ○ less ○ more <p>Output redirection</p> <ul style="list-style-type: none"> ○ < ○ > ○ ○ << ○ >> ○ 2> ○ &> ○ stdin ○ stdout ○ stderr ○ /dev/null ○ /dev/tty ○ xargs ○ tee ○ Here documents <p>Text processing</p> <ul style="list-style-type: none"> ○ grep ○ tr ○ echo ○ sort ○ awk ○ sed 	2.3, 2.7, 2.8, 2.9, 2.10, 2.12, 2.13, 8.8, 8.11, 15.2, 15.6

	<ul style="list-style-type: none"> ○ cut ○ print ○ egrep ○ wc ○ paste <p>File and directory operations</p> <ul style="list-style-type: none"> ○ touch ○ mv ○ cp ○ rm ○ scp ○ ls ○ rsync ○ mkdir ○ rmdir ○ ln: Symbolic (soft) ○ ln: Hard ○ unlink ○ inodes ○ find ○ locate ○ grep ○ which ○ whereis ○ diff ○ updatedb 	
2.4	<p>Given a scenario, manage services.</p> <p>Systemd management</p> <ul style="list-style-type: none"> ○ Systemctl: Enabled ○ Systemctl: Disabled ○ Systemctl: Start ○ Systemctl: Stop ○ Systemctl: Mask ○ Systemctl: Restart ○ Systemctl: Status 	4.3, 4.4, 10.3, 15.4

	<ul style="list-style-type: none"> ○ Systemctl: Daemon-reload ○ Systemd-analyze blame ○ Unit files: Directory locations ○ Unit files: Environment parameters ○ Unit files: Targets ○ Unit files: Hostnamectl ○ Unit files: Automount <p>SysVinit</p> <ul style="list-style-type: none"> ○ chkconfig: on ○ chkconfig: off ○ chkconfig: level ○ Runlevels: Definitions of 0–6 ○ Runlevels: /etc/init.d ○ Runlevels: /etc/rc.d ○ Runlevels: /etc/rc.local ○ Runlevels: /etc/inittab ○ Runlevels: Commands: runlevel ○ Runlevels: Commands: telinit ○ Service: Restart ○ Service: Status ○ Service: Stop ○ Service: Start ○ Service: Reload 	
2.5	<p>Summarize and explain server roles.</p> <p>NTP SSH Web Certificate authority Name server DHCP SNMP File servers Authentication server Proxy Logging</p>	1.1, 10.5, 12.5, 15.6

	<p>Containers VPN Monitoring Database Print server Mail server Load balancer Clustering</p>	
2.6	<p>Given a scenario, automate and schedule jobs.</p> <p>cron at crontab fg bg & kill Ctrl+c Ctrl+z nohup</p>	10.2, 10.3, 15.2, 15.3
2.7	<p>Explain the use and operation of Linux devices.</p> <p>Types of devices</p> <ul style="list-style-type: none"> ○ Client devices ○ Bluetooth ○ WiFi ○ USB ○ Monitors ○ GPIO ○ Network adapters ○ PCI ○ HBA ○ SATA ○ SCSI 	9.1, 9.3, 10.4, 11.2

	<ul style="list-style-type: none"> ○ Printers ○ Video ○ Audio <p>Monitoring and configuration tools</p> <ul style="list-style-type: none"> ○ lsdev ○ lsusb ○ lspci ○ lsblk ○ dmesg ○ lpr ○ lpq ○ abrt ○ CUPS ○ udevadm: add ○ udevadm: reload-rules ○ udevadm: control ○ udevadm: trigger <p>File locations</p> <ul style="list-style-type: none"> ○ /proc ○ /sys ○ /dev ○ /dev/mapper ○ /etc/X11 <p>Hot pluggable devices</p> <ul style="list-style-type: none"> ○ /etc/rc5/udev ○ /etc/udev/rules.d 	
2.8	<p>Compare and contrast Linux graphical user interfaces.</p> <p>Servers</p> <ul style="list-style-type: none"> ○ Wayland ○ X11 <p>GUI</p> <ul style="list-style-type: none"> ○ Gnome ○ Unity ○ Cinnamon ○ MATE 	5.1, 5.2, 5.3, 5.4, 15.7

	<ul style="list-style-type: none"> ○ KDE Remote desktop <ul style="list-style-type: none"> ○ VNC ○ XRDP ○ NX ○ Spice Console redirection <ul style="list-style-type: none"> ○ SSH port forwarding: Local ○ SSH port forwarding: Remote ○ SSH port forwarding: X11 forwarding ○ SSH port forwarding: VNC Accessibility	
3.0	Security	
3.1	<p>Given a scenario, apply or acquire the appropriate user and/or group permissions and ownership.</p> <p>File and directory permissions</p> <ul style="list-style-type: none"> ○ Read, write, execute ○ User, group, other ○ SUID ○ Octal notation ○ umask ○ Sticky bit ○ GUID ○ Inheritance ○ Utilities: chmod ○ Utilities: chown ○ Utilities: chgrp ○ Utilities: getfacl ○ Utilities: setfacl ○ Utilities: ls ○ Utilities: ulimit ○ Utilities: chage <p>Context-based permissions</p> <ul style="list-style-type: none"> ○ SELinux configurations: disabled 	8.8, 8.9, 8.10, 8.11, 15.1, 15.2, 15.8, 15.9

	<ul style="list-style-type: none"> ○ SELinux configurations: permissive ○ SELinux configurations: enforcing ○ SELinux policy: targeted ○ SELinux tools: setenforce ○ SELinux tools: getenforce ○ SELinux tools: sestatus ○ SELinux tools: setsebool ○ SELinux tools: getsebool ○ SELinux tools: chcon ○ SELinux tools: restorecon ○ SELinux tools: ls -Z ○ SELinux tools: ps -Z ○ AppArmor: aa-disable ○ AppArmor: aa-complain ○ AppArmor: aa-unconfined ○ AppArmor: /etc/apparmor.d/ ○ AppArmor: /etc/apparmor.d/tunables <p>Privilege escalation</p> <ul style="list-style-type: none"> ○ su ○ sudo ○ wheel ○ visudo ○ sudoedit <p>User types</p> <ul style="list-style-type: none"> ○ Root ○ Standard ○ Service 	
3.2	<p>Given a scenario, configure and implement appropriate access and authentication methods.</p> <p>PAM</p> <ul style="list-style-type: none"> ○ Password policies ○ LDAP integration ○ User lockouts ○ Required, allowed, or sufficient ○ /etc/pam.d/ ○ pam_tally2+B708 	15.2, 15.3, 15.5, 15.6, 15.10, 15.11

	<ul style="list-style-type: none"> SSH <ul style="list-style-type: none"> ○ faillock ○ ~/.ssh/: known_hosts ○ ~/.ssh/: authorized_keys ○ ~/.ssh/: config ○ ~/.ssh/: id_rsa ○ ~/.ssh/: id_rsa.pub ○ User-specific access ○ TCP wrappers ○ /etc/ssh/: ssh.conf ○ /etc/ssh/: sshd.conf ○ ssh-copy-id ○ ssh-keygen ○ ssh-add TTYs <ul style="list-style-type: none"> ○ /etc/securetty ○ /dev/tty# PTYs PKI <ul style="list-style-type: none"> ○ Self-signed ○ Private keys ○ Public keys ○ Hashing ○ Digital signatures ○ Message digest VPN as a client <ul style="list-style-type: none"> ○ SSL/TLS ○ Transport mode ○ Tunnel mode ○ IPsec ○ DTLS 	
3.3	<p>Summarize security best practices in a Linux environment.</p> <ul style="list-style-type: none"> Boot security <ul style="list-style-type: none"> ○ Boot loader password ○ UEFI/BIOS password 	10.3, 15.2, 15.12

	<ul style="list-style-type: none">Additional authentication methods<ul style="list-style-type: none">○ Multifactor authentication: Tokens: Hardware○ Multifactor authentication: Tokens: Software○ Multifactor authentication: OTP○ Multifactor authentication: Biometrics○ RADIUS○ TACACS+○ LDAP○ Kerberos: kinit○ Kerberos: klistImportance of disabling root login via SSHPassword-less login<ul style="list-style-type: none">○ Enforce use of PKIChroot jail servicesNo shared IDsImportance of denying hostsSeparation of OS data from application data<ul style="list-style-type: none">○ Disk partition to maximize system availabilityChange default portsImportance of disabling or uninstalling unused and unsecure services<ul style="list-style-type: none">○ FTP○ Telnet○ Finger○ Sendmail○ PostfixImportance of enabling SSL/TLSImportance of enabling auditdCVE monitoringDiscouraging use of USB devicesDisk encryption<ul style="list-style-type: none">○ LUKSRestrict cron accessDisable Ctrl+Alt+DelAdd bannerMOTD	
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3.4	<p>Given a scenario, implement logging services.</p> <p>Key file locations</p> <ul style="list-style-type: none"> ○ /var/log/secure ○ /var/log/messages ○ /var/log/[application] ○ /var/log/kern.log <p>Log management</p> <ul style="list-style-type: none"> ○ Third-party agents ○ logrotate ○ /etc/rsyslog.conf ○ journald: journalctl <p>lastb</p>	11.1
3.5	<p>Given a scenario, implement and configure Linux firewalls.</p> <p>Access control lists</p> <ul style="list-style-type: none"> ○ Source ○ Destination ○ Ports ○ Protocol ○ Logging ○ Stateful vs. stateless ○ Accept ○ Reject ○ Drop ○ Log <p>Technologies</p> <ul style="list-style-type: none"> ○ firewalld: Zones ○ firewalld: Run time ○ iptables: Persistency ○ iptables: Chains ○ ufw: /etc/default/ufw ○ ufw: /etc/ufw/ ○ Netfilter <p>IP forwarding</p> <ul style="list-style-type: none"> ○ /proc/sys/net/ipv4/ip_forward 	12.6, 15.4

	<ul style="list-style-type: none"> ○ /proc/sys/net/ipv6/ip_forward <p>Dynamic rule sets</p> <ul style="list-style-type: none"> ○ DenyHosts ○ Fail2ban ○ IPset <p>Common application firewall configurations</p> <ul style="list-style-type: none"> ○ /etc/services ○ Privileged ports 	
3.6	<p>Given a scenario, backup, restore, and compress files.</p> <p>Archive and restore utilities</p> <ul style="list-style-type: none"> ○ tar ○ cpio ○ dd <p>Compression</p> <ul style="list-style-type: none"> ○ gzip ○ xz ○ bzip2 ○ zip <p>Backup types</p> <ul style="list-style-type: none"> ○ Incremental ○ Full ○ Snapshot clones ○ Differential ○ Image <p>Off-site/off-system storage</p> <ul style="list-style-type: none"> ○ SFTP ○ SCP ○ rsync <p>Integrity checks</p> <ul style="list-style-type: none"> ○ MD5 ○ SHA 	8.12, 15.6, 15.10
4.0	Linux Troubleshooting and Diagnostics	

4.1	<p>Given a scenario, analyze system properties and remediate accordingly.</p> <p>Network monitoring and configuration</p> <ul style="list-style-type: none"> ○ Latency: Bandwidth ○ Latency: Throughput ○ Routing ○ Saturation ○ Packet drop ○ Timeouts ○ Name resolution ○ Localhost vs. Unix socket ○ Adapters: RDMA drivers ○ Interface configurations ○ Commands: nmap ○ Commands: netstat ○ Commands: iftop ○ Commands: route ○ Commands: iperf ○ Commands: tcpdump ○ Commands: ipset ○ Commands: Wireshark: tshark ○ Commands: netcat ○ Commands: traceroute ○ Commands: mtr ○ Commands: arp ○ Commands: nslookup ○ Commands: dig ○ Commands: host ○ Commands: whois ○ Commands: ping ○ Commands: nmcli ○ Commands: ip ○ Commands: tracepath <p>Storage monitoring and configuration</p> <ul style="list-style-type: none"> ○ iostat ○ ioping ○ IO scheduling: cfq ○ IO scheduling: noop 	8.1, 8.4, 8.6, 9.1, 11.2 12.4, 12.5, 12.7, 15.4
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	<ul style="list-style-type: none"> ○ IO scheduling: deadline ○ du ○ df ○ LVM tools ○ fsck ○ partprobe <p>CPU monitoring and configuration</p> <ul style="list-style-type: none"> ○ /proc/cpuinfo ○ uptime ○ loadaverage ○ sar ○ sysctl <p>Memory monitoring and configuration</p> <ul style="list-style-type: none"> ○ swapon ○ swapoff ○ mkswap ○ vmstat ○ Out of memory killer ○ free ○ /proc/meminfo ○ Buffer cache output <p>Lost root password</p> <ul style="list-style-type: none"> ○ Single user mode 	
4.2	<p>Given a scenario, analyze system processes in order to optimize performance.</p> <p>Process management</p> <ul style="list-style-type: none"> ○ Process states: Zombie ○ Process states: Uninterruptible sleep ○ Process states: Interruptible sleep ○ Process states: Running ○ Priorities ○ Kill signals ○ Commands: nice ○ Commands: renice ○ Commands: top ○ Commands: ps 	8.6, 10.1, 10.2, 11.2, 15.3

	<ul style="list-style-type: none"> ○ Commands: lsof ○ Commands: pgrep ○ Commands: pkill ○ PIDs 	
4.3	<p>Given a scenario, analyze and troubleshoot user issues.</p> <p>Permissions</p> <ul style="list-style-type: none"> ○ File ○ Directory <p>Access</p> <ul style="list-style-type: none"> ○ Local ○ Remote <p>Authentication</p> <ul style="list-style-type: none"> ○ Local ○ External ○ Policy violations <p>File creation</p> <ul style="list-style-type: none"> ○ Quotas ○ Storage ○ Inode exhaustion ○ Immutable files <p>Insufficient privileges for authorization</p> <ul style="list-style-type: none"> ○ SELinux violations <p>Environment and shell issues</p>	8.7, 8.9, 8.10, 8.11
4.4	<p>Given a scenario, analyze and troubleshoot application and hardware issues.</p> <p>SELinux context violations</p> <p>Storage</p> <ul style="list-style-type: none"> ○ Degraded storage ○ Missing devices ○ Missing volumes ○ Missing mount point ○ Performance issues ○ Resource exhaustion 	7.1, 8.5, 8.8, 8.9, 12.1, 15.4, 15.8

	<ul style="list-style-type: none"> ○ Adapters: SCSI ○ Adapters: RAID ○ Adapters: SATA ○ Adapters: HBA: /sys/class/scsi_host/host#/scan ○ Storage integrity: Bad blocks <p>Firewall</p> <ul style="list-style-type: none"> ○ Restrictive ACLs ○ Blocked ports ○ Blocked protocols <p>Permission</p> <ul style="list-style-type: none"> ○ Ownership ○ Executables ○ Inheritance ○ Service accounts ○ Group memberships <p>Dependencies</p> <ul style="list-style-type: none"> ○ Patching ○ Update issues ○ Versioning ○ Libraries ○ Environment variables ○ GCC compatibility ○ Repositories <p>Troubleshooting additional hardware issues</p> <ul style="list-style-type: none"> ○ Memory ○ Printers ○ Video: GPU drivers ○ Communications ports ○ USB ○ Keyboard mapping ○ Hardware or software ○ compatibility issues ○ Commands: dmidecode ○ Commands: lshw 	
5.0	Automation and Scripting	

5.1	<p>Given a scenario, deploy and execute basic BASH scripts.</p> <ul style="list-style-type: none">Shell environments and shell variables<ul style="list-style-type: none">○ PATH○ Global○ Local○ export○ env○ set○ printenv○ echo#!/bin/bashSourcing scriptsDirectory and file permissions<ul style="list-style-type: none">○ chmodExtensionsCommenting<ul style="list-style-type: none">○ #File globbingShell expansions<ul style="list-style-type: none">○ \${}○ \$()○ `Redirection and pipingExit codes<ul style="list-style-type: none">○ stderr○ stdin○ stdoutMetacharactersPositional parametersLooping constructs<ul style="list-style-type: none">○ while○ for○ untilConditional statements<ul style="list-style-type: none">○ if○ case	2.5, 2.7, 8.11, 14.1, 14.2, 14.3
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	Escaping characters	
5.2	<p>Given a scenario, carry out version control using Git.</p> <p>Arguments</p> <ul style="list-style-type: none"> ○ clone ○ push ○ pull ○ commit ○ merge ○ branch ○ log ○ init ○ config <p>Files</p> <ul style="list-style-type: none"> ○ .gitignore ○ .git/ 	14.4
5.3	<p>Summarize orchestration processes and concepts.</p> <p>Agent</p> <p>Agentless</p> <p>Procedures</p> <p>Attributes</p> <p>Infrastructure automation</p> <p>Infrastructure as code</p> <p>Inventory</p> <p>Automated configuration management</p> <p>Build automation</p>	14.5