## Internetworking

### I. Explain common networking concepts and terminology.

**Tasks Instructions:**

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<tbody>
<tr>
<td>Identify the basic characteristics of LANs and WANs</td>
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<td>Explain the concept of bandwidth and throughput and factors that affect them</td>
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<tr>
<td>List and describe the components necessary to create a small LAN using wire or wireless media</td>
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<tr>
<td>Identify the roles of various network devices in a network (NICs, hubs, switches, routers, firewalls, AP)</td>
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<td>Explain the concept of latency and how it can be minimized</td>
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<tr>
<td>Describe the advantages and disadvantages associated with implementing common physical topologies: star/extended star, ring and mesh</td>
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<td>Explain the importance of implementing basic security in computer networks</td>
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*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

**Total possible points (9)**

### II. Install and troubleshoot basic hardware and software required to communicate in a simple network and test for connectivity.

**Tasks Instructions:**
Identify the pin-outs and construct a UTP (patch, console and crossover) cable for connectivity

Specify the cable type required for the various Ethernet connections

Configure a host with the appropriate addressing parameters to connect to a network

Verify and troubleshoot basic connectivity using various testing tools, utilities and commands (cable testers, ping, trace, IP configuration, etc.)

Document the physical and logical aspects of network topology

Determine and install the appropriate network cabling and media required for connectivity between devices

Configure, connect, verify and troubleshoot issues with the operation of an Ethernet NIC

Determine the physical issues associated with cabling network equipment working over a WAN link

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

### Points earned

- **Total possible points (10)**

### III. Compare and contrast various types of media used for networking.

#### Tasks Instructions:

- Explain the characteristics and benefits of copper cable, fiber and wireless
network media (air) in network applications, including data transmission speeds

Identify the basic characteristics of UTP and fiber cables

Identify Ethernet cabling issues that can cause degraded service

Explain practical factors that cause attenuation of data signals over the different network media types (copper, fiber, air [radio frequency]), and identify possible solutions to a media problem

Identify basic concerns of implementing faster Ethernet

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (7)

IV. Explain the fundamental concepts associated with media access techniques (Ethernet operation, MAC, LLC, CSMA/CD).

Tasks Instructions:

Describe the differences between full duplex and half duplex transmissions

Describe media access considerations of full duplex and half duplex transmissions

Explain the function of auto negotiation of speed and duplex

Describe the function of the Data Link Layer as it applies to Ethernet, including MAC and LLC sublayers

Explain the concept of broadcast media and the addressing of a layer 2 broadcast on an Ethernet media

Describe and discuss CSMA/CD, including the process, listen, send, collision, jam and back off
V. Optimize network design in regard to segmentation, collision domains and broadcast domains.

Tasks Instructions:

1. Describe basic operation of hubs and repeaters as they apply to Ethernet
2. Explain how collisions are detected and managed in Ethernet networks
3. Explain the concepts of collision domains and network segmentation
4. Explain the benefits of using a switch versus using a hub in an Ethernet network
5. Explain how collisions and excessive broadcasts occur in networks
6. Identify devices used to minimize collision and excessive broadcast effects

VI. Implement and correct problems associated with basic IP addressing and subnetting schemes.

Tasks Instructions:

1. Explain the purpose of an IP address, subnet mask and a default gateway
Identify the appropriate address required for internetwork communication between hosts

Categorize the different IP v4 address classes and their identifying features

Explain the advantages and disadvantages of using public and private IP v4 addresses

Determine whether an IP address is a network, broadcast, subnet, public or private IP v4 address

Determine the appropriate subnet mask and IP addressing scheme required to meet network requirements for scalability and functionality

Identify the methods for a node to obtain an IP address (include static and dynamic methods)

Correct common problems associated with implementing basic IP addressing schemes in a network and environment

Contrast IP v4 with IP v6

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

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**VII. Describe fundamental concepts of switching and routing.**

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Explain the major functions of a switch

Explain the major functions of a router

Explain the basic use of routed and routing protocols in a network

Describe the forwarding of frames and packets in switched and routed networks
Describe the characteristics and functions of IP (connectionless and unreliable)

Compare the basic concepts of static and dynamic routing

Explain the OSI model and its functionality in computer networking

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (9)

VIII. Define the Layers of the OSI model.

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Explain the benefits of using OSI model as a conceptual framework for network communication

Explain the process of encapsulation and identify the protocol data units associated with each OSI Layer model

Identify and describe the functions of network devices at each layer of the OSI model

Explain ARP and when it is used

Compare and contrast connection and connectionless delivery of packets in a network

Describe the primary functions of the transport layer

Compare and contrast characteristics of TCP and UDP

Identify and describe the major TCP/IP protocols used in each layer of the OSI model

Identify basic issues that occur at each layer using the OSI model

Identify the fields in the headers of protocol data units
Describe their role in propagating data in a network (MAC address, IP address, TCP port number)

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (13)

IX. Describe the importance of a router in a WAN configuration.

Tasks Instructions:

1. Compare WAN connections to LAN connections
2. Identify the role of a router in a WAN
3. Describe the importance of a WAN router
4. Describe router physical characteristics
5. Connect all router external connections, management, LAN and WAN

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (7)

X. Configure a router to multiple networks by using the IOS software.

Tasks Instructions:

1. Identify the workings of an operating system that works with the router
Determine the state of the router interfaces using the LED indicators

Identify the features of the IOS for services that will be delivered on the network

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

### Points earned

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### XI. Log in to a router, record the IOS and running configuration and use troubleshooting commands.

#### Tasks Instructions:

1. Describe the boot process
2. Log in and navigate throughout the router IOS
3. Fix errors by utilizing troubleshooting command line errors
4. View the image names and memory of the router by using the `show version` command

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

### Points earned

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### XII. Configure a router by utilizing the CLI.

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<td>Utilize CLI command modes</td>
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<td>Configure a router name</td>
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<td>Configure router passwords</td>
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<td>Utilize the show commands</td>
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<td>Configure a serial interface and Ethernet interface</td>
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<td>Change configurations</td>
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<td>Configure interface descriptions</td>
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<td>Configure login banners and MOTD</td>
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<td>Configure host tables</td>
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<td>Back up the configuration file by using the copy command to back up the configuration file</td>
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*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

### Points earned

**Total possible points (12)**

#### XIII. Discover other devices on the network using the router.

<table>
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<tr>
<th>Tasks Instructions:</th>
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<tbody>
<tr>
<td>Document neighboring routes and Cisco devices by using Cisco Discovery Protocol (CDP) commands</td>
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<tr>
<td>Monitor CDP</td>
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<tr>
<td>Disable CDP</td>
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<tr>
<td>Troubleshoot CDP</td>
</tr>
<tr>
<td>Gather information about remote devices by using Telnet</td>
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<tr>
<td>Establish and verify a Telnet connection</td>
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<tr>
<td>Disconnect and suspend Telnet sessions</td>
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</tbody>
</table>
Use advanced Telnet operations
Troubleshoot IP address issues

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

Total possible points (11)

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**XIV. Manage the IOS software.**

**Tasks Instructions:**

1. Identify where a Cisco device locates and loads IOS
2. Utilize the boot system command
3. Configure the register
4. Troubleshoot IOS boot failure
5. Manage the Cisco file system
6. Identify IOS naming conventions
7. Utilize TFTP to manage and copy

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

Total possible points (9)

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**XV. Configure routing protocols.**

**Tasks Instructions:**

1. 2 3 4 5 6 7 8 9 10
| Identify the workings of a static route
| Configure static routes
| Configure default route forwarding
| Verify static route configuration
| Troubleshoot static route configuration
| Identify the purpose of a routing protocol and autonomous system
| Identify the classes of routing protocols
| Identify distance vector routing protocol features and examples
| Describe link-state routing protocol features and examples
| Describe path determination
| Configure RIP and OSPF single area

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

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**XVI. Identify and utilize distance vector routing protocols.**

**Tasks Instructions:**

<table>
<thead>
<tr>
<th>View distance vector routing updates, hold-down timers, and RIP processes</th>
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<tr>
<td>Eliminate routing loops through split horizon, route poisoning and triggered updates</td>
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<tr>
<td>Utilize RIP as the routing protocol</td>
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<tr>
<td>Configure RIP</td>
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<tr>
<td>Utilize the IP classless command</td>
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<tr>
<td>Verify RIP configuration</td>
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<tr>
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<td>----------------------------------------------------------------------</td>
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<tr>
<td>Troubleshoot RIP update issues</td>
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<tr>
<td>Load balance using RIP</td>
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<tr>
<td>Load balance across multiple paths</td>
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<tr>
<td>Integrate static routes with RIP</td>
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</table>

_Safety and infection control are adhered to during all aspects of this task._

_The student completed task within the time limited._

**Points earned**

**Total possible points (12)**

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**XVII. Use TCP/IP suite error and control messages to troubleshoot a router.**

**Tasks Instructions:**

Identify TCP/IP error message

Utilize ICMP

Utilize ICMP message delivery

Discover unreachable networks

Utilize ping to test destination reach ability

Define echo messages

Utilize the TCP/IP suite control messages

Utilize ICMP redirect/change request

Utilize requests and reply message formats

Utilize congestion and flow control message

Configure QoS and Nbar to control congestion

_Safety and infection control are adhered to during all aspects of this task._

_The student completed task within the time limited._

**Points earned**

**Total possible points (13)**
XVIII. Use basic show commands to troubleshoot the router.

Tasks Instructions:

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|   | Utilize the show IP route command to determine the gateway of last resort, route source and destination, L2 and L3 addresses, administrative distance, route metric, the route next hop, last route update and multiple paths to destination. |   |   |   |   |   |   |   |   |    |
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Identify OSI layers

Troubleshoot Layer 1 using show interface

Troubleshoot Layer 2 using show interface

Troubleshoot using show CDP

Troubleshoot using trace route

Troubleshoot routing issues

Troubleshoot using show controllers serial

Utilize the debug command

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

Points earned

Total possible points (11)

XIX. Identify the intermediate TCP/IP operations and porting.

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<tr>
<th>Identify synchronization process or three-way handshake</th>
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<tr>
<td>Define a denial-of-service attack</td>
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<td>Identify how windowing, sequencing numbers and positive ACK work together to deliver data packets</td>
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<tr>
<td>Compare UDP with TCP</td>
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<tr>
<td>Observe transport layer ports</td>
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<tr>
<td>Test multiple conversations between hosts</td>
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<tr>
<td>Define ports for services, clients and numbering and well known port numbers</td>
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<tr>
<td>Compare and contrast MAC addresses, IP addresses and port numbers</td>
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Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (10)

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XX. Identify and utilize access control lists (ACLs) to add security to the network.

Tasks Instructions:

| Create access control list fundamentals (ACL’s) |  |
| Demonstrate the function of a wildcard mask |  |
| Utilize an ACL by Verify |  |
| Compare standard, extended ACL’s and named ACL’s |  |
| Place an ACL to create the requested security inside a firewall |  |

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (7)
XXI. Define and use variable length subnet masking (VLSM).

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- Demonstrate VLSM and why and when it is used
- Calculate subnets with VLSM
- Recognize route aggregation with VLSM
- Configure VLSM on a multi-router network

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

**Total possible points (6)**

XXII. Describe how RIP Version 2 is incorporated in a routed network

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- Compare RIP v1 and v2
- Configure RIP v2
- Verify RIP v2
- Troubleshoot RIP v2

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

**Total possible points (6)**
XXIII. Understand how to design and implement single-area OSPF.

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<th>Tasks Instructions:</th>
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1. Recognize link-state routing protocol
2. Compare the advantages and disadvantages of link-state routing
3. Compare and contrast distance vector and link-state routing
4. Compare OSPF with distance vector routing protocols
5. Identify single area OSPF configuration
6. Configure the OSPF routing process
7. Configure OSPF loopback address and router priority
8. Modify OSPF cost metric
9. Configure OSPF authentication and timers
10. Verify the OSPF configuration

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

**Points earned**

**Total possible points (13)**

XXIV. Describe and implement EIGRP routing protocol.

<table>
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<th>Tasks Instructions:</th>
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1. Identify EIGRP concepts and terminology
2. Configure EIGRP
Configure EIGRP summarization
Verify basic EIGRP
Troubleshoot EIGRP configuration

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

Points earned

Total possible points (7)

XXV. Understand how switching operates switching concepts.

Tasks Instructions:

1. Recognize Ethernet/802.3 LAN technologies
2. Recognize factors that impact network performance
3. Recognize network segmentation using hardware devices
4. Recognize basic operations of a switch
5. Compare Layer 2 and Layer 3 switching
6. Compare symmetric and asymmetric switching
7. Recognize micro segmentation implementation
8. Recognize the effects switches have on a collision domain

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

Points earned

Total possible points (10)

XXVI. Understand the use of the access, distribution and core layers in switching and routing.

Tasks Instructions:
Describe LAN design goals

Utilize a 1, 2, 3 layered model in the switch design

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

**Total possible points (4)**

<table>
<thead>
<tr>
<th>XXVII. Understand how to do a complete switch configuration.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tasks Instructions:</strong></td>
</tr>
</tbody>
</table>

  1. Verify port LEDs during switch POST
  2. View initial boot output from the switch
  3. Examine keyboard help in the switch CLI
  4. Recognize switch modes and configure the switch
  5. Verify the catalyst switch default configuration
  6. Configure the catalyst switch
  7. Manage the MAC address table
  8. Configure static MAC addresses
  9. Configure port security
  10. Execute a plan for adds, moves and changes
  11. Manage switch operating system
  12. Define password recovery
  13. Recognize firmware upgrade

*Safety and infection control are adhered to during all aspects of this task.*
The student completed task within the time limited.

Points earned

Total possible points (15)

<table>
<thead>
<tr>
<th>XXVIII. Understand how spanning tree protocol has an effect on network design and setup.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks Instructions:</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Describe redundant topologies</td>
</tr>
<tr>
<td>Describe a broadcast storm</td>
</tr>
<tr>
<td>Recognize redundant topology and spanning tree</td>
</tr>
<tr>
<td>Describe spanning tree operations</td>
</tr>
<tr>
<td>Design the configuration to select a root bridge</td>
</tr>
<tr>
<td>Select the stages of spanning tree port states</td>
</tr>
<tr>
<td>Describe spanning tree recalculation and its effects on the network</td>
</tr>
</tbody>
</table>

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (9)

<table>
<thead>
<tr>
<th>XXIX. Describe how virtual LANs help to control broadcast domains and how this benefits the LAN network.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks Instructions:</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Recognize VLAN concepts</td>
</tr>
<tr>
<td>Demonstrate the relationship between broadcast domains with VLANs and</td>
</tr>
<tr>
<td>Tasks Instructions:</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Define geographic VLANs</td>
</tr>
<tr>
<td>Configure static VLANs</td>
</tr>
<tr>
<td>Verify VLAN configuration</td>
</tr>
<tr>
<td>Save VLAN configuration</td>
</tr>
<tr>
<td>Delete VLANs</td>
</tr>
<tr>
<td>Troubleshoot VLANs</td>
</tr>
</tbody>
</table>

**Points earned**

**Total possible points (5)**

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**XXXI. Utilize virtual trunking protocol to set up multiple ports on a router and switch.**

<table>
<thead>
<tr>
<th>Tasks Instructions:</th>
<th>1</th>
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</thead>
</table>

**Points earned**

**Total possible points (8)**

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**XXX. Configure a VLAN using network design concept.**

**Safety and infection control are adhered to during all aspects of this task.**

**The student completed task within the time limited.**
Describe Trunking concepts

Describe Trunking operation

Describe VTP concepts and how to configure and implement them in a physical and logical network design

Divide physical interfaces into sub-interfaces

Configure inter-VLAN routing

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (7)

XXXII. Demonstrate how to use NAT and PAT to scale IP addresses over a multi-network configuration.

Tasks Instructions:

Name the private address spaces

Identify the features of NAT and PAT

Configure NAT and PAT

Verify PAT configuration

Troubleshoot NAT and PAT configurations

Identify and utilize DHCP in a router configuration

Verify DHCP operation

Troubleshoot DHCP

Safety and infection control are adhered to during all aspects of this task.

The student completed task within the time limited.

Points earned

Total possible points (10)
XXXIII. Recognize the use of WAN technologies in the configuration of a router and the delivery of data.

Tasks Instructions:

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</tbody>
</table>

- Name the WAN devices
- Identify WAN standards and encapsulation types
- Compare packet and circuit switching
- Name the WAN link options and technology related to them
- Incorporate WAN design into the network scheme
- Demonstrate how to identify and select networking capabilities
- Use a three-layer design model

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

**Points earned**

**Total possible points (9)**

XXXIV. Understand and configure a secure PPP serial connection.

Tasks Instructions:

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</table>

- Define a serial point-to-point links
- Define time-division multiplexing
- Use demarcation point as a reference for security
- Define DTE-DCE
- Compare HDLC encapsulation to PPP
| Configure PPP authentication |
| Compare password authentication protocol (PAP) to challenge handshake authentication protocol |
| Configure PPP |
| Verify the serial PPP encapsulation configuration |
| Troubleshoot the serial PPP encapsulation configuration |

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

| Points earned |
| Total possible points (12) |

XXXV. Illustrate ISDN and DDR concepts.

**Tasks Instructions:**

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<tr>
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</table>

**Demonstrate ISDN standards and access methods**

**Name the ISDN switch types**

**Configure ISDN BRI/PRI ports**

**Verify ISDN configuration**

**Troubleshoot the ISDN configuration**

**Configure legacy DDR**

**Define static routes for DDR**

**Configure DDR dialer information**

**Set up a dialer profile**

**Configure dialer profiles**

**Verify DDR configuration**

**Troubleshoot the DDR configuration**

*Safety and infection control are adhered to during all aspects of this task.*
### XXXVI. Configure a point-to-point and multi-point Frame Relay circuit.

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<tr>
<th>Tasks Instructions:</th>
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</thead>
</table>

- Demonstrate knowledge of frame relay concepts and terminology
- Configure a basic frame relay
- Configure a static frame relay map
- Configure frame relay sub-interfaces
- Verify the frame relay configuration
- Troubleshoot the frame relay configuration

*Safety and infection control are adhered to during all aspects of this task.*

*The student completed task within the time limited.*

<table>
<thead>
<tr>
<th>Points earned</th>
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</table>

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<tr>
<th>Total possible points (8)</th>
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</table>

### XXXVII. Demonstrate best practices of network administration.

<table>
<thead>
<tr>
<th>Tasks Instructions:</th>
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<th>10</th>
</tr>
</thead>
</table>

- Define and compare workstations and servers
- Define NOS
- Use popular network operating systems Microsoft XP, 2000, NET, UNIX Sun,
### HP and LINUX versions as they relate to a network
- Describe SNMP and CMIP standards
- Configure SNMP and use sys-logs to monitor networks

*Safety and infection control are adhered to during all aspects of this task.*
*The student completed task within the time limited.*

**Points earned**

**Total possible points (7)**

### XXXVIII. Provide customer support.

**Tasks Instructions:**

- Converse effectively and correctly with a customer
- Speak clearly and to the point when conversing about products and solutions
- Repeat name, location and phone number back to the customer during technical support conversations
- Record all conversations with customers as either information, need to know or solution delivered
- Make good comparisons that the customer can relate to when troubleshooting a problem
- Take the needed actions to fix the customer’s problem
- Close the conversation with a positive, reassuring attitude

*Safety and infection control are adhered to during all aspects of this task.*
*The student completed task within the time limited.*

**Points earned**

**Total possible points (9)**

**Total points earned for all sections (A)**

**Total possible points for all sections (B) 350**
| Student/candidate score (divide A/B) |   |   |   |   |   |   |   |   |