DoD Model
Process/Application layer, Host-to-Host layer, Internet layer, Network Access layer

Process/Application layer
Application, Presentation, and Session layers

Host-to-Host layer
Transport layer

Internet layer
Network layer

Network Access layer
Data Link and Physical layers

Process/Application Layer Protocols
Telnet, FTP, TFTP, NFS, SMTP, LDP, X Window, SNMP, DNS, DHCP/BootP

Telnet
terminal emulation - allows a user on a remote client machine, called the Telnet client, to access the resources of another machine, the Telnet server

File Transfer Protocol (FTP)
file transfer between 2 machines, a protocol and a program, accesses directories and files, uses Telnet for login, cannot execute remote programs

Trivial File Transfer Protocol (TFTP)
stripped-down version of FTP, no directory-browsing abilities, uses smaller blocks of data, no authentication

Network File System (NFS)
allows two different types of file systems to interoperate

Simple Mail Transfer Protocol (SMTP)
uses a spooled, or queued, method of mail delivery, used to send mail (POP3 is used to receive mail)

Line Printer Daemon (LPD)
designed for printer sharing, along with the Line Printer (LPR) program, allows print jobs to be spooled and sent to the network's printers using TCP/IP

X Window
to allow a program, called a client, to run on one computer and have it display things through a window server on another computer

Simple Network Management Protocol (SNMP)
collects and manipulates network information,

Baseline
a report delimiting the operational traits of a healthy network

Trap
Alerts sent by SNMP agents

Domain Name Service (DNS)
resolves hostnames/fully qualified domain name (FQDN)

Dynamic Host Configuration Protocol (DHCP)
provides an IP Address, Subnet Mask, Domain Name, Default Gateway, DNS, WINS

Bootstrap Protocol (BootP)
gives an IP address to a host but the host's hardware address must be entered manually in a BootP table; used to send 'diskless workstations' their boot image

DHCP
connectionless, uses User Datagram Protocol (UDP)

Host-to-Host Layer Protocols
Transmission Control Protocol (TCP) & User Datagram Protocol (UDP)

TCP
segments and sequences information, waits for acknowledgments over the virtual circuit

TCP
full-duplex, connection-oriented, reliable, and accurate

TCP
lots of overhead

TCP Header
Source Port, Destination Port, Sequence Number, Acknowledgment Number, Header Number, Reserved, Code Bits, Window, Checksum, Urgent, Options, Data

Source port
The port number of the application on the host sending the data

Destination port
The port number of the application requested on the destination host

Sequence number
Puts the data back in the correct order or retransmits missing or damaged data, a process called sequencing

Acknowledgment number
Defines which TCP octet is expected next

Header length
The number of 32-bit words in the TCP header. This indicates where the data begins.

Reserved
Always set to zero

Code bits
Control functions used to set up and terminate a session

Window
The window size the sender is willing to accept, in octets

Checksum
cyclic redundancy check (CRC) checks the header and data fields

Urgent
The urgent pointer points to the sequence number of the octet following the urgent data

Options
May be 0 or a multiple of 32 bits

Data
Handed down to the TCP protocol at the Transport layer

UDP
fast, connectionless, unreliable

UDP Segment
Source Port, Destination Port, Length, Checksum, Data

Port Numbers below 1024
considered well-known port numbers dynamically assigned by the source host

Port Numbers 1024 and above
used by the upper layers to set up sessions with other hosts, used by TCP to use as source and destination addresses

Port 23
Telnet, TCP

Port 25
SMTP, TCP

Port 80
HTTP, TCP

Port 21
FTP, TCP

Port 53
DNS, TCP & UDP

Port 443
HTTPS, TCP

Port 161
SNMP, UDP

Port 69
TFTP, UDP

Port 110
POP3, UDP

Port 119
News, UDP

Internet Layer Protocols
Internet Protocol (IP), Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Proxy ARP

Internet Protocol (IP)
decides where a packet is to be sent next, choosing the best path using a routing table

IP Header
Version, Header Length, Priority & Type, Total Length, Identification, Flags, Fragment Offset, Time to Live, Protocol, Header Checksum, Source IP, Destination IP, Options, Data

Version
IP Version number

Header Length
HLEN in 32-bit words

Priority & Type
how the datagram should be handled

Total Length
Length of of the packet

Identification
Unique IP-packet value

Flags
Specifies whether fragmentation should occur

Fragment offset
Provides fragmentation and reassembly if the packet is too large to put in a frame

Time to Live
Kills packets when time expires

Protocol
Port of upper-layer protocol (TCP is port 6 or UDP is port 17 [hex])

Header checksum
Cyclic redundancy check (CRC) on header only

Source IP
IP address of sending station

Destination IP
32-bit IP address of the station this packet is destined for

Options
Used for network testing, debugging, security, and more

Data
Upper-layer data

Internet Protocol (IP)
the Internet layer; the other protocols found here merely exist to support it

Port 6 (hex)
TCP

Port 17 (hex)
UDP

Internet Control Message Protocol (ICMP)
management protocol and messaging service provider for IP

Internet Control Message Protocol (ICMP)
They can provide hosts with information about network problems

Internet Control Message Protocol (ICMP)
They are encapsulated within IP datagrams

ICMP events and messages
Destination Unreachable, Buffer Full, Hops, Ping, Traceroute,

Destination Unreachable
When a router can't send an IP datagram any further

Buffer Full
When a router's memory buffer for receiving incoming datagrams is full

Hops
Each IP datagram is allotted a certain number of routers, called hops, to pass through. If it reaches its limit of hops before arriving at its destination, the last router to receive that datagram deletes it. The executioner router then uses ICMP to send an obituary message, informing the sending machine of the demise of its datagram

Ping (Packet Internet Groper)
Used to check the physical and logical connectivity of machines on an internetwork

Traceroute
Used to discover the path a packet takes as it traverses an internetwork

Reverse Address Resolution Protocol (RARP)
discovers the identity of the IP address for diskless machines by sending out a packet that includes its MAC address

Address Resolution Protocol (ARP)
Used to find the hardware address from a known IP address

Proxy Address Resolution Protocol (Proxy ARP)
The technique in which one host, usually a router, answers ARP requests intended for another machine. By "faking" its identity, the router accepts responsibility for routing packets to the "real" destination. Proxy ARP can help machines on a subnet reach remote subnets without the need to configure routing or a default gateway.

IP Address
32-bit logical numeric identifier assigned to each machine on an IP network

Bit
one digit, 1 or 0

Byte
8 bits (with parity)

Octet
8 bits

Network Address/Number
numerical identifier for a remote network; uniquely identifies each network

Broadcast Address
address used by applications and hosts to send information to all nodes on a network

IP Address
may be depicted in dotted-decimal, hex, or binary

Node Address
uniquely identifies each machine on a network

What is the Class C address range in decimal and in binary?
192-223, 110xxxxx

What layer of the DoD model is equivalent to the Transport layer of the OSI model?
Host-to-Host

What is the valid range of a Class A network address?
1-126

What is the 127.0.0.1 address used for?
Loopback or diagnostics

How do you find the network address from a listed IP address?
Turn all host bits off

How do you find the broadcast address from a listed IP address?
Turn all host bits on

What is the Class A private IP address space?
10.0.0.0 through 10.255.255.255

What is the Class B private IP address space?
172.16.0.0 through 172.31.255.255

What is the Class C private IP address space?
192.168.0.0 through 192.168.255.255

What are all the available characters that you can use in hexadecimal addressing?
0-9 and A, B, C, D, E, and F

What is the decimal and hexadecimal equivalent of the binary number 10011101?
157 & 0x9D

Which of the following allows a router to respond to an ARP request that is intended for a remote host?
Proxy ARP

You want to implement a mechanism that automates the IP configuration, including IP address, subnet mask, default gateway, and DNS information. Which protocol will you use to accomplish this?
DHCP

What protocol is used to find the hardware address of a local device?
ARP

Which of the following are layers in the TCP/IP model?
Application, Transport, Internet

Which class of IP address provides a maximum of only 254 host addresses per network ID?
Class C

Which of the following describe the DHCP Discover message?
It uses FF:FF:FF:FF:FF:FF as a layer 2 broadcast; It uses UDP as the Transport layer protocol

Which layer 4 protocol is used for a Telnet connection?
TCP

Which statements are true regarding ICMP packets?
They can provide hosts with information about network problems; They are encapsulated within IP datagrams

Which of the following services use TCP?
SMTP, FTP, HTTP

Which of the following services use UDP?
DHCP, SNMP, TFTP

Which of the following are TCP/IP protocols used at the Application layer of the OSI model?
Telnet, FTP, TFTP

If you use either Telnet or FTP, which is the highest layer you are using to transmit data?
Application

The DoD model (also called the TCP/IP stack) has four layers. Which layer of the DoD model is equivalent to the Network layer of the OSI model?
Internet

Which of the following is a private IP address?
172.20.14.36

What layer in the TCP/IP stack is equivalent to the Transport layer of the OSI model?
Host-to-Host

Which statements are not true regarding ICMP packets?
UDP will send an ICMP Information request message to the source host; ICMP guarantees datagram delivery; ICMP is encapsulated within UDP datagrams

What is the address range of a Class B network address in binary?
10xxxxxx

Which of the following protocols use both TCP and UDP?
DNS