Grade 9 Computing

Unit 5 · How the Internet Works

ANSWER KEY · FOR TEACHERS

Full marks 35

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. topology
2. bandwidth
3. latency
4. protocol
5. DHCP
6. NAT
7. DNS
8. MAC address

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. Lab switch
2. Access point
3. Fiber box
4. Router DHCP · NAT · firewall

K · 2

Each carries 0.5 mark.

3 Multiple choice

i. **c.** router — K · 1

A router works at the internet layer, with IP addresses. A hub and a repeater only pass signals on; an access point joins devices by Wi-Fi to one network.

ii. **b.** star — K · 1

In a star, each device has its own cable to the central switch (or hub).

iii. **d.** 128 — K · 1

IPv6 addresses are 128 bits. IPv4's are 32; a MAC address is 48 bits (six bytes).

iv. **c.** SMTP — K · 1

SMTP, the Simple Mail Transfer Protocol, sends email. HTTP carries web pages, FTP files, and DHCP gives out addresses.

v. **c.** 192.168.0.101 — U · 1

192.168.0.0 to 192.168.255.255 is one of the three private ranges (with 10.x.x.x and 172.16 to 172.31). The others are public addresses.

4 Match the columns

1. hub → **c.** repeats every message out of every socket, to every device
2. switch → **d.** sends each message only out of the socket it is for
3. router → **a.** joins networks and passes packets on by their IP address
4. access point → **e.** joins devices to the network by Wi-Fi

K · 2

Each carries 0.5 mark.

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5 True or false

U · 3

i. ✓ **True**
ii. ✗ **False:** It is half duplex: both ways, but only one way at a time.
iii. ✓ **True**
iv. ✗ **False:** UDP is the faster one: it doesn't check or resend; TCP checks every piece and sends lost ones again.
v. ✓ **True**
vi. ✗ **False:** Only https:// is encrypted (with TLS); http:// is sent as plain text.

Each carries 0.5 mark.

6 Short answers

a. A · 3

MARKING SCHEME

✓ i. The network part is 192.168.5 (the mask 255.255.255.0 keeps the first three numbers).
✓ ii. No: 192.168.5.200 has the same network part, so the packet goes straight to it, through the switch.
✓ iii. Yes: 192.168.6.14 is on another network (192.168.6), so the packet goes to the default gateway, 192.168.5.1, which passes it on.

b. A · 2

MARKING SCHEME

✓ Leading zeros off: fe80:0:0:0:202:b3ff:fe1e:8329.
✓ The run of zero groups as a double colon: fe80::202:b3ff:fe1e:8329.

c. U · 3

MARKING SCHEME

✓ TCP sets up a connection, checks that every piece arrived, resends lost ones and puts them in order (reliable, slower); UDP just sends each piece, with no checking or resending (faster, but pieces can be lost).
✓ i. TCP: every byte of the file must arrive, in order.
✓ ii. UDP: a piece sent again would arrive too late to show, so it is better to skip it and carry on.

7 Numerical problems

a. A · 3

ANSWER

i. 1.5 × 1,024 × 1,024 × 1,024 = 1,610,612,736 bytes. × 8 = 12,884,901,888 bits ≈ **12,885 Mb.**
ii. 12,885 ÷ 50 ≈ **258 seconds**, about 4.3 minutes.
iii. 12,885 ÷ 20 ≈ **644 seconds**, about 10.7 minutes.

MARKING SCHEME

✓ $1.5 \times 1{,}024^3 \times 8 = 12{,}884{,}901{,}888$ bits ≈ 12,885 Mb.
✓ 12,885 ÷ 50 ≈ 258 s (about 4.3 minutes).
✓ 12,885 ÷ 20 ≈ 644 s (about 10.7 minutes).

b. A · 2

ANSWER

Up and down is at least 2 × 550 = 1,100 km.
time = 1,100 ÷ 300,000 ≈ 0.0037 s ≈ **3.7 ms** one way.
The answer makes the same trip back: about **7.3 ms**, far less than the 0.48 s of a satellite 35,786 km up.

MARKING SCHEME

✓ 2 × 550 = 1,100 km; 1,100 ÷ 300,000 ≈ 0.0037 s (3.7 ms) one way.
✓ There and back: about 0.0073 s (7.3 ms).

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8 Long answer

ANSWER **U · 4**

1. **DNS lookup** (application layer): the browser finds the address of moecdc.gov.np, from a cache or by asking the resolver.
2. **TCP connection** (transport layer): the browser and the server set up a connection with the three-way handshake.
3. **TLS** (between the transport and application layers): because of https, they agree on a secret key, and the server shows its certificate to prove its name. Everything after is encrypted.
4. **HTTP request** (application layer): the browser sends GET for the page, with the Host moecdc.gov.np.
5. **HTTP response:** the server sends the status 200 OK and the page's HTML.
6. The browser asks for the other files the HTML names (styles, pictures, scripts) and draws the page as they arrive.

All of these messages travel as IP packets (internet layer) across Wi-Fi, cables and fiber (link layer), router to router.

MARKING SCHEME

- ✓ DNS lookup (application layer): the browser finds moecdc.gov.np's IP address, from a cache or by asking the resolver.
- ✓ TCP connection (transport layer), with the three-way handshake; then TLS, because of https: a secret key agreed and the server's certificate checked.
- ✓ HTTP request (application layer): GET for the page; the server's HTTP response with 200 OK and the HTML, then the other files it names.
- ✓ Every message travels as IP packets (internet layer) over Wi-Fi, cables and fiber (link layer), router to router.

9 Think

ANSWER **HA · 2**

It is a bus or chain, with every computer passing on the others' traffic: if PC 3 is switched off or its cable breaks, PCs 4, 5 and 6 lose the internet. Every computer must stay on and run software to pass messages on, the far computers get slower answers, and a fault is hard to find. A switch in the middle (a star) costs little, and a fault then cuts off only one computer.

MARKING SCHEME

- ✓ If one computer in the chain is switched off or its cable breaks, every computer after it loses the internet.
- ✓ Every computer must stay on and pass on the others' traffic, the far ones get slower answers, and faults are hard to find; a switch in the middle (a star) cuts off only one computer when one fails.

10 Activity: Your own address

(not marked)

WHAT STUDENTS SHOULD FIND

An address that starts like the default gateway's, such as 192.168.1.23 with a gateway of 192.168.1.1: with the mask 255.255.255.0, both have the network part 192.168.1, so the router is on the same network, as it must be. The ping times to your own router are tiny, a few milliseconds at most.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	12	11	10	2	**35**

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