

CSC 458H1F Midterm Exam
(Solution Key)
Duration: 110 minutes
Aids allowed: One 8.5 x 11 Study Aid
[BLUE]

Last Name: _____ First Name: _____

Student Number: _____ Lecture Section: _____

Do not turn this page until you are told to do so. Please fill out the identification section above, **write your name and lecture section on the back of the test [BONUS Mark]**, and read the instructions below.

This midterm is double-sided and consists of 21 questions on 10 pages (including this one). Please make sure that you have all pages.

- If you use any space for rough work, indicate clearly what you want marked.
- Do not remove any pages from the exam.
- **You may use a pencil; however, work written in pencil will not be considered for re-marking.**
- **Please write clearly and legibly as possible.** Marks will not be awarded for unreadable answers.

Part I	/ 14
#11	/ 2
#12	/ 1
#13	/ 2
#14	/ 1
#15	/ 4
#16	/ 5
#17	/ 3
#18	/ 6
#19	/ 6
#20	/ 2
#21	/ 4
BONUS	/ 2
TOTAL	/ 52

Part I: Multiple Choice. Circle all that apply/are true.

1. Suppose that instead of using 16 bits for the network part of a class B address originally, 20 bits had been used. How many class B networks would there have been? **[1/1]**
 - (a) 2^{14}
 - (b) 2^{16}
 - (c) 2^{18}
 - (d) 2^{20}
2. Which statement(s) are true regarding MAC and IPv4 addresses. **[2/2]**
 - (a) MAC addresses are used at the link layer within a single network, whereas IP addresses are used at the network layer between networks.
 - (b) MAC addresses are hierarchical, whereas IP addresses are flat.
 - (c) MAC addresses are burned into the device, whereas IP addresses may be assigned dynamically.
 - (d) MAC and IP addresses are 128-bits long
3. Which of the following header fields will be modified by an IP router during packet forwarding? **[3/3]**
 - (a) Source IP address
 - (b) Source MAC address
 - (c) Ethernet header checksum
 - (d) IP header checksum
 - (e) Destination IP Address
 - (f) Destination MAC Address
4. What is the formula for propagation delay? **[1/1]**
 - (a) transfer size/transfer time
 - (b) distance/speed of light
 - (c) message size/bandwidth
 - (d) refraction index/speed of light

5. A code with a Hamming Distance of 8 can... **[1/1]**
- (a) detect 7 bit errors and correct 3.5 bits
 - (b) detect 8 bit errors and correct 4 bits
 - (c) correct 1 bit and detect 3 bit errors
 - (d) correct 3 bits and detect 7 bit errors
6. Why is there a limit of the length of Ethernet? **[1/1]**
- (a) Cost of fibre optic cables are expensive.
 - (b) Signal-to-noise ratio is directly proportional to the length
 - (c) There is a latency in detecting collision
 - (d) Longer lengths will increase transmission speed
7. Which destination address do we send the ARP request if we do not know the MAC address of a host? **[1/1]**
- (a) 40:8E:A2:32:F9:80
 - (b) 0.0.0.0
 - (c) FF:FF:FF:FF:FF:FD
 - (d) FF:FF:FF:FF:FF:FF
8. Which of the following statement(s) are true about link layer protocols? **[1/1]**
- (a) Ethernet switches will always send received frames out all interfaces (except the one on which the packet was received).
 - (b) An Ethernet adapter passes every non-corrupt frame that it receives up to the network layer.
 - (c) Ethernet switches learn which MAC addresses are connected to each physical port so it can answer ARP requests.
 - (d) When many hosts seek to actively communicate, collision will be detected, therefore each host will backup exponentially.
9. A network advertises the CIDR network number 50.1.59/25 (and no other numbers). Which IP addresses could the network own? **[2/2]**
- (a) 50.1.59.66
 - (b) 50.1.60.4
 - (c) 50.1.59.200
 - (d) 50.1.61.44

10. Which of the following statement(s) are TRUE? [1/1]

- (a) The Ethernet is a connectionless and reliable data link protocol
- (b) Ethernet switches, like IP routers, use a table to determine which output links to send a packet.
- (c) Ethernet switches will always send received frames out on all interfaces (except the one on which the packet was received).
- (d) The Maximum Transmission Unit (MTU) of Ethernet is dictated by the buffer size of the link-layer endpoints.

Part II. Short Answers

11. Give one advantage and one disadvantage of fibre optics over copper as a transmission medium? [2/2]

Advantage:

- It can handle much higher bandwidth than copper.
- It is not affected by power surges, electromagnetic interference, power failures, or corrosive chemicals in the air.
- It does not leak light and is quite difficult to tap.
- it is thin and lightweight, resulting in much lower installation costs.

Disadvantage:

- It can be damaged easily by being bent too much.
- fiber interfaces cost more than electrical interfaces.

12. A router has just received the following new IP addresses: 57.6.96.0/21, 57.6.104.0/21, 57.6.112.0/21, and 57.6.120.0/21. If all of them use the same outgoing line, can they be aggregated? If so, to what? If not, why not? [1/1]

Yes

They can be aggregated to 57.6.96.0/19.

13. List one advantage and one disadvantage of classless interdomain routing (CIDR) over the earlier use of classful routing. [2/2]

Advantage:

CIDR allows more efficient allocation of the limited address space, by permitting a wide variety of sizes of address blocks.

Disadvantage:

CIDR requires routers to perform longest-prefix-match forwarding, which is hard to do quickly.

14. Convert the IPv4 address whose hexadecimal representation is C22F1582 to dotted decimal notation. [1/1]

The address is 194.47.21.130.

15. List the name of the 4 layers in the Internet Model and an example protocol that is used in each layer. [4/4]

Layer Name	Protocol Used
Application	FTP/HTTP/Telnet/SMTP/ DNS
Transport	TCP/UDP
Network	IP/IPX
Link	Ethernet/802.11

Part III. Longer Answers

16. A router has the following (CIDR) entries in its routing table:

Address/Mask	Next Hop
135.46.56/22	Interface 0
135.46.60.0/22	Interface 1
192.53.40.1/23	Router 1
default	Router 2

For each of the following destination IP addresses, what will be the next hop that the router selects? [5/5]

Packet IP Address	Selected Next Hop
135.46.63.10	Interface 1
135.46.57.14	Interface 0
135.46.52.2	Router 2
192.53.40.7	Router 1
192.53.56.7	Router 2

17. A sender and receiver have agreed to use CRC scheme with generator $G=10011$ to do error detection. The following data is received from the network layer at the sender: 1010101010

(a) What will be the value of the CRC field? Show all the steps [2/2]

R=0100

```

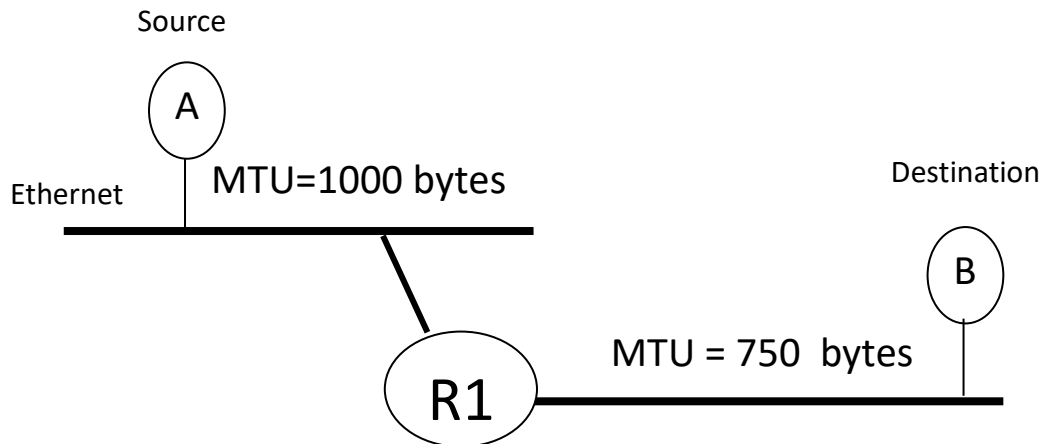
                                1011011100
                                -----
10011 ) 10101010100000
        10011
        ----
          0110010100000
          10011
          ----
            10100100000
            10011
            ----
              0111100000
              10011
              ----
                11010000
                10011
                ----
                  1001000
                  10011
                  ----
                    000100

```

(b) What will be the message sent? [1/1]

10101010100100

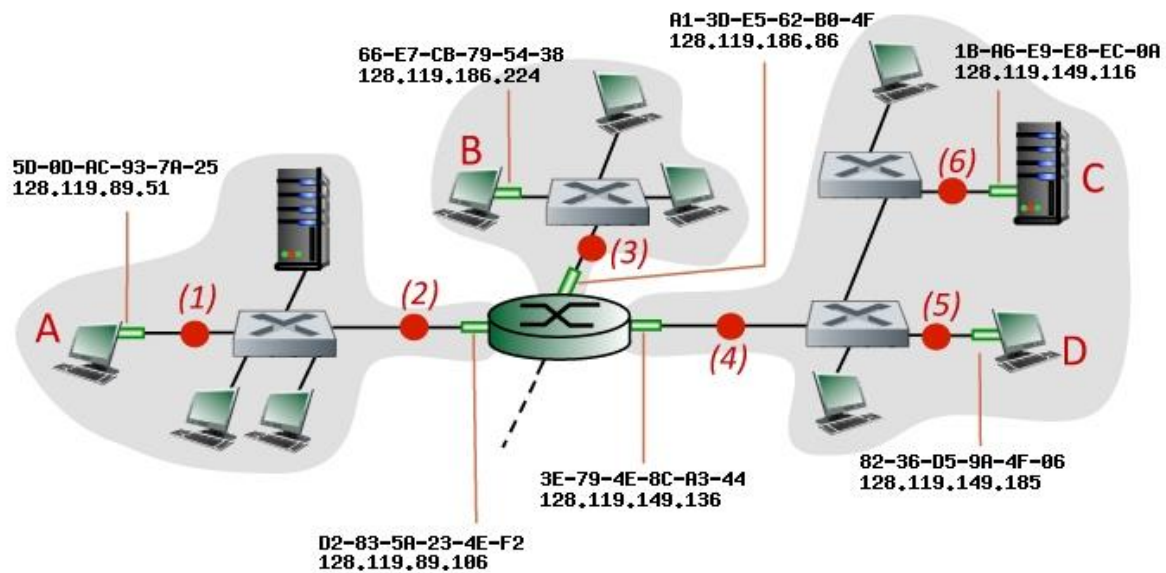
18.



Assume A has a packet of 3350 bytes (including header) to send to B. Fill in the following information about the packets that will arrive at B. [6/6]

More Frag Bit	Packet Length	Offset
1	20+728=748	0
1	20+248=268	91
1	20+728=748	122+0=122
1	20+248=268	122+91=213
1	20+728=748	244+0=244
1	20+248=268	244+91=335
0	20+422=442	366

19.



- (a) Consider an IP datagram being sent from node B to node D. Give the source and destination Ethernet addresses, as well as the source and destination addresses of the IP datagram encapsulated within the Ethernet frame at points (3), (4), and (5) in the figure above. **[3/3]**

Point	Source IP	Destination IP	Source MAC	Destination MAC
(3)	128.119.186.224	128.119.149.185	66-E7-CB-79-54-38	A1-3D-E5-62-B0-4F
(4)	128.119.186.224	128.119.149.185	3E-79-4E-8C-A3-44	82-36-D5-9A-4F-06
(5)	Same as (4)			

- (b) Consider an IP datagram being sent from node C to node D. Give the source and destination Ethernet addresses, as well as the source and destination addresses of the IP datagram encapsulated within the Ethernet frame at points (6) and (5) in the figure above. **[2/2]**

Point	Source IP	Destination IP	Source MAC	Destination MAC
(6)	128.119.149.116	128.119.149.185	1B-A6-E8-E8-EC-0A	82-36-D5-9A-4F-06
(5)	Same as (4)			

- (c) Consider node A sending an ARP request asking for the MAC address of B. Give the source and destination addresses of the Ethernet frame at point (2). **[1/1]**

Source MAC	Destination MAC
50-8-AC-93-7A-25	FF-FF-FF-FF-FF-FF

20. Imagine that you have trained your dog, Bernie, to carry a box of three 8-mm tapes. These tapes each contain 7 GB. The dog can travel to your side, wherever you may be, at 18km/hr. For what range of distances does Bernie have a higher data rate than a transmission line whose data rate (excluding overhead) is 150 Mbps? **[2/2]**

The dog can carry 21 gigabytes, or 168 gigabits. A speed of 18 km/hour equals 0.005 km/sec. The time to travel distance x km is $x/0.005 = 200x$ sec, yielding a data rate of $168/200 \times \text{Gbps}$ or $840/x \text{ Mbps}$. For $x < 5.6$ km, the dog has a higher rate than the communication line.

21. Suppose there is a 10 Mbps microwave link between a geostationary satellite and its base station on Earth. Every minute the satellites takes a digital photo and send it to the base station. Assume a propagation speed of 2.4×10^8 meters/sec.

[A geostationary orbit remains fixed at a distance of $\sim 36,000$ km from sea level.]

- (a) What is the propagation delay of the link? **[1/1]**

$$\text{propagation delay} = d/s = (36,000 \times 10^3) / (2.4 \times 10^8) = 0.15 \text{ second}$$

- (b) What is the bandwidth-delay product? What does it mean? **[2/2]**

$$\text{bandwidth-delay product} = R \times d_{\text{prop}} = 10\text{Mbps} \times 0.15 \text{ seconds} = 1.5\text{Mbits}$$

It gives an idea of the maximum number of bits that can be on the link at a given time.

- (c) Let x denote the size of a photo. What is the minimum value of x for the microwave link to be continuously transmitting? **[1/1]**

$$x / 10\text{Mbps} = 60 \text{ seconds} \Rightarrow x = 600\text{Mbits}$$

LAST NAME: _____

FIRST NAME: _____

STUDENT NUMBER: _____

SELECT YOUR LECTURE SECTION FROM THE TABLE BELOW

<input type="radio"/> L0101- Thurs, 1-3pm	<input type="radio"/> L0201- Tues, 1-3pm	<input type="radio"/> L5101-Tues, 6-8pm
--	---	--

Bonus Question: Location of your instructor's office hours _____