Exam Policies

- You will have a total of 96 hours to complete the exam: the exam releases at 12:00am on April 10st and the exam is due via submission to Canvas at 11:59pm on April 13rd.
- You **may** use the textbook, the slides, your notes... any course material is fair game.
- You **may not** cooperate with anyone else. This is a chance to prove **your** knowledge.
- Use of calculators is fine for checking your answers. The same is true for programs that you may write yourself, or programs that you have written for this class. **You are still expected to show your work!**
- This is designed as a typical exam, so it is designed for a 1 hour block of time to be taken in one sitting. I am giving you four days so that each of you can find your own time to work on the exam and to prepare your solutions for submission.
- You are free to take as much time as you wish for the exam, but you should allocate at least 2 hours for completing your answers, and more if you need to type them up.
- **Read questions in their entirety.**
  Questions may require multiple responses, including an explanation or a justification.

Nondisclosure Agreement

- I attest that I am the person taking the exam.
- I understand that I am on my honor to do my own work without any assistance from others or outside sources not allowed and agree that I will not disclose the contents of this exam.
- If I am discovered to have compromised the exam in any way, I understand that I will receive a zero for the exam and will be referred to the Office of Student Affairs for violation of university policies regarding academic integrity.

By submitting this exam, I affirm that I have read, understand, and agree to the policies of this exam and the terms this agreement.

1. The following flows are entering a router: 78 kbps, 88 kbps, 100 kbps, 12 kbps.
   (a) (6 points) What is the Fairness Index for the set of flows?

   (b) (3 points) Do you think these flows are fair? **Why or why not?**

2. (6 points) The MSS for a given TCP connection is 1000 bytes. The current Congestion Window is 1789 bytes. Show how the Congestion Window size changes when the next ACK arrives.

3. (6 points) A router implementing RED has a maximum drop probability of 1.5% (or 0.015). The MaxThreshold is set to 36 and the MinThreshold is set to 18. The running average of the queue length has just been calculated to be 19. Assuming that the queue length does not change, what is the probability that the 50th packet (Count = 50) will be dropped?

4. (10 points) Define and list the responsibilities of the **control plane** and the **data plane** as thy apply to the Network Layer.

5. (10 points) A router implementing Fair Queuing is busy transmitting a packet when three flows deliver the following packets at approximated the same time, in the order given. Show how these packets will be scheduled for transmission.

Packet	1	2	3	4	5
Size	45	45	75	15	75
Flow	1	1	2	2	3

6. Shown below is a small CIDR routing table.

Address Range	**Port**
0.0.0.0/1	1
128.0.0.0/1	2
16.0.0.0/4	3

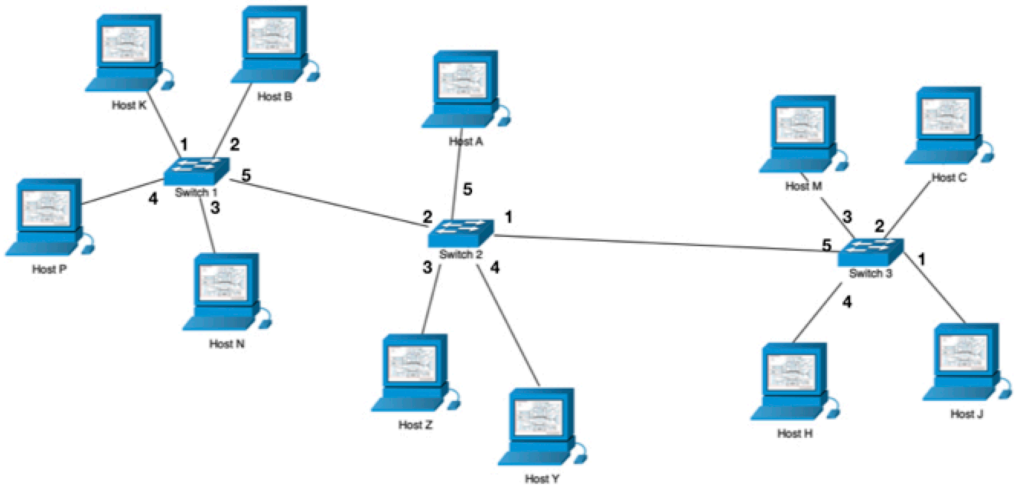
Indicate which entry matches the following IP addresses.

(a) (4 points) 18.156.18.18

(b) (4 points) 88.19.148.127

(c) (4 points) 17.178.96.59

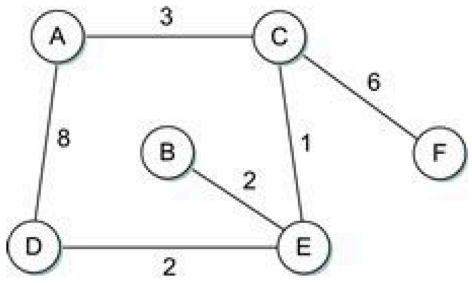
7. (10 points) Shown below is a network to be switched. Show the complete forwarding table for switch 2 (include all hosts).



8. (12 points) A host launches three IP datagrams that have payloads of 1280 bytes, 1280 bytes and 394 bytes. The MTU of the directly attached network is 1460 bytes, but the destination host's network has an MTU of 576 bytes (the "minimum MTU" supported by IP). Assume that these are the only two networks the datagrams must pass through. Indicate how each packet will be fragmented and specify for each fragment the size of each fragment's payload, the status of the "more" bit, and the value of the Offset field.

9. (10 points) A device joins a network for the first time. Which sequence of messages is more logical from that device: a DHCP request followed by an ARP request, or an ARP request followed by a DHCP request? **Justify your answer.**

10. (15 points) Shown below is a (hopefully familiar) simple network, along with the corresponding distance vectors for each node.



–	A	B	C	D	E	F
A	–	6	3	6	4	9
B	6	–	3	4	2	9
C	3	3	–	3	1	6
D	6	4	3	–	2	9
E	4	2	1	2	–	7
F	9	9	6	9	7	–

Suppose that the link between C and E fails. Assuming no count-to-infinity problems, show the series of updates that will eventually reconnect the nodes, along with the cost of the new path between C and E. You don't need to show every table swap—just focus on the updates pertaining to the failed link.

11. **(bonus)** Typically CIDR address 0.0.0.0/0 is considered invalid. Assume we want to instead implement our software-defined network to support 0.0.0.0/0: should it match every IP address, or no IP address? While there is no correct decision, be sure to **justify your answer** with a short (sentence of two) reasoning using appropriate terminology.

Scratch Work

Question	Points	Score
1	9	
2	6	
3	6	
4	10	
5	10	
6	12	
7	10	
8	12	
9	10	
10	15	
11	0	
Total:	100	