

S'09 : 3AN : CP412/422(1454)**COMPUTER NETWORKS***Time : Three hours**Maximum Marks : 100*

*Answer FIVE questions, taking ANY TWO from Group A,
ANY TWO from Group B and ALL from Group C.*

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Group A

1. (a) What is the difference between a bus backbone and a star backbone ? 5
- (b) Compare circuit-switching, message switching and packet switching methods, using timing diagram. 15
2. (a) A transmission network is designed. Identify the delay for utilization values of 25%, 45% and 75%, respectively. Assume that the network delay is 20 ms. 7

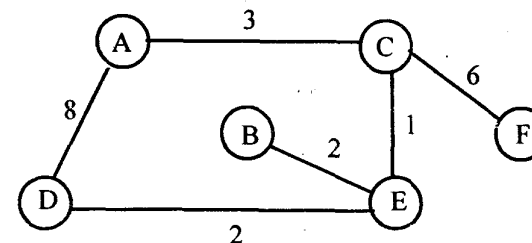
(Turn Over)

- (b) What is a LAN ? Can a LAN has routers ? What is the difference between a packet and a frame. 7
- (c) Distinguish between synchronous and statistical TDM. 6
- 3. (a) How are OSI and ISO related to each other ? 7
- (b) What are the responsibilities of the network layer in the Internet model ? 6
- (c) What is the difference between a port address, a logical address and a physical address ? 7
- 4. (a) In cases where reliability is not of primary importance, UDP would make a good transport protocol. Give examples of specific cases. 7
- (b) Briefly explain the cyclic redundancy check error detection scheme. Prove the validity of the scheme ? 7
- (c) Differentiate between forward error correction and backward error correction schemes. 6

Group B

- 5. (a) Briefly explain X-25 standard. Where is it applied ? 6
- (b) Differentiate between co-back N and stop wait ARQ using diagram. 7
- (c) Compare the frames of transmission for synchronous and asynchronous techniques ? What is meant by a permeable and a post-amble in the frame ? Why are they required ? 7

- 6. (a) Differentiate between a point-to-point direct link and a multipoint guided configuration. 7
- (b) How does information get passed from one layer to the next in the Internet model ? 6
- (c) What is the difference between network layer delivery and transport layer delivery ? 7
- 7. (a) Compare and contrast a circuit-switched network and a packet-switched network. 7
- (b) List four major components of a packet switch and their functions. 7
- (c) What do you mean by routing protocol ? Explain in detail. 6
- 8. (a) Consider the network as shown below. Identify the datagram forwarding table for each node. The links are labelled with relative cost. The tables should forward each packet via the lowest cost path to its destination. 10



- (b) Create a diagram of the NRZ, NRZI and Manchester encodings for the bit pattern 11010011. 10

9. Explain the following terms : 2 × 10

- (i) FDM**
- (ii) Ethernet**
- (iii) Gateways**
- (iv) Multiplexing**
- (v) MAN**
- (vi) HDLC**
- (vii) Topology**
- (viii) Buffer**
- (ix) WWW**
- (x) Intranet.**

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Group A

1. (a) What is a spanning tree ? What is the difference
between a hub and a layer 2 switch. 12
- (b) What are the differences among backend LANs,
SLANs and backbone LANs ? 5
- (c) What do you understand by the term 'time jitter' ? 3
2. (a) Explain the functions of different network support
layers of OSI model in detail. 8

Group B

- (b) What is the total delay (latency) for a frame of size 10 million bits that is being sent on a link with 15 routers, each having a queuing time of $2 \mu\text{s}$ and a processing time of $1 \mu\text{s}$. The length of the link is 3000 km. The speed of light inside the link is $2 \times 10^8 \text{ m/s}$. The link has bandwidth of 6 Mbps. Which is the component of the total delay dominant ? Which one is negligible ? 7
- (c) Discuss the different transmission impairments. 5
5. (a) Explain, with a neat diagram, how frequency division multiplexing works. Why is a statistical time division multiplexer more efficient than a synchronous time division multiplexer. 8
- (b) Ten 9600 bps lines are to be multiplexed using TDM. Ignoring overhead bits in the TDM frame, what is the total capacity required for synchronous TDM ? Assuming that we wish to limit average link utilization of 0.8, and assuming that each link is busy 50 % of the time, what is the capacity required for statistical TDM ? 7
- (c) Compare datagram packet switching and virtual circuit packet switching. 5
6. (a) What is CRC ? List and explain three different ways in which the CRC algorithm can be described. 12
- (b) Explain the effect of packet size on transmission time. 5
- (c) List the advantages and disadvantages of decentralized, centralized and distributed systems. 3
5. (a) How does frame relay differ from X.25 ? What are the relative advantages and disadvantages of frame relay compared to X.25 ? 7
- (b) Describe sliding-window flow control. 8
- (c) A channel has a data rate of 4 kbps and a propagation delay of 20 ms. For what range of frame sizes does stop-and-wait give an efficiency of at least 50 % ? 5
6. (a) Explain the term 'exponential backoff' in reference to CSMA/CD. Also, explain how does the CSMA/CD algorithm improve on the CSMA algorithm. 8
- (b) Compare the MAC frame format for CSMA/CD and token ring. 6
- (c) What is the significance of cell delay variation in an ATM network ? What are the functions included in ATM usage parameter control ? 6
7. (a) When a node experiences saturation with respect to incoming packets, what may be the general strategies used ? 5
- (b) Differentiate between a connection-oriented and a connectionless operation in reference to an internet. 5
- (c) Write a note on network classes. What is the use of subnetting in assigning IP address. 5
- (d) What is multicasting ? Explain the primary requirements for multicasting in an Internet work. 5

8. (a) Explain Dijkstra's algorithm and the Bellman Ford algorithm. What is the difference between them ? 12

(b) Consider a packet-switching network of N nodes connected by the following topologies :

(i) Star—one central node with no attached station; all other nodes attach to the central node.

(ii) Loop—each node connects to two other nodes to form a closed loop.

(iii) Fully connected—each node is directly connected to all other nodes.

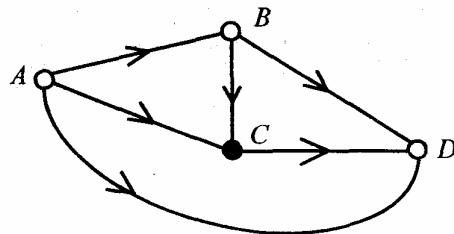
For each case, give the average number of hops between stations. 8

Group C

9. Answer the following in brief : 2 × 10

(i) What is the thermal noise power density at room temperature 17°C ?

(ii) Suppose a packet is transmitted by node A using flooding technique. How many packets will arrive at node B ?



(iii) What destination station does issuing an REJ frame using sliding-window flow control technique ?

(iv) In which situation we say that link utilization is the best in stop-and-wait flow control ?

(v) What is echo cancellation ?

(vi) X-25 standard specifies an interface between a host system and packet-switched network. The functionality of X-25 is specified on three levels. What are they ?

(vii) What do you mean by the term 'robustness' in the context of routing.

(viii) If two end systems are situated in the same network, what is the role of the network layer ?

(ix) Draw IEEE 802 reference model.

(x) Assume that, in a stop-and-wait ARQ system, the bandwidth of the line is 1 Mbps, and 1 bit takes 20 ms to make a round trip. What is the bandwidth-delay product ?

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Group A

1. (a) What is computer network? Explain goals and applications of computer networks. 6
- (b) Define WAN, MAN, LAN and PAN. 4
- (c) Explain, with proper examples, circuit switching, message switching and packet switching. 6
- (d) From the stability point of view, can average arrival rate of data at a node be greater than average service rate of data? Justify your answer. 4

2. (a) Define throughput and latency for a given network. Explain the term 'delay bandwidth product'. 4
- (b) Discuss the error control technique commonly used in data networks. 6
- (c) What are different types of transmission mediums used in data communication systems? Compare their merits and demerits. 10
3. (a) Explain the functions performed by different layers of ISO-OSI model and compare it with TCP/IP model. 10
- (b) What is satellite-based networks? Explain various advantages and applications of GEO, MEO and LEO based communication networks. 10
4. (a) What is queuing system? Explain various characteristics of M/M/1 and M/G/1 queuing systems. Determine the equilibrium state probabilities for M/M/m system. 10
- (b) Mention the advantages and disadvantages of wireless LAN. 3
- (c) Explain IEEE 802.11 MAC. How does it work for reliable data delivery, access control, and security? 7

Group B

5. (a) What are different goals of routing algorithms in a packet switched network? How will you classify the routing algorithms? Mention the advantages of distance vector routing over flow-based routing. 10

- (b) What is IP datagram? Differentiate between IP datagram format and TCP segment format. 6
- (c) Explain how TCP is used to add connection-oriented reliable feature to the service of IP. 4
6. (a) Discuss basic functions of data link layer in brief. 5
- (b) Explain X.25 standard. Where is it applied? 5
- (c) What is congestion? How is it caused? What is done to overcome it? What are the pre-emptive measures taken to avoid the traffic congestion in the networks? 10
7. (a) What is dotted decimal notation? Where is it used? Explain the purpose of subnetting. How is masking related to subnetting? 6
- (b) Explain physical architecture and access protocol for Ethernet (802.3) and Token Rings (802.5) LAN. 10
- (c) Suppose you are designing a sliding window protocol for a 1 Mbps point-to-point link, which has a one way latency of 1.25 sec. Assuming that each frame carries 1 KB of data, what is the minimum number of bits you need for the sequence number? 4
8. (a) Suppose P , Q and R are network service providers, with respective CIDR address allocations $C1.0.0.0/8$, $C2.0.0.0/8$ and $C3.0.0.0/8$. Customers of each service provider initially receives address allocations that are a subset of the service provider. P has the following customers :

P_A , with allocation C1-A3-0-0/16

P_B , with allocation C1-B0-0-0/12

Q has following customers :

Q_A , with allocation C2-0A-10-0/20

Q_B , with allocations C2-0B-0-0/16

Assuming there are no other providers or customers, answer the following questions :

- (i) Give routing tables for P , Q , and R assuming each provider connects to both of the others. 5
- (ii) Now, assume P is connected to Q and Q is connected to R , but P and R are not directly connected. Give tables for P and R . 5
- (iii) Suppose customer PA acquires a direct link to P in addition to existing links. Give tables for P and Q , ignoring R . 5
- (b) What are the parameters for determining the quality of service at transport layer? 5

Group C

9. Explain the following terms : 2x10

(i) TDM

(ii) Virtual communication

(iii) Protocol

(iv) Bridge

(v) Router

(vi) Internet

(vii) ARP

(viii) MAC protocol

(ix) Sliding window

(x) HDLC.

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Group A

1. (a) Describe the following properties of coaxial cable :
(i) Gauge, (ii) bandwidth, (iii) error performance,
(iv) distance, (v) security. 10
- (b) Draw the frame format of IEEE802.3 and explain its
various fields. 10
2. (a) What is meant by data encapsulation ? Explain data
encapsulation in TCP/IP. 10
- (b) Name the 7 layers of OSI reference model and
describe their function in brief. 10

3. (a) Explain Bellman Ford algorithm used in shortest path routing. 10
- (b) A signal of frequency 25 MHz is sampled at Nyquist rate and converted to 7 bit digital signal. Five such signals are multiplexed and transmitted over a channel. Calculate the data transmission speed. 10

4. Explain CRC coding mechanism considering following message and generator polynomial :
- $M = 110010101100101010$
 $G = 1010$
- Show the working of CRC on this data. 20

Group B

5. (a) Describe the ALOHA protocol and its shortcomings. How slotted ALOHA improves the situation? 10
- (b) Differentiate between packet switching and circuit switching. 10
6. (a) Write short notes on the following : 5 + 5
- (i) Sliding window protocol
- (ii) Packet routing.
- (b) What do you mean by URL and Internet address? How is URL mapped to Internet address during a web access? 5 + 5
7. (a) Explain the following in brief : 5 + 5
- (i) Ethernet
- (ii) Frame assembly and disassembly.

- (b) Explain why congestions occur in a packet switched network. How is congestion controlled? 10

8. Write short notes on the following : 4 x 5
- (i) Collision detection
- (ii) Reverse address resolution protocol (RARP)
- (iii) Token ring architecture
- (iv) Stop and wait protocol.

Group C

9. Answer the following in brief : 10 x 2
- (i) List two characteristics of a broadband network.
- (ii) Name *any one* important function of the data link layer.
- (iii) Differentiate between centralized and decentralized routing.
- (iv) Mention *any four* applications of a computer network.
- (v) Name any application layer protocol.
- (vi) Name any transport layer protocol.
- (vii) What is HTTP?
- (viii) Differentiate between connectionless and connection-oriented services.
- (ix) What is datagram?
- (x) What is a hub?

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Group A

1. (a) What are various advantages of layered architecture ?
Explain the unified view of layers, protocols, and
services for the development of OSI model and
TCP/IP model. 6
- (b) Ten signals, each requiring 4000 Hz, are multiplexed
on to a single channel using FDM. How much
minimum bandwidth is required for the multiplexed
channel ? Assume that guard bands are 400 Hz wide. 4

- (c) Explain the difference between datagram packet switching and virtual packet switching. 4
- (d) Explain the architecture of a TCP/IP protocol suite. Draw IP packet format and explain its various components. 6
2. (a) Explain various network topologies and give their merits and demerits. 4
- (b) Prove that a linear block code, with a minimum distance d_{\min} , can correct up to $\lfloor (d_{\min} - 1) / 2 \rfloor$ errors and detect up to $(d_{\min} - 1)$ errors in each code words, where $\lfloor (d_{\min} - 1) / 2 \rfloor$ denotes the largest integer not greater than $(d_{\min} - 1) / 2$. 6
- (c) Mention advantages and disadvantages of wireless LAN. What is 802.11 medium access controls? How it works for the reliable data delivery, access control, and security? 10
3. (a) Explain satellite frequency bands with downlink and uplink frequency. 4
- (b) A group of $2^n - 1$ routers are interconnected in a centralized binary tree, with a router at each tree node. Router i communicates with router j by sending a message to root of the tree. The root then sends the message back to router j . Derive an approximate expression for mean number of hops per message for large n , assuming that all router pairs are equally likely. 10
- (c) Explain IEEE 802.11 architecture and services. 6
4. (a) What is queuing system? Explain various characteristics of M/M/1 and M/G/1 queuing system. Determine the equilibrium state probabilities for M/M/m system. 10
- (b) Explain the basic principle of FDM and TDM. What are various applications of FDM and TDM systems? 10
- Group B**
5. (a) A large number of consecutive IP addresses are available starting at 198.16.0.0. Suppose that four organisations A , B , C and D request 4000, 2000, 4000 and 8000 addresses, respectively in that order. For each of these, give the (i) first IP address assigned, (ii) last IP address assigned, and (iii) mask in the W.X.Y.Z/S notation. 6
- (b) When IPv6 protocol is introduced, does the ARP protocol have to be changed? If so, are the changes conceptual or technical? 6
- (c) Discuss basic functions of network layer in brief. 4
- (d) 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 have been there? 4
6. (a) Ethernet frame must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size? 8

- (b) Explain X.25 standard. Compare X.25 standard with frame relay on the OSI layer operation and node error checking. 6
- (c) Explain logical link control. 6
7. (a) Compare the TCP header and UDP header. List the field in the TCP header that is missing from UDP header. Give the reason for their absence. 10
- (b) What is the minimum size of an Ethernet frame that carries an IPv4 packet which in turn carries an ICMPv4 packet? What is the maximum size? 4
- (c) What is the difference between delivery of a frame in the data link layer and delivery of the packet in the networks layer? 6
8. (a) Which of the TCP/IP transport protocol would you select for the following applications? State the reason for your choice : 10
- (i) Packet voice
- (ii) File transfer
- (iii) Remote login
- (iv) Multicast communication.
- (b) Write a program for transmitter and the receiver implementing stop-and-wait protocol over data link layer that can introduce errors in transmission. Assume station A has an unlimited supply of frames to send to station B. Only ACK frames are sent from station B to station A. 10

Group C

9. Choose the *correct* answer for the following : 10×2
- (i) Which one of the following is a primary advantage of low earth orbit satellites for two way communication?
- (a) Ground location
- (b) Power to access
- (c) Weather
- (d) Immunity to solar flares.
- (ii) Throughput using a half duplex protocol
- (a) exceeds that of a full duplex protocol.
- (b) is less than that of a full duplex protocol.
- (c) equals throughput on a full-duplex protocol.
- (d) is faster than all other types of protocols.
- (iii) The data link control identifier
- (a) is always fixed in a value.
- (b) has global significance.
- (c) can vary through a frame relay network.
- (d) always matches the entry value at the exit from the network.
- (iv) Which one of the following transmission system provides the highest data rate to an individual device?
- (a) Voice band modem
- (b) Unlimited expansion
- (c) Low cost access for low bandwidth channels
- (d) Application independent interfaces.

- (v) Which one of the following options is a characteristic of a LAN?
- (a) Parallel transmission
 - (b) Global significance
 - (c) Can vary through a frame relay network
 - (d) Always matches the entry value at the exit from the network.
- (vi) Which one of the following functions is not provided as part of the basic Ethernet design?
- (a) Access control
 - (b) Addressing
 - (c) Automatic re-transmission of a message
 - (d) Multiple virtual networks
- (vii) What is the minimum length of Ethernet frame?
- (a) 64 bytes
 - (b) 72 bytes
 - (c) 1500 bytes
 - (d) 1526 bytes.
- (viii) Which one of the following features is not possible in a token passing loop network?
- (a) Unlimited number of stations
 - (b) Unlimited distances
 - (c) Multiple time division channels
 - (d) In-service expansion.
- (ix) A bridge operates at which layer?
- (a) Data link layer
 - (b) Application layer
 - (c) Network layer
 - (d) Segmentation layer
- (x) What layer does a router operate at?
- (a) Data link layer
 - (b) Application layer
 - (c) Network layer
 - (d) Segmentation layer

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Group A

1. (a) Explain the difference between circuit switching and packet switching. Discss their relative advantages. 10
(b) Briefly explain how error detection and correction achieved by a network. 10
2. (a) Explain mesh topology. Write its primary advantages and disadvantages. 10
(b) What is meant by multiplexing. Discuss various types of multiplexing. 10
3. (a) The bit rate of a signal is 3000 per second. If each signal unit carries 6 bits, calculate baud rate. Ignore parity and other overhead bits. 10

- (b) What is a modem? Explain its operation using a suitable diagram. 10
4. (a) What is the difference between baseband and broad band signalling? Explain the usage of each with examples. 10
- (b) Determine the minimum bandwidth required for an amplitude shift keying signal transmitting at 2000 bps. It is given that the transmission mode is half duplex. 10

Group B

5. (a) What is the difference between connection-oriented and connectionless services? 10
- (b) Explain the important characteristics of following types of cables. Also, mention one application in which they are used : 10
- (i) Coaxial cable
- (ii) Twisted pair cable
- (iii) Optical fiber cable
6. (a) What do you understand by CSMA/CD protocol? Briefly explain its working. 10
- (b) What do you understand by HTTP protocol. Explain its working. At which layer does it operate? 10
7. (a) Explain functioning of user datagram protocol (UDP). Mention at least one application that is based on UDP protocol. 10
- (b) What is meant by address resolution protocol. How is mapping performed between IP address into a MAC address? 10

8. Write short notes on the following : 4 × 5
- (i) IP addressing
- (ii) Flow control
- (iii) Domain Name Server
- (iv) Routing.

Group C

9. Answer the following in brief : 10 × 2
- (i) Mention one networking application of twisted pair cable.
- (ii) In TCP/IP, which layer of the protocol stack is responsible for flow control?
- (iii) Name any networking layer protocol.
- (iv) What do you mean by signal quantization?
- (v) Name any analog-to-analog modulation technique.
- (vi) What is ARPANET.?
- (vii) How many bits are present in class E address format.
- (viii) At which layer does a hub operate?
- (ix) What is subnet address if the destination address is 200.45.34.56 and subnet mask is 255.255.255.0.
- (x) Mention *any one* important role of a proxy server.

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Group A

1. (a) Why are protocol needed ? 5
- (b) What are the responsibilities of the network layer in the Internet model ? 5
- (c) Give some advantages and disadvantages of combining the session, presentation, and application layer in OSI model into one single application layer in the Internet model. 10
2. (a) Distinguish between baseband transmission and broad-band transmission. 5
- (b) Distinguish between multilevel TDM, multiple slot TDM, and pulse-stuffed TDM. 5

(Turn Over)

- (c) List three traditional switching methods. What are the most common methods today? 10
3. (a) List *four* major components of a packet switch and their functions. 5
- (b) What is the Hamming distance? What is the minimum Hamming distance? 5
- (c) Discuss the concept of redundancy in error detection and correction. 10
4. Answer the following: 4 × 5
- (a) What is the polynomial representation of 101100?
- (b) What is the result of shifting 101010 three bits to the left?
- (c) What is the result of shifting 101010 four bits to the right?
- (d) Apply the following operation on the corresponding polynomial:
- $$(x^3 + x^2 + x + 1) + (x^4 + x^2 + x + 1).$$

Group B

5. (a) Compare and contrast the Go-Back-N ARQ protocol with Selective-Repeat ARQ. 5
- (b) Define framing and the reason for its need. 5
- (c) A sender sends a series of packets to the same destination using 5-bit sequence numbers. If the sequence number starts with 0, what is the sequence number after sending 100 packets? 10

6. (a) How does a repeater extend the length of a LAN? 5
- (b) TCP uses a transition state diagram to handle sending and receiving segments. Find about this diagram that how it handles flow and control. 10
- (c) What is the half-duplex close case in TCP? 5
7. (a) What can you say about the TCP segment in which the value of the control field of the following: 000001. 5
- (b) Briefly describe the issues involved in using ATM technology in LANs? 10
- (c) Why is multiplexing more efficient if all the data units are of the same size? 5
8. (a) What is the size of an ARP packet when the protocol is IPv₄ and the hardware is Ethernet? 5
- (b) If a router has 15 entries in its group table, should it send 15 different queries periodically or just one? Explain your answer. 5
- (c) What is the difference between open-loop congestion control and closed-loop congestion control? 10

Group C

9. Choose the *correct* answer with proper justification for the following: 10 × 2
- (i) How long is an IPv₆ address?
- (a) 32 bits
- (b) 128 bytes
- (c) 64 bits
- (d) 128 bits

- (ii) What flavor of network address translation can be used to have one IP address allow many users to connect to the global Internet ?
- (a) NAT
 - (b) Static
 - (c) Dynamic
 - (d) Port Address Translation (PAT).
- (iii) What is the command used to create a backup configuration ?
- (a) Copy running backup
 - (b) Copy running-config startup-config
 - (c) Config mem
 - (d) Wr mem
- (iv) What protocol does PPP use to identify the network layer protocol ?
- (a) NCP
 - (b) ISDN
 - (c) HDLC
 - (d) LCP
- (v) Which protocol does DHCP use at the transport layer ?
- (a) IP
 - (b) TCP
 - (c) UDP
 - (d) ARP

- (vi) Where is a hub specified in the OSI model ?
- (a) Session layer
 - (b) Physical layer
 - (c) Data link layer
 - (d) Application layer
- (vii) What is the layer in the TCP/IP stack equivalent to the transport layer of the OSI model ?
- (a) Application
 - (b) Host-to-Host
 - (c) Internet
 - (d) Network access
- (viii) Which one of the following is a private IP address ?
- (a) 12.0.0.1
 - (b) 168.172.19.39
 - (c) 172.15.14.36
 - (d) 192.168.24.43
- (ix) Which one of the following allows a router to respond to an ARP request that is intended for a remote host ?
- (a) Gateway DP
 - (b) Reverse ARP (RARP)
 - (c) Proxy ARP
 - (d) Inverse ARP (IARP)

- (x) Which class of IP address provides a maximum of only 254 host addresses per network ID ?
- (a) Class A
 - (b) Class B
 - (c) Class C
 - (d) Class D

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