Circuit switching: In circuit switching, before transmitting data between two nodes, the network establishes a dedicated end-to-end connection between the node and reserves bandwidth in each link & along the connection. The reserved connection bandwidth is wasted whenever the concerned nodes are not sending data.

Packet switching: when one node sends data to another node, the sending node breaks the data into packets, and then sends each packet seperately. Here packet is routed using the destination address written on the packet. When a packet is received, it uses this destination address to determine on which link it should forward the packet. This in packet switching incoming packets are forwarded to outgoing link packet by packet. Also, packet switching typically uses store and forward mechanism which receives and stores the entire packet before forwarding. In store and forward, the packet is stored until it has fully arrived so that checksum can be computed/verified. Then it forward to the appropriate outgoing link for delivery.

Frequency division multiplexing and Time division multiplexing are two common multiplexing used in circuit switching network. In FDM, the bandwidth of the link is partitioned into frequency bands. TDM partitions time in a link with a revolving frame giving each connection the same slot in the revolving frame.

f. Suppose that all of the network resources send data at a constant bit rate (CBR). Would packet-switching or circuit switching be more appropriate in this case and why?
Here, no statistical multiplexing gain is there. Therefore, Circuit-switching is more desirable here because by using circuits, each connection will get a constant amount of bandwidth that matches with its CBR. But circuit switching has more overhead in terms of signaling needed to set up the call, so there is an argument that packet-switching may also be preferable. here since there is no call setup overhead with packet-switching. If this is an exam question, either answer would be correct as long as you provide correct reasoning.

g. Suppose that all of the network resources are bursty - that they only occasionally have data to send. Would packet-switching or circuit-switching be more appropriate and why?
Packet-switching is better here because there are statistical multiplexing gain — when a source does not have data to send it will not be allocated bandwidth. With packet-switching this bandwidth is then available for use by others sources.

h. Suppose users share a 1 Mbps link. Assume each user needs 500kbps when transmitting, but each user transmit only 10% of the time.
a) If circuit-switching is used, how many users can be supported?
Ans: Two users each will get a dedicated 500 kbps.
b) If packet-switching is used and there are three users, find the fraction of time during which the queue grows?
Ans: If two users transmit simultaneously, the input rate is 1 mbps. Since the link is 1 mbps, there will be no queuing delay. If three users transmit simultaneously, then the input rate is 1.5 mbps. Since the output rate is 1 mbps, the queue will grow at the rate of 0.5 mbps. The prob that a user is transmitting = 0.1. Prob. that all 3 users transmit simultaneously = $(0.1)^3 = 0.001$. Thus the fraction is 0.001 during which queue grow (all 3 trans. Simul).

Datagram and virtual circuit

Datagram: If Connectionless service is offered, packets are injected into the subnet individually and routed independently of each other. No advance setup is required. In this context, the packets are called datagrams and the subnet is called datagram subnet.

Virtual circuit: If Connection-oriented service is offered, a path from the source router to the destination router must be established before any data packet can be sent. This connection is called virtual circuit and the subnet is called virtual circuit subnet.

Issue	Datagram Subnet	Virtual circuit Subnet
circuit setup	Not needed	Required
Addressing	Each packet contains the full source and destination address.	Each packet contains a short virtual circuit number
State information	Routers do not hold state information about connections	each virtual circuit requires router table space per connection
Routing	each packet is routed independently	Route chosen when virtual circuit is set up; all packets follow this chosen route
effect of router failures	None, except for packets lost during the crash	All virtual circuits that passed through the failed router are terminated.
Quality of service	Difficult	Easy, if enough resources can be allocated in advance for each virtual circuit
Congestion Control	Difficult	Easy, if enough resources can be allocated in advance for each virtual circuit.