Exercise of introduction to networking

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1. Consider sending a file of $M \times L$ bits over a path of Q links. Each link transmits at R bits per second. The network is lightly loaded so that there are no queuing delays. When a form of packet switching is used, the $M \times L$ bits are broken up into M packets, each packet with L bits. Propagation delay is negligible.

   (a) Suppose the network is a packet-switched virtual circuit network. Denote the VC set-up time by t_s seconds. Suppose the sending layers add a total of h bits of header to each packet. How long does it take to send the file from source to destination?

   (b) Suppose the network is a packet-switched datagram network and a connectionless service is used. Now suppose each packet has $2h$ bits of header. How long does it take to send the file?

   (c) Repeat case 1b but assume message switching is used (that is, $2h$ bits are added to the message, and the message is not segmented).

   (d) Finally, suppose that the network is a circuit-switched network. Further suppose that the transmission rate of the circuit between source and destination is R bit/s. Assuming t_s seconds of set-up and h bits of header appended to the entire file, how long does it take to send the file?