Q1. **Circuit switching in the Internet**
In the Internet backbone, packet-switching is employed as the switching mechanism instead of circuit-switching. Circuit switching however was used before the Internet in the early telephone networks.

Q1.1: Name at least 2 reasons why employing circuit switching is not a good idea for the Internet in general.

Q1.2: Despite all the downsides you answered in Q1.1, can you give an example of an application which would greatly benefit from a circuit-switched Internet over the current packet-switched Internet? Why?

Q2: How would you implement flow prioritization in circuit switching? And in packet switching?

Q3: The success of cloud services is primarily thanks to the principle of resource sharing. Explain this with regards to network connectivity from the perspective of an medium-sized company focused on selling toys. Name at least 2 practical reasons.

Q4. **Provisioning**
Assume that \( N \) users share the same up-link to their Internet Service Provider. The link capacity is \( C \) Mbps. When online, a user will require \( U \) Mbps bandwidth. The probability of a user being online at any point in time is \( P_{online} \) independent of other users.

Q4.1: In closed form, what is the probability \( P_{inadequate} \) that there is not enough available link capacity to fully satisfy the needs of the online users?

Q4.2: For \( N = 5 \) users, \( C = 20 \) Mbps, \( U = 7 \) Mbps, and \( P_{online} = 0.3 \): what is the probability \( P_{inadequate} \) of the link being inadequate?
Q4.3: Because provisioning for peak usage is too expensive, provisioning is done by keeping risk within a reasonable bound. In this exercise, risk is the probability of the link being inadequate. Given \((N,U,P_{\text{online}}, P_{\text{max.risk}})\) we want to know: what is the minimum \(C\) such that \(P_{\text{inadequate}} \leq P_{\text{max.risk}}\)? Write the algorithm that answers this question.

Q4.4: Implement the algorithm of Q4.3 in a language of your choosing. For \(N = 130\) users, \(U = 4\) Mbps, and \(P_{\text{online}} = 0.2\): what is the minimum link capacity \(C_{\text{min}}\) needed such that \(P_{\text{inadequate}} \leq 0.01\)?

Q4.5: Suppose now that users’ requested bandwidth \(U\) is no longer constant \textit{a priori}, but follows a \(\text{Poisson}(\lambda)\) distribution. I.e. for any user \(i\), \(U_i \sim \text{Poisson}(\lambda)\). What is the probability \(P_{\text{inadequate}}\) now?

\textit{Hint: the distribution of the sum of independent Poisson distributions also follows a Poisson distribution.}

Q5: DNS Statements

1. Every IP address maps to a host name. (true / false)
2. A host name can map to multiple IP addresses. (true / false)
3. No two host names can map to the same IP addresses. (true / false)
4. There can be one or more physical servers behind an IP address. (true / false)

Q6: The \texttt{hosts.txt} file still exists on systems (i.e. in \texttt{/etc/hosts}/). Why is it only writable with administrator privileges? Similarly, why is it important that we only use trusted DNS servers?