Handout #9
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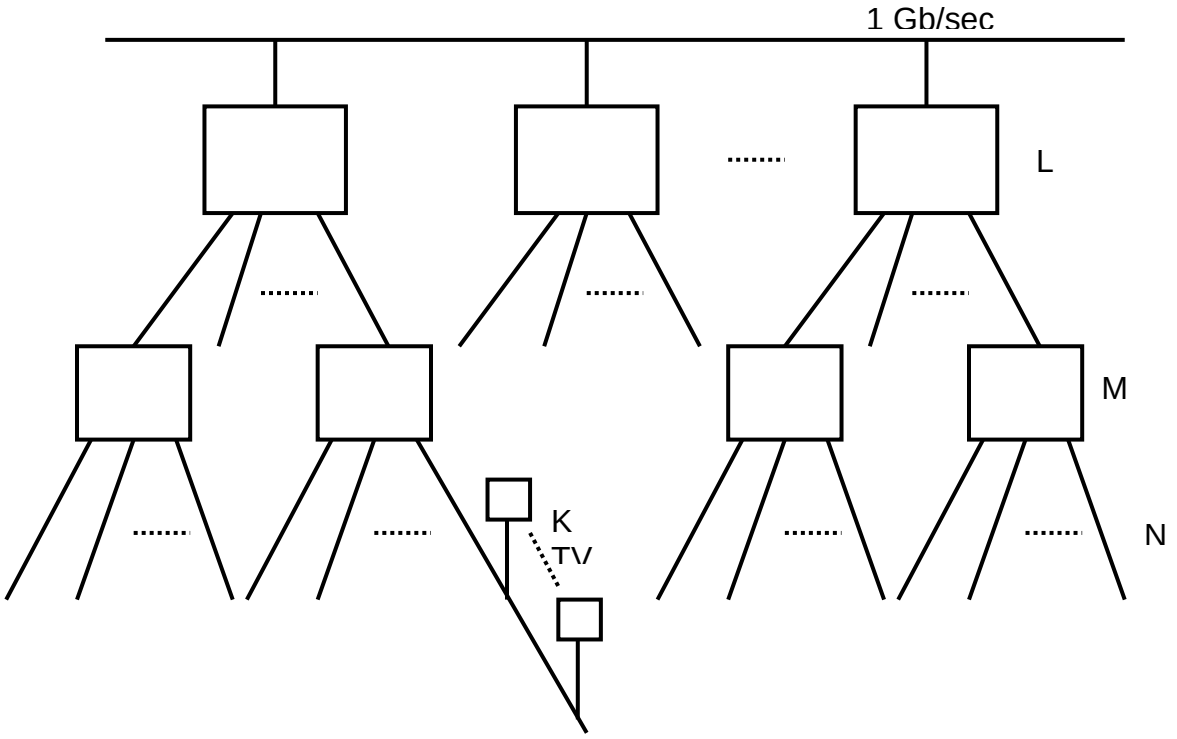
EE384A: Network Protocols and Standards
Homework #2
Multicast and GMRP
Due Date: Thursday January 28, 1999

Problem 1: LAN Multicast

A large hotel uses a bridged LAN for the distribution of video to the rooms. The hotel consists of L floors, M wings per floor and a certain number of rooms per wing. The structure of the LAN is as shown in figure 1 below. It consists of:

1. a backbone segment running at 1 Gb/sec;
2. one switch per floor having one Gb/sec port connecting the switch to the backbone segment and M ports running at 100 Mb/sec;
3. on each floor, one switch per wing, each such switch having one 100 Mb/sec port connecting it to the floor's switch, and N 10 Mb/sec ports to which television sets in individual rooms are connected. There are K sets per 10 Mb/sec port.



There are video channels that are constantly being multicast on the network. A video channel may be a TV network's video program (such as CNN, ABC, NBC, TL etc…) or a particular movie. The movie is being repeatedly multicast on that channel, and the same movie may be multicast in multiple channels, with the starting times on different channels being separated in time by some duration, say 5 minutes, to provide near-on-demand service to the guests.

In this problem, it is *imperative* that each guest be able to select any of the many channels available without getting blocked due to lack of bandwidth anywhere in the network.
Each video channel is an MPEG-2 video stream with bandwidth equal to 4 Mb/sec. To simplify the problem, it is assumed that the entire bandwidth of a segment is utilizable (i.e., we assume that there is no other traffic than the video traffic, there is no overhead, control traffic is negligible etc…). That is, on a 100 Mb/sec link, you can support 25 video streams of 4 Mb/sec each.

a) Consider first that all bridges in the LAN are GMRP-unaware. What is the maximum number of channels that can be offered to the guests and does it depend where the video sources are? Explain.

b) Consider now that all bridges in the LAN are GMRP-aware. Consider that the video sources are connected to the backbone segment.

    1. What is the maximum number of video channels that can be offered to the guests? Explain.
    2. What conditions should be satisfied by L, K, M, N for the goal stated above to be achieved (namely, that each guest be able to tune and view any of the channels offered at any time). Explain.

c) Consider now that instead of connecting the sources of video to the backbone (thus requiring 1 Gb/sec interface cards), they are connected to the 10 Mb/sec ports on switches similar to those available in wings, and these switches are connected to the backbone by means of a hierarchical structure similar to that used to distribute traffic in a given floor.
    1. same questions as b) 1.
    2. same questions as b) 2.

d) Consider now that the Gb/sec LAN backbone segment in the configuration described in b) is replaced by a switch with ports running at 1 Gb/sec each (assume that there is no limitation on the number of ports nor on its internal switching capacity).
    1. same questions as b) 1.
    2. same questions as b) 1.

e) Consider now that the network configuration consists of that described in d) with the sources connected directly to the backbone switch. We are interested in exploring the effects of some switches being GMRP-aware while others are GMRP-unaware. For each of the cases shown in the table below, answer questions b) 1. and 2. Note the first two cases have already been done and do not need to be repeated

Backbone Switch (GB/s)	**Floor Switches (100 MB/s)**	**Wing Switches (10 MB/s)**
GMRP Unaware	GMRP Unaware	GMRP Unaware
GMRP Aware	GMRP Aware	GMRP Aware
GMRP Unaware	GMRP Aware	GMRP Aware
GMRP Unaware	GMRP Unaware	GMRP Aware
GMRP Aware	GMRP Aware	GMRP Unaware
GMRP Aware	GMRP Unaware	GMRP Unaware
GMRP Aware	GMRP Unaware	GMRP Aware
GMRP Unaware	GMRP Aware	GMRP Unaware

Table 1.1

What comments can you make about the placement of GMRP aware bridges in a large network as far as the possible gain attained.

Problem 2: GARP/GMRP

Consider a network whose active topology is depicted in Figure 2.1. There are 2 video multicast groups with multicast addresses M1 and M2. Stations belonging to a given multicast group are denoted by the multicast number 1 or 2 placed in the squares representing the stations. Interested stations are assumed to have already registered for the desired multicast groups.

a.) Show in Table 2.1 the dynamic group registration entries for M1 and M2 in all switches. Use M1 and M2 to indicate the multicast addresses. Use 'FD' to indicate a port which will forward the multicast groups, and use 'FT' to indicate a port which will filter the multicast groups. The entry for Bridge 1 is shown as an example. Note: you may not need to use all the entries in the table.

b.) On Figure 2.2, show which multicast traffic flows on each segment of the network

Consider now that there are two old multicast addresses O1 and O2 with traffic of interest to Stations A and B. We assume that any station connected to bridges 1, 2, 4, 5, and 7 may be source of traffic on these two multicast addresses

c.) Consider that station A registers the filtering service "Forward All Groups with Bridge 7, Port 3. Show in Table 2.2 the dynamic group registration entries for M1, M2, and AG (All Groups). Use the same notation as in part a.)

d.) On Figure 2.3, show which multicast traffic flows on each segment of the network

e.) Finally, Consider that station A registers for the filtering service "Forward All Unregistered" instead of "Forward All Groups." Show in Table 2.3 the dynamic group registration entries for M1, M2, and AU (All Unregistered).

f.) On Figure 2.4, show which multicast traffic flows on each segment of the network

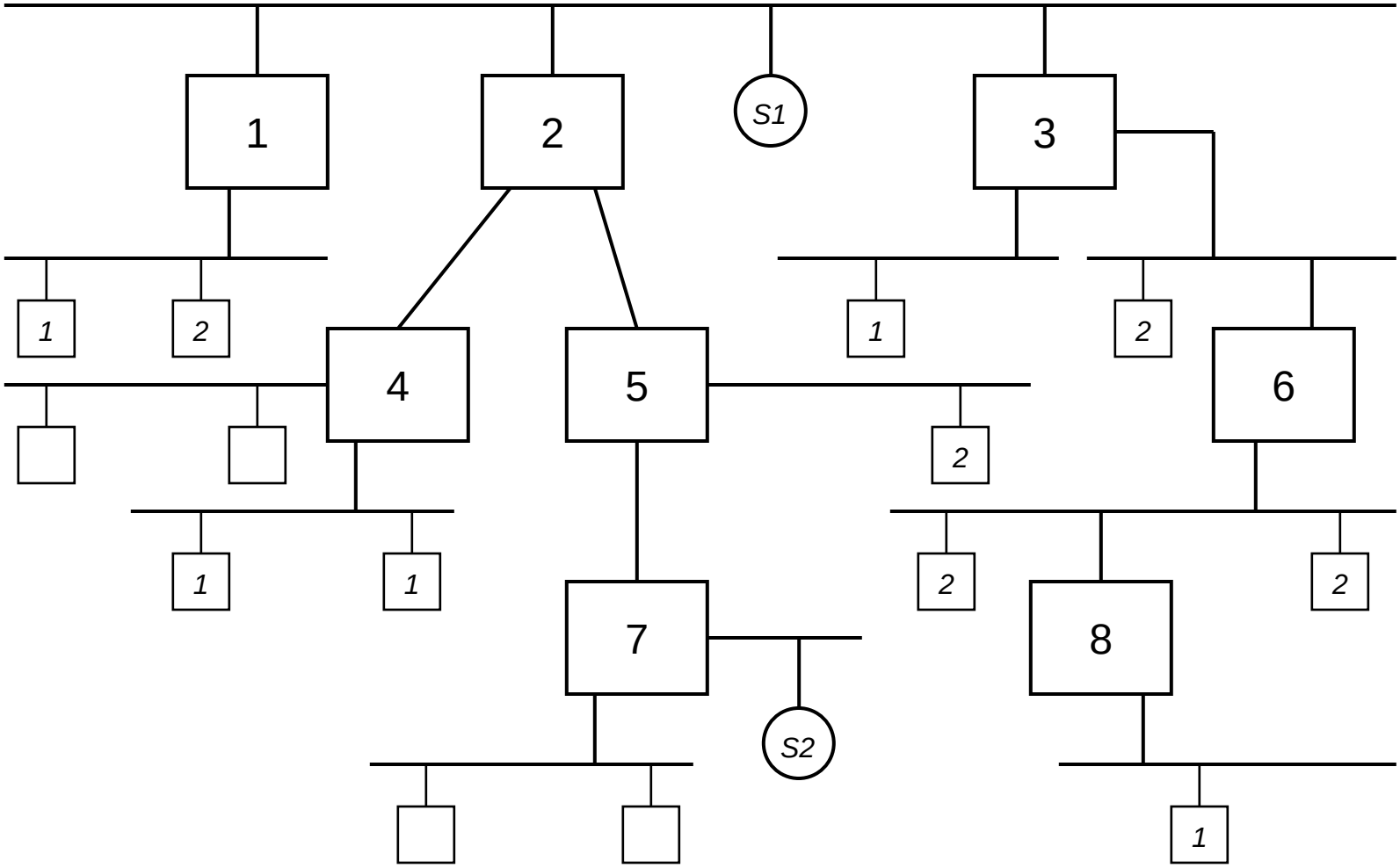


Figure 2.1

Bridge #	Multicast Addr.	Port 1	Port 2	Port3
1	M1	FD	FD	-
1	M2	FD	FD	-
2				
2				
3				
3				
4				
4				
5				
5				
6				
6				
7				
7				
8				
8				

Table 2.1 – Question 2a.)

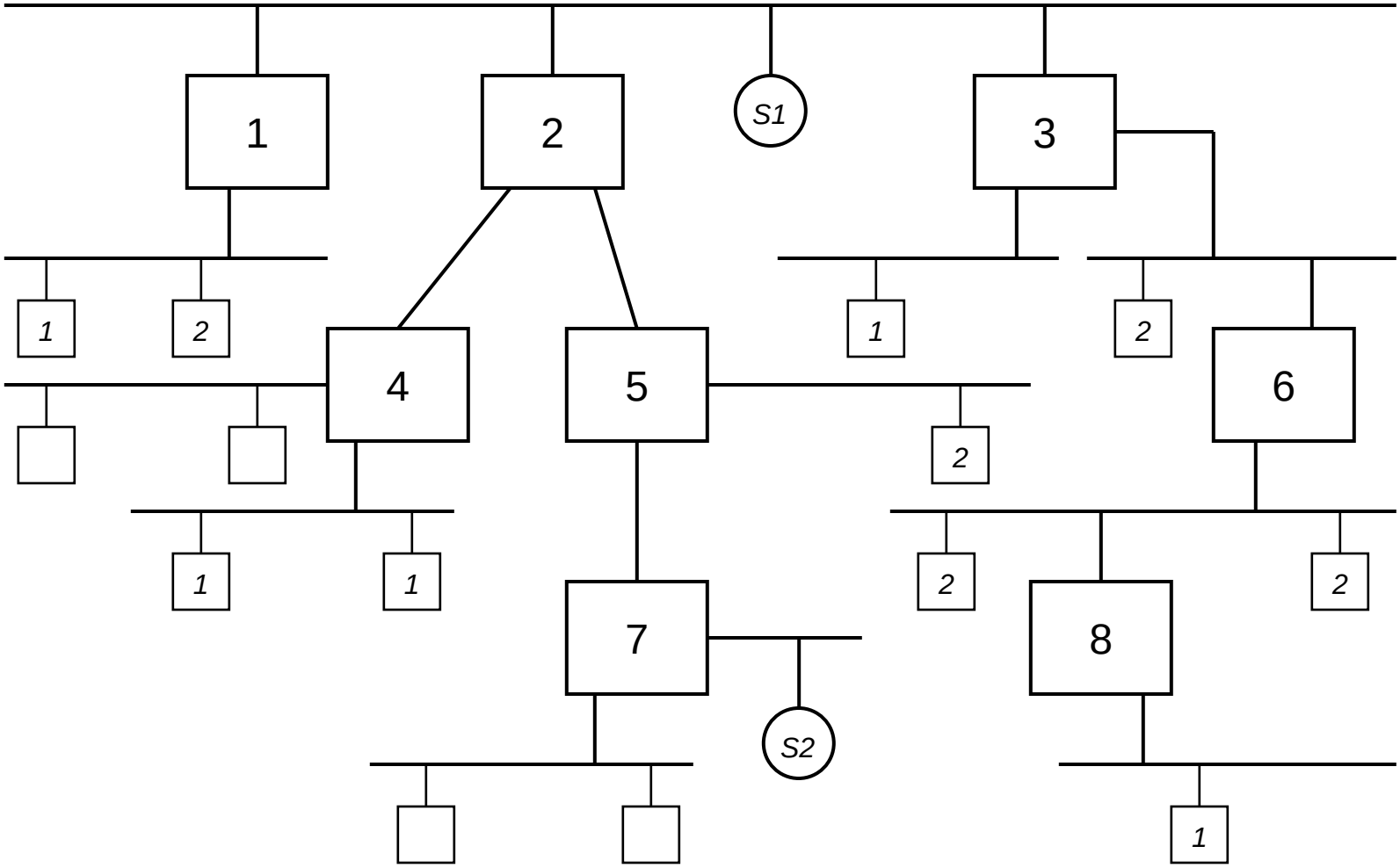


Figure 2.2 – Question 2b.)

Bridge #	Multicast Addr.	Port 1	Port 2	Port3
1				
1				
1				
2				
2				
2				
3				
3				
3				
4				
4				
4				
5				
5				
5				
6				
6				
6				
7				
7				
7				
8				
8				
8				

Table 2.2 – Question 2c.)

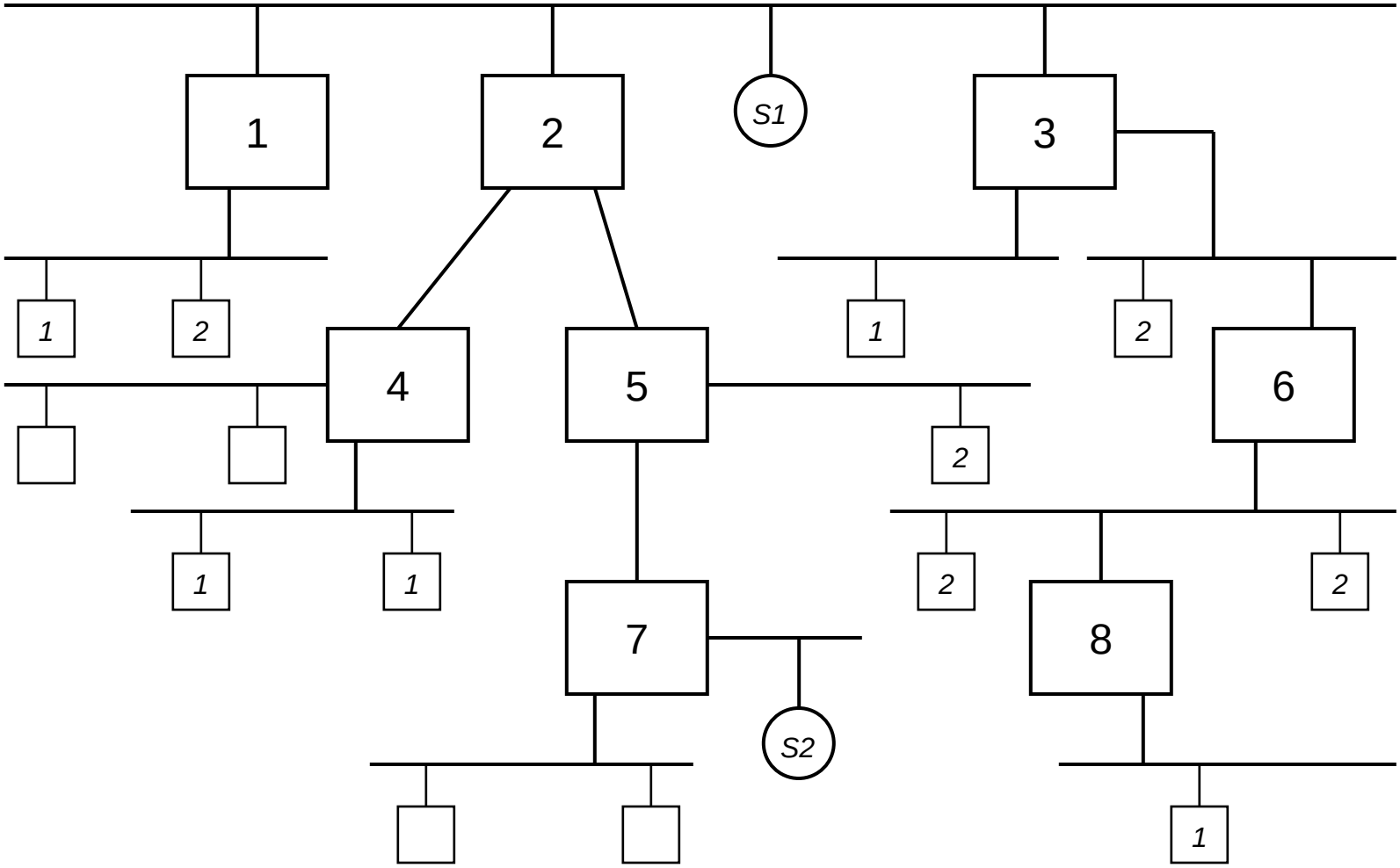


Figure 2.3 – Question 2d.)

Bridge #	Multicast Addr.	Port 1	Port 2	Port3
1				
1				
1				
2				
2				
2				
3				
3				
3				
4				
4				
4				
5				
5				
5				
6				
6				
6				
7				
7				
7				
8				
8				
8				

Table 2.3 – Question 2e.)

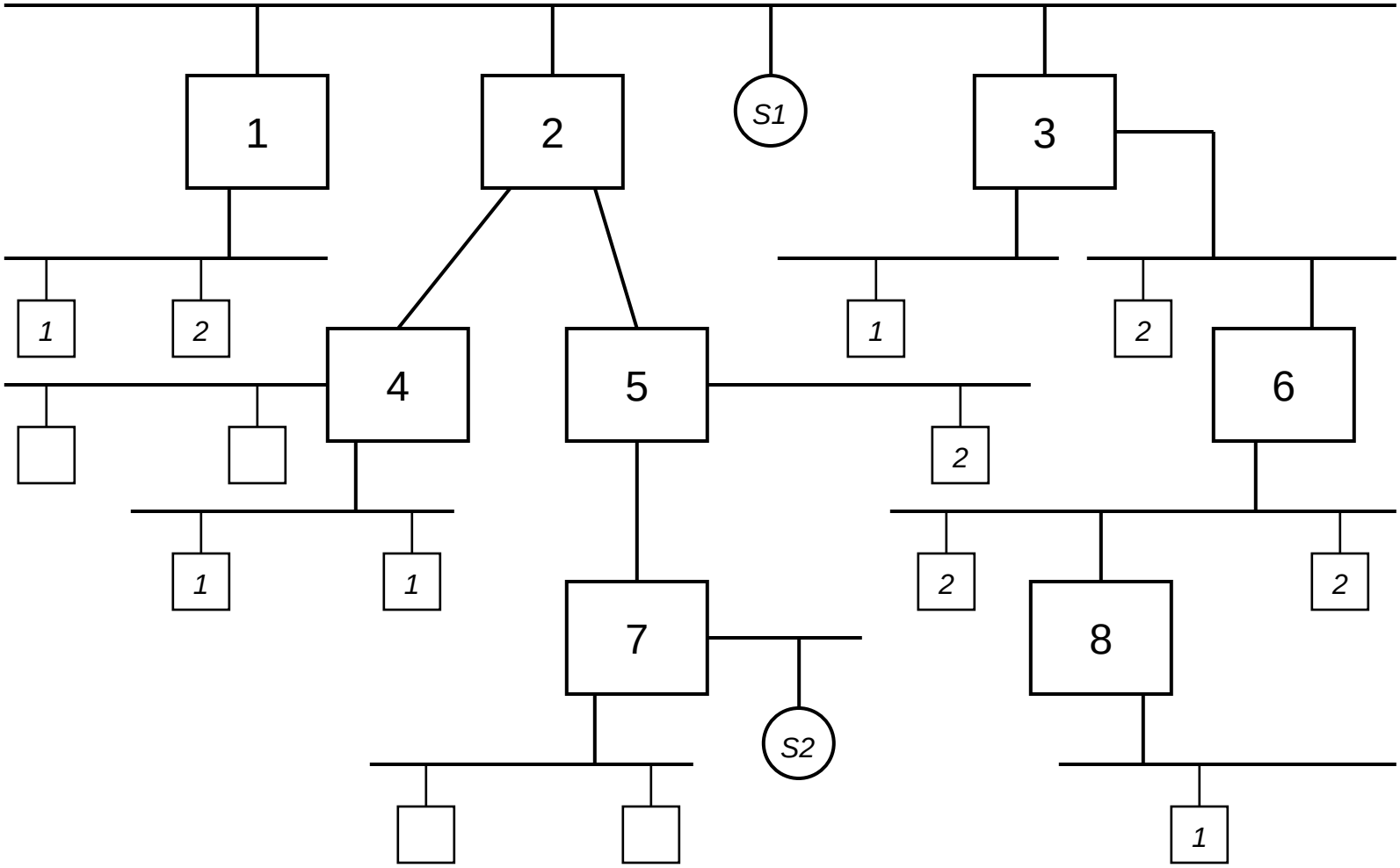


Figure 2.4 – Question 2f.)