1. The s-process branches at $^{147}\text{Nd}$ because this isotope has a beta decay half life of 5.3 days (under stellar conditions, this is slightly modified compared to what you would find in a table of terrestrial rates), which is not too many orders of magnitude away from the neutron capture timescale. Below is a simplified scheme of the reaction flows in the Nd/Sm region during the s-process (stable isotopes are marked with thick lines)

As you can see $^{148}\text{Sm}$ and $^{150}\text{Sm}$ are s-only isotopes. The neutron capture rates for a stellar neutron spectrum corresponding to a temperature of kT=30 keV (typical for s-process) have been measured in the laboratory. The ratio of the $^{148}\text{Sm}$ neutron capture rate to the $^{150}\text{Sm}$ neutron capture rate could be determined particularly accurately and was found to be 0.596. This laboratory result can be used directly to determine the neutron density during the s-process (see Winters et al. ApJ300(1986)41 to see how this is really done – here we simplify the problem considerably).

a. [5 pts] Determine the fraction of the reaction flow that branched into the beta decay at $^{147}\text{Nd}$ during the s-process that produced the solar system abundance distribution. You can use the steady flow approximation (which is locally a very good approximation) that tells you that the reaction flow is proportional to $Y\lambda$, where $Y$ is the observed s-process abundance of the nuclide and $\lambda$ is the rate of destruction per target nucleus. This means you can measure the (relative) flow that occurred during the s-process at any isotope provided you know $Y$ and $\lambda$. Pick the suitable isotopes and work with ratios only.

b. [5 pts] Using the measured neutron capture rate for $^{147}\text{Nd}$ at a temperature of kT=30 keV of $2\times10^7$ cm$^3$/s/mole determine the neutron density during the s-process.
c. [5pts] Determine the relative r-process contribution to the solar abundance of $^{148}\text{Nd}$ using your result from 1a (use same temperature and reaclib database). Compare with the result from Arlandini et al. 1999 (ApJ 525 886) [http://iopscience.iop.org/0004-637X/525/2/886/] for their classical model and their stellar model (also give those two relative r-process contributions).

2. 2. [5 pts] The total mass fraction of all heavy (A>100) r-process nuclei in the solar system is about 1e-7. Given a supernova rate of 2.2e-2/yr/galaxy and a neutron star merger rate of 8e-6/yr/galaxy, calculate the total mass (in solar masses) of A>100 r-process nuclei that has to be ejected in either scenario per event to account for the observed r-process abundances in our Galaxy assuming the respective scenario is the ONLY source of r-process nuclei. Assume that the solar abundance distribution is typical for the whole Galaxy.