

## 7.013 Immunology Section Solutions

### A.

You would like to generate antibodies against a specific antigen, antigen A, derived from a mammalian virus. You inject a rabbit with antigen A to hopefully elicit antibodies, and you assay antigen A specific antibody levels in rabbit blood every seven days. On day 28 you inject the same rabbit with more antigen A and measure antibody response for the next four weeks.

The results of your measurements are shown below. As a necessary control, you tested the blood of this rabbit prior to any injections (0 time point).

Days after injection (before injection)	0	Presence of antibodies against antigen A
	7	++
	14	++
	21	+
	28	+
	35	+++++++
	42	+++++++
	49	++++++

a) Why is the antibody response low on day 28 and high after day 35?

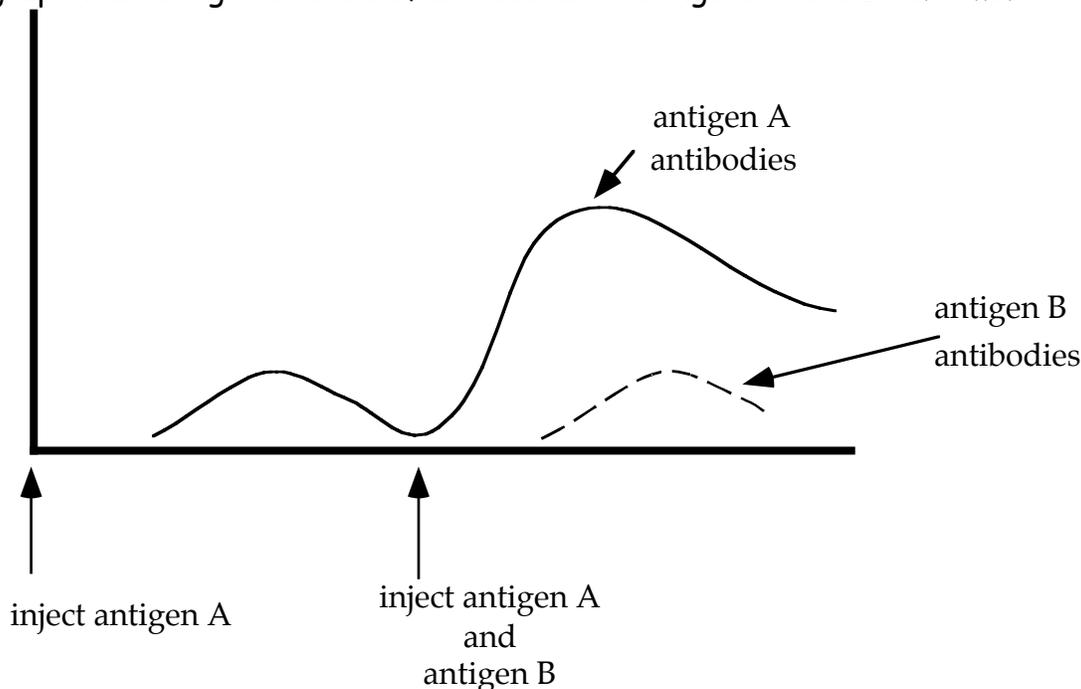
*On day 28, the level of antibodies produced in the initial response has fallen. After the second injection, there is a rapid increase antibody production in the secondary response to an antigen due to clonal expansion of the memory B cells.*

b) Antibodies to antigen A were detected on day 0 (prior to injection of antigen A) in a second rabbit in this study. How could this be explained?

*The presence of antibodies to antigen A on day 0 suggests that the rabbit had previously been infected with the mammalian virus and had raised antibodies to counter the infection.*

c) Suppose on day 28 the rabbit was injected with both antigen A and a different antigen, antigen B. Would you expect the levels of antibody against antigen B on day 35 to be higher, lower, or the same as the levels of antibodies against antigen A?

Draw a graph indicating the levels of antibodies to antigens A and B vs. time.



**B.**

a) Which virus does  $T_HA$  cells recognize?

**virus 1**

b) Which virus does  $T_HB$  cells recognize?

**virus 2**

c) Why are  $T_HA$  cells stimulated to grow by B cells plus virus 1, but not by B cells plus virus 2?

**The  $T_HA$  cells have a TCR that can recognize virus 1 peptide but not virus 2 peptide presented on MHC II molecules on the B cells. The virus 1 peptide on MHC II molecules on B cells was displayed after the antibody on the B cell recognized virus 1 as an antigen and the antibody-antigen complex was internalized.**

d) Why are  $T_HB$  cells stimulated to grow by macrophages plus virus 2, but not by B cells plus virus 2?

**Macrophages non-specifically engulf virus 2 and present viral peptides on MHC II proteins. B cells only internalize antigen by way of a specific antibody. The antibody on the B cell clone in this experiment is does not recognize virus 2.**