Questions

1. Viral infections can be treated using anti-viral drugs, or they can be prevented in the first place through the use of vaccines. Some vaccines are just injections of viral particles that have been inactivated in some way (such as extreme heat). Other vaccines are injections of a single viral protein that has been purified and produced using recombinant DNA techniques. How does a vaccine work?
Vaccination is the process of injecting either a weakened form of a virus or a single viral protein into an individual. Since both the weakend virus and introduced viral protein are regarded as foreign particles by the host immune system, it results in cell mediated and /or humoral immune response and the production of memory B and T cells. If the individual encounters a viral infection later in life, these memory B and T cells can rapidly proliferate to produce more of their own kind and the antibody secreting plasma cells. This results in a rapid and strong secondary immune response that can combat viral infection.

2. Each one of your gametes contains 3×10^9 base pairs of DNA in its nucleus. How many base pairs of DNA are contained within:
a) Each nerve cell? *$2 \times (3 \times 10^9$ base pairs) since it is diploid.*
b) Each antibody-producing white blood cell? *$2 \times (3 \times 10^9$ base pairs) minus the base pairs that are lost after VDJ joining.*
c) Each red blood cell? *None since it lacks the nucleus.*

3. The cellular arm of the immune system employs cytotoxic T lymphocytes (T_c) and natural killer cells. The T_c cells can recognize the viral infected body cells.

a) What proteins are involved in the presentation of the antigen to the Tc lymphocytes?
CD8 and MHC-I

b) Explain why the Tc lymphocytes do not recognize an infected cell if the virus is latent i.e. viral capsid protein does not occur.
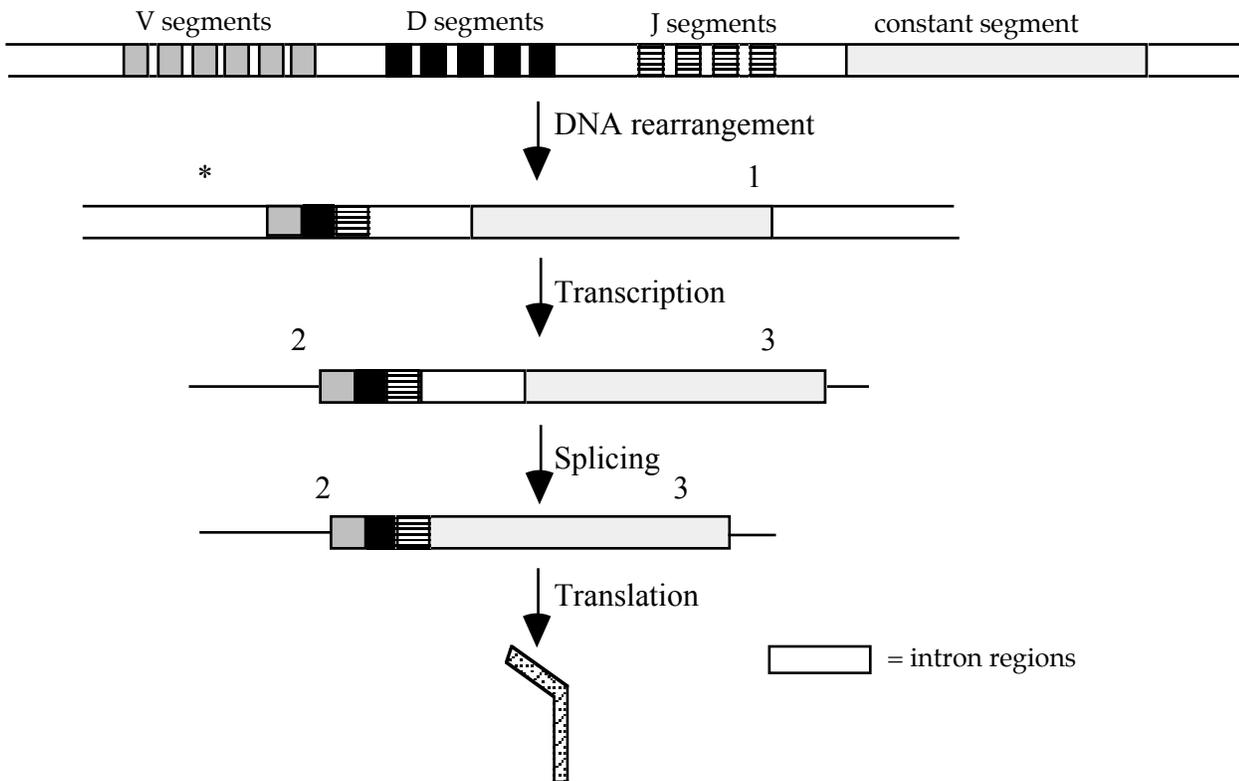
If the virus is latent, the virus protein will not be presented on the surface of infected cells through MHC-I molecules and will therefore not be recognized by T_C cells.

4. Shown below is a schematic of the production of a heavy chain polypeptide for an antibody. At the top is the chromosomal arrangement found in an immature B cell, at the bottom is shown the heavy chain polypeptide.

   i.   Label the process indicated by each arrow. Choose the one best option for each from:
homologous recombination , transcription , translation, translocation, ligation, DNA rearrangement, splicing

   ii.   Indicate on the diagram below where you would expect to find each of the following
       components:
Promoter (*), Transcriptional terminator (1), start codon (2), stop codon (3)

   iii.   Indicate on the diagram below the variable and the constant region of the heavy chain and the N
       and C terminus of this polypeptide.

7.013 Introductory Biology
Spring 2013