1. (6 points) Define the following:
   Lytic infection
   
   Persistent infection
   
   Latent infection

2. (12 points)
   Answer the following questions with respect to SV40.
   Is the viral genome
   DNA
   or RNA (circle one)
   single-stranded
   or double stranded (circle one)

   Describe the steps in viral infection shown in the diagram using one or a very few words for each step. The numbers should be used to refer to the arrows which precede them.

   1. 
   2. 
   3. 
   4. 
   5. 
   6. 
   7. 
   8. 
   9. 
   10. 

3. (2 points)
What are 2 diseases caused by Epstein-Barr virus?

_________________________________ and ______________________

4. (10 points) Eukaryotic RNA viruses have to solve the problem that eukaryotic cells only read one protein from a message (monocistronic messages). How is this problem solved by polio virus

influenza virus

TMV
5. (6 points)
You have the following ingredients available to prepare media:
- complex medium
- minimal medium (no carbon source)

**Sugars**
- lactose
- maltose
- glucose
- arabinose

**Amino acids**
- arginine
- tryptophan
- methionine
- tyrosine
- glycine
- leucine

**Nucleic acid bases**
- thymine
- adenine

**Vitamins**
- biotin
- thiamine

**Antibiotics**
- streptomycin
- ampicillin
- rifamycin
- tetracycline

You wish to prepare medium to select various recombinants from the following cross:

*E. coli*  
Hfr *thy*, *ara*, *trp*, *tyr*, *met*, *mal*, *rif*  
F⁻ *thy*, *ara*, *trp*, *tyr*, *met*, *mal*, *rif*  

What ingredients do you use to select for the transfer of each of the following genes from the Hfr strain to the F⁻ strain?

a. *thy*  

b. *mal*  

c. *trp*
6. (12 points) In a later experiment you wish to determine the gene order for three genes in *E. coli*: 

*arg*, *tyr*, and *ara*. You have an Hfr strain which is *tyr*\(^+\), *arg*\(^+\), *ara*\(^+\), *rif*\(^{R}\). You conjugate this Hfr strain with an F- strain which is *tyr*\(^-\), *arg*\(^-\), *ara*\(^-\), *rif*\(^{R}\). The mating is interrupted at the following time points: 5, 10, 15, 20, 25, and 30 minutes. Immediately after interrupting the mating 0.1 ml of the cells were placed on each of the following media:

A minimal medium plus glucose, *arg*, and *rif*

B minimal medium plus glucose, *tyr*, and *rif*

C minimal medium plus arabinose, *tyr*, *arg*, and *rif*

(Use the key for the chemicals given in question 5).

Two days later you check the plates and record the data indicated in the table below.

<table>
<thead>
<tr>
<th>medium</th>
<th>Number of colonies from plating at time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 min</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
</tr>
</tbody>
</table>

a. Graph this data on the graph paper provided. **Clearly label all lines and axes.**

b. Determine the gene order and time of transfer in minutes and indicate them in the box below.

<table>
<thead>
<tr>
<th>gene order</th>
</tr>
</thead>
<tbody>
<tr>
<td>time of transfer</td>
</tr>
<tr>
<td>--------------</td>
</tr>
</tbody>
</table>

c. If you replica plate the colonies obtained on medium C at 15 min to medium A will most of them grow? Yes or no (circle one)

If you replica plate the colonies obtained on medium C at 15 min to medium B will most of them grow? Yes or no (circle one)
7. (8 points) You wish to determine the relative order and distances between genes for the biosynthesis of leu, tyr, and arg [all of these compounds are amino acids]. You grow a generalized transducing phage P1 on an E. coli which is leu<sup>+</sup>, tyr<sup>+</sup>, arg<sup>-</sup> and use it to infect an E. coli recipient which is leu<sup>-</sup>, tyr<sup>-</sup>, arg<sup>+</sup>.

a. What medium do you use to select for leu<sup>+</sup> transductants?

b. You select for transductants and replica plate to determine the frequency of coinheritance of the genes. The following results were obtained:

<table>
<thead>
<tr>
<th>gene selected</th>
<th>per cent of selected cells which were</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>leu&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>leu&lt;sup&gt;+&lt;/sup&gt;</td>
<td>100%</td>
</tr>
<tr>
<td>tyr&lt;sup&gt;+&lt;/sup&gt;</td>
<td>40</td>
</tr>
</tbody>
</table>

Indicate the gene order and the relative distances between the genes on the line below:

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8. (9 points) Fill in the following table using yes or no. (This question will be scored as the number of correct minus the number of incorrect squares, but no score less than 0 will be given).

<table>
<thead>
<tr>
<th>Characteristic of process</th>
<th>Conjugation</th>
<th>Transduction</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires competent cells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requires a pilus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F factors usually transfer this way</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requires phage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requires cell contact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results in DNA transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results in the formation of a complete diploid</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. (6 points) Draw a schematic structure of a typical transposon. Indicate only the most major features (that is don't show ATGs, etc.).

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