1. The properties of a lipid bilayer are determined by the structures of its lipid molecules. Predict the properties of the lipid bilayers and the effect on the phase transition point that would result if the following were true:

a) The hydrocarbon chains of phospholipids were shorter than normal, say about 10 carbon atoms long.

   The membrane would become more fluid because shorter chains have a lower melting temperature. This would lower the membrane’s phase transition point.

b) All of the hydrocarbon chains were saturated.

   The membrane would become more solid or crystalline because saturated fatty acids pack together more tightly than do unsaturated fatty acids and this would raise the phase transition point.

c) All of the hydrocarbon chains were unsaturated.

   The membrane would become more liquid because the fatty acids chains cannot pack together as well. This would lower the phase transition point.

d) Half the normal amount of cholesterol was present in the membrane.

   Sterols prevent tight packing of the fatty acid chains, much as unsaturated fatty acids do. Thus the membrane would become more solid or crystalline when there are fewer of them present. This would raise the phase transition point for the membrane.
2.

Answer the following questions regarding the types of transport illustrated in the diagram: (Give letters)

a) Which ones represent passive transport?
   
   A   B   C

b) Which ones represent active transport?
   
   D

c) Which ones exhibit specificity?
   
   B   C   D

d) Which ones are driven by a free energy gradient?
   
   A   B   C

e) Which ones provide an enhanced rate of uptake?
   
   B   C   D

f) Which ones would be considered integral membrane proteins?
   
   B   C   D
In the figure above the CRP protein and the lac repressor protein have been placed in the four possible combinations on their binding sites in the promoter for the lac operon. Each combination of gene regulatory proteins corresponds to a particular mixture of glucose and lactose. For each of the four combinations, indicate on the left-hand side of the figure (with *y* for yes or *n* for no) which sugars must be present and, on the right-hand side, whether the operon is expected to be **on** or **off**.

<table>
<thead>
<tr>
<th>glucose</th>
<th>lactose</th>
<th>operon activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>y</td>
<td>off</td>
</tr>
<tr>
<td>y</td>
<td>n</td>
<td>off</td>
</tr>
<tr>
<td>n</td>
<td>n</td>
<td>off</td>
</tr>
<tr>
<td>n</td>
<td>y</td>
<td>on</td>
</tr>
</tbody>
</table>
4. Relative level of transcription

   a) +
   b) --
   c) --
   d) ++++

a) Indicate on the right-hand side of the figure above the relative level of transcription you would expect with the various combinations of control elements shown (use + or – signs).

b) Explain how an enhancer region produces its effect.

   The enhancer region binds with transcription factors called activators and then bends around to the promoter region where it binds with co-activators before binding to additional transcription factors associated with the core promoter region, all of which help RNA polymerase bind and initiate transcription.

c) Explain the relationship of an enhancer to a response element. Describe how the heat shock response element helps turn on heat shock genes.

   An enhancer is a response element, responding to intra- or intercellular signals such as light or hormones.

   The heat shock response element is an enhancer that is activated when temperatures are raised above normal. Then specific heat shock transcription factors undergo a conformational change induced by the high temperatures making them now able to bind to the heat shock response element. This leads to activation of the various heat shock genes scattered throughout the genome and the resulting production of heat shock proteins to help the cell deal with the heat stress.