DIRECTIONS: Read each question carefully. Ask for help if any question is unclear. The number in parentheses by each question is the points for that question. Enough space is given for each question for a complete answer. Partial credit is given for partial answers. Please fill in your name and student ID now!! All questions have a single answer unless otherwise stated.

1. (4) What is the difference between an inducible and a repressible regulatory system in Prokaryotes?
   Thus to do with when the genes are turned on. In a repressible system, they are turned off when the concentration is high. In an inducible system, they are turned on when the concentration is high.

2. (4) In flower development, explain how the whorls will develop if B is expressed everywhere.
   From outer to inner whorls:
   Petal, Petal, Stamen, Stamen

3. (4) WHY does the Antibody gene undergo Class Switching in response to an infection?
   To change the type of antibody without changing the antigen specificity

4. (4) Considering what bicoid and nanos are doing in early development, explain WHY it is useful for Drosophila not to create plasma membranes until the developmental cascade is well underway.
   Plasma membranes would hinder the diffusion of the bicoid & nanos proteins in the cell.

5. (6) In Drosophila sexual development, there are three genes that are important, sxl, tra, and dsx. For each of the following statements, CIRCLE ALL the genes where the statement is true. (dsx can be either form).
   a) sxl tra dsx Is a transcription factor.
   b) sxl tra dsx Splicing produces alternate forms.
   c) sxl tra dsx Is expressed and functional in males.
   d) sxl tra dsx Gene produces a transcript in both males and females.
6. (6) With the technique of interrupted mating, four Hfr strains were tested for the sequence in which they transmitted a number of genes in a unique sequence, as shown in the accompanying table:

<table>
<thead>
<tr>
<th>Hfr Strains</th>
<th>First</th>
<th>Order of Transmission</th>
<th>Last</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>his</td>
<td>bio</td>
<td>azi</td>
</tr>
<tr>
<td>2</td>
<td>thi</td>
<td>thr</td>
<td>azi</td>
</tr>
<tr>
<td>3</td>
<td>thy</td>
<td>arg</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>his</td>
<td>phe</td>
<td>arg</td>
</tr>
</tbody>
</table>

Give the order of these genes on the chromosome below:

```
  phe  his  bio
  arg  azi
  thy  thr
```

7. (16) This section refers to **Eukaryotic Regulation**. Fill in the number of the term **best described** by each phrase. Each number is used at most once.

1) 5' Guanine Cap
2) *cis*-element
3) DNA Splicing
4) *dsx*
5) Euchromatin
6) Phosphorylation
7) Heterochromatin
8) *hox*
9) Leader Sequence
10) Mating Type in Yeast
11) Methylation
12) Poly-A tail
13) Polyprotein
14) RNA Splicing
15) *sxl*
16) Trans-factor

3. Creating diversity in the variable region for an antibody gene.
10. Example of regulation by transposition.
5. Active form for DNA.
4. A specific gene that is regulated by RNA splice sites.
1. Involved with transporting the transcript to where it will be translated.
16. General class of proteins that bind to regulatory regions of the DNA.
2. GC elements, for example.
11. Method in development used to determine which hemoglobin genes are active.
8. (10) Recombination in bacteria can involve several attributes
   1. Can never recombine more than 25kb.
   2. Involves a bacterial/viral DNA hybrid.
   3. Involves the donation of DNA from one bacterial to another (whether voluntary or not).
   4. Involves an error in order for the DNA to be incorporated into the recipient cell.
   5. Can bring an entire plasmid into the recipient cell.

   For each type of recombination, circle **ALL** attributes that are true for that type. *Each attribute can be used more than one time.*

   a) Specialized Transduction  
      ![Diagram](image1.png)
   b) Generalized Transduction  
      ![Diagram](image2.png)
   c) Transformation  
      ![Diagram](image3.png)
   d) Conjugation  
      ![Diagram](image4.png)

9. (8) The following are four specific snippets of time during Bacterial Recombination. **For each**, indicate whether it is seen in Conjugation, Transformation, Generalized Transduction, and/or Specialized Transduction. (It is possible for a snippet to be seen in more than one type of recombination.) For each diagram, all the lines are DNA and are assumed to be double stranded unless told otherwise. The thicker lines are chromosomal.

   ![Diagram](image5.png)
10. (8) Attenuation for His operon (Fill in the blanks, be specific)

The his operon contains ten cistrons which are transcribed and translated into proteins that create histidine. In addition to these cistrons is a 5' region used for attenuation, called the _______ region. As transcription starts, Regions 1 and 2 are transcribed. Translation starts at Region _______. If the concentration of his is ________, then translation will stall, due to several adjacent _______. Since translation is stalled, this will allow the pairing of Regions _______ and ________, and transcription continues into the his genes. If the concentration of his is ________, then translation will go quickly, which allows pairing of Regions _______ and ________. This pairing is a _______ and terminates transcription.

11. (8) Your instructor has located a new antibody gene that appears to be responsible for most of the allergic reactions of students to Genetics. He has characterized the light chain as:

Eventually, the cell responsible for the allergic reaction to Genetics will have selected L-V₁ and J₂. Sketch what the DNA/RNA/Protein will look like at each of the following stages (i.e., show the L-V's, J's, and C, you do not have to draw the boxes!!).

a) DNA of Zygote

\[ L-V₁ \quad L-V₂ \quad L-V₃ \]

b) DNA of Stem Cell

\[ L-V₁ \quad L-V₂ \quad L-V₃ \quad J₁ \quad J₂ \quad C \]

c) hnRNA during allergic response

\[ L-V₂ \quad J₁ \quad J₂ \quad C \]

d) Mature mRNA

\[ L-V₂ \quad J₂ \quad C \]
12. (4) The following are the levels of Drosophila development. Place them in the correct time-order, by indicating which is first (1), second (2), third (3), fourth (4), and fifth (5).

1. Bicoid
2. Gap Genes
3. Homeotic Gene
4. Pair Rule
5. Segment Polarity Genes

13. (8) Genetic regulation in Prokaryotes can involve several attributes

1. Involves the attachment (or no attachment) of a protein to the DNA.
2. The various ways the Lac genes are regulated.
3. Involves a DNA binding protein (of any sort).
4. Is found in bacteria (yes, this is obvious, but it is after midnight!!)

For each type of regulation, circle ALL attributes that are true for that type. Each attribute can be used more than one time, and each type of regulation may involve several attributes.

a) Attenuation 1 2 3 4
b) Negative Control (Repressible) 1 2 3 4
c) Negative Control (Inducible) 1 2 3 4
d) Positive Control (Catabolite Repression) 1 2 3 4

14. (4) Circle ALL that are normally inducible:

a) Trp
b) Lac

15. (4) Circle ALL that are regulated by Attenuation:

a) Trp
b) Lac

16. (2) Drosophila is a good organism to study developmental genetics because (Circle ALL that apply)

a) It is a model organism, so a lot is known about Drosophila.
b) Drosophila tastes better than Arabidopsis.
c) Drosophila geneticists are a fun bunch of people.
d) It has a relatively short generation time.
e) Flies are pesky and so is genetics.
f) A lot of developmental mutants have been found and characterized.
g) Other ____________________________