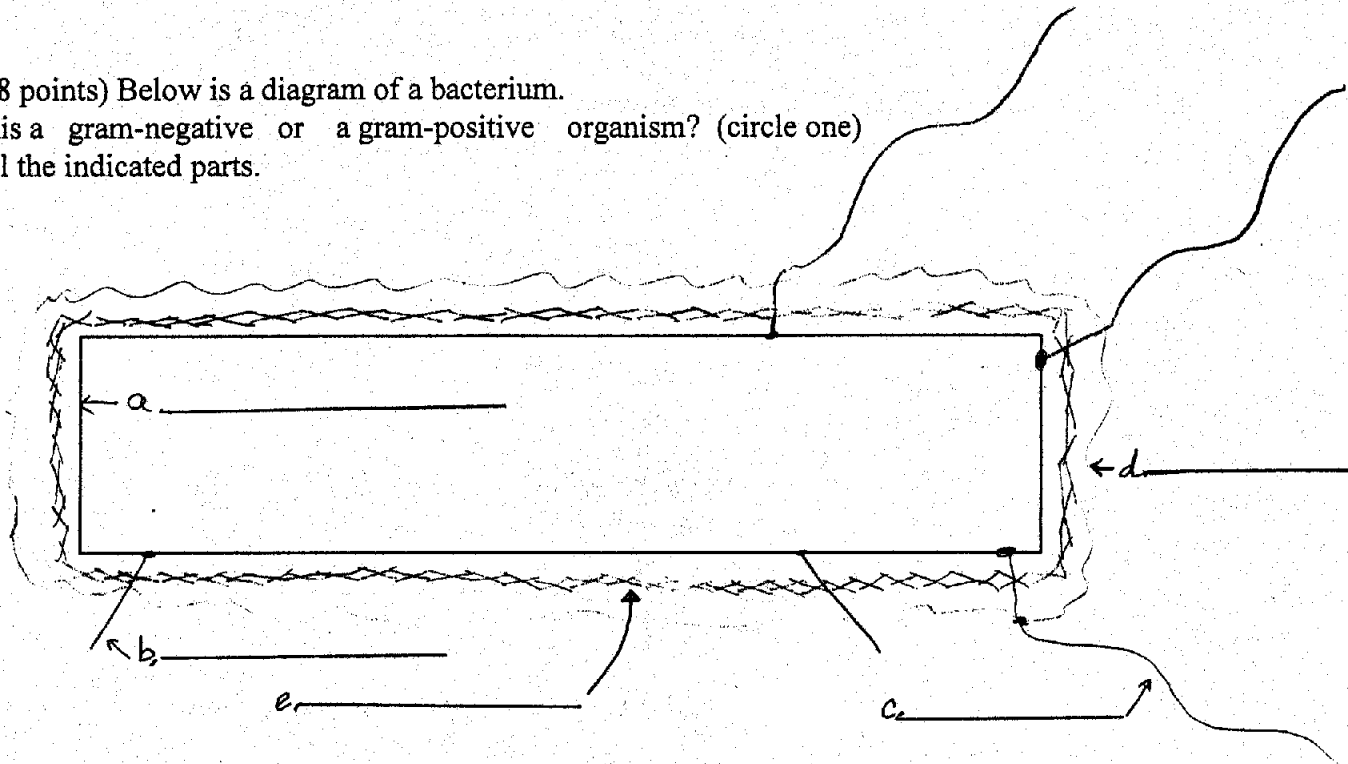


1. (18 points) Below is a diagram of a bacterium.
 Is this a gram-negative or a gram-positive organism? (circle one)
 Label the indicated parts.



What is the composition in terms of major macromolecules of

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

If this bacterium were of the other type with respect to the Gram stain, what would be 3 major differences in the cell structure?

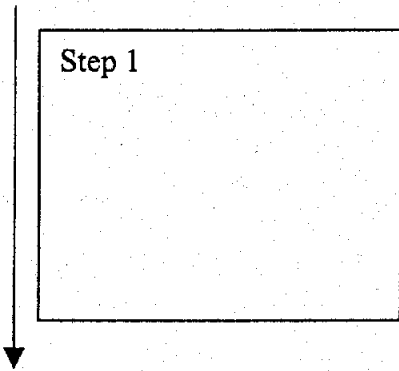
1.
2.
3.

What is the location in the cell of

- DNA _____
- ribosomes _____
- enzymes of the glycolytic pathway _____
- cytochromes _____

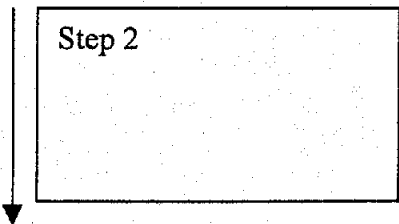
2. (7 points) Each of the items on the left is associated with a step in the process on the right. Write the letter of the item in the appropriate box.

Template DNA

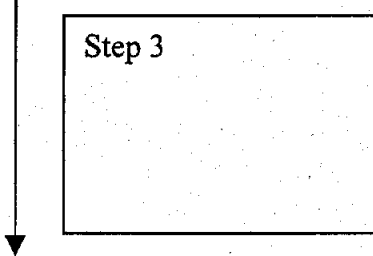


- a. helicases
- b. sigma factor
- c. ribosomes
- d. RNA polymerase
- e. transfer RNA
- f. DNA polymerase III
- g. lagging strand

Newly synthesized DNA



Messenger RNA



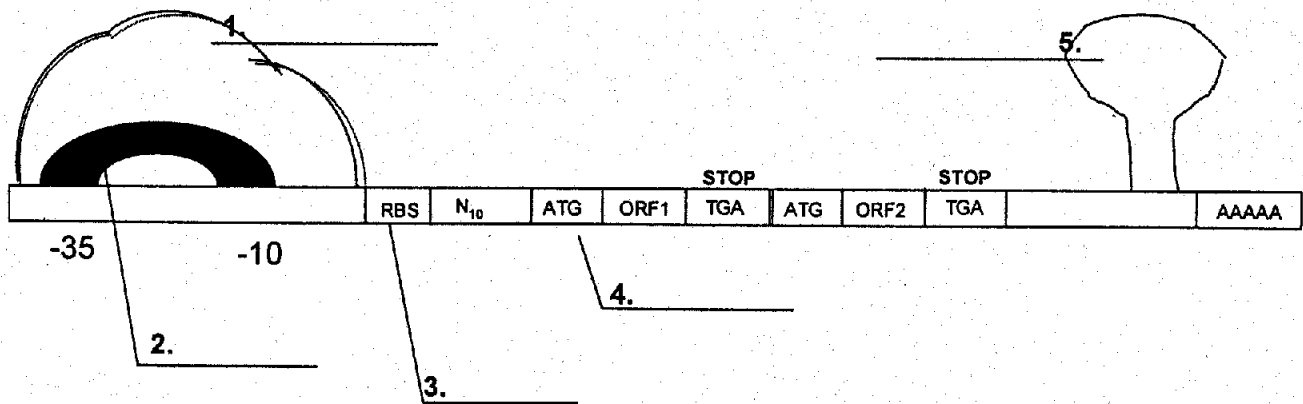
Protein

3. (6 points) Answer the following questions with respect to bacterial protein synthesis.

1. What aminoacyl (aa) tRNA do all proteins in prokaryotes begin with? _____
2. In which site on the ribosome is the first aa tRNA situated? _____
3. Which two sites on the ribosome are involved in forming the peptide bond made between amino acids on adjacent tRNA molecules? _____
4. Which site on the ribosome contains an empty tRNA? _____
5. Which subunit of the RNA polymerase is responsible for recognition of DNA sequences of the promoters of genes? _____
6. What type of secondary structure can lead to termination of transcription? _____

4. (9 points)

Label the following diagram showing a bacterial operon in the spaces provided.



6. Mark the region encoding protein number 2 (above the gene).
7. How many proteins will a prokaryote make from this message? _____
8. How many proteins will a eukaryote make from this message? _____
9. Mark the location(s) of the protein(s) made by eukaryotes (below the gene).

5. (11 points) The level of transcription of an individual gene (or group of genes) can be altered in a regulated manner. This alteration is usually influenced by the organisms' environment and the presence or absence of specific small molecules.

There are two major mechanisms of regulation of transcription: negative and positive control. What are the proteins involved in each? Give an example of each.

1. Mechanism of negative control:
major type of protein involved: _____

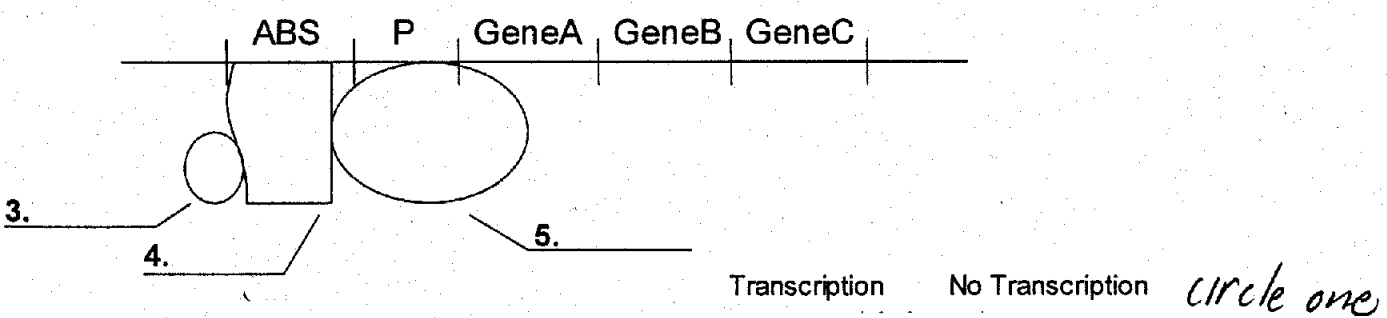
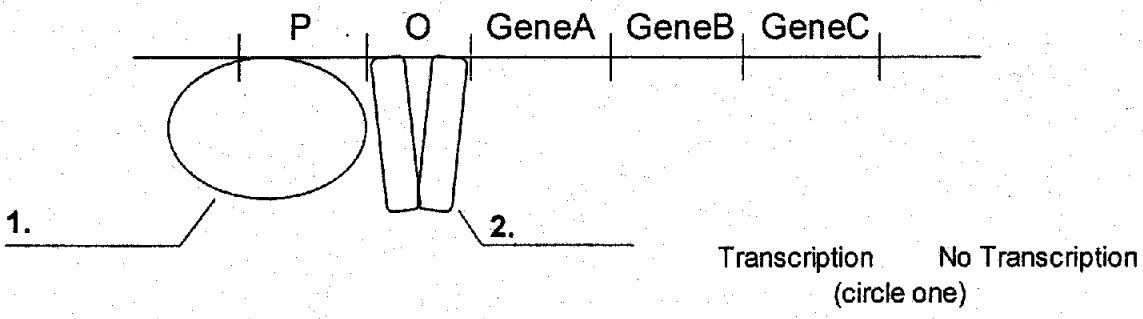
Example: _____

2. Mechanism of positive control:
major type of protein involved: _____

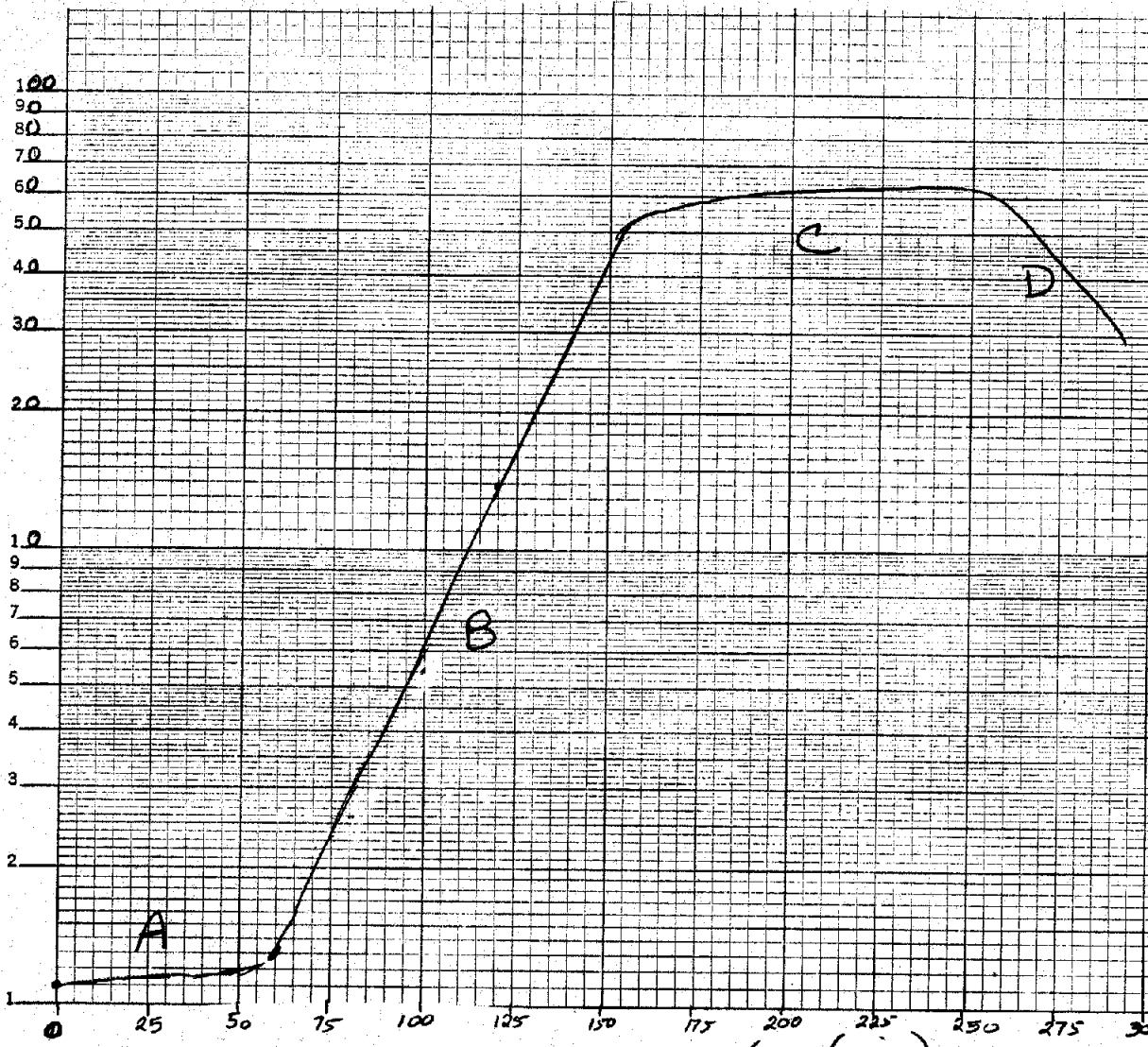
Example: _____

a. Using the components listed below, label the molecules involved in the regulation of the potential gene groups depicted below. In addition, circle whether the depicted scenario will lead to transcription or not. Note that not all the choices will be used and some of the proteins can be used more than once.

- a. Repressor
- b. Activator protein
- c. Promotor
- d. Inducer
- e. E site
- f. Helicase
- g. RNA polymerase
- h. Operator
- i. Activator binding site
- j. Co-repressor



Number of viable bacteria



6. (7 points)

Identify each of the phases of bacterial growth shown in the above graph.

Time (min)

A _____

B _____

C _____

D _____

What is the doubling time of the cells in phase B (to within 3 min.)? _____

In which phase are most bacteria in nature? _____

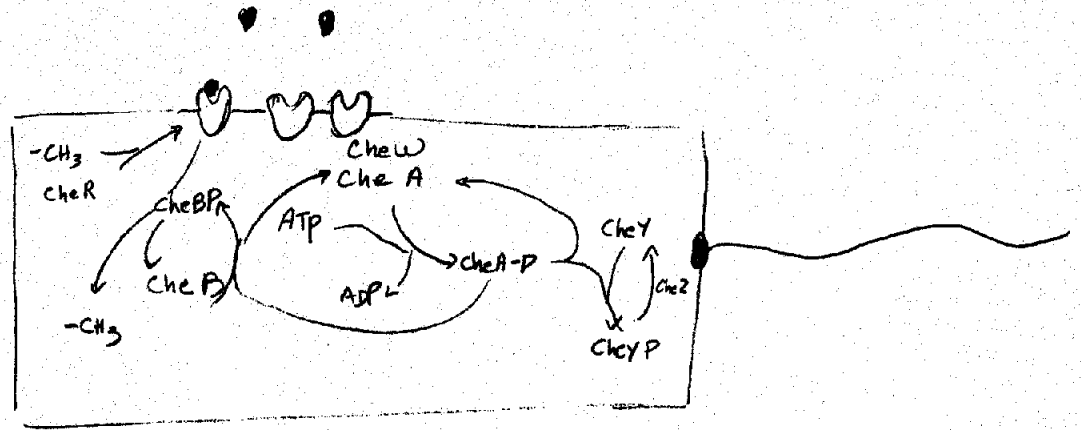
7. (11 points) Fill in the blank boxes to indicate how these bacteria would grow under these conditions. All the bacteria are in minimal salts medium.

Organism and	Electron donor	Final electron acceptor	Growth rate (fast or slow)
<i>E. coli</i> with glucose and NH ₄ , aerobic			
<i>E. coli</i> with glucose and NH ₄ , anaerobic			
<i>E. coli</i> with glucose and NO ₃ , anaerobic			XXXXXXXXXX XXXXXXXXXX XXXXXXXXXX XXXXXXXXXX
<i>Thiobacillus</i> in medium with S ₂ O ₃ ²⁻ and CO ₂ , anaerobic.			

8. (9 points) T4 bacteriophage has a complicated transcription sequence. Next to the mRNAs listed below, list the respective host and T4 transcription molecules needed for transcription of these messages. In addition list the classes of proteins each mRNA encodes for.

	Host transcription machinery	T4 transcription machinery	Class of Proteins mRNA encodes for
Early mRNA			
Middle mRNA			XXXX
Late mRNA			

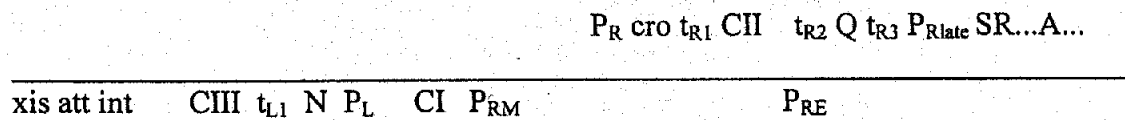
What would be the major change in the above table if it concerned T7 rather than T4?



9. (6 points) What would be the phenotype of an *E. coli* cell with a mutation in the following genes?

mutant (nonfunctional) gene	phenotype
cheA	
cheZ	
cheR	

10. (6 points) A map of lambda (λ) phage.

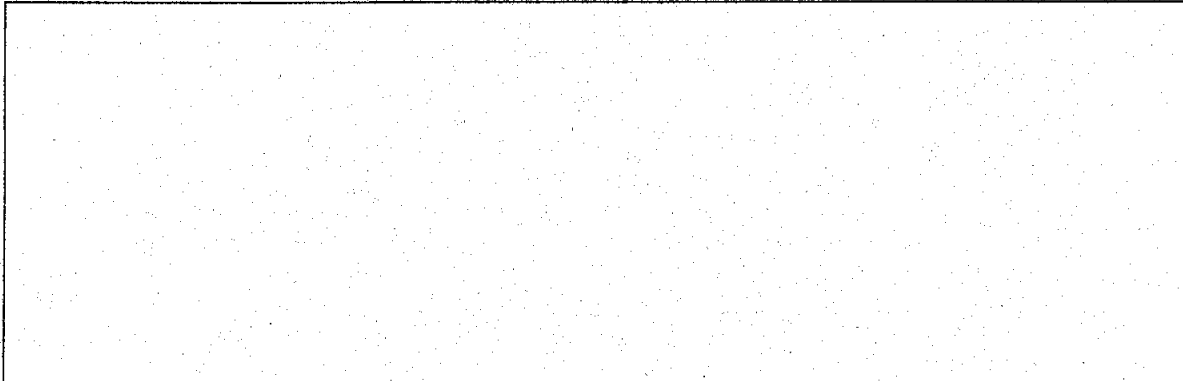


What would be the phenotype of an infection of the indicated genotype of *E. coli* with the indicated lambda (λ) phage? (clear plaques, cloudy plaques, or no plaques).

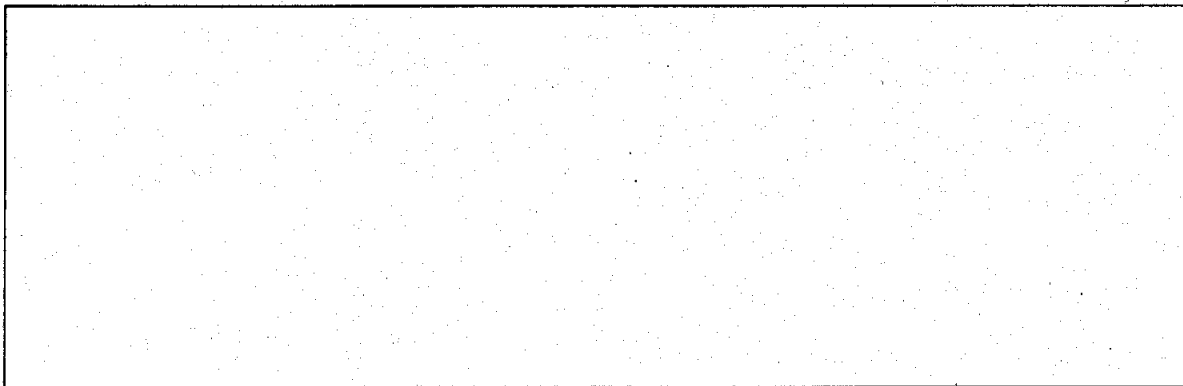
phage genotype	<i>E. coli</i> K12 (-)	<i>E. coli</i> (λ)
wild type		
P_{RE} deleted		
att deleted		

11. (10 points)

How does the poliovirus produce the various different proteins it needs to create new viruses?



What steps does a negative strand RNA virus such as influenza go through to produce new virus genomes?



An _____ dependent _____ polymerase is needed for influenza to do this. From where does the virus get this enzyme when it enters a host cell? _____