

NAME: _____

MICR/MBMB 460

Fall, 2008

Exam III

1. **(2 pts)** In one complete sentence, what would be the likely result to the *lac* operon if the IIA^{Glc} was mutated such that it became permanently dephosphorylated?

2. **(6 pts)** In a few words each, give the specific mechanism(s) that controls expression of the *lac* operon:

a) when only glucose is present.

b) when only lactose is present.

c) at the level of translational regulation.

3. **(4 pts)** You isolate an *E. coli* mutant in which only long transcripts are produced from transcription of the *trp* operon, even if the amount of tryptophan in the cell is relatively high. You decide that the simplest explanation would be a mutation in one of the leader regions that destroys the secondary structure. If your hypothesis is correct, which specific leader region (1, 2, 3 or 4) is most likely mutated? (Do NOT give one of the possible secondary structures for your answer; you should only be writing a single number.)

4. **(2 pt)** What would be the final product of replicative transposition of a transposable element that produced a non-functional resolvase protein?

5. (12 pts) For each of the following merodiploids, indicate whether *lacZ/lacY* expression would be I (inducible), C (constitutive), or A (absent). (Please use the letter code only.)

a) $lacI^S lacP^- lacO^C lacZ^- lacY^+ / lacI^- lacO^+ lacP^+ lacZ^+ lacY^-$

lacZ: _____ *lacY*: _____

b) $lacI^- lacO^C lacZ^- lacY^+ / lacI^S lacO^+ lacZ^+ lacY^-$

lacZ: _____ *lacY*: _____

c) $lacI^Q lacO^C lacZ^+ lacY^- / lacI^- lacO^+ lacZ^- lacY^+$

lacZ: _____ *lacY*: _____

6. (4 pts) You have isolated an *E. coli* mutant in which the autokinase activity of NtrB has been lost. That is, NtrB can never be phosphorylated. How would this mutation affect NtrC and its subsequent activity?

7. (4 pts) If the 5' UTR (Untranslated Region) of the mRNA for *rpoH* was substituted with the 5' UTR region of *rpoS*, what molecule would necessary to get translation and production of sigma 32?

8. (4 pts) What happens to the host *E. coli* cell if the phage repressor is unable to control Mu's transposase?

9. (4 pts) RecBCD and RecA are required for what type(s) of homologous recombination?

10. **(14 points)** For the following items, indicate whether they are involved in genetic regulation at the level of:

- A) Transcription
- B) Translation
- C) Posttranslation
- D) None of the above

_____ Antisense RNA

_____ cAMP-CRP complex

_____ Attenuation

_____ DnaK binding to σ_{32}

_____ Antitermination

_____ Multiple copies of the rRNA/tRNA operons

_____ Phosphorylation of NtrC

11. **(4 pts)** In order for RelA to catalyze the synthesis of ppGpp, the cell must be under amino acid starvation conditions. How does the bacterial cell sense that it is starved for amino acids?

12. **(6 pts)** State whether the following processes typically involve reciprocal (R) or non-reciprocal (NR) recombination.

Recombination between...

_____ the bacterial chromosome and a linear piece of DNA obtained through transformation.

_____ the bacterial chromosome and bacteriophage lambda.

_____ two plasmids.

13. **6 pts)** Explain how the riboswitch region of an mRNA sequence can affect:

a) Transcription

b) Translation

c) mRNA degradation or cleavage

14. **(4 pts)** Draw how the structure of the mRNA for *rpoH* would look under normal 37°C growth in *E. coli*. Make sure to indicate the region that corresponds to the ribosome-binding site (RBS).

15. **(4 pts)** An *E. coli* strain has a 4-kb plasmid that carries a transposon capable of replicative transposition. You transform this same strain with a 6-kb plasmid that carries an ampicillin resistance marker. You now attempt to move this 6-kb Amp^R plasmid into a new host strain. However, when you check the ampicillin-resistant recipients, they ALL carry a 10-kb plasmid NOT a 6-kb plasmid. Briefly explain these results. Your answer MUST include transposition.

16. **(6 pts)** What affect does iron have on luciferase production in *V. fischeri*? Make sure to include what gene(s) is/are directly influenced by iron in your answer.

17. **(6 pts)** If recombination between the two DNA molecules below occurred, draw the two possible outcomes following the resolution of the Holliday junction. Make sure to label each drawing with the type of recombination that occurred.



18. **(8 pts)** Explain how Fur positively regulates production of the peroxidase SodB. Make sure to explain how and why the level of SodB differs under conditions of low and high iron as well as why the production of SodB is necessary under certain cellular conditions.