

# Spring 2005 Molecular Biology Exam #1 - Learning the Tools

[http://www.bio.davidson.edu/courses/Molbio/Exams/2005/MolExam1\\_05.doc](http://www.bio.davidson.edu/courses/Molbio/Exams/2005/MolExam1_05.doc)

There is no time limit on this test, though I have tried to design one that you should be able to complete within 4 hours. You do not have to take this exam in one block of time; you may come and go as you wish. However, if you feel another course presents a conflict of interest, please discuss this with me. You are not allowed to use your notes, any books, any electronic sources except those specified in the exam, nor are you allowed to discuss the test with anyone until Wednesday Feb. 2, 2003. **EXAMS ARE DUE AT 9:30 ON WEDNESDAY, FEBRUARY 2 in DANA 256 lab.** You may use a calculator and/or ruler. The answers to the questions must be typed into this file unless the question specifically says to hand write/draw the answer in the space provided. If you do not place your answers in the appropriate locations, I may not find them.

There are 4 pages for this exam, including this cover sheet.

## **-3 Pts if you do not follow this direction:**

Please do not write or type your name on any page other than this cover page. Staple all your pages (INCLUDING THE TEST PAGES) together when finished with the exam.

Name (please print here):

Write out the full pledge and sign:

How long did this exam take you to complete (excluding typing)?

**16 pts.**

1. My grandmother has lost her molecular cloning manual and needs some help. She has been doing molecular biology most of her life, but with her age, her mind is not as sharp as it used to be. Please help her by providing the information requested below.

a) How do you make a 400 mL of a 2X stock solution when the 1X solution is 0.15 M Tris; 200 mM NaCl; pH 8.0?

b) Grandma needs to electrophorese some DNA from her transgenic tomatoes to see which one she should serve cousin Elmo who refuses to eat GMO's. Remind her how to make a 200 mL gel that is: 0.35% agarose; 1 $\mu$ g/mL EtBr; 0.5X TBE.

c) The molecular grocery store had some stock solutions, but not the ones she is used to. Please help her make 200  $\mu$ L of a DNA solution that is 88  $\mu$ g/mL from the store brand stock solution that came in 400 $\mu$ g/mL concentration.

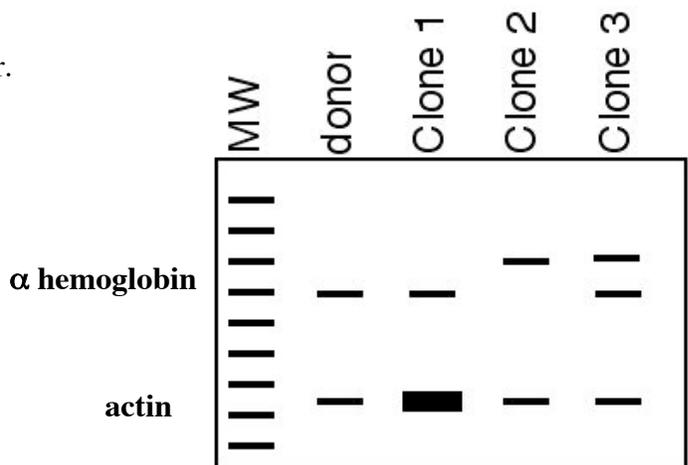
d) Grandma is ready to digest her DNA stock solution. She wants to digest 150 ng (1  $\mu$ g = 1,000 nanograms, ng) of her stock solution you helped her make in c above. The final volume will be 15  $\mu$ L, and you need to digest the DNA with EcoRI and BamHI which work well in the same 10X buffer that came with the enzymes. Tell her how to set up this DNA digestion.

**FWs:** NaCl = 58.5; EcoRI = 125; BamHI = 415; EtBr = 394; EDTA = 416; Tris = 121; HCl = 36.5; agarose = 204. Other raw materials include SDS = stock solution of 10%; TBE = stock solution that is 5X; stock solution of EtBr = 10 mg/mL.

**12 pts.**

2. Someone claims to have cloned human beings and produced a Northern blot to prove his point (Figure 1). RNA has been isolated from whole blood of 3 alleged clones plus the original donor and all 4 samples were subjected to gel electrophoresis. Two probes were used on the same blot.

- Interpret the data as fully as you can.
- Do the data support the claim that one of these three clones are true clones? Explain your answer.



**Figure 1.**

**12 pts.**

3. It turns out there are two kinds of people in the world: those who have a Mickey Mouse (MM) protein and those who have a Donald Duck (DD) protein in their toenails and these two proteins are very different from each other. As it turns out, heterozygotes are lethal *in utero*. A new constitutional amendment is being proposed that MM's cannot marry DD's and there is a need for a quick screen. Explain how you would:

- produce an antibody for each protein (use outline format only)
- verify your antibodies using a method that incorporates DNA (use outline format only)
- Draw a picture of the experimental data from b above.

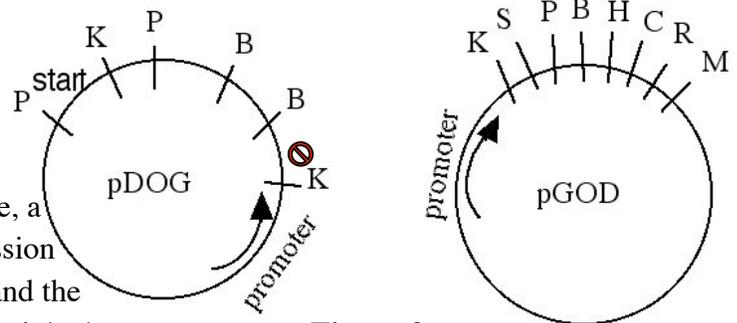
**12 pts.**

4. More news from the field.... salmon can produce mad salmon disease in humans if the meat is eaten raw (the first symptom is an urge to run up the down-escalators to eat more sushi). The cause of the disease is a fish version of a prion protein found in cattle. Explain how you could:

- clone the salmon gene (outline format)
- demonstrate which tissues in the fish transcribe the prion gene (outline format with diagram of data)

**10 pts.**

5. Figure 2 shows the results of a poorly planned cloning experiment. The sad student had not taken Molecular Biology and therefore did not have a full tool belt at her disposal. As you can see, a PCR product was cloned backwards into an expression vector (pDOG). The start codon is near the P site and the stop codon is between the B and K sites at about 3 o'clock.



**Figure 2**

Please help this unprepared student clone the ORF (from P → K, including the P and K cut sites) into pGOD so the encoded protein will be expressed properly. You may use any method you want, but you must explain all critical steps. To get full credit, you must experimentally verify your cloning has been successful. You may use diagrams and/or outlines. If you hand write anything, make sure I can read your writing.

**12 pts.**

6. People are making a stink about driving over skunks in the road and they want something done about this smelly problem. The Division of Roadkill (DoK) has developed a plan, all they need is a transgenic skunk that produces GFP in the fur of the white stripe. Design a recombinant gene that will perform this function. Lucky for you, the cDNA that encodes the white pigment has recently been cloned. You do not have to tell me how to get it into the skunks, only DNA design. Getting the DNA into the skunk is the responsibility of DoJYDW.

**14 pts.**

7. On the back of this page, draw an RNA dinucleotide with U as the first base and G as the second base added to the growing polymer. Do not take any shortcuts in the atoms except in the two bases. For

the bases only, you can draw circles as appropriate, but you do not need to fill in all the carbons or nitrogens, etc. for the bases. You do need to include all other atoms.

**12 pts.**

8. Using the table provided, hand PRINT in the name for each amino acid. DO NOT TYPE.

Abbreviations	FULL NAME
W	
I	
L	
D	
T	
H	
N	
G	
K	
V	
E	
Y	