

Molecular Biology 1st Exam - spring 1997
ALL EXAMS ARE DUE AT 9:30 am ON MONDAY February 3, 1997.

There is no time limit on this test. You may find it easier to take this test in two hour blocks over several days, though if you are confident in your molecular skills, you could wait until Sunday night. However, I predict it may take you a bit longer to *think* of all the answers (just some friendly advice). You are not allowed to use your notes, any books or journals, nor are you allowed to discuss the test with anyone until all exams are turned in at 9:30 am on Monday, Feb. 3. **While you are taking the exam, you may not study for any science classes that will help you with this exam (e.g. Organic Chem.) I do not know which classes may present problems so talk to me if you are unsure.** You may use a calculator. The answers to the questions must be typed, though you may want to supplement your text with hand drawn figures (write neatly for any labels in your figures).

-3 pts if you do not follow this direction.

Please do not write 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):

Write out the full pledge and sign:

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

You might find it more fun to take this test while humming (Dunt, dunt, dunt, dunt, dunt, dunt...) the tune to Mission Impossible.

20 pts.

1) (Good news, bad news.) You bought a ticket to London for spring break and the plane is over booked (bad news). You get bumped to first class (good news) and the man sitting next to you looks a lot like Tom Cruise (really good news). He is reading what looks like a secret file. On this file is the following:

A) This not-so-smart-agent needs help. Write down the DNA sequence shown here in the proper 5' to 3' orientation.

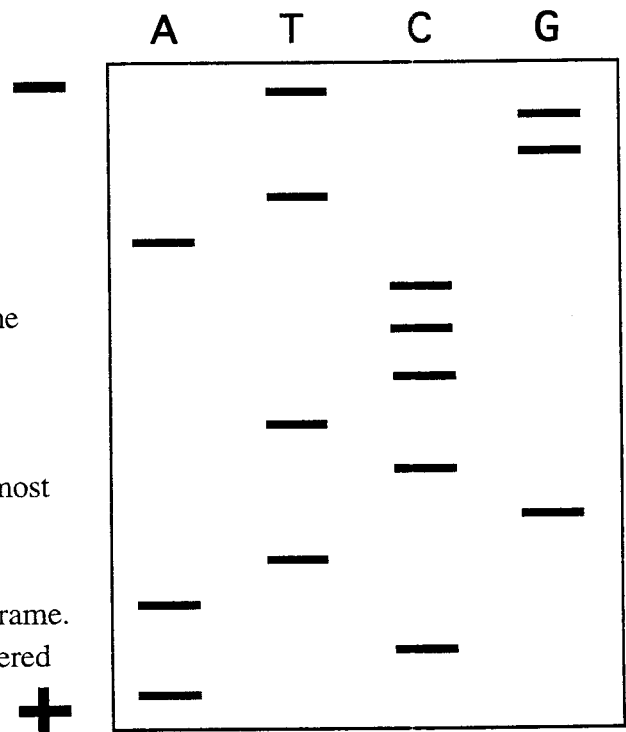
He thanks you for your help and then offers you a deal. If you will answer a few more questions, he will give you a stick of gum.

B) He tells you that the sequence you have written down is the template strand for an mRNA. There are no introns, but he needs you to write down the mRNA sequence in the proper 5' to 3' orientation.

C) Now he asks you to translate the mRNA using the table provided to you at the bottom of this page. Start with the 5' most mRNA nucleotide and then write down the amino acid sequence beginning with the N-terminus.

D) Now he asks you to see if you can find an open reading frame. You must tell him yes or no and explain why you have answered this way.

You say no thank you for the gum but ask for some peace and quiet.



First position (5' end)	Second position				Third position (3' end)
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

15 pts.

2) You are having lunch at a cafe, and you see the following on your menu. Please convert these letters to the full names of the amino acids:

GING TW SELF DESTRCT IN PHIVE SEC

14 pts.

3) A woman sits down and tells you that a new monoclonal antibody has been generated and the CIA thinks that it will bind to acetylcholinesterase. This agent asks you to design one or more experiments (including controls) that would:

A) find out if the antibody's epitope is also present on acetylcholinesterase isolated from flies, mice, worms, and humans and if so, how big each version of acetylcholinesterase is.

B) since all of these species do express acetylcholinesterase, clone the cDNA that encodes the fly version of acetylcholinesterase. (It has never been cloned from flies, though it has from the other species.)

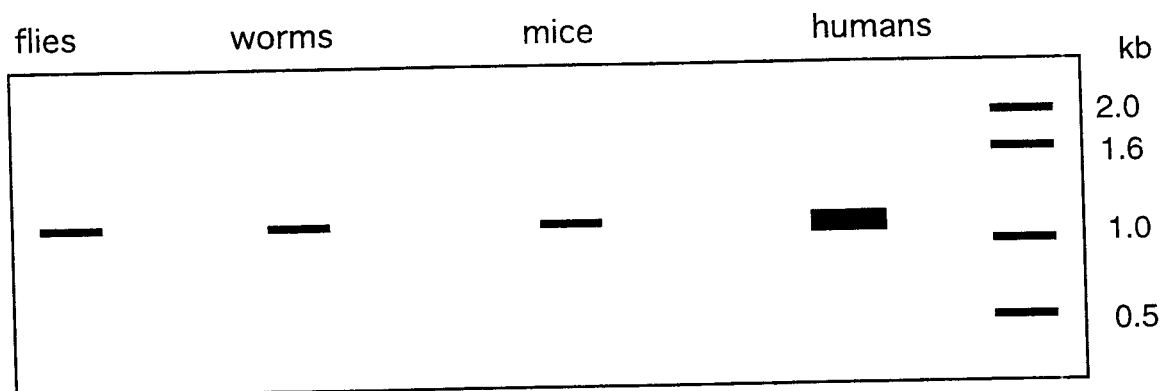
9 pts.

4) Below, you see two northern blots. One for Free Bacterial Intake protein, and one for actin, the universally expressed protein. What can you deduce from these data? Explain how you made your deduction.

Free Bacterial Intake protein



actin



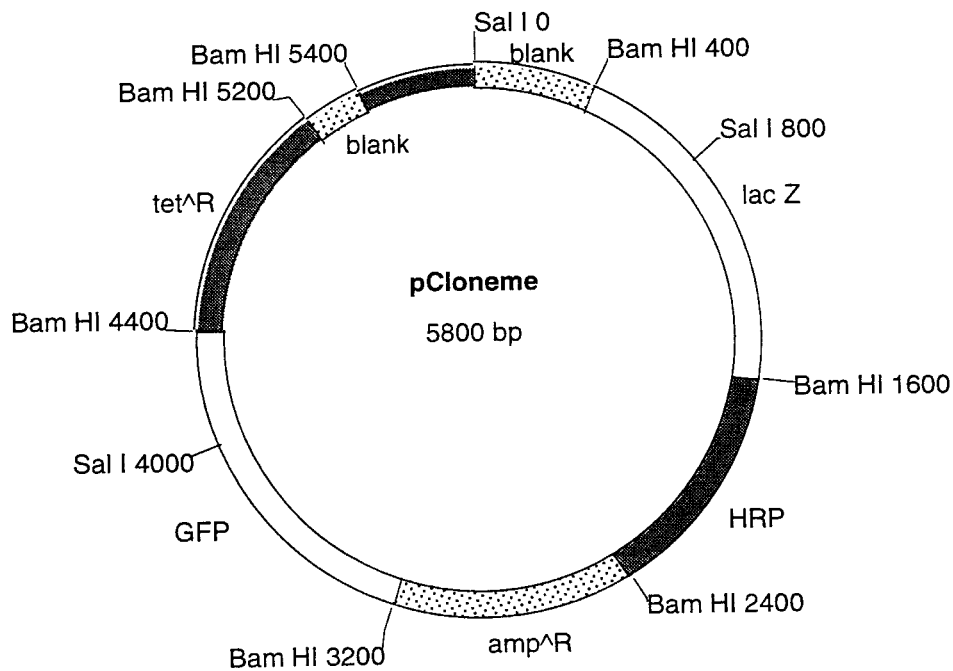
12 pts.

5) When you return to your hotel room, you find a balance, a pH meter, some chemical bottles, various pipets, a calculator and the following directions:

- A) make solution with a final volume that is 225 ml of a 0.35 M NaCl, 5% v/v acetic acid. Tell me all the volumes and all reagents.
- B) A stock solution is 2.59 mg/ml of DNA and you want to make 100 μ l that is 1 μ g/ μ l. How do you do this?
- C) Set up a restriction digestion of 1 μ g the DNA above and cut it in 15 μ l final volume with the enzymes Bam HI and Hind III.
- D) Make 250 ml of 10X TE which is 100 mM Tris (pH 8.0) and 10 mM EDTA.

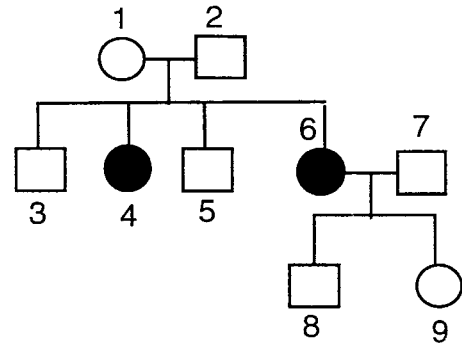
10 pts.

6) How could you subclone the following 2 fragments (no need for exact volumes; just the strategy)? Clone each of them into separate plasmids and convince me that you know which is which. The boxes represent segments of DNA that terminate with the indicated restriction sites. There are two segments of DNA that are nonfunctional (blank) but the rest of the DNA segments have been labeled. Your task is to clone two fragments into a typical cloning plasmid. The two fragments you should clone are: fragment 1 is from 400 to 1600, and fragment 2 is from 4400 to 5200.



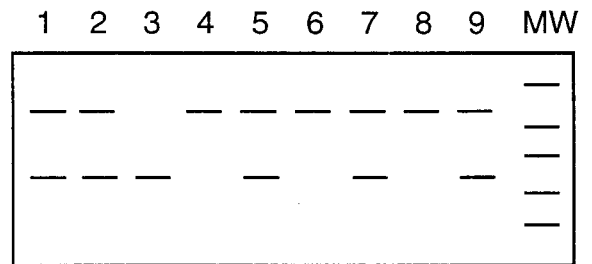
10 pts.

7) John Majors (#2 in pedigree) is heterozygous for a rare genetic disease of compulsive secrete telling. You can see a family pedigree and a series of RFLPs below.



A) Which band is associated with the diseased allele? How do you know this?

B) Which grandchild should not be trusted with secretes



10 pts.

8) A top covert operative almost lost his life when he refused to drink the customary milk drink that all international spies drink. Design a method to generate a hypoallergenic cow's milk. Since many people develop allergies to a milk protein called casein, how could you produce casein-free milk using transgenic technology?

10 pts.

9) Finally, you return home. You are glad to be away from international spies and the doorbell rings. (Dunt, dunt, dunt, dunt, dunt...) The secrete service has been following your vacation moves, and wants some advice. It appears that a biological weapon has been discovered in the White House. It is a normal protein except a single amino acid has be changed from cysteine to methionine. After looking at the structures below, tell the agent what possible effect this substitution might have on the protein.

