GENETICS, DECISIONS AND SOCIETY: EXAM 2 1997

Name:

1. For DNA and RNA, fill in the following table: (6 points)

Characteristic	RNA	DNA
sugar used		
bases present		
number of strands		

2. For the following piece of DNA:

3' T A A C G A T A C G T A A C T G A A C T G

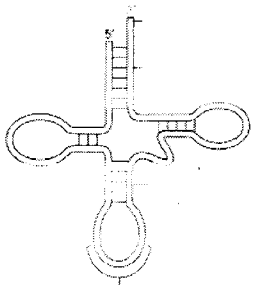
a: Write the RNA strand that will assembled on this DNA template. (4 points).

b: Using the attached genetic code, translate the RNA into a sequence of amino acids. Remember the rules which govern the start of translation. (4 points).

3. Explain why some base pair changes in DNA within protein encoding regions fail to give rise to a protein with any amino acid change. (6 points).

4. Describe **semi-conservative** replication. Mention the sites at which the process begins and the enzyme which is responsible for synthesizing the new DNA (6 points).

5. Shown below is a schematic diagram of a tRNA. Show where on the tRNA the amino acid is attached and where the anticodon (which interacts with the codon by base pairing) is found. (6 points).



6. Tell the affect of each of the following types of mutation on the production of a particular protein which you are investigating. (4 points each).

a: nonsense

b: missense

c: a mutation which causes the promoter of the gene to be inactive.

7. Give a brief description of the function of any **five** of the following (4 points each).

a: mRNA

b: ribosome

c: splicing

d: Polymerase Chain Reaction

e: nucleosome

f: vector

g: restriction enzyme

8. You are studying the human disease *Familial Obnoxiousness*. Mutations in genes which lie in a pathway leading to production of a protein product called tactin result in the production of no tactin gene product and lead to symptoms of the disease. In extreme cases, symptoms include belching, general rudeness, chewing with one's mouth open, and the inability to utter the words please and thank you. In order to determine the number of genes which operate in this pathway and the order of the intermediates, you first co-culture cells from individuals with this disease and then determine if tactin has been produced in the culture dishes. You then test the ability of the cells from each individual to produce tactin when grown on known intermediates in the pathway. The results are shown in the tables below.

CO-CULTURE OF CELLS FROM MUTANT INDIVIDUALS

	1	2	3	4	5	6	7
7	+	-	+	+	+	+	-
6	-	+	+	-	+	-	
5	+	+	-	+	-		
4	-	+	+	-			
3	+	+	-				
2	+	-					
1	-						

+ indicates that when the cells from these individuals are cultured together, tactin is produced.

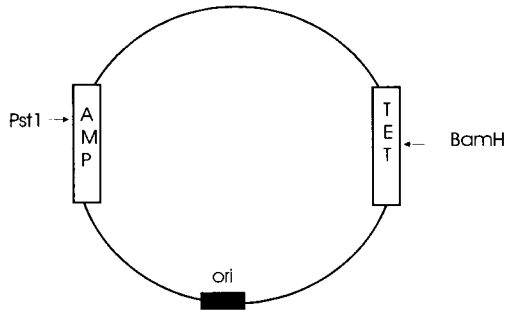
TACTIN PRODUCTION ON INTERMEDIATES

	A	B	C	Tactin
1	-	-	-	+
2	+	+	-	+
3	-	+	-	+
4	-	-	-	+
5	-	+	-	+
6	-	-	-	+
7	+	+	-	+

a: How many different genes are involved in this pathway? Which individuals carry mutations in the same gene? How do you know? (5 points).

b: Give the order of the intermediates in the pathway. (4 points).

9. You have isolated a fragment of DNA which contains the gene encoding the final step of the pathway above. This fragment was generated by cutting total DNA with the restriction enzyme BamH1. You wish to clone this fragment by inserting it into a plasmid which can replicate in bacteria, and then transforming that plasmid into the bacteria. You are using the plasmid pBR322 which is shown below.



a: Why is it important that **ori** be present in this plasmid? (3 points).

b: With which restriction enzyme would you cut this plasmid to insert your gene of interest? (3 points).

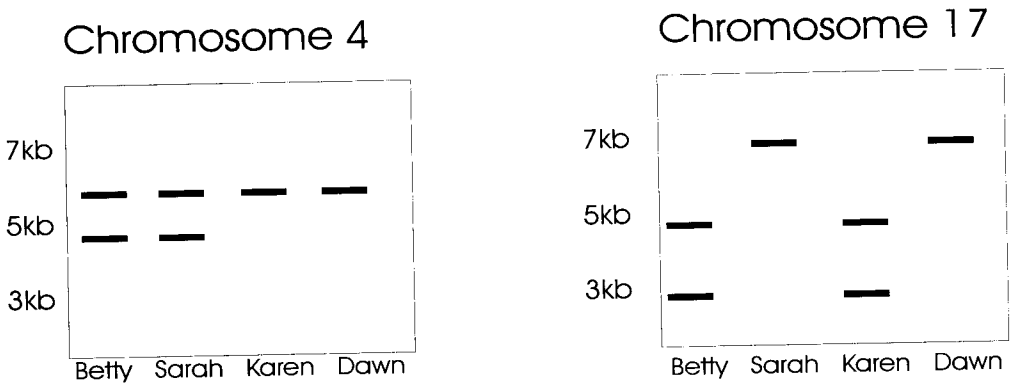
c: If you introduce the recombinant plasmid (containing your DNA fragment) into bacteria which are sensitive to both ampicillin and tetracycline, what will be the phenotype of the transformed bacteria? (3 points).

10. The following is a description of a family that has a history of inherited breast cancer, where the affected gene acts as an autosomal dominant. Betty does not carry the gene. Don, her husband does. Don's mother and sister had breast cancer. One of Don and Betty's daughters (Sarah) has breast cancer, the other (Karen) does not. Sarah's daughters are in their 30s. Dawn, 33, has breast cancer, Debbie, 31, does not. Debbie is wondering if she will get the disease because she looks like her mother. Dawn is wondering if her two-year old daughter (Nicole) will get the disease.

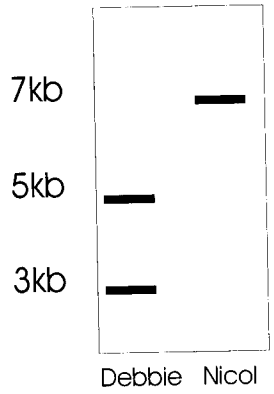
a: On the attached blank piece of paper, draw a pedigree, indicate affected individuals and identify all individuals. (4 points).

b: What is Don's genotype and phenotype? (3 points).

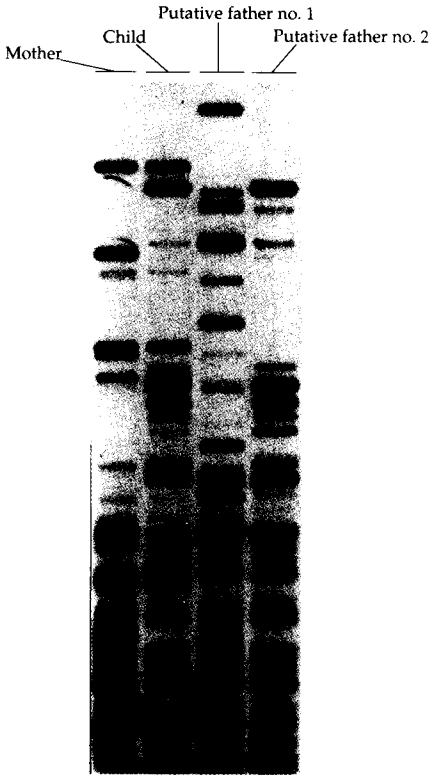
c: a RFLP marker has been found that maps very close to the gene. Given the following RFLP data for chromosomes 4 and 17, to which chromosome does this gene map? How do you know? (3 points).



d: Using the same RFLP marker, Debbie and Nicole were tested. The results are shown below. Based on their genotypes, are either of them at increased risk for breast cancer? Explain. (3 points).



11. The paternity of a child is in question. Mother, child, and two possible fathers are tested by DNA fingerprinting. The results are shown below.



DNA fingerprints of a mother, her child, and two men, each of whom claimed to be the child's father.

Which of the two "putative" fathers is the real father of the child? Mention two specific bands of the gel which support your conclusion. (5 points).

CODON	AMINO ACID	CODON	AMINO ACID	CODON	AMINO ACID	CODON	AMINO ACID
AAU, AAC	Asparagine	CAU, CAC	Histidine	GAU, GAC	Aspartic acid	UAU, UAC	Tyrosine
AAA, AAG	Lysine	CAA, CAG	Glutamine	GAA, GAG	Glutamic acid	UAA, UAG	Terminator*
ACU, ACC, ACA, ACG	Threonine	CCU, CCC, CCA, CCG	Proline	GCU, GCC, GCA, GCG	Alanine	UCU, UCC, UCA, UCG	Serine
AGU, AGC	Serine	CGU, CGC, CGA, CGG	Arginine	GGU, GGC, GGA, GGG	Glycine	UGU, UGC	Cystine
AGA, AGG	Arginine					UGA	Terminator*
						UGG	Tryptophan
AUU, AUC, AUA	Isoleucine	CUU, CUC, CUA, CUG	Leucine	GUU, GUC, GUA, GUG	Valine	UUU, UUC	Phenylalanine
AUG	Methionine**					UUA, UUG	Leucine

*Terminator codons signal the end of the formation of a polypeptide chain.
**Codon has two functions: specifies the amino acid methionine and serves as the start codon, marking the beginning of a polypeptide chain.