Birla Institute of Technology & Science (BITS), Pilani

Intro to Mol Bio and Immuno (PHA F215); Mid Sem Exam, 9th Mar 2017

Max. Marks: 30 **Closed Book** **Duration: 90Minutes**

Q1. In the space provided next to each definition or description, clearly write the letter of the appropriate term from the list of terms given on the last page. **[20 × 0.5 =10]**

i) ______A short, single-stranded DNA that serves as the necessary starting material for the synthesis of the new DNA strand in PCR

ii) _______The synthesis of DNA using DNA as a template

iii) ______The building blocks of DNA and RNA

iv) ______The synthesis of protein using information encoded in mRNA

v) _______The location in a eukaryotic cell where the electron transport chain occurs

vi) _______The major component of cell membranes

vii) _______The genetic composition of an organism

viii) _______An organism without membrane-bound organelles

ix) _______A cell with 1n chromosomes

x) ____The building blocks of proteins

xi) ____A cell with 2n chromosomes

xii) ____A major source of energy that has the general formula (CH2O)n

xiii) ____ An enzyme needed for completion of lagging strand synthesis, but not leading strand synthesis

xiv) ____ The synthesis of RNA using one strand of DNA as a template

xv) ____ A circular DNA molecule that can be used to move foreign DNA in or out of a cell

xvi) ____ The membrane that surrounds the cell

xvii) ____ The DNA from a eukaryote formed by the enzyme reverse transcriptase; this DNA lacks introns.

xviii) ____ An organism with 2 identical alleles for the same gene

xix) ____ An organism with genetic material inside a nucleus

xx) ____ A technique for the rapid production of millions of copies of a particular region of DNA

Q2. You have discovered a new enzyme, enzyme X, which breaks down proteins by cleaving peptide bonds after tyrosine or phenylalanine. Enzyme X is the product of gene X that encodes a protein with the molecular weight of 50 kilodaltons (50 kD). You purify active enzyme X and find it has a molecular weight of 250 kilodaltons (250 kD). Why is active enzyme X larger than the product encoded by gene X? What you can interpret about its structure? **[2]**

Q3. The following double-stranded DNA contains sequence of an eukaryotic gene:

```
                 a    b
5'-ATGGCCTTCACACAGGAAACAGCTATGGCCATGAGCACGCCAGTCTCGGCATTATCCTATTAAAGGGAACTGAGGTGA-3'
3'-TACCGGAAGTGTGTCCTTTGTCGATACCGGTACTCGTGCGGTCAGAGCCGTAATAGGATAATTTCCCTTGACTCCACT-5'
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a) Transcription begins at the underlined A/T at base pair 17 **(a)** and proceeds to the right. What are the first 12 nucleotides of the resulting mRNA? Indicate the 5' and 3' ends of the mRNA. **[2]**

b) The first 7 amino acids of the protein encoded by this gene are:

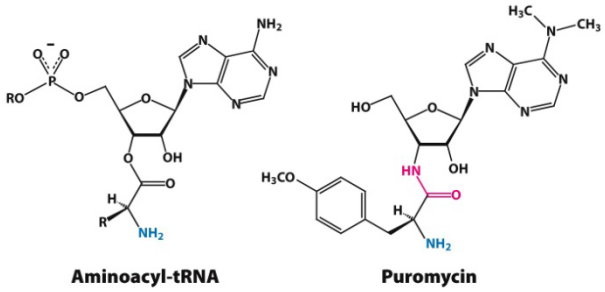
NH3+ -met-ala-met-ser-pro-his-tyr....COO^-

Draw a box around the intron region in this gene. **[3]**

c) What would be the preferred secondary structure of the initial amino acids in this sequence? **[2]**

d) How would the resulting protein change if the underlined G/C base pair at position 22 (**b**) was deleted from the DNA sequence? Briefly explain. **[2]**

Q4. Puromycin, which is structurally similar to the aminoacyl terminus of an aminoacyl-tRNA (see diagram), inhibits protein synthesis. Based on these information, can you give a hypothesis how puromycin can affect protein synthesis? **[1]**



Q5. The following is the sequence of two DNA helices. Which DNA helix (*helix 1 or helix 2*) needs a higher temperature to denature (uncoiling)? **Explain** why you selected this option. **[1]**

Helix 1:	5'ATGCGGGAGA3' 3'TACGCCCTCT5'	**Helix 2:**	5'ATGTTTTAGA3' 3'TACAAAATCT5'

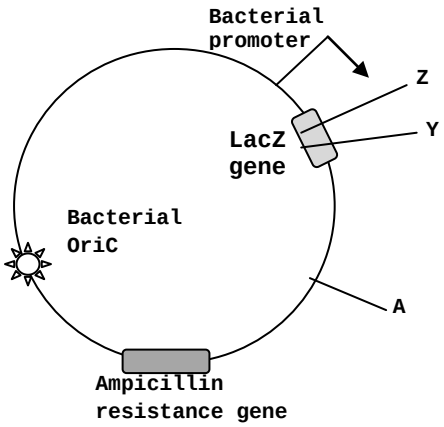
Q6. You have identified a mutant cell line that shows a **single mutation** in the **X** gene. You find that although the **X** gene has the same protein coding sequence in the wild-type and mutant cells, it is **NOT transcribed in mutant cells**. Based on this information, select the sequence from the choices below that might have a mutation and explain why you selected this sequence. **[2]**

i) Promoter **ii)** Introns **iii)** Exons **iv)** 3' Untranslated region **v)** 5'Cap **vi)** Ribosome binding site

Q7. The **X** cDNA has the recognition site for restriction enzymes **R** and **A**. You want to clone **X** cDNA into the following plasmid that has recognition sites for restriction enzyme **Z**, **Y** and **A** as shown. *Please note: A slash (/)represents the cutting site for each restriction enzyme.*

Z	**Y**	**R**	**A**
5′GT/TATT AC3′	5′AG AATT/CT3′	5′AT AATT/GC3′	5′TG CCTT/CC3′
3′CA ATAA/TG5′	3′TC/TTAA GA5′	3′TA/TTAA CG5′	3′AC/GGAA GG5′

Which enzyme (*R/ A*) would you use to cut the cDNA to insert into the plasmid? Which enzyme will you use to cut the plasmid for a successful and detectable transfection? Explain. **[2.5+2.5]**



You may detach this page during the exam.

List of terms for Question 1.

a) allele
b) amino acids
c) autosomal gene
d) carbohydrate
e) cDNA
f) competitive inhibitor
g) diploid
h) endoplasmic reticulum
i) eukaryote
j) G protein
k) genotype
l) haploid
m) heterozygote
n) homozygote
o) mitochondria
p) non-competitive inhibitor
q) nucleotides
r) DNA ligase
s) phenotype
t) phospholipids
u) plasma membrane
v) plasmid
w) polymerase chain reaction
x) primer
y) prokaryote
z) DNA polymerase
aa) replication
bb) repressor protein
cc) sex-linked gene
dd) transcription
ee) translation

Genetic Code - Table