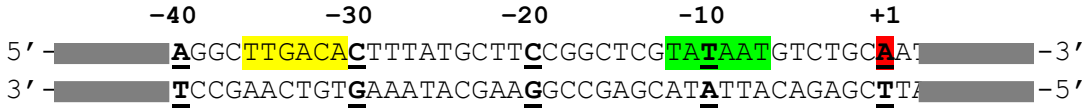
# Quiz/Self-assessment-II

Q. 1 Shown below is the fragment of an *E. coli* gene (the bold and underlined nucleotides are numbered):




(a) Name the regions highlighted in yellow and green?
(b) What is the basis of the numbering of the nucleotides?
(c) Which of the above strands (top strand or bottom strand) is the template strand?

**Answer:**

**(a) Yellow: –35 box Green: –10 box**
**(b) +1 is the first nucleotide to be transcribed; sequences in the 5; direction on the non-template strand are negatively numbered.**
**(c) Bottom strand is the template strand (Transcription is from 5' – 3' end)**

Q. 2 Complete the following table:

| | Replication | Transcription | Translation |
|---|---|---|---|
| Where does this take place in an eukaryotic cell? | **Nucleus** | **Cytoplasm** | **Ribosomes** |
| Which enzyme/protein complex carries out this process | **DNA polymerase** | **RNA polymerase** | **Ribosomes** |
| What is the template that is read during this process? | **DNA** | **DNA** | **mRNA** |
| Which direction the template is read in? | **3' – 5' (Because synthesis is from 5' – 3')** | **3' – 5' (Because synthesis is from 5' – 3')** | **5' – 3'** |
| What is the start signal for this process | **Origin of replication** | **Promoter** | **Ribosome binding site in prokaryotes**<br><br>**5' cap in eukaryotes** |
| What is the product of this process | **DNA** | **RNA** | **Protein** |
| What are the monomers used in this | **Deoxyribonucleotides** | **Ribonucleotides** | **Amino acids** |
| What type of bond is formed between the monomers? | **Phosphodiester** | **Phosphodiester** | **Peptide** |

Q. 3 Insertion or deletion of one or two base-pairs from the coding region of the gene changes the reading frame of the gene; such mutations are known as ……**frameshift mutations**…….

Q. 4 In the process of translation, each amino acid is coded for by 3 nucleotides—a codon. Why does it has to be at least 3 nucleotides as opposed to 2 or 1 nucleotides coding for an amino acid?

**Answer: As there are only four nucleotides present in RNA, a single nucleotide code can code only for $4^1 = 4$ amino acids, a two nucleotide code can code only for $4^2 = 16$ amino acids, and a three nucleotide code can code for $4^3 = 64$ amino acids. As we have 20 different amino acids in the proteins, the code has to be at least three nucleotides long.**

Q. 5 Codon is the three nucleotide code present in ……**mRNA**…….

Q. 6 How many codon are required for specifying 5 amino acids?

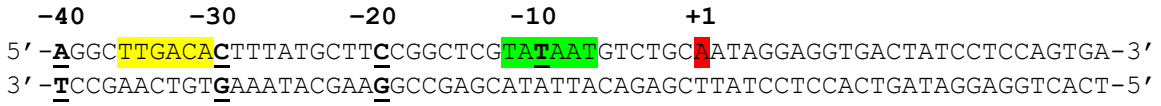
**Answer: Five codons (15 nucleotides)**

Q. 7 What do aminoacyl t-RNA synthetases do?

**Answer: They attach an amino acid to the 3'-end of the tRNA molecules**

Q.8 The 80S eukaryotic ribosome is composed of two subunits of ……**60S**…… and ……**40S**…….

Q. 9 Given below is a hypothetical bacterial gene:




(a) Write down the sequence of the RNA molecule that will be synthesized from the above gene.
(b) What will be the length of the protein/peptide synthesized from this mRNA (Given: AGGAGGU is the ribosome binding site on the mRNA).

**Answer: (a) AAUAGGAGGUGACUAUCCUCCAGUGA**

**(Justification: As bottom strand is the template strand, the other strand is the sequence of the RNA molecule to be synthesized with T replaced by U).**

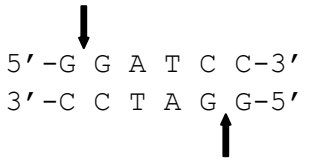
**(b) Zero**

**(Justification: The first amino acid will be coded by AUG (initiation codon), as there is no AUG in the RNA molecule, the length of the peptide/protein to be synthesized is zero).**

Q. 10 Match the columns

| A | B |
|---|---|
| (a) *E. coli* is grown in a medium having both glucose and lactose | (i) Binds to the operator |
| (b) Repressor | (ii) Binds to the promoter |
| (c) RNA polymerase | (iii) Repressor becomes inactive |
| (d) Bacteria growing in a medium having lactose as the only carbon source | (iv) Catabolite activator protein (CAP) active |
| | (v) High concentration of cyclic AMP |

Q.11 BamHI is a restriction endonuclease with the cleavage sites as shown below:




Which of the following statements is/are correct (tick all correct options):

(a) The enzyme produces sticky ends with 5' overhangs ✓
(b) The enzyme produces blunt ends
(c) The enzyme produces sticky ends with 3' overhangs
(d) The enzyme produces sticky ends with 3' overhang in one strand and 5' overhang in the other

Q. 12 Mention in one or two sentences is the function of β-galactosidase in *lac* operon?

**Answer:**

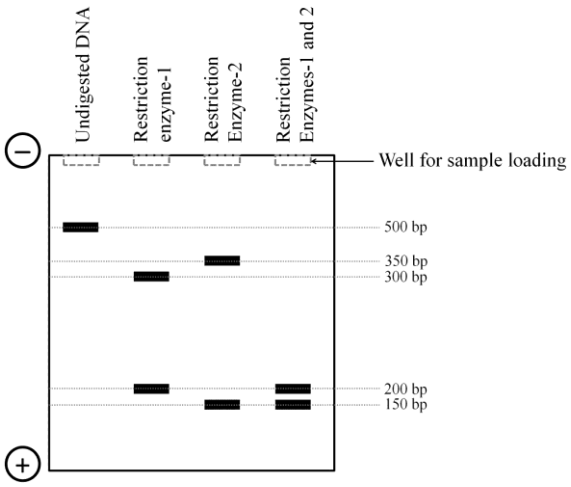
1. **β-galactosidase converts lactose into allolactose**
2. **β-galactosidase converts lactose into glucose and galactose**

Q. 13 Name three key steps of polymerase chain reaction.

**Answer:**

1. **Denaturation**
2. **Annealing**
3. **Extension**

Q. 14 Shown below is the gel run following restriction digestion of a given linear DNA molecule with two restriction enzymes. Prepare the restriction map of the enzyme:

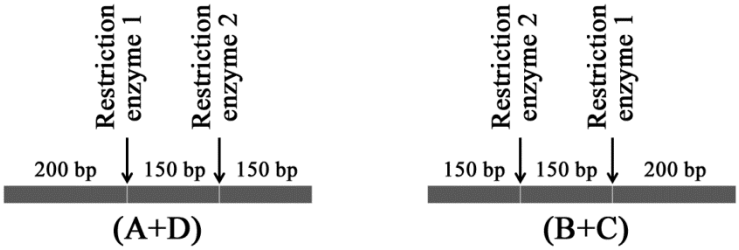



**Answer:**

**Digestion with restriction enzyme-1 gives two bands of sizes 200 bp and 300 bp. This results in following two possibilities:**

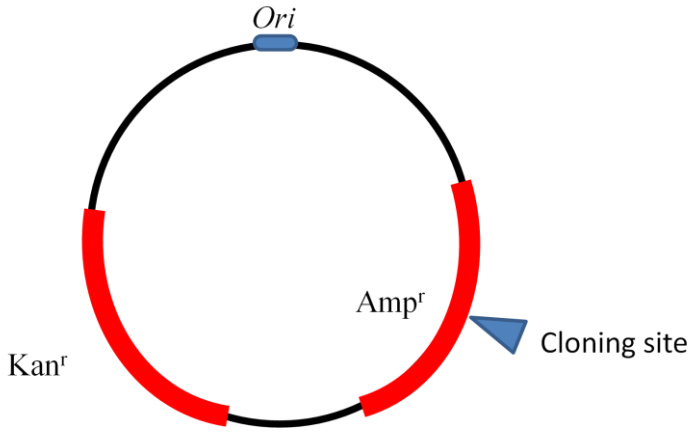

**Digestion with restriction enzyme-2 gives two bands of sizes 350 bp and 150 bp:**


**Digestion with both restriction enzymes-1 and 2 gives two bands of sizes 200 bp and 150 bp. The possible restriction maps from the given data are: (A+D) and (B+C) *i.e.***




**The combinations, (A+B), (A+C), (B+D), and (C+D) do not fit the given data.**

Q. 15 You performed cloning of a gene using following vector:




where, Kan$^r$ and Amp$^r$ are the Kanamycin resistance and ampicillin resistance genes, respectively. You go ahead like this:

(a) Cut the plasmid with the appropriate enzyme.
(b) Cut out your gene of interest from the genome using the same enzyme.
(c) Mix the cut plasmid and the gene of interest and add a DNA ligase in the reaction. Allow the reaction to go for some time
(d) Perform bacterial transformation (putting the DNA into bacterial cell) with the above mix.
(e) Grow these bacteria in a suitable liquid medium

How will you now select the bacteria that have got your gene of interest? Give your answers step-by-step (in not more than 5 sentences).

**Answer:**

1. **Grow the bacteria after step (e) on a plate containing Kanamycin**
2. **Only those bacteria that have got the plasmid will grow and produce colonies**
3. **Take a small amount of bacteria from the plate and try to grow them on the plates containing ampicillin.**
4. **The bacteria that do not grow on ampicillin have the gene of interest.**