Problem set 2

1. What will be the transcript (i.e. RNA) of this gene (gene is highlighted in yellow)?
5' G C T C A G C A T G G G G G C G……TAA 3'
3' C G A G T C G T A C C C C C G C…….. ATT 5'

ans : 5'AUCCCCCGC……..UAA3'

2. Which of the following best describes a promoter:
(A) A specific DNA sequence from where transcription starts
(B) A specific DNA sequence that promotes termination of transcription
(C) A specific DNA sequence to which RNA polymerase binds
(D) An extracellular inducer that controls genes expression

C

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Types of RNA Polymerases

Promoters control the binding of RNA polymerase to DNA to initiate the transcription of genes. There are three types of RNA polymerases that all transcribe different genes.

RNA polymerase I transcribes genes encoding ribosomal RNA (rRNA) which is a main component of a cell's ribosome structure. Ribosomes are the site of protein syntehsis where mRNA is translated into a protein.

RNA polymerase II transcribes messenger RNA (mRNA) which is the RNA responsible for providing a stable template for the translation of a protein.

RNA polymerase III transcribes genes encoding transfer RNAs (tRNA), the adaptor molecules that are responsible for bringing amino acids to the ribosome when proteins are being synthesized. RNA Polymerase III also transcribes small RNAs, such as shRNAs and gRNAs.

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3. State TRUE OR FALSE for the following statements:
(A) Poly-A tailing is a template independent synthesis TRUE
(B) 3' end of nascent eukaryotic mRNA acquires a poly A tail TRUE
(C) Splicing removes introns from eukaryotic transcripts TRUE
(D) Transcription and translation occurs in same cellular compartment in prokaryotes but not in eukaryotes TRUE

4. During transcription, RNA polymerase reads the template DNA strand in:
(A) 3'to 5' direction (B) 5'to 3' direction
(C) In both directions (D) Does not require a DNA template

ans : A

5. A genetic analysis of an unknown infectious agent reveals that it contains only nucleotides G, A, U and C, in the proportion 30 %, 35 %, 15 % and 20 %, respectively. Based on this information, this infectious agent is most likely

(A) Double-stranded DNA virus (B) Single-stranded DNA virus
(C) Single-stranded RNA virus (D) Not enough information is provided

ans : C

6. The lac operon is turned ON

(A) In the presence of lactose (B) In the presence of glucose
(C) In the presence of lactose and presence of glucose (D) In the presence of lactose and absence of glucose

ans : D

7. In lac operon, if you remove the lac operator (the repressor binding site) what will be the effect on the metabolic state of the bacteria?

(A) Lactose metabolizing enzymes will be produced irrespective of the presence or absence of lactose
(B) Glucose metabolism will be hampered
(C) Lactose will never be metabolized because the enzymes will never be synthesized
(D) RNA Polymerase will not be able to bind the promoter

ans : A

8. The rate of protein synthesis in E. coli is limited by the rate of mRNA synthesis. If mRNA synthesis occurs at the rate of 51 nucleotides/sec, then the rate of protein synthesis occurs at _____ amino acids/sec:

(A) 12 (B) 17 (C) 25 (D) 51

ans : B

9. In classic Sanger DNA sequencing technique, four types of ddNTPs are used along with the normal dNTPs. Which of the following is the correct combination?

(A) All four ddNTPs and four dNTPs in same reaction tube
(B) Each tube with one type of ddNTP and one type of dNTP (e.g., ddATP + dATP in tube 1, ddGTP + dGTP in tube 2 and so on)
(C) Each tube will have one type of dNTP and all four types of ddNTP
(D) Each tube will have one type of ddNTP and all four types of dNTP

ans : D

10. Estimate the length of the protein coded by the following DNA sequence. Start and stop codons are in bold letters; introns are underlined.

5’ GCACAT**ATG**GCGATACGAAGGGGACGCGGTTGAGGCCGTTGTGTTT**TAA**GGTTGT 3’

(A) 10 (B) 11 (C) 13 (D) 9

mRNA: 5’
GCACAU**AUG**GCGAUACGAAGGGGACGCGGUUGAGGCCGUUGUGUUU**AA**GGUUGU 3’
after removing introns :

5’ GCACAU**AUG**GCGAUACGAAGGGAGGCCGUUGUGUU**UAA**GGUUGU 3’
ans : A