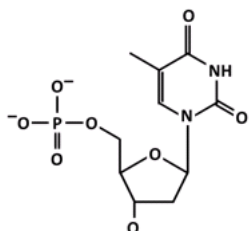


**Designer Genes C - Designer Genes - Pearl City Invitational - 12-12-2020**

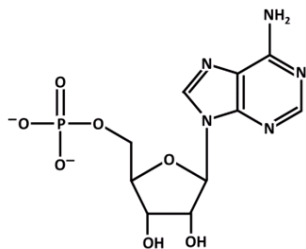
This event will test the participants' knowledge of molecular genetics and basic principles of genetics with emphasis in no one particular area.

1. (1.00 pts) Identify the following nucleotide based on its structure:



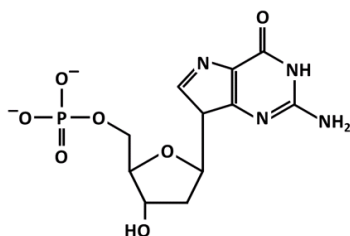
- ☐ A) Uracil
- ☐ B) Adenine
- ☐ C) Guanine
- ☐ D) Thiamine
- ☐ E) Cytosine

2. (1.00 pts) Identify the following nucleotide based on its structure:



- ☐ A) Uracil
- ☐ B) Guanine
- ☐ C) Adenine
- ☐ D) Thiamine
- ☐ E) Cytosine

3. (1.00 pts) This nucleotide is found in which of the following?



- ☐ A) RNA only
- ☐ B) DNA only
- ☐ C) mRNA only

- ☐ D) Both DNA and RNA
- ☐ E) Neither DNA nor RNA

4. (1.00 pts) mRNA strands are assembled with assistance from DNA strands in a process called:

- ☐ A) Nucleation
- ☐ B) Decryption
- ☐ C) Replication
- ☐ D) Transcription
- ☐ E) Translation

5. (1.00 pts) Which strand of DNA will pair correctly with the given single stranded DNA?  
5'-ATTGCCTCAA-3'

- ☐ A) 5'-TTGAGGCAAT-3'
- ☐ B) 5'-TAACGGAGTT-3'
- ☐ C) 5'-GCCATTCTGG-3'
- ☐ D) 5'-ATTGCCTCAA-3'
- ☐ E) 5'-AACTCCGTTA-3'

6. (1.00 pts) Given the following DNA coding strand, what would be the resulting mRNA strand?  
5'-ATTCGAT-3'

- ☐ A) 5'-UAGCUUA-3'
- ☐ B) 5'-UAAGCUA-3'
- ☐ C) 5'-TAAGCTA-3'
- ☐ D) 5'-ATTCGAT-3'
- ☐ E) 5'-AUUCGAU-3'

7. (1.00 pts) Given the following DNA template strand, what would be the resulting mRNA strand?  
5'-TTGGCATT-3'

- ☐ A) 5'-AATGCCAA A-3'
- ☐ B) 5'-AACCGUAA-3'
- ☐ C) 5'-AAUGCCAA-3'
- ☐ D) 5'-UAGCUUA-3'
- ☐ E) 5'-AACCGTAA-3'

8. (1.00 pts) What protein chain is made from the mRNA strand:  
5' - AUG UUU AAA UAA GGG UUU GUA - 3'

- ☐ A) Met - Phe - Gly - STOP - Lys - Phe - Val
- ☐ B) Met - Phe - Gly
- ☐ C) Met - Phe - Lys - STOP - Gly - Phe - Val
- ☐ D) Met - Phe - Lys

9. (1.00 pts) The following strand occurs after the START codon. What protein chain is made from the mRNA strand:  
3' - CCC UUU AAA GGG UUU - 5'

- ☐ A) Pro - Phe - Lys - Gly - Phe
- ☐ B) Phe - Gly - Lys - Phe - Pro
- ☐ C) Gly - Lys - Phe - Pro - Lys
- ☐ D) Lys - Pro - Phe - Lys - Gly

10. (1.00 pts) There is a mutation in a single codon identified on an mRNA Strand. What type of mutation occurred?  
5' - CAC - 3' -----> 5' - CCC - 3'

- ☐ A) Missense
- ☐ B) Nonsense
- ☐ C) Silent
- ☐ D) Nonstop
- ☐ E) Frameshift

11. (1.00 pts) There is a mutation in a single codon identified on an mRNA Strand. What type of mutation occurred?  
5' - UAA - 3' -----> 5' - UCA - 3'

- ☐ A) Missense
- ☐ B) Nonsense
- ☐ C) Silent
- ☐ D) Nonstop
- ☐ E) Frameshift

12. (1.00 pts) There is a mutation in a single codon identified on an mRNA Strand. What type of mutation occurred?  
5' - GGA - 3' -----> 5' - GGG - 3'

- ☐ A) Missense
- ☐ B) Nonsense
- ☐ C) Silent
- ☐ D) Nonstop
- ☐ E) Frameshift

13. (1.00 pts) Which of the following sequence of events is correct?

- ☐ A) DNA ---Ribosome---> mRNA ---RNA Polymerase---> Protein
- ☐ B) mRNA ---RNA Polymerase---> DNA ---Ribosome---> Protein
- ☐ C) Protein ---RNA Polymerase---> DNA ---Ribosome---> mRNA
- ☐ D) DNA ---RNA Polymerase---> mRNA ---Ribosome---> Protein

14. (1.00 pts) During which stages of viral replication does the host cell get completely destroyed?

- ☐ A) Attachment
- ☐ B) Uncoating
- ☐ C) Assembly
- ☐ D) Release
- ☐ E) Replication

15. (1.00 pts) From the punnet square below, identify the parental genotypes used in this dihybrid cross:

	Ab	ab	Ab	Ab
AB	AAbB	AabB	AAbB	AabB
AB	AAbB	AabB	AAbB	AabB
Ab	AAbB	Aabb	AAbb	Aabb
Ab	AAbB	Aabb	AAbb	Aabb

- ☐ A) AABB x AAbb
- ☐ B) Aabb x AABb
- ☐ C) aabb x aabb
- ☐ D) Aabb x Aabb
- ☐ E) AaBb x Aabb

16. (1.00 pts) If a 16n organism has a cell that undergoes MEIOSIS, what is the result:

- ☐ A) 2 daughter cells that are 8n
- ☐ B) 2 daughter cells that are 16n
- ☐ C) 4 daughter cells that are 8n
- ☐ D) 4 daughter cells that are 16n
- ☐ E) 4 daughter cells that are 32n

17. (1.00 pts)

An organism has a gene that controls leg length and a gene that controls arm length. The dominant allele (L) codes for short legs and the recessive allele (l) codes for long legs. The dominant allele (A) codes for long arms and the recessive allele (a) codes for short arms. What is the phenotype of an organism with the genotype "Llaa"?

- ☐ A) Short legs, long arms
- ☐ B) Long legs, short arms
- ☐ C) Long legs, long arms
- ☐ D) No legs, no arms

18. (1.00 pts)

An organism has a gene that controls leg length and a gene that controls arm length. The dominant allele (L) codes for short legs and the recessive allele (l) codes for long legs. The dominant allele (A) codes for long arms and the recessive allele (a) codes for short arms. What is a possible genotype of an organism that has long legs and long arms?

- ☐ A) lIAa
- ☐ B) lIAa
- ☐ C) Llaa
- ☐ D) LLaa
- ☐ E) LLAA

19. (1.00 pts)

An organism is codominant for eye color. Yellow eye color is dominant (Y) and Blue eye color is recessive (B). An organism has the genotype "YB", what is its phenotype?

- ☐ A) Blue eyes
- ☐ B) Yellow eyes
- ☐ C) Green eyes

- ☐ D) Yellow and Blue eyes
- ☐ E) Red eyes (albino)

**20. (1.00 pts)**

A certain cat has a gene that controls fur color. The dominant allele (B) codes for brown fur and the recessive allele (b) codes for black furs. A second control gene indicates whether the feather color is expressed (C) or not expressed (c). What is the phenotype of an organism with the genotype "Bbcc"?

- ☐ A) Black fur
- ☐ B) Brown fur
- ☐ C) Brown and black fur
- ☐ D) No furs on the cat
- ☐ E) White fur (Albino)

**21. (1.00 pts)**

A plant is incomplete dominant for flower color. Red flower color is dominant (R) and white flower color is recessive (r). A second control gene indicates whether the flower color is expressed (C) or not expressed (c). From the following cross "RrCc x RrCc", which phenotypes would you expect to see from the offspring?

- ☐ A) Red and white flowers
- ☐ B) Red, white, and red/white flowers
- ☐ C) Red, white, and pink flowers
- ☐ D) Red, white, red/white, and albino flowers
- ☐ E) Red, white, pink, and albino flowers

**22. (1.00 pts)**

A plant is incomplete dominant for flower color. Red flower color is dominant (R) and white flower color is recessive (r). A second control gene indicates whether the flower color is expressed (C) or not expressed (c). From the following cross "RrCc x RrCc", what is probability of having an offspring flower that has the phenotype or red?

- ☐ A) 75%
- ☐ B) 56.5%
- ☐ C) 50%
- ☐ D) 6.25%
- ☐ E) 0%

**23. (1.00 pts)**

A plant is incomplete dominant for flower color. Red flower color is dominant (R) and white flower color is recessive (r). A second control gene indicates whether the flower color is expressed (C) or not expressed (c). From the following cross "RrCc x RrCc", what is the phenotype ratio of this cross?

- ☐ A) 1:1
- ☐ B) 3:1
- ☐ C) 9:4:3
- ☐ D) 9:3:3:1
- ☐ E) 6:3:3:2:1:1

**24. (1.00 pts)** In DNA replication, DNA ligase performs which of the following tasks?

- ☐ A) Assembles the new DNA strand
- ☐ B) Separates double stranded DNA to two single strands of DNA

- ☐ C) Provides the RNA primer needed for the DNA replication initiation
- ☐ D) Unwinds the double stranded DNA
- ☐ E) Connect and fuses Okazaki fragments together

**25. (1.00 pts)** In DNA replication, which of the following proteins is used to separate double stranded DNA to single stranded DNA?

- ☐ A) Primase
- ☐ B) Helicase
- ☐ C) Topoisomerase
- ☐ D) DNA polymerase
- ☐ E) RNA Primase

**26. (1.00 pts)**

A plant has a gene that codes for bean pod shape. The dominant allele (L) codes for long and the recessive allele (l) codes for short. If the following cross was completed, "Ll x Ll", what is the probability the offspring will have short bean pods?

- ☐ A) 100%
- ☐ B) 75%
- ☐ C) 50%
- ☐ D) 25%
- ☐ E) 0%

**27. (1.00 pts)**

A plant has a gene that controls fruit color and a gene that controls fruit shape. The dominant allele (B) codes for blue fruit and the recessive allele (b) codes for green fruit. The dominant allele (R) codes for round fruit and the recessive allele (r) codes for long fruit. If the following dihybrid cross was conducted "BbRR x BbRr", what is the probability of having an offspring that produces green and round fruit?

- ☐ A) 75%
- ☐ B) 50%
- ☐ C) 25%
- ☐ D) 12.5%
- ☐ E) 6.25%

**28. (1.00 pts)**

A plant has a gene that controls fruit color and a gene that controls fruit shape. The dominant allele (B) codes for blue fruit and the recessive allele (b) codes for green fruit. The dominant allele (R) codes for round fruit and the recessive allele (r) codes for long fruit. If the following dihybrid cross was conducted "BbRR x BbRr", what is the probability of having an offspring that has the genotype "Bbrr"?

- ☐ A) 50%
- ☐ B) 25%
- ☐ C) 12.5%
- ☐ D) 6.25%
- ☐ E) 0%

**29. (1.00 pts)**

A plant has a gene that controls fruit color and a gene that controls fruit shape. The dominant allele (B) codes for blue fruit and the recessive allele (b) codes for green fruit. The dominant allele (R) codes for round fruit and the recessive allele (r) codes for long fruit. If the following dihybrid cross was conducted "BbRR x BbRr", what percentage of the offspring will be heterozygous for both alleles?

- ☐ A) 75%
- ☐ B) 50%
- ☐ C) 25%
- ☐ D) 12.5%

- ☐ E) 6.25%

**30. (1.00 pts)**

A bear has a gene that controls fur color. The allele (F) codes for black fur and the allele (f) codes for white fur. The genes follow non-mendelian genetics and show incomplete dominance. If the following cross was conducted "Ff x ff", what is the probability of having offspring with the genotype "Ff"?

- ☐ A) 100%  
☐ B) 75%  
☐ C) 50%  
☐ D) 25%  
☐ E) 0%

**31. (1.00 pts)**

A bear has a gene that controls fur color. The allele (F) codes for black fur and the allele (f) codes for white fur. The genes follow non-mendelian genetics and show incomplete dominance. If the following cross was conducted "Ff x ff", what is the probability of having offspring with that have white fur phenotype?

- ☐ A) 100%  
☐ B) 75%  
☐ C) 50%  
☐ D) 25%  
☐ E) 0%

**32. (1.00 pts)**

A bat has a gene that controls skin color. The allele (B) codes for black fur and the allele (W) codes for white fur. The genes follow non-mendelian genetics and show codominance. If the following cross was conducted "BW x WW", which of the following phenotypes will not be represented in the offspring this cross? (Select all that apply)

(Mark **ALL** correct answers)

- ☐ A) Black fur  
☐ B) Gray fur  
☐ C) White fur  
☐ D) Black and white fur  
☐ E) No fur

**33. (1.00 pts)**

A tree population has an allele for green leaf color(G) and red leaf color(g). The population is in Hardy-Weinberg Equilibrium. The frequency of the green allele is 0.60 and the frequency of the red allele is 0.40. What is the percentage of homozygous recessive individuals in this population?

- ☐ A) 60%  
☐ B) 50%  
☐ C) 40%  
☐ D) 36%  
☐ E) 16%

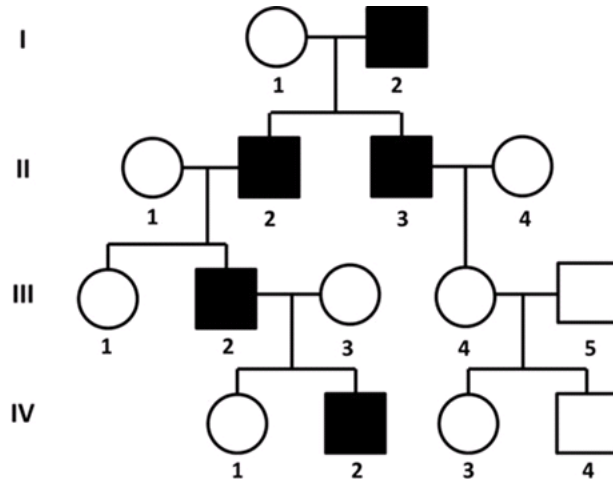
**34. (1.00 pts)**

A clam population has an allele for round shell shape(R) and square shell shape(r). The population is in Hardy-Weinberg Equilibrium. Reviewing the total clam population, 75% of individuals are square. What is the allele frequency of the recessive allele square in this population?

- ☐ A) 67%

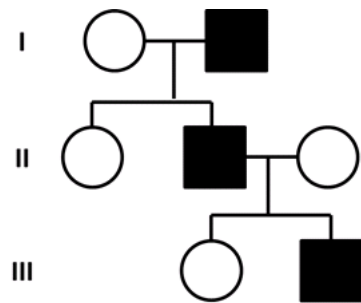
- ☐ B) 45%  
☐ C) 22%  
☐ D) 11%  
☐ E) 5%

35. (1.00 pts) Determine the type of sex-linked trait based on the given Pedigree:



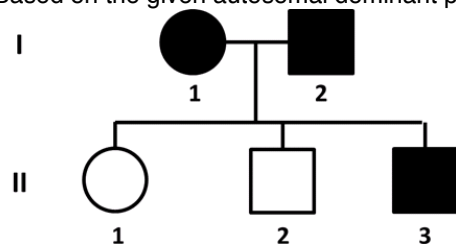
- ☐ A) X-linked Dominant  
☐ B) X-Linked Recessive  
☐ C) Y-Linked  
☐ D) Autosomal

36. (1.00 pts) For the following Y-linked pedigree, what is the genotype of all the males?



- ☐ A) XX  
☐ B) XX\*  
☐ C) XY  
☐ D) XY\*

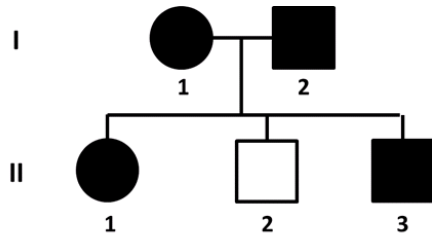
37. (1.00 pts) Based on the given autosomal dominant pedigree, what is the genotype of Generation-I cross?





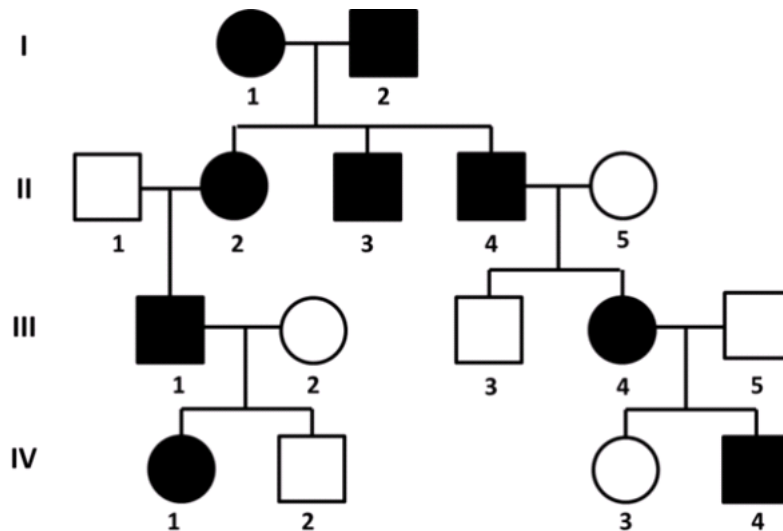
- ☐ A) QQ x QQ
- ☐ B) qq x qq
- ☐ C) Qq x Qq
- ☐ D) Qq x QQ

38. (1.00 pts) Based on the given autosomal dominant pedigree, what is the genotype of individual "I-2"?



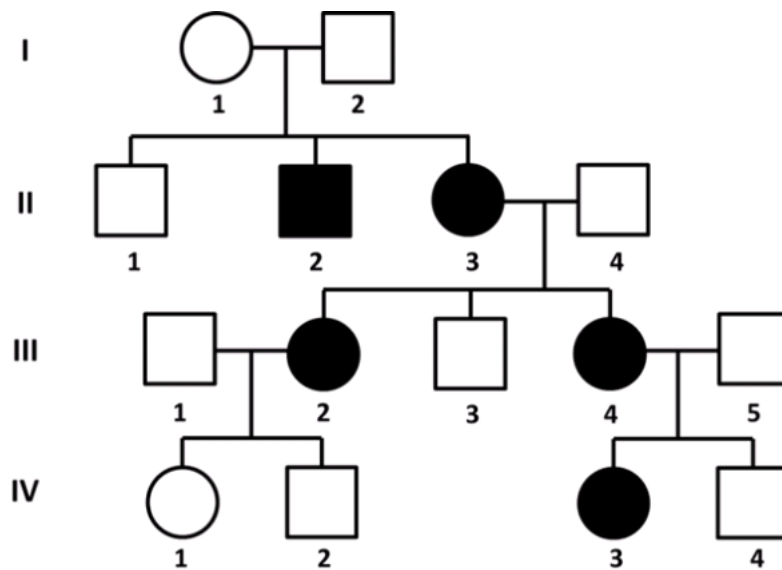
- ☐ A) MM
- ☐ B) mm
- ☐ C) Mm
- ☐ D) Inconclusive

39. (1.00 pts) Determine the type of trait based on the Pedigree:



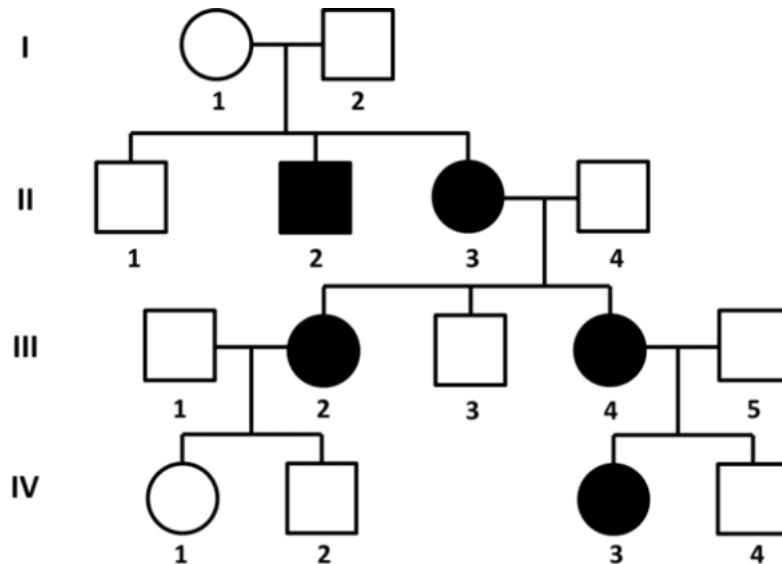
- ☐ A) Autosomal Dominant
- ☐ B) Autosomal Recessive
- ☐ C) X-Linked Recessive
- ☐ D) Y-Linked

40. (1.00 pts) The following pedigree is autosomal recessive for Gene T (T or t). What is the genotype of individual "II-4"?



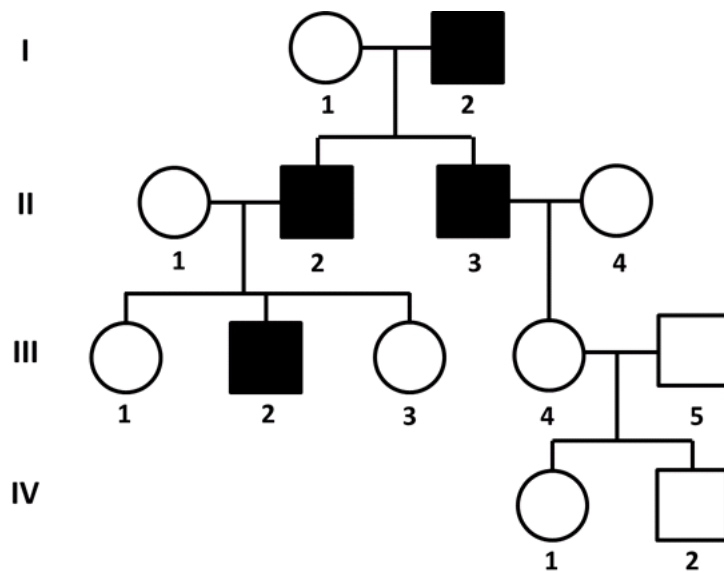
- ☐ A) TT  
☐ B) tt  
☐ C) Tt  
☐ D) Inconclusive

41. (1.00 pts) The following pedigree is autosomal recessive for Gene T (T or t). What is the genotype of individual "IV-3"?



- ☐ A) TT  
☐ B) tt  
☐ C) Tt  
☐ D) Inconclusive

42. (1.00 pts) What type of dominance pattern is shown for the given sex-linked pedigree?



- ☐ A) X-Linked Dominant  
☐ B) X-Linked Recessive  
☐ C) Y-Linked  
☐ D) Inconclusive

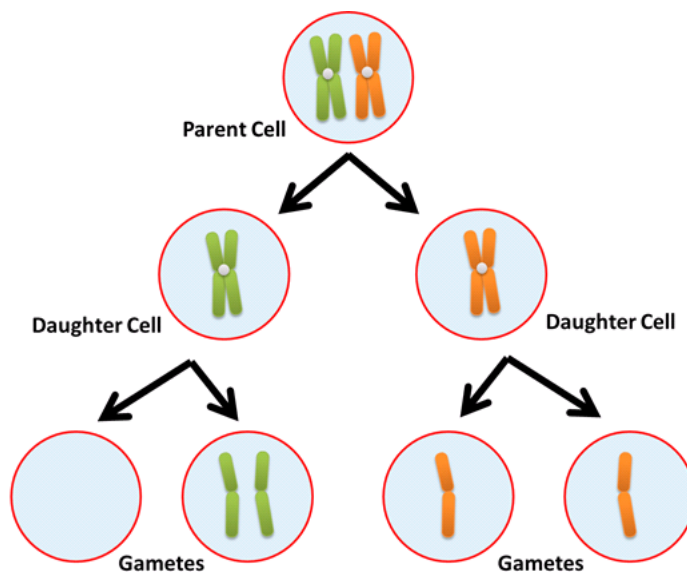
43. (1.00 pts)

A restriction enzyme cuts at the following restriction site 5'-AAAA-3'. How many strands will result from cutting the following DNA strand with the given restriction enzyme?

5'-GCTATCAGAAAAGGGGCTGAGATTTTAAAGAGTTAAAGGATCGAGCTAAAAAGGCTCGACCCCAAATGGAGGGGAAA-3'

- ☐ A) 6 DNA Strands  
☐ B) 5 DNA Strands  
☐ C) 4 DNA Strands  
☐ D) 3 DNA Strands  
☐ E) 2 DNA Strands

44. (1.00 pts) In which stage of Meiosis did the nondisjunction occur?



- ☐ A) Prophase 1
- ☐ B) Anaphase 1
- ☐ C) Telophase 1
- ☐ D) Anaphase 2
- ☐ E) Telophase 2

45. (1.00 pts) In gel electrophoresis, a DNA will move towards the \_\_\_\_\_ electrode.

- ☐ A) Positive
- ☐ B) Negative

46. (1.00 pts) If one strand of DNA is put through 4 PCR cycles, how many DNA strands will be made?

- ☐ A) 128 strands
- ☐ B) 64 strands
- ☐ C) 32 strands
- ☐ D) 16 strands
- ☐ E) 8 strands

47. (1.00 pts) In this step of a Polymerase Chain Reaction (PCR), the DNA primers attach to the DNA strand.

- ☐ A) Denaturation
- ☐ B) Annealing
- ☐ C) Extension
- ☐ D) Duplication

48. (1.00 pts) In this step of a Polymerase Chain Reaction (PCR), the double stranded DNA separates into two DNA strands.

- ☐ A) Denaturation
- ☐ B) Annealing
- ☐ C) Extension
- ☐ D) Duplication

49. (1.00 pts) After a sample gel has been run, the longer strands of DNA will be:

- ☐ A) Near the loading well
- ☐ B) Far from the loading well

50. (1.00 pts) The nitrogenous base Cytosine bonds to \_\_\_\_\_ creating a DNA base pair

- ☐ A) Uracil
- ☐ B) Thiamine
- ☐ C) Adenine
- ☐ D) Guanine
- ☐ E) Cytosine

You have complete the Designer Genes Event.

