Designer Genes Practice Exam

Section 1: Genetics Problems

1. In pea plants, the allele for **yellow coloration (P)** is typically dominant to the allele for **green coloration (p).** Fill in the table for the phenotype of each genotype given.

Genotype	**Phenotype**
PP	
Pp	
pp	

2. If a **yellow pea plant (Pp)** is crossed with a **green pea plant (pp)**, what percentage of the resulting offspring will be yellow? _____

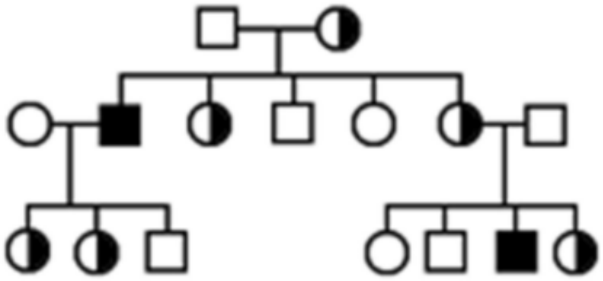
What percentage will be green? _____

3. The gene for **wrinkled peas (W)** is typically dominant to the gene for **smooth peas (w).** Fill in the table for each genotype of a cross between a **yellow, wrinkled pea plant (PpWW)** and a **green, wrinkled pea plant (ppWw).**

4. What percentage of the offspring will have a yellow, wrinkled phenotype? _____

5. What is the phenotypic ratio of green to yellow offspring in this cross? _____

Using the Pedigrees provided, answer the following questions. **Shaded symbols represent affected individuals, whereas half-shaded symbols represent carriers. Blank symbols are unaffected.**

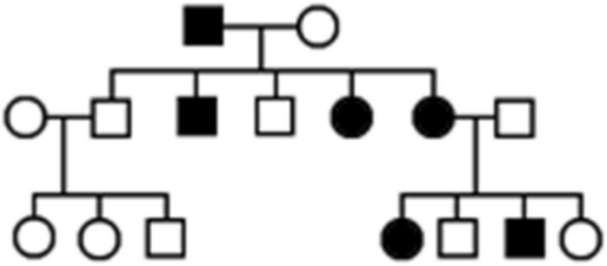


Use **"A"** for the dominant allele and **"a"** for the recessive allele. If sex-linked, also use **X** and **Y**.

6. What kind of inheritance pattern is shown here? _____

7. What would be the genotype of an affected individual? _____

8. What would be the genotype of a carrier individual? _____



Use **"A"** for the dominant allele and **"a"** for the recessive allele. If sex-linked, also use **X** and **Y**.

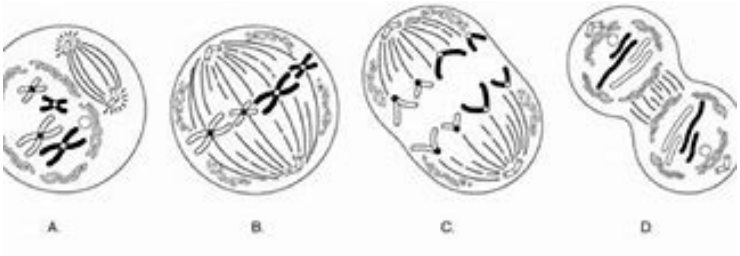
9. What kind of inheritance pattern is shown here? _____

10. What would be the genotype of an affected individual? _____

11. What would be the genotype of a carrier individual? _____

<u>Section 2: Mitosis/Meiosis</u>

For questions 12-13, use the picture provided.



12. What process is shown above? _____

13. What is the name of stage A? _____

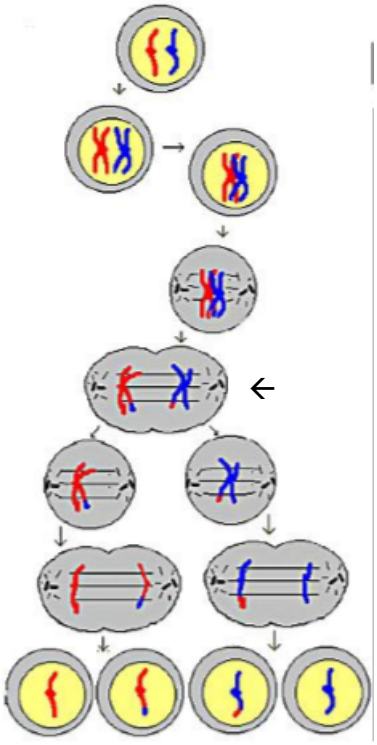
Stage B? _____

Stage C? _____

Stage D? _____

14. Are the resulting cells haploid or diploid? _____

For questions 15-16, use the picture provided.



15. What process is shown above? _____

16. What is the name of the process of swapping genetic information between chromatids denoted by the arrow? _____

17. What is the name of the process that consists of splitting the cytoplasm to form the 4 new cells? _____

18. During what phase does the process in question 17 happen? _____

19. Are the 4 resulting cells haploid or diploid? _____

20. What is the name of the 4 resulting cells? _____

21. What is the name for the chromosomes from each parent that pair up? _____

Section 3: Molecular Genetics

22. What is the structure of DNA? _____

23. The strands of DNA run _____ to each other.

24. What nitrogenous base is found in RNA but not in DNA? _____

25. Which base in DNA does this replace? _____

26. Is the bond between Cytosine and Guanine or Thymine and Adenine stronger? _____

27. Which nitrogenous bases are pyrimidines? _____

Purines? _____

28. How many strands of bases make up RNA? _____

29. Name the three types of RNA and their functions

a) _____ - _____

b) _____ - _____

c) _____ - _____

30. What is the difference between exons and introns?

_____

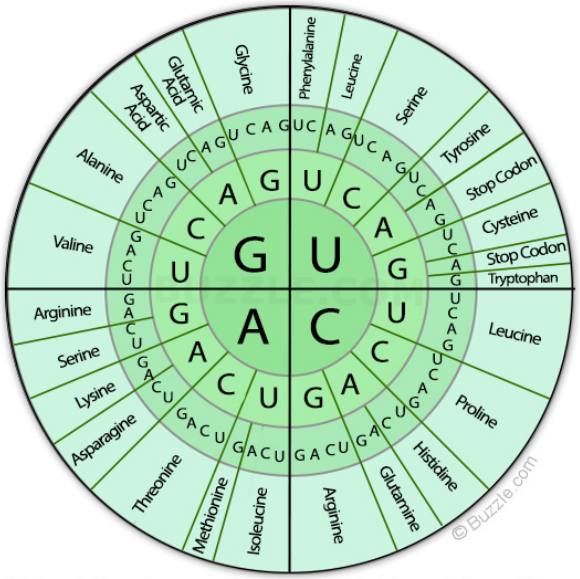
31. What are the two processes of gene expression and their functions?

_____ - _____

_____ - _____

32. How many nucleotides make up a codon? _____

33. What is the sequence of the “start” codon for translation? _____



To decode the codon, move from the center circle towards the periphery.

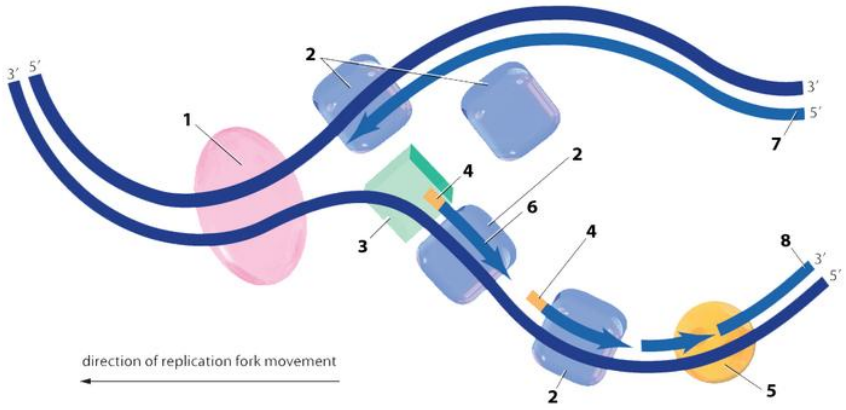
34. Using the chart above, translate this m-RNA sequence starting at the start codon:

UUU GAC GCA AUG UCU AUC CGG GAU CAG CUC UGA GGC ACC

_____

35. How many amino acids are in this sequence? _____

For questions 36-37, use the picture provided.



36. What process is shown here? _____

37. a) What number represents the lagging strand? _____

b) What number represents the leading strand? _____

c) What number represents the okazaki fragments? _____

d) What is represented by 1? _____

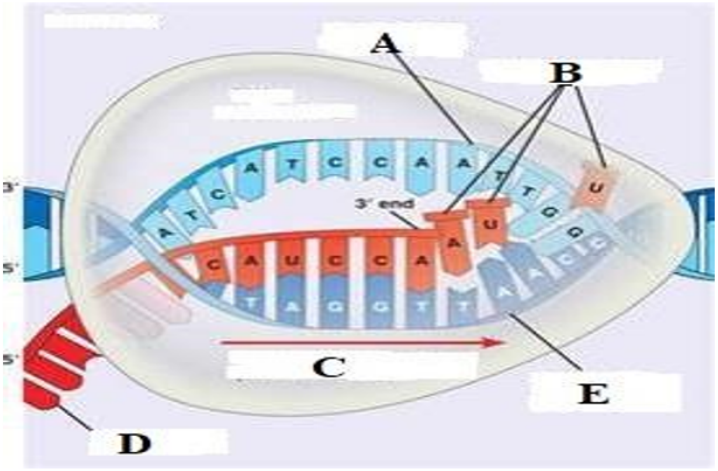
e) What is represented by 2? _____

f) What is represented by 3? _____

g) What is represented by 4? _____

h) What is represented by 5? _____

For questions 38-40, use the picture provided.



38. What process is shown above? _____

39. What type of RNA is represented by the letter D? _____

40. Which letter on the diagram represents the template strand of DNA? _____

41. Is DNA read in the 5' to 3' direction or the 3' to 5' direction? _____

42. What is the process of converting m-RNA information into a peptide chain called? _____

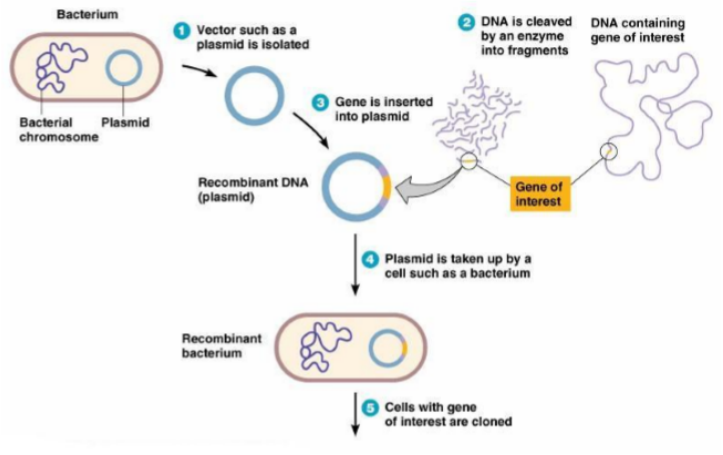
43. Where does this process happen? _____

44. How is replication different in prokaryotic vs eukaryotic cells? _____

45. How is transcription different in prokaryotic vs eukaryotic cells? _____

<u>Section 4: Biotechnology</u>

For question 46, use the picture provided.



46. Put the numbers of the following activities in the correct chronological order.

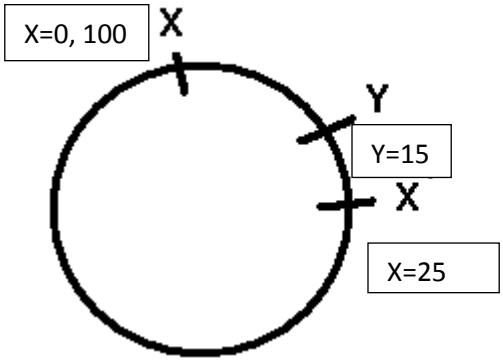
1. Cutting DNA sequence with restriction enzymes
2. Clone cells with successful uptake of desired gene
3. Identifying desired DNA sequence
4. Inserting DNA sequence into vector as a plasmid
5. Inserting vector into host cell
6. Connecting DNA pieces together with Ligase

47. Why are plasmids used as vectors? _____

48. What role do restriction enzymes play? _____

49. What are transgenic organisms? _____

For questions 50-52, use the picture provided.

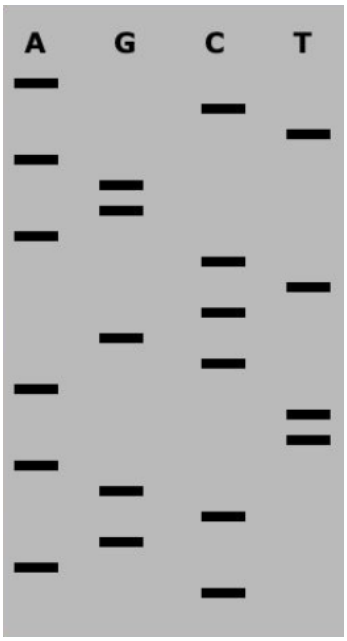


50. This is the restriction map of some DNA sequence. What is the size of the fragments if X is cut using restriction enzymes (in bp)? _____

51.How many fragments will be created if both X and Y are cut? _____

52. How long will the fragments be if X and Y are cut (in bp)? _____

For questions 53-54, use the picture provided.



This is an example of a gel produced by the Sanger method of sequencing

53. Using the picture, write the DNA sequence described. _____

54. Using the sequence from the previous question, write the complementary DNA strand. _____

55. If the frequency of the recessive allele of a rare sex-linked recessive genetic disorder is .2, what is the frequency of heterozygous individuals within a population? _____

For questions 56-58, use the tables provided.

Person	Blood typing	DNA Analysis key
Mother	I^A i	#1
Child	i i	#2
Potential Father A	I^A I^A	#3
Potential Father B	I^A i	#4
Potential Father C	I^A i	#5

DNA ANALYSIS

1	2	3	4	5
_____	_____	_____		
	_____		_____	_____
_____	_____	_____		
	_____		_____	
_____	_____	_____	_____	_____
	_____		_____	_____
_____	_____	_____		
	_____	_____	_____	
				_____
_____	_____			
	_____		_____	

56. What is the blood type of the child? _____

57. Based solely on blood type, who are the potential father? _____

58. Based upon blood type and DNA analysis, who is most likely the father? _____

For questions 59-60, use the picture provided.

59. What number on the diagram has a genetic abnormality? _____

60. What is the name of the event where sister chromatids fail to separate during meiosis, that can cause disorders like trisomy 21? _____

Answer Sheet:

Section 1

1. Yellow, Yellow, Green

2. 50%, 50%

3.

	pW	pW	pw	pw
PW	PpWW	PpWW	PpWw	PpWw
PW	PpWW	PpWW	PpWw	PpWw
pW	ppWW	ppWW	ppWw	ppWw
pW	ppWW	ppWW	ppWw	ppWw

4. 50%

5. 8:8 or 1:1

6. Sex-linked recessive

7. X_aY

8. X_AX_a

9. Autosomal dominant

10. AA or Aa

11. There are none – having the allele means having the disorder

Section 2

12. Mitosis

13. Prophase, Metaphase, Anaphase, Telophase

14. Diploid

15. Meiosis

16. Crossing over

17. Cytokinesis

18. Telophase II

19. haploid

20. Gametes

21. Homologous Pairs

Section 3

22. Double helix

23. Antiparallel

24. Uracil

25. Thymine

26. Cytosine and Guanine pairing is stronger – it is a triple bond whereas Adenine/Thymine is a double bond

27. Cytosine, Thymine, and Uracil are pyrimidines while Adenine and Guanine are purines

28. 1 strand

29. m-RNA – DNA cannot leave the nucleus, so m-RNA copies the info encoded in the DNA

t-RNA – t-RNA "reads" the encoded info in the m-RNA and adds the correct amino acid to the peptide chain based on its anticodon

r-RNA – r-RNA is part of the ribosome where m-RNA is translated and helps to link the amino acids together

30. Exons encode genetic information and are later translated, where introns are genetic nonsense that is edited out of the pre m-RNA by spliceosomes

31. Transcription – the reading of genetic info encoded in DNA and assembly of m-RNA, which leaves the nucleus

Translation- the reading of m-RNA, which leads to the assembly of peptide chains (proteins)

32. 3 nucleotides make up 1 codon

33. AUG is the start codon, also known as methionine

34. Methionine, Serine, Isoleucine, Arginine, Aspartic Acid, Glutamine, Leucine, Stop

35. 7

36. DNA replication

37. a) 8

b) 7

c) 6

d) Helicase

e) DNA Polymerase

f) RNA Primase

g) Primer

h) Ligase

38. DNA transcription

39. m-RNA

40. E

41. 5’ to 3’

42. Translation

43. The nucleus

44. DNA is circular in prokaryotes so there is only one replication bubble, whereas DNA is linear in eukaryotes, so there are many replication bubbles. Prokaryotic replication takes place in the cytoplasm whereas eukaryotic replication takes place in the nucleus

45. m-RNA must be edited to remove introns as well as a poly-a tail and a cap added to the strand in eukaryotes

Section 4

46. (3, 1, 4, 6, 5, 2)

47. They are not part of the bacteria’s genome, they are circular, and they are easily replicated

48. Restriction enzymes help to isolate and cut specific sections of DNA – used as a defense by the bacteria against viral DNA insertion

49. Transgenic organisms are those who have DNA from another organism within them

50. 25bp, 75bp

51. 3

52. 15bp, 10bp, 75bp

53. ACTAGGACTCGCATTAGCGAC

54. TGATCCTGAGCGTAATCGCTG

55. This is a Hardy-Weinberg equilibrium problem – so heterozygotes are 2pq, or in this case 2x.2x.8= .32

56. The child has O type blood

57. Father B or C could be the father

58. Father B is most likely the father

59. 18

60. Nondisjuction

Whew! You did it! This test covers a ton of the material you could see on the Designer Genes test, however there are lots more stuff that you might see. While this test focuses primarily on practicing the skills that will most likely be asked of you, I suggest using (https://www.soinc.org/sites/default/files/uploaded_files/3_19_DGENES_GENERAL_PRINCIPLES.pdf) to practice more of the raw memorization info that could find its way to the test. Best of luck!