

Designer Genes Tryout Test 2018-2019

Carmel Science Olympiad

Name: _____

Score: ___ / 105 Rank: _____

(Do NOT complete score and rank, for officer use only)

Directions:

- You will have 40 minutes to individually complete this test.
- Allowed materials
 - One double sided 8.5" x 11" sheet of notes
 - One non-programmable, non-graphing calculator
- No penalty for guessing
- Each MCQ is worth 1 pt or more depending on level of difficulty, SAQ pts are marked next to the question (mostly, it's done where you obtain 2 points for every right answer, or part of an answer)
- Tiebreakers are marked with an asterisk (*)
- Write legibly or **I will not bother to grade your test**
- Write the letter for your MCQ answer in the blank to the left of the question number
- Don't cheat.
- If you need more space to answer any of the questions, ask the person proctoring this test for extra paper
 - Write down your name and the question number on the extra sheet
 - Staple it to your test when you're done
 - Indicate that the answer continues to another sheet of paper on the original test
- Good luck, you got this!

1. What is the most common start codon? (1 pt)

_____ 2. Which amino acid is this? (1 pt)

- a. Serine
- b. Arginine
- c. Threonine
- d. Methionine

3. What are the criteria for Hardy-Weinberg equilibrium? (10 pts)

4. Name and explain three basic differences between RNA and DNA.* (6 pts- 2 pt per difference)

5. What is genetic mosaicism? (2 pt)

6. How does it differ from chimerism? (2 pt)

7. Why is mitochondrial DNA (mtDNA) usually exclusively inherited from the mother? (2 pts)

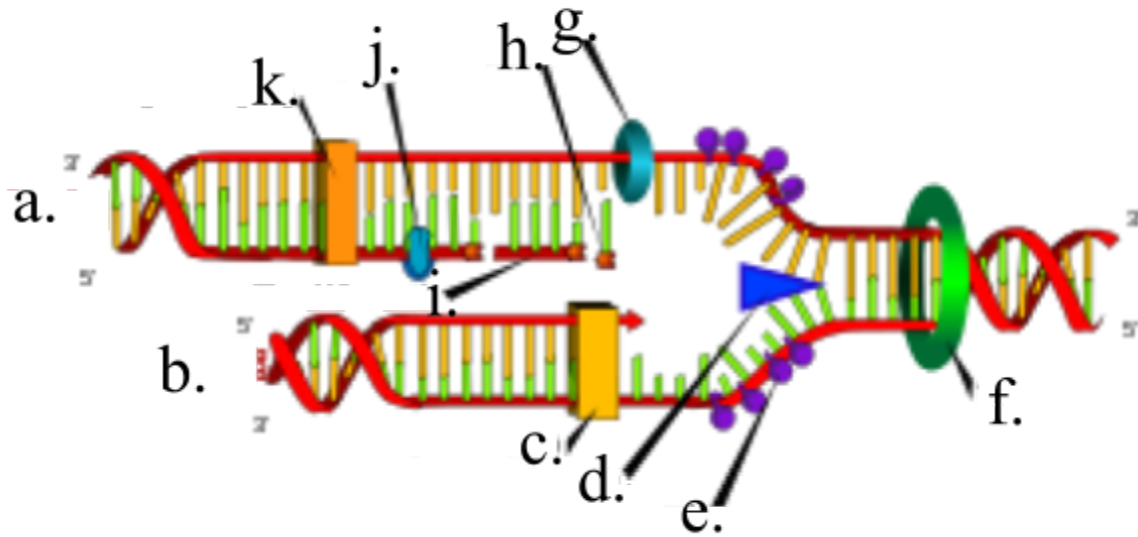
8. Label the different strands/enzymes/parts of DNA replication in the figure below. (11 pts)

a) h)

b) i)

- c)
- d)
- e)
- f)
- g)

- j)
- k)



_____ 9. What kind of DNA mutation would usually have the greatest negative effect? (1 pt)

- a. Missense
- b. Silent
- c. Nonsense
- d. Insertion

20. What is the role of a spliceosome? (2 pts)

_____ 21. What amino acid would be found in large proportion in a histone? (1 pt)

- a. Lysine

- b. Aspartate
- c. Cysteine
- d. Glycine

_____ 22. Choose the correct statement for RACE. (1 pt)

- a. It stands for Random Amplification of cDNA ends
- b. It is for cloning particular cDNA ends
- c. It is only of one type, which is 5' RACE
- d. Sequence data is not available in any case

_____ 23. The genetic relatedness between organisms can be identified by studying the band patterns when different PCR products are analysed electrophoretically. This method is called: (1 pt)

- a. restriction fragment length polymorphism (RFLP)
- b. amplified fragment length polymorphism (AFLP)
- c. random amplification of polymorphic DNA (RAPD)
- d. polymorphism

_____ 25. The ability to control the expression of Cre allows controlling what? (1 pt)

- a. Recombination
- b. Replication
- c. Excision
- d. Packaging

_____ 26. Self-cleavage reaction can take place in? (1 pt)

- a. DNA
- b. RNA
- c. Both DNA and RNA
- d. Can take place in both but is preferred in DNA

_____ 27. The F plasmid is often used in conjugation. Which of the following is true? (1 pt)

- a. The F plasmid encodes the factor which is transferred from one cell to another
- b. The factor encoded by the F plasmid is called as Filamentous (F) factor
- c. It is transferred from one cell to another by filament
- d. The bacteria must belong to same species to carry out the conjugation

28. What is the difference between the two ends of DNA? (3 pts)

29. a. What is an oncogene? (2 pt)

b. What is the difference between an oncogene and a proto-oncogene? (2 pt)

_____ 30. Western blotting is used for detecting (1 pt)

- a. Specific RNA in a sample
- b. Specific DNA in a sample
- c. Specific protein in a sample
- d. Specific glycolipid in a sample

_____ 31. Polyacrylamide gel is usually used for (1 pt)

- a. Protein
- b. DNA
- c. both A and B
- d. Vitamins

_____ 32. What is a probe? (1 pt)

- a. Chemically synthesized DNA
- b. Purified DNA
- c. Fragmented DNA duplex
- d. Either purified or synthesized single stranded DNA

33. What are the five general principles of bioethics? (5 pt)

34. Loosely define the purpose for the following methods: (12 pt)

a. Karyotyping -

b. Gene therapy -

c. Cloning -

d. DNA fingerprinting -

e. PCR -

f. 2D gel electrophoresis -

35. What are two types of DNA binding motifs? (4 pt)

36. What is a gene family? How are gene families produced over time? With regard to gene function, what is the biological significance of a gene family? (6 pts)

_____ 37. The cytoplasm of an animal cell is divided by means of: (1 pt)

- a. A cleavage furrow.
- b. A cell plate.
- c. A cell membrane formed within the cytoplasm.
- d. Mitosis.

_____ 38. The step of mitosis in which chromosomes line up along the equatorial plane of the cell is called: (1 pt)

- a. Prophase.
- b. Metaphase.
- c. Anaphase.
- d. Telophase

39. The Ames test determines whether a compound is mutagenic by measuring _____ frequencies of two different types of auxotrophic histidine mutations. (2 pts)

40. A crossover within the inverted region of _____ inversion will give rise to an acentric fragment and a dicentric fragment. (2 pts)

41. What principle did the fluctuation test of Luria and Delbruck establish? (2 pts)

42. What is the difference between mutation rate and mutation frequency? (3 pt)

_____ 43. Assuming that the level of glucose is low, a mutation in the repressor of the lac operon in *E. coli*, preventing binding of the repressor to the operator, should result in: (1 pt)

- a. constitutive expression of the lac operon genes
- b. lack of expression or reduced expression of the lac operon genes under all circumstances
- c. expression of the genes only when lactose is present
- d. expression of the genes only when lactose is absent

_____ 44. Assuming that the level of glucose is low, a mutation in the repressor associated with the lac operon of *E. coli* which prevents binding of the repressor to lactose should result in: (1 pt)

- a. constitutive expression of the lac operon genes
- b. lack of expression or reduced expression of the lac operon genes under all circumstances
- c. expression of the genes only when lactose is present
- d. expression of the genes only when lactose is absent

_____ 45. Positional cloning refers to (1 pt)

- a. using a selection procedure to clone a cDNA
- b. cloning a portion of a gene using PCR
- c. isolating a gene by PCR using primers from another species
- d. isolating a gene from a specific tissue in which it is being expressed
- e. mapping a gene to a chromosomal region and then identifying and cloning a genomic copy of the gene from the region

_____ 46. Large quantities of useful products can be produced through genetic engineering involving (select all that apply) (2 pts- all or nothing)

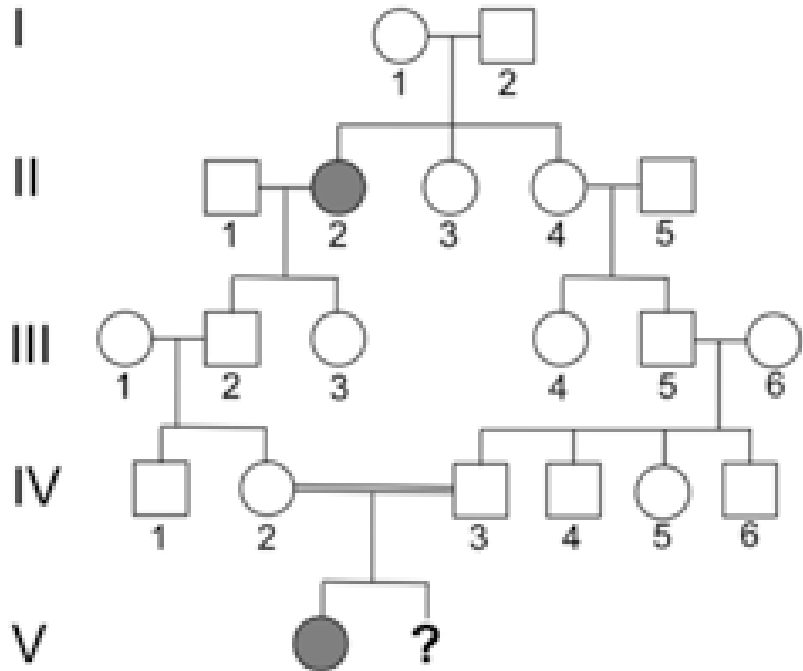
- a. bacteria containing recombinant plasmids
- b. yeast carrying foreign genes
- c. transgenic plants
- d. mammals producing substances in their milk

_____ 47. QTL analysis is used to (1 pt)

- a. identify RNA polymerase binding sites
- b. map genes in bacterial viruses
- c. determine which genes are expressed at a developmental stage
- d. identify chromosome regions associated with a complex trait in a genetic cross
- e. determine the most rapidly-evolving parts of genes

48. Alkaptonuria (aka black urine disease) is a rare inherited genetic disorder that causes the urine of affected individuals to turn brown or black after prolonged exposure to air. It results from a defect in tyrosine metabolism. Affected individuals show the trait from birth. The pedigree to the right shows an extended family including two individuals affected by the trait. Assume those who marry in don't have the mutation.

- a. What mode of inheritance does alkaptonuria show? (2 pts)



- b. Obligate carriers are individuals who must carry the mutation that produces the trait. Please list the obligate carriers in the pedigree at right. (3 pts- all or nothing)

- c. What is the probability that II-3 carries the mutation (i.e. is heterozygous)? (2 pts)
- d. What is the probability that IV-2 and IV-3's next child will be a boy who is affected by the disease? (2 pts)