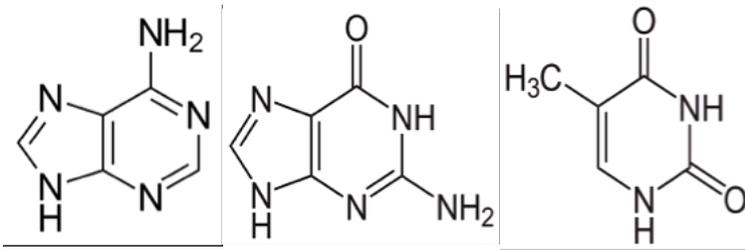


C - Designer genes - Nov 7 Country-wide SO Practice - 11-07-2020

1. (3.00 pts) Name the following structures:



Expected Answer: A, G, T

2. (1.00 pts) All of the following enzymes are involved in DNA replication EXCEPT:

- A) helicase
- B) DNA ligase
- C) RNA polymerase
- D) Primase
- E)
- F)

3. (4.00 pts)

You have isolated two different true-breeding mutant strains of *Drosophila* with black bodies (designated b1- and b2-). When flies from either the b1- or b2- strains are crossed to wild type males, the female progeny have wild-type brown bodies, whereas the male progeny have black bodies. What does this tell you about the b1- and b2- mutations?

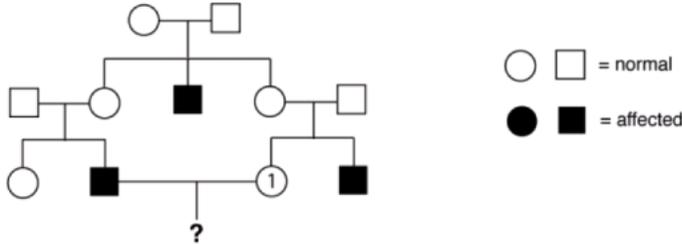
Expected Answer: 2. Female b1- x Male XY : Female Xb1-(brown) + Male Yb1-(black/mutant) if b1- is X-linked, the cross is as this diagram. This matches the observed. Since the heterozygous female shows the wild type trait, b1- is recessive to the wild type allele with respect to body color. B2- is the same..

4. (1.00 pts) ATP, the common energy-carrying molecule, most resembles the

- A) adenine DNA nucleotide
- B) adenine RNA nucleotide
- C) adenine DNA nucleotide with two extra phosphates
- D) adenine RNA nucleotide with two extra phosphates

5. (15.00 pts)

The pedigree shows inheritance of an X-linked recessive trait. (Assume the trait is completely penetrant) Please answer questions a-e:



- a. What is the probability that the female designated 1 is a carrier for the trait? (3pt)
- b. If the child indicated by ? is a boy, what is the probability he will be affected by the trait?(2pt)
- c. If the child indicated by ? is a girl, what is the probability she will be affected by the trait? (2pt)
- d. If the child indicated by ? is affected by the trait, what is the probability that the couple's next child will be affected by the trait? (3pt)
- e. If the child indicated by ? is not affected by the trait, calculate the new probability that the female designated 1 is a carrier for the trait.(5pt)

Expected Answer: a. $\frac{1}{2}$. b. $\frac{1}{4}$ c. $\frac{1}{4}$ d. $\frac{1}{2}$. e. 33.33%.

6. (1.00 pts) which of the following changes following the start codon in the mRNA would most likely have the greatest deleterious effect?

- A) a deletion of a single nucleotide
- B) a deletion of a nucleotide triplet
- C) a single nucleotide substitution of the nucleotide occupying the first codon position
- D) a single nucleotide substitution of the nucleotide occupying the third codon position

7. (5.00 pts)

In peas, the genes for seed color (yellow or green) and flower color (colored or white) are located on the same chromosome. Find the crossover frequency if a cross between a plant heterozygous for both trait and a plant homozygous recessive for both traits produces the following progeny:

Yellow/colored	Green/white	Yellow/white	Green/colored
652	683	77	88

Expected Answer: 0.11

8. (1.00 pts) The mRNA actively being translated in the cytoplasm would have all of the following EXCEPT

- A) a poly A tail
- B) a 5' cap
- C) exons
- D) introns

9. (6.00 pts) This sequence of DNA of TAC GCG ACG CGA ATC codes for the Designer Genes protein. (2 pt. each question)

- a) Write the corresponding sequence of RNA.
- b) The DNA unfortunately undergoes a mutation where the first adenine of the sequence is deleted. With this mutation, is this mRNA transcribed? Why?
- c) What are three potential causes of this mutation?

Expected Answer: a, AUG CGC UGC GCU UAG b, No, no start codon c, Radiation, chemicals, excess heat, error created when DNA is copied.

10. (4.00 pts) cytokinesis begins (); chromosomes begin migrating to opposite poles (); MTOCs migrate to opposite poles (); chromosomes replicate ().

- A. anaphase
- B. telophase
- C. prophase
- D. interphase

you may use the above choice once, twice or more or none.

- A) B, A, C, D
- B) D, A, C, D
- C) D, A, C, B
- D) D, A, A, B

11. (6.00 pts) Operons are one method of controlling gene expression in organisms

- a) Which types of organisms are operons found in? Prokaryotic or eukaryotic? (1pt)
- b) A common example of an operon is the trp operon. Is this an inducible or repressible operon? (1pt)
- c) Another common example of an operon is the lac operon. In these following conditions, state whether or not the lac operon undergoes strong, weak, or no transcription. (4 pt.)
 - I. Glucose present, lactose absent
 - II. Glucose present, lactose present
 - III. Glucose absent, lactose present
 - IV. Glucose absent, lactose absent

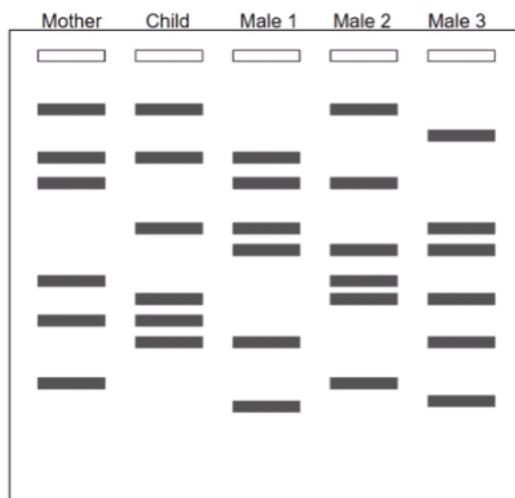
Expected Answer: a, Prokaryotic b, repressible, c, no transcription cii, weak, ciii strong civ no transcription

12. (1.00 pts) For the cross AABBCCDd x AAbbCcDd, what is the probability that an offspring will be AABbCcDd?

- A) 1/16

- B) 1/8
- C) 1/4
- D) 1/2

13. (6.00 pts) Mary took samples of DNA from a mother, a child, and three different males. After running RFLP analysis and running the DNA samples on a gel, these are the results. (2pt each question).



- a) Which male is possibly the father of the child?
- b) Why does the DNA run from negative to positive?
- c) What is missing from this gel?

Expected Answer: a, male 3 b, DNA is negative; positives attract negatives c, ladder.

14. (1.00 pts) Two genes, A and B, are linked. An individual who is AaBb produces equal numbers of four gametes AB, Ab, aB, and ab. The best explanation for this would be that

- A) nondisjunction occurred
- B) the genes are on nonhomologous chromosomes
- C) the two genes are close together on the same chromosome.
- D) The two genes are separated by a large distance the same chromosome.

15. (6.00 pts) CRISPR stands for Clustered Regularly-Interspaced Palindromic Repeats (6 pt.).

- a) What was the original purpose of CRISPR in bacteria?
- b) What are the two repair pathways that can happen after Cas9 cuts?
- c) CRISPR is currently being studied as a potential method of gene therapy. How can CRISPR be used for gene therapy?

Expected Answer: a) a, Helped bacteria fight against viruses OR acted as immune system of bacteria b) Non-homologous end joining OR NHEJ ; Homology-directed repair OR HDR c) c, CRISPR can be used to modify genes that are causing issues/diseases OR remove genes that are causing issues/diseases

16. (1.00 pts)

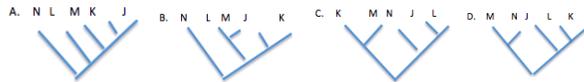
Four genes, J, K, L, and M, reside on the same chromosome. Given that the crossover frequency between K and J is 3, between K and L is 8, between J and M is 12, and between L and M is 7, what is the order of the genes on the chromosome

- A) J K L M
- B) J K M L
- C) K J L M
- D) K J M L

17. (3.00 pts)

The data in the following table compare the DNA sequences of a short segment of DNA from five species (J, K, L, L and N). The number of nucleotide differences between each pair of species was determined, then divided by the total number of nucleotides in the segment and multiplied by 100.

species	J	K	L	M	N
J	0	20	6	24	14
K		0	28	8	30
L			0	18	12
M				0	34
N					0



Which of the following phylogenetic trees best represents the evolutionary relationships of the five species presented in the table? (3 pt.)

- A) A
- B) B
- C) C
- D) D

18. (6.00 pts)

Classify each of these human genetic disorders as autosomal dominant, autosomal recessive, sex-linked, nondisjunction, or multifactorial. Note : Choices may be used once, more than once or not at all.

- a) Diabetes
- b) Down's Syndrome
- c) Duchenne Muscular Dystrophy
- d) Hemophilia

- e) Cystic Fibrosis [11] [SEP]
- f) Spina bifida [11] [SEP]

Expected Answer: a, multifactorial b, nondisjunction c, sex-linked d, sex-linked e, Autosomal recessive f multifactorial

19. (1.00 pts)

A goat can produce milk containing the same polymers present in the silk produced by spiders when particular genes from a spider are inserted into the goat's genome. Which of the following reasons describes why this is possible?

- A) Goats and spiders share a common ancestor and thus produce similar protein excretions
- B) Goats retain all the genes that were found in ancestral species and will express these proteins when activated by a gene insertion.
- C) The proteins in goats' milk and spiders' silk have the same amino acid sequence.
- D) The universal nature of the genetic code allows for the production of identical proteins from different organisms as long as the DNA sequence is identical.

20. (1.00 pts)

RNA retrovirus such as HIV discharge both strands of RNA and molecules of reverse transcriptase into cells they infect. What is the purpose of the reverse transcriptase?

- A) The host cells rapidly destroy the viral RNA so more must constantly be made.
- B) The host cells lack enzymes that can replicate the viral genome.
- C) The reverse transcriptase is required to translate viral mRNA into proteins.
- D) The reverse transcriptase binds to active sites of the lytic enzymes of the host cells.

21. (1.00 pts)

Microarrays use single-stranded pieces of DNA of known genes, which are placed on a slide to determine whether these genes are being expressed in a particular tissue. For example, if the cells come from seedling that are germinated and kept in the dark, the chlorophyll genes would not be active. Which of the following would you wash across the slide to determine that the chlorophyll genes are active in a plant grown in light

- A) single -stranded cDNA made from the mRNA transcribed from the chlorophyll genes.
- B) a portion of the amino acid sequence of the chlorophyll molecules.
- C) mRNA transcribed from the plant grown in the dark
- D) cell fragments that include ribosomes and both tRNA and rRNA

22. (1.00 pts)

The human genome appears to have only about as many genes as the simple nematode worm, *C. elegans*. Which of the following best explains how the more complex humans can have relatively few genes?

- A) Human genes have unusually long introns involved in the regulation of gene expression.
- B) More than one polypeptide can be produced from a gene by alternative splicing.
- C) The human genome has a high proportion of noncoding DNA.
- D) The human genome has a large number of SNPs (single nucleotide polymorphisms), which increases genetic variability.

23. (1.00 pts) Lac operon is an example of

- A) only positive regulation.
- B) only negative regulation.
- C) both positive and negative regulations.
- D) sometimes positive, sometimes negative.

24. (1.00 pts) In the post-transcriptional modification of mRNA in () cells, () are removed from mRNA before it exits the ().

- A) prokaryotic, introns, nucleus
- B) prokaryotic, exons, nucleus
- C) eukaryotic, introns, nucleus
- D) eukaryotic, exons, nucleus

25. (2.00 pts) What is the amino acid sequence produced from the following template strand?
3' TACTTGACGATTCCC 5'

- A) Tyr-Arg-Cys-Trp
- B) Phe-Ile-Gly
- C) Met-Asn-Cys-Gly
- D) Met-Asn-Cys

26. (5.00 pts) 1, Used to analyze gene expression
2, Uses next-generation sequencing
3, Requires prior knowledge of mRNA sequences
4, Can provide absolute quantification of mRNA levels
5, Allows for comparison of gene expression under different conditions

Indicate whether each statement best applies to:

- A. DNA microarrays
- B. RNA-seq
- C. Both
- D. Neither

- A) 1, C
2, B
3, A
4, B
5, C
- B) 1, C
2, A
3, A
4, B
5, C
- C) 1, C
2, A
3, C

- 4, C
- 5, A
- D) 1, C
- 2, A
- 3, B
- 4, C
- 5, A

27. (1.00 pts) Methylation of DNA is generally thought to alter gene expression by

- A) Increasing recruitment of transcriptional activators to their binding sites.
- B) increasing expression.
- C) Preventing binding of transcriptional activators, decreasing expression.
- D) Increasing recruitment of transcriptional repressors, decreasing expression.
- E) Blocking ribosome binding site, decreasing expression.

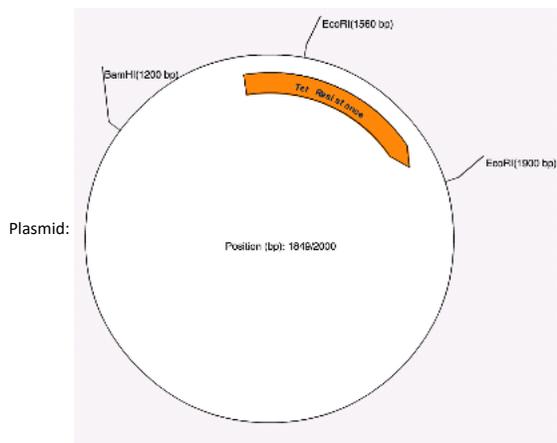
28. (1.00 pts) Which eukaryotic DNA polymerase(s) will incorporate the largest number of nucleotides during one round of DNA replication?

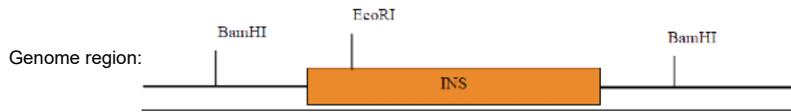
- A) Polymerase alpha
- B) Polymerase delta
- C) Polymerase epsilon
- D) Polymerase delta and epsilon

29. (1.00 pts) The transcribed region of a prokaryotic gene is 633 bp in length. Approximately how many amino acids are in the translated peptide?

- A) 633
- B) Less than 633, more than 211
- C) 211
- D) Less than 211

30. (2.00 pts) Use the images provided below to answer question:

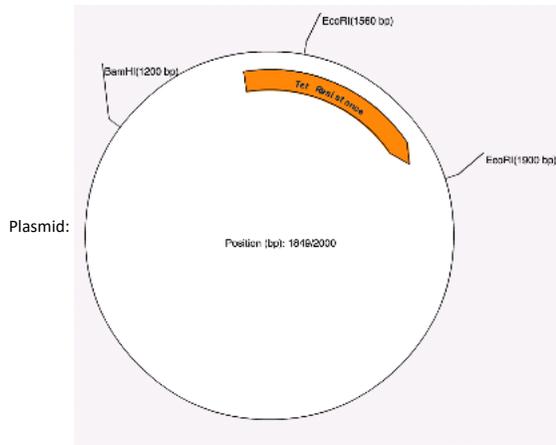




How many linear DNA fragments would result from digesting the plasmid with EcoRI?

- A) 1
- B) 2
- C) 3
- D) 4

31. (2.00 pts) Use the images provided below to answer question:

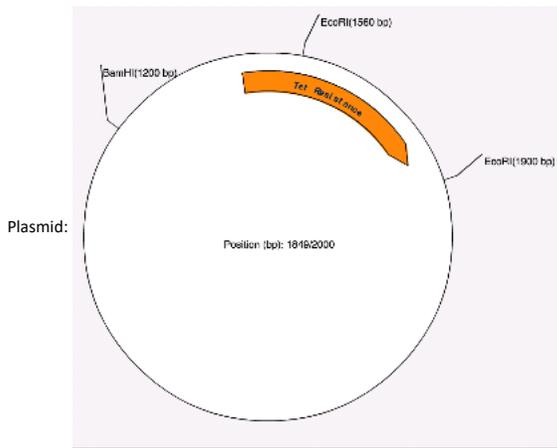


How many linear DNA fragments would result from digesting the plasmid with BamHI?

- A) 1
- B) 2
- C) 3
- D) 4

32. (2.00 pts)

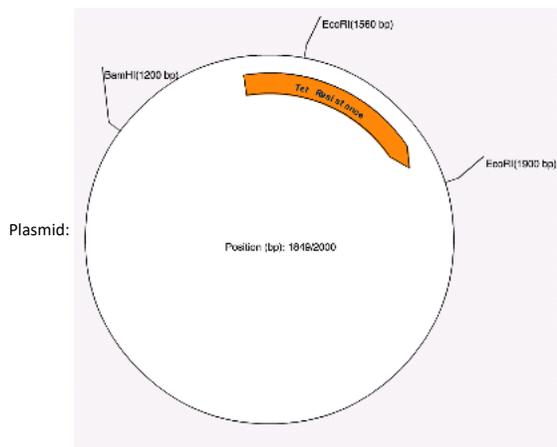
Use the images provided below to answer question:



You want to clone the DNA region shown above into the plasmid to express the human insulin gene(INS) in E coli. Which restriction enzyme(s) should you use to digest the fragment of human genomic DNA and the plasmid?

- A) BamHI for both human DNA and plasmid.
- B) BamHI for human DNA, EcoRI for plasmid
- C) EcoRI for both human DNA and plasmid.
- D) EcoRI for human DNA, BamHI for plasmid

33. (2.00 pts) Use the images provided below to answer questions:

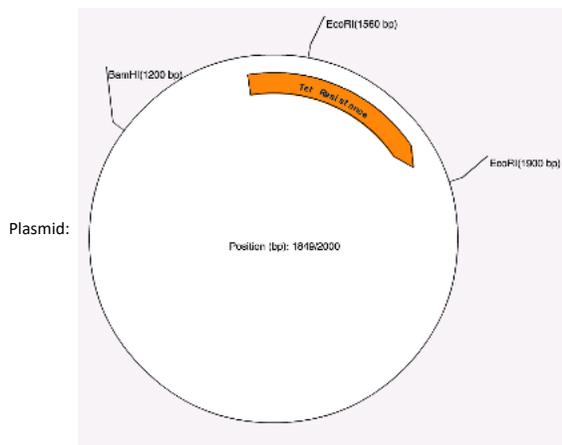


What is the correct order of steps to clone the human insulin gene into the plasmid shown above?

- A) 1, mixture of the restriction digest products with DNA ligase;
2, selection for cells which have been successfully transformed;

- 3, restriction digest of plasmid and genomic DNA;
- 4, transformation of bacterial cells with recombinant plasmid.
- B) 1, Transformation of bacterial cells with recombinant plasmid;
- 2, selection for cells which have been successfully transformed;
- 3, restriction digest of plasmid and genomic DNA;
- 4, mixture of the restriction digest products with DNA ligase.
- C) 1, restriction digest of plasmid and genomic DNA;
- 2, mixture of restriction digest products with DNA ligase;
- 3, transformation of bacterial cells with recombinant plasmids;
- 4, selection for cells which have been successfully transformed.
- D) 1, restriction digest of plasmid and genomic DNA;
- 2, transformation of bacterial cells with recombinant plasmids;
- 3, mixture of restriction digest products with DNA ligase;
- 4, selection for cells which have been successfully transformed.

34. (2.00 pts) Use the images provided below to answer question:



After transformation of E. coli, which cells will be resistant to be the antibiotic tetracycline (Tet)?

- A) All cells with or without the plasmid
- B) Only cells which were transformed with an empty vector (a plasmid without the genomic DNA inserted)
- C) Only cells which were transformed with a plasmid containing the genomic DNA insert.
- D) All cells which were successfully transformed with either the empty vector or the plasmid + genomic DNA.

35. (2.00 pts) What goes wrong when a cell is overtaken by cancer?

Expected Answer: when the DNA of a cell is damaged by radiation or chemicals genes that produce protein that regulate cell division may have mutated. If, for example the gene product is a damaged protein that normally monitors the integrity of the DNA, it may not trigger DNA repair and damaged DNA will be passed on to daughter cells. Accumulation of damaged DNA may result in a further breakdown of cell cycle regulation, and the cell line may begin dividing without control, thus becoming cancerous.

36. (2.00 pts) What is the purpose of running a DNA microarray?

Expected Answer: Allows for analysis of whole genome in one experiment or used to study expression levels of large numbers of genes at the same time.

37. (9.00 pts) Given the sequence of codons below, answer the following questions. 5' UUU CAU AGU AGG GAG CAA AAA 3'

- Write out a possible mRNA strand for the sequence of codons. Make sure to indicate directionality of the strand. (3 pt.)
- Write out the amino acid chain that would be produced. (3 pt.)
- Write out a possible DNA template for the amino acid chain. Make sure to indicate directionality of the strand. (3 pt.)

Expected Answer: a. 5' UUU CAU AGU AGG GAG CAA AAA 3' (no point for wrong directionality) b. Phe-His-Ser-Arg-Glu-Gln-Lys c. 3' AAA GTA TCA TCC CTC GTT TTT 5' (-1 point for wrong directionality)

38. (4.00 pts) Chromosomal sex is determined at _____, however, sexual differences begin to appear at the _____ week of development.

Fertilization

7th

39. (4.00 pts)

what is the most common trisomy in human? What are the most common trisomies seen in human infants? Does this fact mean that these chromosomes are the most difficult to segregate? Why?

Expected Answer: Trisomy 16, Tri 21 and Tri 18 No, nondisjunction.

40. (2.00 pts) An inter-homolog connection that arises from an individual crossover event between nonsister chromatid is called ()

Chiasma

41. (2.00 pts) End of a chromosome, associated with a characteristic DNA sequence that is replicated in a special way. It is called().

Telomere

42. (2.00 pts) A blood group consists of two alleles, M and N. The following data were obtained for a population:

BLOOD TYPE	NUMBER OF INDIVIDUAL
M	169
MN	182
N	49

Calculate the percentage for the M allele to the nearest whole number

0.65

43. (2.00 pts) For the following human genetic disorders, please explain and give disease examples: Point mutation

sickle cell disease

tay-sach

44. (2.00 pts) For the following human genetic disorders, please explain and give disease examples: aneuploidy

down syn.

Edward syn.

45. (2.00 pts) For the following human genetic disorders, please explain and give disease examples: chromosomal aberrations

cri du chat

huntington's disease

46. (2.00 pts) is horizontal gene transfer is more prevalent in single cell organisms? Why?

Expected Answer: yes. One cell, genome is the germ line.

47. (2.00 pts) Full set of chromosomes of a cell arranged with respect to size, shape, and number, it is called ().

Karyotype

48. (2.00 pts) any one of a group of small abundant proteins rich in arginine and lysine, that form the primary level of chromatin organization, it is named ().

histone

49. (2.00 pts) complex of DNA, histones, and non-histone proteins found in the nucleus of a eukaryotic cell, named as ().

chromatin

