

Name \_\_\_\_\_

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Feather color in budgies is determined by two different genes,  $Y$  for pigment on the outside of the feather, and  $B$  for pigment on the inside of the feather.  $YYBB$ ,  $YyBB$ , or  $YYBb$  is green;  $yyBB$  or  $yyBb$  is blue;  $YYbb$  or  $Yybb$  is yellow; and  $yybb$  is white. Two blue budgies were crossed. Over the years, they produced 22 offspring, five of which were white. What are the most likely genotypes for the two blue budgies? 1) \_\_\_\_\_
- A)  $yyBb$  and  $yyBb$       B)  $yyBB$  and  $yyBB$       C)  $yyBB$  and  $yyBb$       D)  $yyBb$  and  $yybb$

- 2) Use the figure and the following description to answer the question. 2) \_\_\_\_\_

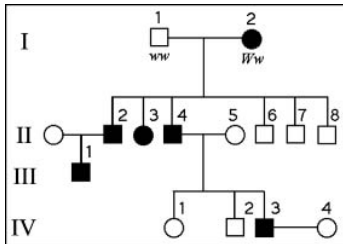
In a particular plant, leaf color is controlled by gene locus  $D$ . Plants with at least one allele  $D$  have dark green leaves, and plants with the homozygous recessive  $dd$  genotype have light green leaves. A true-breeding, dark-leaved plant is crossed with a light-leaved one, and the  $F_1$  offspring is allowed to self-pollinate. The predicted outcome of the  $F_2$  is diagrammed in the Punnett square shown in the figure, where 1, 2, 3, and 4 represent the genotypes corresponding to each box within the square.

	$D$	$d$
$D$	1	2
$d$	3	4

Which of the boxes marked 1-4 correspond to plants with dark leaves?

- A) 1 only      B) 2 and 3      C) 1, 2, and 3      D) 4 only
- 3) Phenylketonuria (PKU) is a recessive human disorder in which an individual cannot appropriately metabolize the amino acid phenylalanine. This amino acid is not naturally produced by humans. Which of the following treatments would be most effective for people with PKU? 3) \_\_\_\_\_
- A) Regulate the diet of the affected persons to severely limit the uptake of phenylalanine.  
 B) Feed them the substrate that can be metabolized into phenylalanine.  
 C) Feed the patients the missing enzymes in a regular cycle, such as twice per week.  
 D) Feed the patients an excess of the missing product.
- 4) Which of the following scenarios describes an example of epistasis? 4) \_\_\_\_\_
- A) In rabbits and many other mammals, one genotype ( $ee$ ) prevents any fur color from developing.  
 B) In cacti, there are several genes for the type of spines.  
 C) Recessive genotypes for each of two genes ( $aabb$ ) results in an albino corn snake.  
 D) In *Drosophila* (fruit flies), white eyes can be due to an X-linked gene or to a combination of other genes.

- 5) The following question refers to the pedigree chart in the figure for a family, some of whose members exhibit the dominant trait, *W*. Affected individuals are indicated by a dark square or circle. 5) \_\_\_\_\_

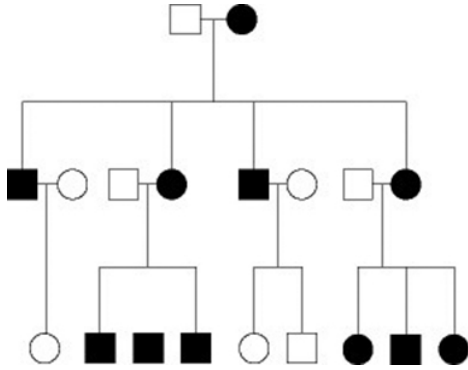


What is the genotype of individual II-5?

- A) *ww* or *Ww*      B) *WW*      C) *ww*      D) *Ww*
- 6) An obstetrician knows that one of her patients is a pregnant woman whose fetus is at risk for a serious disorder that is detectable biochemically in fetal cells. The obstetrician would most reasonably offer which of the following procedures to her patient? 6) \_\_\_\_\_
- A) amniocentesis or CVS      B) X-ray  
C) blood transfusion      D) karyotyping of the woman's somatic cells
- 7) A man who is a dwarf with achondroplasia and normal vision marries a color-blind woman of normal height. The man's father was six feet tall, and both the woman's parents were of average height. Dwarfism caused by achondroplasia is autosomal dominant, and red-green color blindness is X-linked recessive. What proportion of their sons would be color blind and of normal height? 7) \_\_\_\_\_
- A) none      B) all      C) one out of four      D) half
- 8) Abnormal chromosomes are frequently found in malignant tumors. Errors such as translocations may place a gene in close proximity to different control regions. Which of the following events might then occur to make the cancer worse? 8) \_\_\_\_\_
- A) a decrease in mitotic frequency  
B) failure of the cancer cells to multiply  
C) an increase in nondisjunction  
D) expression of inappropriate gene products
- 9) Generally, only female cats have the tortoiseshell phenotype for fur color. Which of the following statements explains this phenomenon? 9) \_\_\_\_\_
- A) Only males can have Barr bodies.  
B) The Y chromosome has a gene blocking orange coloration.  
C) A male inherits only one allele of the X-linked gene controlling hair color.  
D) Multiple crossovers on the Y chromosome prevent orange pigment production.
- 10) Map units on a linkage map cannot be relied upon to calculate physical distances on a chromosome for which of the following reasons? 10) \_\_\_\_\_
- A) The gene order on the chromosomes is slightly different in every individual.  
B) The relationship between recombination frequency and map units is different in every individual.  
C) Physical distances between genes change during the course of the cell cycle.  
D) The frequency of crossing over varies along the length of the chromosome.

11) Use the following figure to answer the question.

11) \_\_\_\_\_



The pedigree in the figure shows the transmission of a trait in a particular family. Based on this pattern of transmission, the trait is most likely \_\_\_\_\_.

- A) autosomal dominant
- B) sex-linked dominant
- C) mitochondrial
- D) sex-linked recessive

12) Pseudohypertrophic muscular dystrophy is a human disorder that causes gradual deterioration of the muscles. Only boys are affected, and they are always born to phenotypically normal parents. Due to the severity of the disease, the boys die in their teens. Is this disorder likely to be caused by a dominant or recessive allele? Is the inheritance of this trait sex-linked or autosomal?

12) \_\_\_\_\_

- A) incomplete dominant, sex-linked
- B) dominant, sex-linked
- C) recessive, autosomal
- D) recessive, sex-linked

13) In a nucleosome, the DNA is wrapped around \_\_\_\_\_.

13) \_\_\_\_\_

- A) ribosomes.
- B) polymerase molecules.
- C) a thymine dimer.
- D) histones.

14) If a cell were unable to produce histone proteins, which of the following results would be a likely effect on the cell?

14) \_\_\_\_\_

- A) Spindle fibers would not form during prophase.
- B) There would be an increase in the amount of DNA produced during replication.
- C) The cell's DNA could not be packed into its nucleus.
- D) Amplification of other genes would compensate for the lack of histones.

15) After the first replication was observed in their experiments testing the nature of DNA replication, Meselson and Stahl could be confident of which of the following conclusions?

15) \_\_\_\_\_

- A) Replication is not dispersive.
- B) Replication is neither dispersive nor conservative.
- C) Replication is semi-conservative.
- D) Replication is not conservative.

16) What are telomeres?

16) \_\_\_\_\_

- A) the ends of linear chromosomes
- B) the sites of origin of DNA replication
- C) enzymes that elongate the DNA strand during replication
- D) the structures that hold two sister chromatids together

- 17) *E. coli* cells grown on  $^{15}\text{N}$  medium are transferred to  $^{14}\text{N}$  medium and allowed to grow for two more generations (two rounds of DNA replication). DNA extracted from these cells is centrifuged. What density distribution of DNA would you expect in this experiment? 17) \_\_\_\_\_
- A) one high-density and one intermediate-density band
  - B) one low-density and one intermediate-density band**
  - C) one high-density and one low-density band
  - D) one intermediate-density band
- 18) The most commonly occurring mutation in people with cystic fibrosis is a deletion of a single codon. What is the result of this type of mutation? 18) \_\_\_\_\_
- A) a frameshift mutation
  - B) a polypeptide missing an amino acid**
  - C) a nonsense mutation
  - D) a base-pair substitution
- 19) What would be the consequence of a mutation in a bacterial cell that produces a defective aminoacyl-tRNA synthetase that attaches a lysine instead of the normal phenylalanine to tRNAs with the anticodon AAA? 19) \_\_\_\_\_
- A) The ribosome will skip a codon every time a UUU is encountered.
  - B) Proteins in the cell will include lysine instead of phenylalanine at amino acid positions specified by the codon UUU.**
  - C) The cell will compensate for the defect by attaching phenylalanine to tRNAs with lysine-specifying anticodons.
  - D) None of the proteins in the cell will contain phenylalanine.

20) The following question refers to this table of codons.

20) \_\_\_\_\_

		Second Base				
		U	C	A	G	
First Base	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	U C A G
		UUC } Leu	UCC } Ser	UAC } Tyr	UGC } Cys	
		UUA } Leu	UCA } Ser	UAA } Stop	UGA } Stop	
		UUG } Leu	UCG } Ser	UAG } Stop	UGG } Trp	
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg	U C A G
		CUC } Leu	CCC } Pro	CAC } His	CGC } Arg	
		CUA } Leu	CCA } Pro	CAA } Gln	CGA } Arg	
		CUG } Leu	CCG } Pro	CAG } Gln	CGG } Arg	
	A	AUU } Ile	ACU } Thr	AAU } Asn	AGU } Ser	U C A G
		AUC } Ile	ACC } Thr	AAC } Asn	AGC } Ser	
		AUA } Ile	ACA } Thr	AAA } Lys	AGA } Arg	
		AUG } Met or Start	ACG } Thr	AAG } Lys	AGG } Arg	
	G	GUU } Val	GCU } Ala	GAU } Asp	GGU } Gly	U C A G
		GUC } Val	GCC } Ala	GAC } Asp	GGC } Gly	
		GUA } Val	GCA } Ala	GAA } Glu	GGA } Gly	
		GUG } Val	GCG } Ala	GAG } Glu	GGG } Gly	

Which of the following sequences of nucleotides are possible in the template strand of DNA that would code for the polypeptide sequence Phe-Leu-Ile-Val?

A) 3'-AAA-AAT-ATA-ACA-5'

B) 5'-AUG-CTG-CAG-TAT-3'

C) 3'-AAA-GAA-TAA-CAA-5'

D) 5'-TTG-CTA-CAG-TAG-3'

21) The following question refers to this table of codons.

21) \_\_\_\_\_

		Second Base				
		U	C	A	G	
First Base	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG } Stop	UGU } Cys UGC } UGA } Stop UGG } Trp	U C A G
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G
	A	AUU } AUC } Ile AUA } AUG } Met or Start	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } GUC } Val GUA } GUG }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G

What amino acid sequence will be generated, based on the following mRNA codon sequence?

5'- AUG-UCU-UCG-UUA-UCC-UUG-3'

- A) Met- Glu- Arg- Arg- Glu- Leu
- B) Met- Ser- Leu- Ser- Leu- Ser
- C) Met- Ser- Ser- Leu- Ser- Leu
- D) Met- Arg- Glu- Arg- Glu- Arg

22) How does extracellular glucose inhibit transcription of the *lac* operon?

22) \_\_\_\_\_

- A) by strengthening the binding of the repressor to the operator
- B) by weakening the binding of the repressor to the operator
- C) by reducing the levels of intracellular cAMP
- D) by inhibiting RNA polymerase from opening the strands of DNA to initiate transcription

23) What would be the result of a mutation in a maternal effect gene in a female *Drosophila*?

23) \_\_\_\_\_

- A) She will not develop past the early embryonic stage.
- B) Only her male offspring will show the mutant phenotype.
- C) All of her offspring will show the mutant phenotype, regardless of their genotype.
- D) Only her female offspring will show the mutant phenotype.

24) Cell differentiation always involves

24) \_\_\_\_\_

- A) the production of tissue-specific proteins.
- B) the movement of cells.
- C) transcription of the *myoD* gene.
- D) the selective loss of certain genes from the genome.

25) Gene expression is often assayed by measuring the level of mRNA produced from a gene. What level of the control of gene expression can be analyzed by this type of assay? 25) \_\_\_\_\_

A) translational control  
B) replication control  
C) alternative splicing  
D) transcriptional control

26) Refer to the treatments listed to answer the question. 26) \_\_\_\_\_

You isolate an infectious substance capable of causing disease in plants, but you do not know whether the infectious agent is a bacterium, virus, or prion. You have four methods at your disposal to analyze the substance and determine the nature of the infectious agent.

- I. Treat the substance with enzymes that destroy all nucleic acids, and then determine whether the substance is still infectious.
- II. Filter the substance to remove all elements smaller than what can be easily seen under a light microscope.
- III. Culture the substance on nutritive medium, away from any plant cells.
- IV. Treat the sample with proteases that digest all proteins, and then determine whether the substance is still infectious.

If you already know that the infectious agent was either a virus or a prion, which method(s) listed above would allow you to distinguish between these two possibilities?

- A) IV only                      B) II only                      C) I only                      D) either I or IV

27) Which of the following statements best reflects what we know about how the flu virus moves between species? 27) \_\_\_\_\_

- A) An influenza virus gains new sequences of DNA from another virus, such as a herpesvirus; this enables it to be transmitted to a human host.
- B) The flu virus in a pig is mutated and replicated in alternate arrangements so that humans who eat the pig products can be infected.
- C) A flu virus from a human epidemic or pandemic infects birds; the birds replicate the virus differently and then pass it back to humans.
- D) An animal such as a pig is infected with more than one virus, genetic recombination occurs, the new virus mutates, the virus is passed to a new species such as a bird, and the virus mutates again and can now be transmitted to humans.

28) Which of the following characteristics is typical of the lytic cycle of a bacteriophage? 28) \_\_\_\_\_

- A) Viral DNA is incorporated into the host genome.
- B) The viral genome replicates without destroying the host.
- C) The virus-host relationship usually lasts for generations.
- D) A large number of phages are released at a time.

29) In a comparison of two DNA sequences found in the same location on homologous chromosomes, one of the homologs carries the sequence 5'-AACTACGA-3', and the other homolog carries the sequence 5'-AACTTCGA-3'. Within a population, you discover that each of these sequences is common. Which of the following statements correctly describes these sequences? 29) \_\_\_\_\_

- A) They may cause disease.
- B) They contain a SNP that may be useful for genetic mapping.
- C) They can identify a protein-coding region of a gene.
- D) They may carry out RNA interference.

- 30) RNAi methodology uses double-stranded pieces of RNA to trigger breakdown of a specific mRNA or inhibit its translation. For which of the following processes might this technique be useful? 30) \_\_\_\_\_
- A) to form a knockout organism that will not pass the deleted sequence to its progeny
  - B) to decrease the production from a harmful mutated gene**
  - C) to destroy an unwanted allele in a homozygous individual
  - D) to raise the concentration of a desired protein
- 31) Scientists developed a set of guidelines to address the safety of DNA technology. Which of the following safety measures is one that has been adopted by researchers? 31) \_\_\_\_\_
- A) Microorganisms used in recombinant DNA experiments must be genetically crippled to ensure that they cannot survive outside of the laboratory.**
  - B) Experiments involving HIV or other potentially dangerous viruses have been banned.
  - C) Transgenic plants are engineered so that the plant genes cannot hybridize.
  - D) Genetically modified organisms are not allowed to be part of our food supply.
- 32) A microarray is a tool used in genetic research to determine the mRNAs being produced in a particular tissue, and their relative level of expression. Known genes can therefore be assayed for their expression in different situations. One use of the technology is in cancer diagnosis and treatment. If a known gene functions as a tumor suppressor, predict which of the following pieces of evidence would be most useful in diagnosis of a cancer due to a mutation in this tumor-suppressor gene. 32) \_\_\_\_\_
- A) The tissue sample responds to treatment with a mitosis-promoting compound.
  - B) The tissue sample shows a high level of gene expression relative to a control (noncancerous) sample.
  - C) The mRNAs for cyclins and kinases show unusually high levels of expression.
  - D) The mRNAs for the targeted tumor suppressor sequence are not being produced.**
- 33) Which of the following statements defines *proteomics*? 33) \_\_\_\_\_
- A) It is the linkage of each gene to a particular protein.
  - B) It is the totality of the functional possibilities of a single protein.
  - C) It is the study of the full protein set and its properties.**
  - D) It is the study of how amino acids are ordered in a protein.
- 34) Which of the following can be duplicated in a genome? 34) \_\_\_\_\_
- A) only entire chromosomes
  - B) only DNA sequences
  - C) only entire sets of chromosomes
  - D) DNA sequences, chromosomes, or sets of chromosomes**



35) Use the figure and the following description to answer the question.

35) \_\_\_\_\_

In a particular plant, leaf color is controlled by gene locus *D*. Plants with at least one allele *D* have dark green leaves, and plants with the homozygous recessive *dd* genotype have light green leaves. A true-breeding, dark-leaved plant is crossed with a light-leaved one, and the F<sub>1</sub> offspring is allowed to self-pollinate. The predicted outcome of the F<sub>2</sub> is diagrammed in the Punnett square shown in the figure, where 1, 2, 3, and 4 represent the genotypes corresponding to each box within the square.

	<i>D</i>	<i>d</i>
<i>D</i>	1	2
<i>d</i>	3	4

Which of the boxes marked 1-4 correspond to plants that will be true-breeding?

- A) 1, 2, 3, and 4      B) 1 and 4 only      C) 1 only      D) 2 and 3 only

36) In some parts of Africa, the frequency of heterozygosity for the sickle-cell anemia allele is unusually high, presumably because this reduces the frequency of malaria. Such a relationship is related to which of the following?

36) \_\_\_\_\_

- A) the malarial parasite changing the allele      B) Darwin's explanation of natural selection  
C) Mendel's law of independent assortment      D) Mendel's law of segregation

37) In cats, black fur color is determined by an X-linked allele; the other allele at this locus determines orange color. The heterozygote is tortoiseshell. What kinds of offspring would you expect from the cross of a black female and an orange male?

37) \_\_\_\_\_

- A) tortoiseshell females; tortoiseshell males      B) orange females; black males  
C) tortoiseshell females; black males      D) black females; orange males

38) When Thomas Hunt Morgan crossed his red-eyed F<sub>1</sub> generation flies to each other, the F<sub>2</sub> generation included both red- and white-eyed flies. Remarkably, all the white-eyed flies were male. What was the explanation for this result?

38) \_\_\_\_\_

- A) The gene involved is located on the Y chromosome.  
B) The gene involved is located on an autosome, but only in males.  
C) Other male-specific factors influence eye color in flies.  
D) The gene involved is located on the X chromosome.

39) The spontaneous loss of amino groups from adenine in DNA results in hypoxanthine, an uncommon base, opposite thymine. What combination of proteins could repair such damage?

39) \_\_\_\_\_

- A) telomerase, primase, DNA polymerase  
B) nuclease, DNA polymerase, DNA ligase  
C) telomerase, helicase, single-strand binding protein  
D) DNA ligase, replication fork proteins, adenylyl cyclase

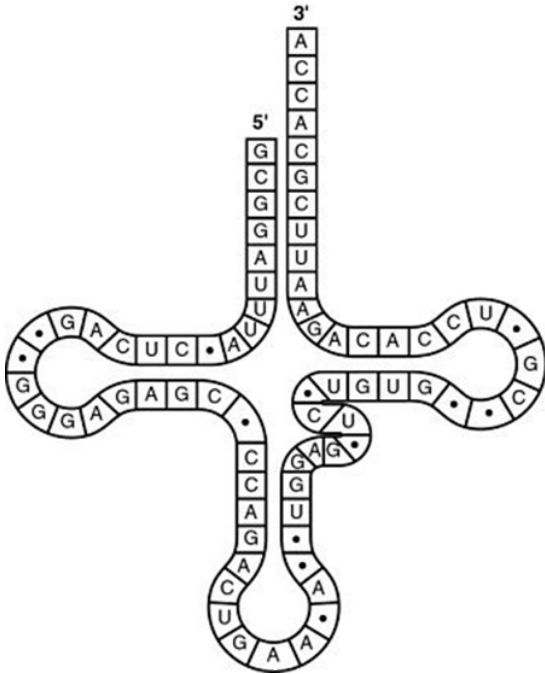
40) Semiconservative replication involves a template. What is the template?

40) \_\_\_\_\_

- A) DNA polymerase      B) one strand of the DNA molecule  
C) an RNA molecule      D) single-stranded binding proteins

41) Use the figure to answer the question.

41) \_\_\_\_\_



The tRNA shown in the figure has its 3' end projecting beyond its 5' end. Which of the following processes will occur at this 3' end?

- A) The excess nucleotides (ACCA) will be cleaved off at the ribosome.
- B) The 5' cap of the mRNA will become covalently bound.
- C) The small and large subunits of the ribosome will attach to it.
- D) The amino acid binds covalently.**

42) When taken up by a cell, which of the following molecules binds to a repressor so that the repressor no longer binds to the operator?

42) \_\_\_\_\_

- A) inducer**
- B) repressor
- C) corepressor
- D) promoter

43) Which of the following processes can be effective in preventing the onset of viral infection in humans?

43) \_\_\_\_\_

- A) taking drugs that inhibit transcription
- B) taking vitamins before being exposed to various viruses
- C) taking antibiotics to inhibit bacterial growth
- D) getting vaccinated to certain viruses**

44) Which of the following statements correctly describes how RNA interference (RNAi) silences selected genes?

44) \_\_\_\_\_

- A) Synthetic double-stranded RNA molecules trigger the breakdown of a gene's messenger RNA.**
- B) Synthetic double-stranded RNA molecules stop mitosis from occurring.
- C) Synthetic double-stranded RNA molecules stop DNA replication from occurring.
- D) Synthetic double-stranded RNA molecules stop transcription from occurring.

- 45) Bioinformatics includes all of the following *except* 45) \_\_\_\_\_  
A) using DNA technology to combine DNA from two different sources in a test tube.  
B) using computer programs to align DNA sequences.  
C) developing computer-based tools for genome analysis.  
D) using mathematical tools to make sense of biological systems.
- 46) Albinism is a recessive trait. A man and woman both show normal pigmentation, but both have one parent who has albinism (without melanin pigmentation). What is the probability that their first child will have albinism? 46) \_\_\_\_\_  
A) 1/2 B) 1/4 C) 1 D) 0
- 47) A phenotypically normal prospective couple seeks genetic counseling because the man knows that he has a translocation of a portion of his chromosome 4, which has been exchanged with a portion of his chromosome 12. Although his translocation is balanced, he and his wife want to know the probability that his sperm will be abnormal. What is your prognosis regarding his sperm? 47) \_\_\_\_\_  
A) Half will be normal, and the rest will have the father's translocation.  
B) All will carry the same translocation as the father.  
C) None will carry the translocation.  
D) One-quarter will carry the two normal chromosomes, 4 and 12, one-quarter will have only the two translocation chromosomes and no normal chromosomes 4 and 12, and half will have one normal and one translocated chromosome.
- 48) Which of the following statements describes the process of transformation in bacteria? 48) \_\_\_\_\_  
A) External DNA is taken into a cell, becoming part of the cell's genome.  
B) A strand of RNA is created from a DNA molecule.  
C) Bacterial cells are infected by a phage DNA molecule.  
D) A strand of DNA is created from an RNA molecule.
- 49) Which component is *not* directly involved in translation? 49) \_\_\_\_\_  
A) tRNA B) ribosomes C) GTP D) DNA
- 50) Which of the following statements about the DNA in one of your brain cells is true? 50) \_\_\_\_\_  
A) Each gene lies immediately adjacent to an enhancer.  
B) The majority of genes are likely to be transcribed.  
C) It is the same as the DNA in one of your liver cells.  
D) Most of the DNA codes for protein.
- 51) What is difference between an epidemic and a pandemic? 51) \_\_\_\_\_  
A) An epidemic is caused by a bacterial infection; a pandemic is caused by a viral infection.  
B) An epidemic has low mortality; a pandemic has higher mortality.  
C) An epidemic is restricted to a local region; a pandemic is global.  
D) An epidemic is a disease; a pandemic is a treatment.
- 52) For which of the following processes can dideoxynucleotides be used? 52) \_\_\_\_\_  
A) to produce cDNA from mRNA  
B) to sequence a DNA fragment  
C) to separate different sized DNA fragments  
D) to visualize DNA expression

- 53) Which of the following conclusions has led to the comparison between the number of human genes and those of other animal species? 53) \_\_\_\_\_
- A) The genomes of most other organisms are significantly smaller than the human genome.
  - B) Most human DNA consists of genes for protein, tRNA, rRNA, and miRNA.
  - C) The number of proteins expressed by the human genome is far greater than the number of its genes.**
  - D) The density of the human genome is far higher than in most other animals.
- 54) The individual with genotype *AaBbCCDdEE* can make many kinds of gametes. Which of the following correctly describes why this situation is possible? 54) \_\_\_\_\_
- A) crossing over during prophase I leads to genetic variety
  - B) different possible assortment of chromosomes into gametes occurs**
  - C) there is a tendency for dominant alleles to segregate together
  - D) recurrent mutations form new alleles
- 55) Genomic imprinting is generally due to the addition of methyl (-CH<sub>3</sub>) groups to C nucleotides and chemical histone changes to silence a given gene. If this depends on the sex of the parent who transmits the gene, which of the following statements must be true? 55) \_\_\_\_\_
- A) The imprints are transmitted only to gamete-producing cells.
  - B) Methylation of this kind must occur more in males than in females.
  - C) Genes required for early development stages must not be imprinted.
  - D) Methylation must be reversible in ovarian and testicular cells.**

**SHORT ESSAY QUESTIONS. Write your answer on the provided answer sheet of paper. (3% each)**

1. Explain how introns were removed and exons spliced together during RNA processing.
2. What is the role of homeotic genes in development?
3. Describe the multistep model for the development of colorectal cancer.
4. Define and explain the difference among homologs, orthologs and paralogs.
5. List the key events that give rise to a gene family through the evolution time line.
6. How will you plan a gene therapy for sickle cell disease?