Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. Gene expression can be
   a. regulated before transcription.
   b. during transcription.
   c. after transcription but before translation.
   d. at or after translation.
   e. All of the above

2. ______ genes are expressed all of the time.
   a. Inducible
   b. Repressed
   c. Activator
   d. Constitutive
   e. Clustered

3. Bacterial viruses (phage)
   a. can reproduce on their own.
   b. require a host cell to replicate.
   c. carry out metabolism.
   d. have a plasma membrane.
   e. are alive.

4. Regulation of gene expression during the phage lytic cycle does not include
   a. binding of a host RNA polymerase to a viral promoter.
   b. stimulation of viral late gene transcription.
   c. enhancement of the host’s gene transcription.
   d. enhancement of viral early gene transcription.
   e. down regulation of the host’s gene transcription.

5. A retrovirus
   a. has a double-stranded DNA genome.
   b. has a single-stranded DNA genome.
   c. has a double-stranded RNA genome.
   d. encodes a reverse transcriptase.
   e. integrates its genome directly into the host’s genome.

6. Structural genes
   a. code for structural proteins.
   b. are regulatory regions of DNA.
   c. specify the primary structure (amino acid sequence) of proteins.
   d. are always constitutively expressed.
   e. are absent in eukaryotes.

7. Operons
   a. are common in eukaryotes.
   b. consist of structural genes only.
   c. consist of a promoter, an operator, structural genes, and a repressor gene.
   d. consist of a promoter, an operator, and two (or more) structural genes.
e. include inducer genes.

8. A(n) _______ operon is turned off unless needed.
   a. repressible
   b. constitutive
   c. inducible
   d. clustered
   e. None of the above

9. A(n) _______ operon is turned on unless not needed.
   a. repressible
   b. constitutive
   c. inducible
   d. clustered
   e. None of the above

10. The expression of the lac structural genes is _______ when lactose is absent from the culture medium and is _______ when lactose is added because lactose binds to the _______ and inactivates it.
    a. low; high; lac repressor
    b. high; low; lac inducer
    c. low; high; lac promoter
    d. high; low; lac operator
    e. low; high; lac operator

11. _______ are present in prokaryotes and bind to and direct the polymerase to specific promoters.
    a. Sigma factors
    b. Sporulation proteins
    c. Reverse transcriptases
    d. Proteases
    e. Ribosomes

12. Prokaryotes and eukaryotes differ in transcription in that
    a. there are three RNA polymerases in eukaryotes.
    b. initiation of transcription is simpler in prokaryotes.
    c. structural genes for a pathway are more likely to be clustered in prokaryotes.
    d. eukaryotic promoters have a TATA box.
    e. All of the above

13. Which of the following statements about RNA polymerase is true?
    a. Bacteria use RNA polymerase III to transcribe tRNA and mRNA.
    b. Eukaryotes use different RNA polymerases to transcribe rRNA and mRNA.
    c. In eukaryotes, RNA polymerase II binds directly to the DNA promoter and initiates transcription.
    d. Bacteria contain more regulatory sequences than eukaryotes.
    e. Eukaryotes use RNA polymerase III to transcribe ribosomal RNA.

14. In the initiation of the transcription of protein-coding genes in eukaryotes, _______ cannot bind directly to the _______. Initiation requires _______ and other regulatory proteins called “______.”
    a. RNA polymerase I; TATA box; TFIID; transcription factors
    b. RNA polymerase II; initiation site; TFIID; transcription factors
    c. RNA polymerase III; initiation site; TFIID; initiation factors
    d. RNA polymerase I; TATA box; initiation factors; TFIID
    e. TFIID; RNA polymerase I; initiation site; transcription factors
15. Which of the following are not involved in the process of transcription?
   a. RNA polymerase
   b. Transcription factors
   c. Promoters
   d. TATA box
   e. Ribosomes

16. DNA methylation
   a. is important in the development of mammalian embryos.
   b. may repress the transcription of genes.
   c. involves the modification of the pyrimidine cytosine.
   d. is abundant in promoters.
   e. All of the above

17. Epigenetics may be defined as changes in the expression of a gene or set of genes by ______ and ______.
   a. transcription factors; DNA methylation
   b. chromosomal protein alteration; transcription factors
   c. DNA methylation; chromosomal protein alteration
   d. promoters; DNA methylation
   e. promoters; chromosomal protein alteration

18. Which of the following does not regulate gene expression after transcription?
   a. MicroRNA
   b. Translational repressor proteins
   c. Modifications to the G cap
   d. Alternative splicing
   e. All of the above regulate gene expression.

19. An enzyme adds a(n) ______ tag to proteins that are recognized by proteasomes for destruction.
   a. methionine
   b. lactate
   c. ubiquitin
   d. phosphate
   e. methyl

20. Predict what would happen to the synthesis of the enzyme HMG CoA reductase (an enzyme that catalyzes an initial step in the synthesis of cholesterol) if trichostatin A, a histone deacetylase inhibitor, is added to liver cells.
   a. The amount of HMG CoA reductase increases.
   b. The amount of HMG CoA reductase decreases.
   c. The HMG CoA reductase levels do not change.
   d. The HMG CoA reductase undergoes a conformational change and loses function.
   e. None of the above

21. “Sticky ends”
   a. are produced by the action of all restriction enzymes.
   b. form associations with complementary DNA that are very stable.
   c. are the result of staggered cuts of DNA by restriction enzymes.
   d. must interact with each other in the formation of recombinant DNA.
   e. have non-specific base sequences.

22. Restriction enzymes
23. Restriction enzymes
   a. cut single-stranded DNA.
   b. cut double-stranded DNA at any palindromic sequence.
   c. cleave DNA to very small pieces.
   d. cleave double-stranded DNA at specific palindromic sequences.
   e. have been isolated from just a few species of microorganisms.

24. In gel electrophoresis of DNA fragments,
   a. the fragments migrate towards the cathode (negative charge).
   b. the fragments are separated based on their charge differences.
   c. the fragments are separated on the basis of their sizes.
   d. the fragments migrate towards the anode (positive charge) because of the positive charge of the bases.
   e. large fragments migrate more quickly than small fragments.

25. The function of DNA ligase in the generation of recombinant DNA is to
   a. cut DNA.
   b. replicate DNA.
   c. unwind DNA.
   d. join DNA fragments by the formation of phosphodiester bonds.
   e. join DNA fragments noncovalently.

26. Which of the following statements about bacterial antibiotic resistance genes is false?
   a. They are usually present in the bacterial large circular genome.
   b. They were used by Cohen and Boyer in their first recombinant DNA experiments.
   c. They are convenient selectable markers.
   d. They can confer antibiotic resistance to other prokaryotes.
   e. They are importance to medicine.

27. A host cell or organism that contains recombinant DNA is referred to as a _______ cell or organism.
   a. transfected
   b. transformed
   c. transgenic
   d. chimeric
   e. selectable

28. A plasmid
   a. is the bacterial genome.
   b. is a small, circular double-stranded DNA molecule that replicates autonomously.
   c. is only recombinant.
   d. does not code for proteins.
   e. is double-stranded RNA.

29. To replicate within the cells of a host, recombinant DNA must either _______ into the host’s genome or contain a(n) _______. Otherwise the recombinant DNA would not be replicated, since _______ requires specific sequences to bind to DNA.
a. integrate; origin of replication; DNA polymerase
b. integrate; vector; DNA polymerase
c. recombine; origin of replication; DNA ligase
d. recombine; stop transcription signal; DNA polymerase
e. integrate; stop transcription signal; DNA ligase

30. In recombinant DNA technology, _______ may be used as a selectable marker or reporter gene.
a. lacZ
b. the GFP gene
c. tet
(d. amp
(e. All of the above

31. The Ti plasmid
a. is derived from E. coli.
b. replicates in host cells.
c. is useful in introducing foreign DNA into yeasts.
d. is useful in introducing foreign DNA into plants.
e. is of viral origin.

32. cDNA libraries
a. are the same as genomic libraries.
b. include DNA from non-coding sequences.
c. require DNA polymerase to generate.
d. require reverse transcriptase to generate.
e. likely contain all protein-coding genes.

33. What information would you need to design a synthetic gene for a protein to be translated in yeast?
a. Primary structure of the protein and the genetic code
b. Primary structure and secondary structure of the protein, and the genetic code
c. Primary structure of the protein, the genetic code, and promoter sequence
d. Secondary structure of the protein, the genetic code, and promoter sequence
e. Primary structure of the protein and promoter sequence

34. Complementary RNA
a. inhibits transcription.
b. forms hybrids with mRNA to prevent translation.
c. blocks DNA replication.
d. is sense RNA.
e. blocks translation by joining with rRNA.

35. The RNA in RNAi (RNA interference) is
a. single stranded.
b. not made in vivo.
c. relatively stable in cells.
d. capable of binding to specific mRNAs.
e. Both c and d

36. DNA microarrays
a. are used to analyze genomic DNA.
b. determine genes that are transcribed.
c. use oligoribonucleotides as probes.
d. probe noncoding regions of DNA.
e. detect proteins that are translated.

37. Biotechnology may perhaps best be described as
   a. a branch of the science of molecular biology.
   b. its own scientific discipline.
   c. a collection of approaches to the exploitation of living systems to make useful products.
   d. an industry to make products useful to medicine.
   e. an industry to make products useful to agriculture.

38. Recombinant DNA technology is least applicable to which of the following approaches?
   a. The analysis of traits determined by multiple genes
   b. Overexpression of a particular gene
   c. Silencing a particular gene
   d. Knocking out a particular gene
   e. Targeting a protein to the nucleus

39. Suppose that you wanted to express a protein from animal cells using recombinant DNA technology. Why might you prefer to use yeast as the host rather than E. coli?
   a. Posttranslational protein processing in yeasts is similar to that in animals.
   b. Yeast is a multicellular organism.
   c. Yeast has a smaller genome than E. coli.
   d. Yeast is a prokaryote.
   e. Yeast is easier to cultivate than the bacterium.

40. Recombinant DNA technology has produced medically useful products. Most of these products are ______ that are normally present in low amounts in animals and are difficult to ______; ______ vectors are used to obtain these products in large amounts.
   a. hormones; purify; expression
   b. proteins; purify; expression
   c. hormones; detect; plasmid
   d. proteins; detect; plasmid
   e. proteins; purify; plasmid

41. ______ is the production of pharmaceuticals in farm animals or plants.
   a. Pharming
   b. Fishing
   c. Quality control
   d. Manufacturing
   e. Gene expression

42. The use of biotechnological approaches for the improvement of crop plants has been more controversial than their use to prepare medically useful products. Why?
   a. People eat food that could contain transgenes.
   b. Crops are grown outside, and there is a chance that a transgene could escape to other organisms.
   c. Herbicide-resistance could spread to weed species.
   d. Beneficial insects could be harmed by plants expressing the BT toxin.
   e. All of the above
MULTIPLE CHOICE

1. **ANS:** E  
   **PTS:** 1  
   **REF:** Page 209  
   **TOP:** Concept 11.1 Several Strategies Are Used to Regulate Gene Expression  
   **SKL:** 1. Remembering

2. **ANS:** D  
   **PTS:** 1  
   **REF:** Page 209  
   **TOP:** Concept 11.1 Several Strategies Are Used to Regulate Gene Expression  
   **SKL:** 1. Remembering

3. **ANS:** B  
   **PTS:** 1  
   **REF:** Page 210  
   **TOP:** Concept 11.1 Several Strategies Are Used to Regulate Gene Expression  
   **SKL:** 2. Understanding

4. **ANS:** C  
   **PTS:** 1  
   **REF:** Page 210-211  
   **TOP:** Concept 11.1 Several Strategies Are Used to Regulate Gene Expression  
   **SKL:** 4. Analyzing

5. **ANS:** D  
   **PTS:** 1  
   **REF:** Page 211  
   **TOP:** Concept 11.1 Several Strategies Are Used to Regulate Gene Expression  
   **SKL:** 4. Analyzing

6. **ANS:** C  
   **PTS:** 1  
   **REF:** Page 213  
   **TOP:** Concept 11.2 Many Prokaryotic Genes Are Regulated in Operons  
   **SKL:** 1. Remembering

7. **ANS:** D  
   **PTS:** 1  
   **REF:** Page 213  
   **TOP:** Concept 11.2 Many Prokaryotic Genes Are Regulated in Operons  
   **SKL:** 3. Applying

8. **ANS:** C  
   **PTS:** 1  
   **REF:** Page 213  
   **TOP:** Concept 11.2 Many Prokaryotic Genes Are Regulated in Operons  
   **SKL:** 1. Remembering

9. **ANS:** A  
   **PTS:** 1  
   **REF:** Page 213  
   **TOP:** Concept 11.2 Many Prokaryotic Genes Are Regulated in Operons  
   **SKL:** 1. Remembering

10. **ANS:** A  
    **PTS:** 1  
    **REF:** Page 213-214  
    **TOP:** Concept 11.2 Many Prokaryotic Genes Are Regulated in Operons  
    **SKL:** 2. Understanding

11. **ANS:** A  
    **PTS:** 1  
    **REF:** Page 215  
    **TOP:** Concept 11.2 Many Prokaryotic Genes Are Regulated in Operons  
    **SKL:** 1. Remembering

12. **ANS:** E  
    **PTS:** 1  
    **REF:** Page 216  
    **TOP:** Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes  
    **SKL:** 2. Understanding

13. **ANS:** B  
    **PTS:** 1  
    **REF:** Page 216-217  
    **TOP:** Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes  
    **SKL:** 4. Analyzing

14. **ANS:** B  
    **PTS:** 1  
    **REF:** Page 216-217  
    **TOP:** Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes  
    **SKL:** 3. Applying

15. **ANS:** E  
    **PTS:** 1  
    **REF:** Page 216-217
TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
16. ANS: E  PTS: 1  REF: Page 218-219

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
17. ANS: C  PTS: 1  REF: Page 218-220

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 1. Remembering
18. ANS: E  PTS: 1  REF: Page 221-223

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
19. ANS: C  PTS: 1  REF: Page 223

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 1. Remembering
20. ANS: A  PTS: 1  REF: Page 224

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 3. Applying
21. ANS: C  PTS: 1  REF: Page 245

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
22. ANS: E  PTS: 1  REF: Page 245

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
23. ANS: D  PTS: 1  REF: Page 245

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
24. ANS: C  PTS: 1  REF: Page 246

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
25. ANS: D  PTS: 1  REF: Page 247

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 4. Analyzing
26. ANS: A  PTS: 1  REF: Page 247-248

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 2. Understanding
27. ANS: C  PTS: 1  REF: Page 248

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 1. Remembering
28. ANS: B  PTS: 1  REF: Page 249

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 1. Remembering
29. ANS: A  PTS: 1  REF: Page 249

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 4. Analyzing
30. ANS: E  PTS: 1  REF: Page 249-251

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes
SKL: 1. Remembering
31. ANS: D  PTS: 1  REF: Page 249-250

TOP: Concept 11.3 Eukaryotic Genes Are Regulated by Transcription Factors and DNA Changes