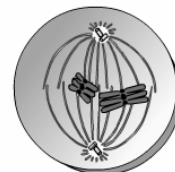


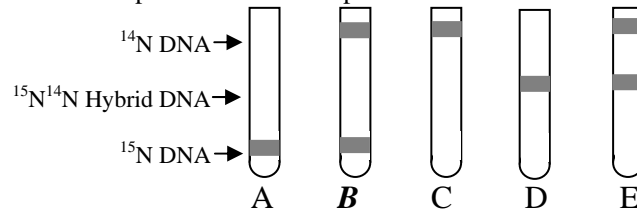
- 1) The function of the cell cycle is to produce daughter cells that:
  - (A.) have the same number of chromosomes as the parent cell but not the same genetic content
  - (B.) have a random assortment of maternal and paternal chromosomes
  - (C.) are genetically identical to the parent cell**
  - (D.) have half the number of chromosomes as the parent cell
  - (E.) none of the above
  
- 2) At which phase of mitosis do dyads separated and move to opposite poles of the cell?
  - (A.) anaphase**
  - (B.) prophase
  - (C.) telophase
  - (D.) cytokinesis
  - (E.) metaphase
  
- 3) Which event normally occurs in meiosis but not in mitosis?
  - (A.) chromosome replication
  - (B.) nuclear membrane disintegration
  - (C.) synapsis of homologous chromosomes**
  - (D.) sister chromatids line up at metaphase plate
  - (E.) movement of chromosomes to opposite poles
  
- 4) A cell entering the cell cycle with 32 chromosomes will produce two daughter cells, each with:
  - (A.) 16 chromosomes
  - (B.) 32 chromosomes**
  - (C.) 32 pairs of chromosomes
  - (D.) 64 pairs of chromosomes
  - (E.) None of the above
  
- 5) The sister chromatids of a dyad are held together at a specific region of the chromosome called:
  - (A.) centriole
  - (B.) centrosome
  - (C.) centromere**
  - (D.) mitotic spindle
  - (E.) chromosome binding site
  
- 6) Which of the following is most directly responsible of the increase of MPF (maturation promoting factor) activity that causes cells to enter mitosis?
  - (A.) the completion of DNA synthesis in S phase
  - (B.) an increase in the concentration of cdk's (cyclin dependent kinases)
  - (C.) an increase in the concentration of cyclin D**
  - (D.) an increase in DNA polymerase activity at the beginning of S phase
  - (E.) all of the above
  
- 7) When we say that an organism is haploid, we mean that \_\_\_\_\_.
  - (A.) its cells each have one chromosome
  - (B.) it has one half of a chromosome
  - (C.) its cells have a single set of chromosomes**
  - (D.) its cells have two sets of chromosomes
  - (E.) none of the above
  
- 8) In which stage of meiosis is the cell diagrammed to the right?
  - (A.) Anaphase II
  - (B.) Telophase/cytokinesis
  - (C.) prophase II
  - (D.) metaphase II
  - (E.) metaphase I**



- 9) A plant with purple flowers is allowed to self-pollinate. Generation after generation, it produces purple flowers. This is an example of what?
- (A.) hybridization
  - (B.) complete dominance
  - (C.) true-breeding**
  - (D.) law of segregation
  - (E.) a polygenic trait
- 10) In pea plants, the long-stem trait (*L*) is dominant and the short-stem trait (*l*) is recessive. Two pea plants were crossed, producing seeds that yielded 165 long-stem plants and 54 short-stem plants. The genotypes of the parent plants were most likely:
- (A.) *Ll* and *LL*
  - (B.) *Ll* and *Ll***
  - (C.) *LL* and *ll*
  - (D.) *ll* and *ll*
  - (E.) none of the above
- 11) What is indicated when a single-character testcross yields offspring that all have the dominant phenotype?
- (A.) The parent with the dominant phenotype was homozygous**
  - (B.) The parent with the dominant phenotype was heterozygous
  - (C.) Epistasis has occurred
  - (D.) The alleles are codominant
  - (E.) Both parents are heterozygous
- 12) The F1 generation differed from the F2 in Mendel's experiments in that \_\_\_\_\_.
- (A.) all of the F1 showed the dominant phenotype, whereas only half of the F2 did
  - (B.) all of the F1 showed the dominant phenotype, but only three-fourths of the F2 did**
  - (C.) all of the F1 showed the dominant phenotype, and all of the F2 showed the recessive phenotype
  - (D.) one-half of the F1 showed the dominant phenotype, and three-fourths of the F2 did
  - (E.) none of the F1 showed the dominant phenotype, but one-half of the F2 did
- 13) A red bull is crossed with a white cow and all of the offspring are roan, an intermediate color that is caused by the presence of both red and white hairs. This is an example of:
- (A.) Nonhomologous chromosomes
  - (B.) Aneuploidy in vertebrates
  - (C.) Codominant alleles**
  - (D.) A polygenic trait
  - (E.) Pleiotropy
- 14) Which of the following matings cannot produce a child with blood type O? The letters refer to blood types (phenotypes).
- (A.) A X A
  - (B.) A X B
  - (C.) O X AB**
  - (D.) O X O
  - (E.) none of the above
- 15) Tay-Sachs disease runs in Rebecca's family. On a family pedigree, she saw a shaded circle. What does this represent?
- (A.) male with Tay-Sachs
  - (B.) female carrier
  - (C.) male carrier
  - (D.) female with Tay-Sachs**
  - (E.) male of unknown genotype

- 16) Which of the following would best illustrate a hemizygous condition?
- (A.) two different alleles of a specific gene in the same individual
  - (B.) alleles in which no dominance is involved
  - (C.) interaction in which one gene affects the phenotypic expression of another
  - (D.) an allele on the X chromosome in a male**
  - (E.) two identical alleles in the same individual
- 17) When the bacterium *Serratia marcescens* is grown on a sterile culture medium in a petri dish at 30°C, the bacterial colonies will be cream colored. When this same bacterium is cultured under identical conditions, except at a temperature of 25°C, the colonies will be brick red. This illustrates that:
- (A.) gene expression is influenced by the environment**
  - (B.) colony size effects the synthesis of color pigments
  - (C.) gene expression is not influenced by biochemical factors
  - (D.) all of the above
  - (E.) none of the above
- 18) In humans, normal color vision ( $N$ ) is dominant over color blindness ( $n$ ). A man and a woman with normal color vision produced two colorblind sons and two daughters with normal vision. The parental genotypes must be:
- (A.)  $NY$  and  $NN$
  - (B.)  $nY$  and  $NN$
  - (C.)  $NY$  and  $Nn$**
  - (D.)  $Nn$  and  $Nn$
  - (E.)  $nY$  and  $nn$
- 19) Which of the following statements best describes the term incomplete dominance?
- (A.) a gene that can be mutated to give partial activity instead of full activity
  - (B.) both of the phenotypic traits are expressed in the heterozygote
  - (C.) heterozygote phenotype is intermediate between the two homozygous parents**
  - (D.) half of each heterozygote is expressed
  - (E.) the recessive trait masks the expression of the dominant trait
- 20) If a trait is polygenic, then:
- (A.) the trait controls many genes
  - (B.) the trait is seen in many individuals
  - (C.) the trait is controlled by several genes**
  - (D.) many different alleles exist for the gene
  - (E.) none of the above
- 21) In people with sickle-cell disease, red blood cells break down, clump, and clog the blood vessels. The blood vessels and the broken cells accumulate in the spleen. Among other things this leads to physical weakness, heart failure, pain, and brain damage. Such a suite of symptoms can be explained by:
- (A.) the polygenic nature of sickle-cell disease
  - (B.) the pleiotropic effects of the sickle-cell allele**
  - (C.) an epistatic interaction between the sickle-cell allele and a proteolytic enzyme gene
  - (D.) bacterial infection interacting with the sickle-cell allele
  - (E.) side effects of the drugs used to cure sickle-cell disease
- 22) Four genes (A, B, C, and D) are on the same chromosome. The recombination frequencies are as follows: A-B: 19%; B-C: 14%; A-C: 5%; B-D: 2%; A-D: 21%; C-D: 16%. Based on this information, which sequence of genes is correct?
- (A.) ABCD
  - (B.) ACDB
  - (C.) DBAC
  - (D.) DCAB
  - (E.) ACBD**

- 23) The role of DNA polymerases in DNA replication is to:
- attach DNA free nucleotides to the new strand**
  - attach RNA free nucleotides to the new strand
  - link together newly synthesized strands
  - separate the two strands of DNA
  - all of the above
- 24) What determines the sequence of newly synthesized strand during DNA replication
- The particular DNA polymerase catalyzing the reaction
  - The relative amounts of the four deoxynucleotides in the cell
  - The nucleotide sequence of the template strand**
  - The primase used by the cell
  - Both A and D
- 25) In a DNA double helix an adenine of one strand always pairs with a(n) \_\_\_\_\_ of the complementary strand, and a guanine of one strand always pairs with a(n) \_\_\_\_\_ of the complementary strand.
- guanine ... adenine
  - cytosine ... uracil
  - cytosine ... thymine
  - thymine ... cytosine**
  - uracil ... cytosine
- 26) Meselson and Stahl grew bacteria in a medium containing heavy nitrogen ( $^{15}\text{N}$ ) and then transferred them to a medium containing  $^{14}\text{N}$ . The DNA was analyzed by density centrifugation. What results would you expect after one round of replication if DNA replication were conservative?



- 27) Which statement about DNA is *false*?
- The sugar in DNA has one less oxygen than that in RNA
  - DNA is a double stranded molecule
  - In DNA, the base uracil replaces thymine**
  - DNA is a polymer made of nucleotide subunits
  - DNA strands are anti-parallel to each other
- 28) The S form of pneumococcus causes the disease pneumonia in mice, while the R form does not. The series of experiments on the R and the S forms of pneumococcus led to the 1944 discovery by Avery, McLeod, and McCarty that:
- the transforming factor for S cells is proteins
  - both R and S forms could cause pneumonia
  - S cells has DNA, but R cells did not
  - R cells could be transformed by phages
  - the transforming factor for R cells is DNA**

- 29) Hershey and Chase used which radioactive nucleotide of which of the following elements to label the protein coat of T2 bacteriophages?
- (A.) **Sulfur**
  - (B.) Carbon
  - (C.) Radium
  - (D.) Phosphorus
  - (E.) Uranium
- 30) Chargaff found that for DNA \_\_\_\_\_.
- (A.) the ratio of A to C is close to 1:1 and the ratio of G to T is close to 1:1
  - (B.) **the ratio of A to T is close to 1:1 and the ratio of G to C is close to 1:1**
  - (C.) the ratio of A to G is close to 1:1 and the ratio of T to C is close to 1:1
  - (D.)  $A + T = G + C$
  - (E.)  $A + T = 50\%$  of the total bases
- 31) Genetic information of eukaryotic cells is transferred from the nucleus to the cytoplasm in the form of:
- (A.) DNA
  - (B.) **RNA**
  - (C.) lipids
  - (D.) proteins
  - (E.) carbohydrates
- 32) The correct order of molecules involved in protein synthesis is:
- (A.) DNA, messenger RNA, transfer RNA
  - (B.) messenger RNA, transfer RNA, DNA, polypeptide
  - (C.) transfer RNA, polypeptide, DNA, messenger RNA, DNA
  - (D.) DNA, messenger RNA, polypeptide, transfer RNA
  - (E.) **DNA, messenger RNA, transfer RNA, polypeptide**

For questions# 33-37, refer to the following DNA sequence and the Genetic Code table.

5' TTTTACTATCGTACAGTTTGCATA 3'

- 33) If this sequence is used as a template during DNA replication, what sequence would be generated?
- (A.) TTTTACTATCGTACAGTTTGCATA
  - (B.) **AAAATGATAGCATGTCAAACGTAT**
  - (C.) AAAAUGAUAGCAUGUCAAAACGUAU
  - (D.) UUUUACUAUCGUACAGUUUGCAUA
  - (E.) none of the above
- 34) If this sequence were used as a template during transcription, what sequence would be generated?
- (A.) TTTTACTATCGTACAGTTTGCATA
  - (B.) AAAATGATAGCATGTCAAACGTAT
  - (C.) **AAA AUGAUAGCAUGUCAAAACGUAU**
  - (D.) UUUUACUAUCGUACAGUUUGCAUA
  - (E.) none of the above
- 35) Which is the correct sequence of amino acids that would be *translated* from the above sequence?
- (A.) Lys-Met-Ile-Ala-Cys-Gln-Thr-Tyr
  - (B.) Phe-Tyr-Tyr-Arg-Thr-Val-Cys-Ile
  - (C.) **Met-Ile-Ala-Cys-Gln-Thr-Tyr**
  - (D.) Met-Phe-Tyr-Tyr-Arg-Thr-Val-Cys-Ile
  - (E.) none of the above

- 36) What would be the result if the 9<sup>th</sup> base was mutated from a T to a C?  
(A.) the protein would not be functional  
(B.) The protein would be several amino acids shorter  
(C.) **The protein would be the same except for one amino acid substitution**  
(D.) The mRNA would change but the protein would be unaffected  
(E.) none of the above
- 37) The type of mutation described in #36 is known as a:  
(A.) nonsense mutation  
(B.) frame-shift mutation  
(C.) silent mutation  
(D.) translocation mutation  
(E.) **missense mutation**
- 38) In eukaryotic cells, transcription cannot begin until:  
(A.) the two DNA strands have completely separated and exposed the promoter  
(B.) **several transcription factors have bound to the promoter**  
(C.) the 5' caps are removed from the mRNA  
(D.) the DNA introns are removed from the template  
(E.) DNA nucleases have isolated the transcription unit
- 39) Which of the following mutations would be *most* likely to have a harmful effect on an organism?  
(A.) a base-pair substitution  
(B.) a single nucleotide deletion in the middle of an intron  
(C.) a deletion of three nucleotides near the middle of a gene  
(D.) a single nucleotide deletion near the end of the coding sequence  
(E.) **a single nucleotide insertion downstream of, and close to, the start of the coding sequence**
- 40) Which of the following is *not* true of RNA processing?  
(A.) **Exons are cut out before mRNA leaves the nucleus.**  
(B.) Nucleotides may be added at both ends of the RNA.  
(C.) Ribozymes may function in RNA splicing.  
(D.) RNA splicing can be catalyzed by spliceosomes.  
(E.) A primary transcript is often much longer than the final RNA molecule that leaves the nucleus.
- 41) Which of the following is true for both prokaryotic and eukaryotic genes?  
(A.) After transcription a polyA tail is added to the 3' end of the mRNA  
(B.) Translation of the mRNA begins before transcription is complete  
(C.) RNA polymerase binds directly to the promoter sequence  
(D.) mRNA is synthesized in the 3' – 5' direction  
(E.) **None of the above**
- 42) A bacterium can make the amino acid glycine or absorb it from its surroundings. A biochemist finds that glycine binds to a repressor protein and causes the repressor to bind to the bacterial chromosome, turning off an operon. If it is like other operons, the presence of glycine will result in the \_\_\_\_\_.  
(A.) inhibition of bacterial cell division  
(B.) breakdown of glycine  
(C.) **stopping of the synthesis of glycine**  
(D.) formation of sex pili  
(E.) production of the repressor protein
- 43) What would occur if the repressor of an inducible operon were mutated so it could not bind the operator?  
(A.) **continuous transcription of the operon's genes**  
(B.) reduced transcription of the operon's genes  
(C.) buildup of a substrate for the pathway controlled by the operon  
(D.) irreversible binding of the repressor to the promoter  
(E.) overproduction of catabolite activator protein (CAP)

- 44) Why are viruses described as obligate parasites?  
(A.) **They can not reproduce outside of the host cell**  
(B.) Viral DNA always inserts itself into the host DNA  
(C.) They invariably kill any cell they infect  
(D.) They can incorporate nucleic acids from other viruses  
(E.) The virus must use enzymes encoded by the virus to replicate.
- 45) What would be the result if the *trp* repressor were mutated so that it could not bind tryptophan?  
(A.) the repressor would always be bound to the operator  
(B.) the levels of typtophan in the cell would decrease  
(C.) **the cell would not be able to catabolize tryptophan**  
(D.) transcription of the *trp* operon would increase.  
(E.) all of the above
- 46) Gene duplication can ultimately give rise to all of the following **except**:  
(A.) Pseudogenes  
(B.) structurally related genes with entirely different functions  
(C.) two closely related versions of a gene that are expressed in different tissues, or at different times during development  
(D.) **groups of genes with identical functions, but entirely unrelated sequences**  
(E.) groups of identical genes that are expressed together
- 47) Promoters for eukaryotic mRNA synthesis:  
(A.) are more complex than prokaryotic promoters  
(B.) can require binding of multiple transcription factors to form a transcription complex  
(C.) have specific DNA sequences such as the "TATA" box that are recognized by proteins  
(D.) are the stretches of DNA to which RNA polymerase binds to initiate transcription  
(E.) **all of the above**
- 48) Which of the following statements about the DNA in one of your brain cells is true?  
(A.) **Some DNA sequences are present in multiple copies**  
(B.) Most of the DNA codes for protein  
(C.) The majority of genes are likely to be transcribed  
(D.) Each gene lies immediately adjacent to an enhancer.  
(E.) Many genes are grouped into operon-like clusters.
- 49) What makes a liver cell different from a heart cell?  
(A.) operons of liver genes are turned on  
(B.) chromatin near liver genes is de-acetylated  
(C.) presence of liver specific *cis* elements in liver cells  
(D.) **presence of liver specific *trans* factors in liver cells**  
(E.) presence of an RNA polymerase that is specific for liver genes
- 50) Which of the following is true of gene regulation in both eukaryotes and prokaryotes?  
(A.) Packing of DNA in chromosomes is elaborate  
(B.) **Transcription is the usual point at which gene expression is regulated**  
(C.) A cap and a tail are added to mRNA.  
(D.) Genes are organized into operons  
(E.) Noncoding portions of RNA are removed in the making of mRNA.