The examples of the questions for SMC № 4

1. Which one of the following statements is FALSE?

    a. A post-translationally modified amino acid might be detected in a eukaryotic protein isolated from animal tissue.
    b. A post-translationally modified amino acid is formed by a modifying enzyme that has as its substrate a specific amino acid within a protein as synthesized by the ribosome.
    c. Post-translationally modified amino acids are relatively rare; the only known examples are 3- and 4-hydroxy proline, γ-carboxyglutamate, and phosphoserine.
    d. Post-translationally modified amino acid residues are sometimes required to endow a particular protein with its structure and/or function.
    e. Post-translationally modified amino acids are not specified directly by messenger RNA (mRNA).

2. Which one of the following statements concerning the structure of cellular DNA is FALSE?

    a. It is a right handed double stranded helix.
    b. The monomers are called nucleotides and consist of a sugar, a phosphate, and one of the bases adenine, guanine, cytosine, or thymine.
    c. The strands are joined by hydrogen bonds between the bases.
    d. Adenine is paired to thymine and cytosine is paired to guanine
    e. The strands are defined as antiparallel based on the orientation of their glycosidic linkages.

3. What would happen if a DNA polymerase tried to extend a chain of normal DNA by adding a 2' 3' dideoxynucleoside 5' triphosphate. (This would look just like a normal dNTP but in addition to lacking the 2' OH group it would also lack the 3' OH group).

    a. It would be impossible to make a phosphodiester bond to the end of the normal DNA if the incoming nucleotide was missing its 3' OH group.
    b. Long stretches of DNA might be synthesized lacking 3' OH groups.
    c. One such nucleotide might be added, but there would be no place to link the next nucleotide. So synthesis would have to stop after one addition.
    d. The phosphodiester backbone could be formed, but there would be no place to join the bases.
    e. This would produce RNA.

4. The (diploid) human genome consists of _____.

    a. 46 circles of double stranded DNA
    b. 46 linear chromosomes of double stranded DNA
    c. one small chromosome for each of 23,000 genes
    d. one big circle of double stranded DNA
    e. one long double stranded piece of DNA

5. Oncogenes were originally discovered as virus borne genes that would drive cancerous growth of infected cells. Are viruses involved in most human cancers; and what is the relationship of oncogenes to most cancer?

a. Yes; an increasing array of viruses carrying oncogenes has been found explaining most human cancers.
b. No; the oncogene hypothesis has been disproven.
c. No; but oncogenes have been found to be acquired by eating cancerous meat.
d. No; but oncogenes have been found to be spontaneously created by mutation of normal human genes.
e. Yes; but viruses are responsible for causing most cancers by means other than carrying oncogenes.

6. Some blood disorders are treated with a protein named erythropoietin produced from a cloned human gene. The clone was likely to have been _____.

a. an R factor
b. an oncogene
c. a cDNA clone
d. a tumor suppressor
e. a nonsense mutant

7. Long double stranded RNA helixes do not generally exist in eucaryotic cells because _____.

a. RNA can not form a double helix because of the 2' OH group
b. RNA can not form a double helix because uracil can not form a base pair
c. RNA polymerase is directed to only copy one strand of each gene
d. the temperature is too high
e. None of the above

8. Some aminoacyl tRNAs are allowed to "wobble" at the ribosome, translating more than one codon. As a result _____.

a. fidelity is lost during translation
b. the wobbling tRNA is rejected without incorporating its amino acid
c. the ribosome shifts to a new frame
d. translation proceeds normally because the wobble is consistent with the degeneracy of the genetic code
e. incorrect amino acids are incorporated, but then removed by a proofreading process

9. Which one of the following substances is known to bind a receptor which is also a transcription factor in human cells?

a. steroid hormones
b. lactose
c. sigma factor
d. releasing factor
e. aminoacyl tRNA

10. Which one of the following eucaryotic mRNA processing steps is INCORRECTLY paired with its function?

a. Capping - used to help associate an mRNA with the ribosome
b. Splicing - done in alternative patterns to produce different versions of a protein
c. Polyadenylation - used to prevent an mRNA from being translated
d. Transport - refers to moving the mRNA from nucleus to the cytoplasm
e. Degradation - may be regulated to control the resulting protein levels

11. To test a "candidate" gene for a human genetic disorder would generally require _____.

a. sequencing of the gene from normal and affected individuals
b. nucleic acid hybridization experiments
c. breaking a new genetic code
d. a very large family in which the disorder was descending
e. examination of an EST library

12. Which one of the following reactions are carried out by aminoacyl tRNA synthetases?

a. Amino acid + ATP -> aminoacyl AMP + PPi; Aminoacyl AMP + tRNA -> aminoacyl tRNA + AMP
b. Precursor tRNA -> mature tRNA
c. cytoplasmic aminoacyl tRNA -> ribosome bound aminoacyl tRNA
d. peptidyl tRNA + aminoacyl tRNA -> longer peptidyl tRNA + uncharged tRNA
e. methionyl tRNA + ribosomal subunits -> initiated ribosome

13. Which one of the following is NOT a step in the ribosome elongation cycle and the associated EF-Tu factor cycle?

a. Elongation factor EF-Tu delivers an aminoacyl tRNA to an empty A site.
b. The aminoacyl tRNA is rejected unless it satisfactorily base pairs with the codon in the A site.
c. EF-Tu cleaves GTP in coordination with a successful delivery of the aminoacyl tRNA
d. Peptidyl transferase transfers a peptide from the peptidyl tRNA to the amino group of an aminoacyl tRNA.
e. The ribosome translocates 1 codon towards the 5' end of the mRNA.

14. Which one of the following statements about the signal peptide pathway is FALSE?

a. For proteins destined for secretion, a signal peptide is encoded at the 5' end of the coding region of the mRNA.
b. Synthesis of the signal peptide causes the elongation cycle to pause while the ribosome docks to the endoplasmic reticulum.
c. The elongation cycle resumes while the polypeptide is injected into the ER.
d. The signal peptide is removed in the ER.
e. Only secreted proteins follow this pathway. Membrane and cytoplasmic proteins are both handled differently.

15. Consider a protein derived from a previously uncharacterized human cDNA clone, expressed in *E. coli*, and purified by methods not requiring a biochemical assay for the human protein. If a biochemical assay for the activity of the protein became available, it would enable finding which of the following kinds of information?

a. how much active protein was present in a given sample
b. if a given mutation damaged the activity of the protein
c. which tissues contained the activity
d. whether a drug inhibited the activity of the protein
e. all of the above

16. Which one of the following statements about the structure of cellular DNA is FALSE?

a. It is double stranded helix with antiparallel polynucleotide chains.
b. Bases are paired with A opposite T and G opposite C.
c. The strands are held together by hydrogen bonds, and can be separated by heating.
d. The linkage holding nucleotides together joins carbon 1 to carbon 5 of adjacent deoxyribose moieties.
e. The genetic information is encoded in the sequence of bases.

17. The complement of the sequence GACTACT is _____. [Remember to apply the convention for the direction in which sequence is written].

a. AGTAGTC
b. CTGATGA
c. TCATCAG
d. GACTACT
e. TACTGAC

18. During replication of the lagging strand, _____.

a. DNA polymerase adds nucleotides to the 5' end of the growing chain instead of the 3' end.
b. a different DNA polymerase is needed
c. the new strand is synthesized continuously from one end of a chromosome to the other
d. a different phosphodiester sterioisomer is used to connect the nucleotides
e. fragments of DNA are synthesized in the reverse direction of fork movement, and joined together to make a continuous chain

19. Molecular cloning of a human gene _____.

a. often involves making cDNA
b. may allow production of the encoded protein in bacteria
c. is often followed by determining the sequence of the gene
d. facilitates using the DNA as a hybridization probe
e. all of the above

20. Nucleic acid hybridization was used to _____.

a. demonstrate that DNA replication is semi-conservative
b. establish that normal cells have DNA sequences similar to some viral oncogenes
c. show that replication occurs 5' to 3'
d. establish that DNA replication is discontinuous
e. discover restriction enzymes

21. Which one of the following statements about oncogenesis is FALSE?

a. Most carcinogens are mutagens.
b. A key event in initiation of cancer often is the mutation of a protooncogene.
c. A protooncogene is involved in regulating cell reproduction, and an oncogene is a mutated version that drives inappropriate reproduction.
d. An end-stage malignant cancer cell differs from a normal cell by a single mutation.
e. The cell contains protective systems to repair DNA damage and prevent mutation.

22. RNA differs from DNA by _____.

a. a substitution of uracil (U) for thymine (T)
b. being unable to form a double helix
c. having a deoxy 3' carbon
d. being synthesized in the 3' to 5' direction instead of the 5' to 3' direction
e. by being synthesized from nucleoside diphosphates instead of nucleoside triphosphates

23. Which one of the following statements about the classic case of transcriptional regulation of the lac operon in *E. coli* is FALSE?

a. The effect of the regulation is to maintain expression of the operon at a constant level.
b. The lac promoter is a sequence were RNA polymerase binds and initiates transcription.
c. The lac repressor binds near the promoter and prevents RNA polymerase from initiating transcription.
d. The lac repressor is allosterically induced to leave the DNA by lactose or a molecule derived from lactose.
e. Mutations causing the lac operon to be expressed constitutively are found in the gene for the lac repressor.

24. Transcriptional regulation of a eucaryotic gene ____.

a. bears no resemblance to bacterial gene regulation
b. is not influenced by the presence of histones
c. is based on sigma factors
d. is not involved in cellular differentiation
e. may involve many transcription factors acting at the same time to influence the rate of initiation at the promoter

25. Which one of the following statements about the genetic code is FALSE?

a. An amino acid is specified by 3 consecutive nucleotides called a codon.
b. There is an A in the third position of every codon to prevent translation in the wrong frame.
c. The code has a few special codons that cause the ribosome to stop and release the finished polypeptide.
d. Is either the same or nearly the same in all known organisms.
e. Is said to be "degenerate" because more than one codon encodes the same amino acid.

26. By comparing the sequences of Expressed Sequence Tags (ESTs) to the human genomic sequence, it may be observed that _____.

a. multiple transcription factors regulate each gene
b. human chromosomes are circular
c. some genes are spliced in several alternative patterns
d. DNA replication is bidirectional
e. transcripts have a modified 5' end called a CAP

27. Other than codon/anticodon recognition, which one of the following is critical for enforcing fidelity of translation? "Fidelity" in this sense means avoiding inserting incorrect amino acids.

a. 5' capping of the mRNA
b. the reaction catalyzed aminoacyl-tRNA synthetases
c. the reaction catalyzed by releasing factors
d. the reaction catalyzed by peptidyl transferase
e. the use of a separate initiator methionyl tRNA from the methionyl tRNA used during elongation.

28. A peptidyl tRNA is found _____.

a. always in the ribosomal A site
b. always in the ribosomal P site
c. in the A site before translocation, and in the P site after translocation
d. in the P site before translocation, and in the A site after translocation
e. free in the cytoplasm after termination of translation

29. A gene for a secreted protein in the human genome database has the first 20 codons marked as a "pre" sequence. If the gene was altered to remove all of these codons except the initiator codon, the resulting effect would most probably be that _____.

a. the gene could not be transcribed
b. the message could not be translated
c. the protein would be produced in the cytoplasm
d. the protein would be secreted in a prematurely active form
e. the protein would be secreted in an inactive form

30. There are two pathways that can synthesize purines, the *de novo* pathway and the salvage pathway. Which one of the following statements about the relationship between these two pathways is FALSE?

a. Some cells make excess purine by the *de novo* pathway.
b. Some cells apparently depend on the salvage pathway for their purine supply.
c. The salvage pathway is not important since knocking it out in transgenic mice causes no obvious symptoms.
d. Dietary purines do not flow into either pathway.
e. Misregulation of the *de novo* pathway is involved in some cases of gout.

31. Adenosine deaminase (ADA) deficiency is the first disease successfully treated by gene therapy. Which one of the following statements about this is FALSE?

a. ADA normally functions to clear trace amounts of adenosine and deoxyadenosine from the blood stream.
b. If deoxyadenosine is allowed to accumulate, it is taken up by lymphocytes, converted to dATP, and then inappropriately feedback inhibits making the other three deoxynucleoside triphosphates.
c. During gene therapy, some hemopoetic stems cells from the patient were repaired *in vitro* and returned to the bone marrow.
d. The suppressive effect of deoxyadenosine build-up on replication favored the replication of the repaired stem cells over the defective ones and caused them to eventually take over the generation of the patient's blood cells.
e. This method is directly applicable to treating Lesch Nyhan Syndrome.

32. The term "beta lactam" refers to _____.

a. all antibiotics derived from the mold, *Beta lactamus*
b. all antibiotics inhibiting the enzyme transglycosylase
c. all antibiotics with a 4 member ring mimicking the dipeptide D-Ala-D-Ala
d. all antibiotics that interfere with cell wall synthesis
e. the resistance factor produced by penicillin resistant bacteria

33. Methicillin is a penicillin derivative designed to avoid the action of beta-lactamase. Methicillin-resistant *Staphylococcus aureus* (MRSA) usually resists methicillin by _____.

a. pumping it out of the cell
b. existing without a cell wall
c. making a thicker cell wall
d. making an altered beta-lactamase
e. avoiding DNA synthesis

34. New isolates of methicillin-resistant *Staphylococcus aureus* (MRSA) are most often found in hospitals. This is because _____.

a. many patients are treated with antibiotics in hospitals
b. MRSA only infects people who are already sick
c. MRSA is more resistant to disinfectants used in hospitals than are other bacteria
d. hospital food is derived from cattle that were fed antibiotics
e. MRSA is deliberately spread in hospitals to suppress other bacteria

35. Which one of the following is NOT caused by R factors?

a. increased incidence of strains of bacteria resistant to multiple antibiotics
b. increased incidence of viral infections
c. use of one antibiotic causing increased resistance to a different antibiotic
d. appearance of several antibiotic resistance genes on a small plasmid
e. spread of antibiotic resistance from nonpathogenic species to pathogenic ones

36. Post-translationally modified amino acids _____.

a. are formed by modifying enzymes and then incorporated into proteins by the ribosome
b. are typically of a different chirality relative to that of the other 20 common amino acids
c. are formed by a second subunit of the ribosome with enzymatic activity capable of catalyzing these types of modifications
d. might confound traditional chemical approaches used for the determination of protein primary sequences
e. are incorporated at a specific position depending whether or not they are specified by a codon for a non-modified or modified form of the amino acid

37. Which one of the following statements about DNA structure is FALSE?

a. Cellular DNA is double stranded, with the strands associated by hydrogen bonds between nucleotide bases.
b. The genetic information is carried in the sequence of the bases.
c. The two strands are organized such that each contains an identical sequence.
d. Bases pair such that A pairs with T and G pairs with C.
e. The two strands are antiparallel in the sense that the 5'/3' orientation of phosphodiester bonds in one strand runs opposite to the other.

38. During DNA replication, what does it mean to be "lagging"?

a. The DNA polymerase is moving in the opposite direction from the replication fork, and must synthesize the strand in a series of discontinuous segments.
b. The concentration of dNTPs is low, causing DNA polymerase to move slowly.
c. The fork moving clockwise around the genome moves more slowly than the one moving counterclockwise.
d. Due to poor nutrition, replication has slowed down.
e. Replication has slowed down passing through an actively transcribed gene.

39. What is the complement of 5'-TAG-3' ?

a. 5'-TAG-3'
b. 5'-GAT-3'
c. 5'-CTA-3'
d. 5'-ATC-3'
e. Since 5'-TAG-3' is a stop codon, it has no complement.

40. Which one of the following is NOT a current capability of recombinant DNA technology?

a. Turning a small amount of DNA into a large amount for diagnosis or analysis by *in vitro* replication (called PCR or the Polymerase Chain Reaction).
b. Expressing the protein encoded by a human gene within a bacterial cell.
c. Creating new species of animals by recombining the DNA from two other species.
d. Creating a mouse with a predetermined genetic defect.
e. Determining the species of bacterial pathogen in a sample (by nucleic acid hybridization).

41. Which of the following occur during oncogenesis (cancer)?

a. Normal genes called proto-oncogenes are mutated to become oncogenes.
b. Oncogenes drive cells to replicate too rapidly.
c. Genes that protect against mutation are lost or destroyed by mutations.
d. Genes that protect against over replication of cells are lost or destroyed by mutation.
e. all of the above; oncogenesis is a multistep process.

42. A major difference between the use of RNA in procaryotes and eucaryotes is that _____.

a. in procaryotes RNA contains T (thymine), but in eucaryotes it contains U (uracil).
b. in procaryotes RNA is usually double stranded, but in eucaryotes it is usually single stranded.
c. production of messenger RNA is highly regulated in procaryotes, but not in eucaryotes.
d. in eucaryotes, but not procaryotes, segments of mRNA are spliced out before translation.
e. none of the above; there are no differences in how RNA is used between eucaryotes and procaryotes.

43. Does it ever happen that a protein functions to stimulate its own transcription?

a. Yes; a transcription factor that specifies a differentiated cell state may stimulate its own transcription as a means of maintaining that state.
b. Yes; all proteins stimulate their own transcription if their concentration is too low.
c. No; this would lead to an unregulatable cycle.
d. No; proteins are never involved in stimulating transcription.
e. No; transcription is not regulated.

44. What does knowing the genetic code allow us to do in the absence of other data?

a. predict the sequence of a protein from the sequence of its cDNA

b. determine the antigen-binding specificity of an antibody
c. predict the K_m of an enzyme
d. predict the tissues in which a gene will be expressed
e. all of the above

45. To quickly predict the function of a newly discovered gene from its sequence, one would _____.

a. calculate the isoelectric point of the encoded protein
b. use Chargaff's rules
c. compare the sequence of the encoded protein to all proteins of known function, and hope to find one with a similar sequence.
d. determine the tertiary structure of the protein.
e. use nucleic acid hybridization

46. Comparison of sequenced human cDNAs to the sequenced genome has revealed _____.

a. the presence of an alternative genetic code in many genes
b. the presence of alternative splicing for many genes
c. that there was a much higher number of human genes than had previously been anticipated
d. that there were no human genes beyond those for which a function is already known
e. that the prior concept that human genes were often in families was false

47. Which one of the following biological processes does NOT require a net input of energy?

a. Synthesizing a protein
b. Synthesizing ATP
c. Increasing the rate of a chemical transformation by an enzyme
d. Replicating DNA
e. Transcribing messenger RNA (mRNA)

48. Which one of the following processes would occur in eucaryotes, but NOT procaryotes?

a. DNA replication
b. Transcription factor binds a promoter to initiate transcription
c. Messenger RNA (mRNA) is translated by the ribosome
d. Metabolic energy is derived by catabolism of fuel molecules
e. Secretory granules fuse with the plasma membrane

49. The structure of a polynucleotide chain consists of nucleotides linked to each other by _____.

a. 5’ to 2’ phosphodiester bonds

b. 5’ to 3’ phosphodiester bonds
c. 5’ bonds for one strand of a double helix and by 3’ bonds on the other strand
d. triphosphate bonds
e. glycosidic bonds

50. Which one of the following statements about replication is FALSE?

a. Hydrogen bonds are broken and the parental DNA strands are separated at a replication fork.
b. There is a separate DNA polymerase for each strand: one that works 5’ to 3’ and one that works 3’ to 5’.
c. An RNA polymerase named primase is used to create short sections of RNA that acts as a primer for DNA polymerase to extend.
d. An enzyme named DNA ligase is required to create the final link in the backbone between adjacent synthesized segments of DNA.
e. The process is said to be “semi-conservative”.

51. Which one of the following was NOT a product of molecular cloning?

a. production of recombinant proteins for use as drugs
b. the sequencing of cDNA for many human genes
c. the original determination of the genetic code
d. the discovery of oncogenes
e. the exploration of gene therapy

52. Which of the following factors may be involved in causing a particular cancer?

a. A mutation may activate a proto-oncogene to an oncogene.
b. A mutation may destroy a gene that protects against runaway cell growth or that repairs damage to DNA.
c. A virus may introduce an oncogene into a cell.
d. A patient may inherit a defect in a protective gene.
e. All of the above

53. Which one of the following technologies is used to determine the DNA sequence of a gene in a large number of patients?

a. cDNA cloning
b. nucleic acid hybridization
c. restriction enzyme cleavage
d. DNA ligation
e. the polymerase chain reaction (PCR)

54. Which one of the following is COMMON TO BOTH replication and transcription?

a. the requirement for a primer
b. the reaction features a 3’ OH displacing a PP_i group to form a phosphodiester bond.

c. the sugar in the added nucleotides
d. the identity of the 4 bases in the newly synthesized chain
e. the direct production of double helix as a product

55. Which one of the following properties is SHARED by transcriptional regulation of procaryotes and eucaryotes?

a. Proteins called transcription factors bind to specific sites in DNA and influence the transcription of nearby genes.
b. Sometimes histones have to be "remodelled".
c. It is common for a regulatory protein to bind its effector in the cytoplasm and then transfer to the nucleus and regulate transcription.
d. Sometimes alternative splicing is involved.
e. The overall level of complexity in terms of the number of factors involved to regulate an individual gene is about the same.

56. In order to efficiently use the candidate gene strategy to identify the gene underlying a genetic defect, it is necessary to have _____.

a. a large collection of cDNA clones
b. patient consent to conduct gene therapy
c. nucleic acid hybridization probes for the genes to be tested
d. enough sequence of the genes to be tested to make PCR primers
e. a large family in which the genetic disease is descending

57. A single nucleotide insertion in the coding region of a gene would result in ____.

a. a missense mutation and likely a mild phenotype
b. a frameshift and likely a nonfunctional gene product
c. a nonsense mutation and likely a severe phenotype
d. an altered promoter
e. either a defect in the gene product or no defect, depending on the degeneracy of the affected codon.

58. Why is methotrexate used as an anticancer drug?

a. It functions as a competitive inhibitor for the enzyme thymidylate synthase.
b. It inhibits the enzyme dihydrofolate reductase, thus interfering in the catalytic cycle in which deoxythymidine-5'-phosphate is synthesized.
c. It functions as a competitive inhibitor for enzymes involved in synthesis of the purine ring.
d. It stimulates transcription of a gene encoding a tumor suppressor protein that inhibits the growth and proliferation of cancer cells.
e. It inhibits the enzyme that synthesizes N^{10}-formyl-FH_4 from FH_4, formate, and ATP.

59. What role does tRNA play in translation?

a. It is charged with a specific amino acid by an aminoacyl-tRNA synthetase, and then after carrying the amino acid to the ribosome it recognizes the corresponding codon by base pairing.
b. It is a component of the ribosome that catalyzes formation of peptide bonds.
c. It catalyzes hydrolysis of one GTP for each amino acid addition, thus lending direction and energy to the elongation cycle.
d. It encodes a special peptide used to direct secretion.
e. It is required for the recognition of stop codons to bring about termination of translation.

60. What roles do the A site and the P site play during translation?

a. These are sites on the ribosome where two protein factors bind, named the A and the P factors.
b. These are two sequences found on mRNA required to properly initiate translation.
c. These are two sites within the ribosome occupied by an aminoacyl-tRNA and a peptidyl-tRNA ready for peptide bond formation.
d. The A site is where aminoacyl-tRNA enters the ribosome during initiation; and the P site is where aminoacyl-tRNAs enter during elongation.
e. The A site is also called the anticodon, and the P site is the part of a peptidyl-tRNA that joins to a peptide.

61. Which one of the following statements about translation of secreted proteins is FALSE?

a. The gene encoding the secreted protein includes the information specifying secretion.
b. The nascent N-terminus of a secreted protein is called a “signal peptide”.
c. The presence of a nascent signal peptide causes translation to pause, and then the ribosome to dock with the endoplasmic reticulum.
d. After completion of translation of a protein to be secreted, its signal peptide causes it to be transferred from the cytoplasm to the endoplasmic reticulum.
e. The prefix “pre” is added to the beginning of the name of a protein sequence to indicate that a signal peptide is included.

62. Gout is caused by excessive serum urate. How does high serum urate come about in purine metabolism?

a. It is only caused by excessive purines in the diet.
b. It is only caused by excessive purine synthesis.
c. Gout may be contributed to by excessive purine synthesis as well as the amount of purines in the diet.
d. Gout is caused by a deficiency in the enzyme xanthine oxidase.
e. Gout is not related to purine metabolism.

63. Which one of the following statements about Lesch-Nyhan syndrome is FALSE?

a. It is caused by an inherited deficiency in the enzyme hypoxanthine phosphoribosyl transferase (HPRT).
b. The gene responsible is X-linked and therefore only males get Lesch-Nyhan syndrome.
c. Current theory says that certain brain cells require purine salvage to maintain their purine levels, and if deprived they malfunction and cause the characteristic neurological symptoms of the disease.
d. There is also a tendency for high serum urate levels which can be controlled with the drug allopurinol.
e. Allopurinol alleviates symptoms of the disease by acting as a neurotransmitter.

64. Adenosine deaminase (ADA) deficiency has been successfully treated by gene therapy. Which one of the following factors was found to be helpful in this achievement?

a. A genetically altered herpes virus was used to seek out lymphocytes and deliver a new ADA gene to them.
b. Whole body radiation was used to kill all the indigenous bone marrow so that genetically engineered bone marrow could replace it.
c. By genetically knocking out the synthesis of adenosine, the need for adenosine deaminase was eliminated.
d. Since high serum adenosine kills off the patient's stem cells, a small number of genetically repaired cells were able to eventually take over bone marrow function.
e. By genetically knocking out the synthesis of the enzyme ribonucleotide reductase, the metabolic derangement was reversed.

65. Which one of the following statements about β-lactam antibiotics is TRUE?

a. They are analogues of the prototypical antibiotic tetracycline.
b. They are all based on a chemical structure featuring a four membered ring.
c. They are the last line of defense after there is antibiotic resistance to all the penicillin derivatives.
d. They are all classified as illegal drugs.
e. They all inhibit the enzyme β-lactamase.

66. Penicillin inhibits the enzyme glycopeptide transpeptidase. This causes ____.

a. cessation of translation due to ribosome malfunction
b. lysis due to cell wall defects
c. resistance to a whole class of antibiotics
d. hyperimmunity
e. bacterial death due to an overabundance of glycopeptide

67. Which one of the following statements about multiple antibiotic resistance is FALSE?

a. The antibiotic resistance genes tend to be carried by an R-factor.

b. An R-factor is a plasmid which may be able to transmit itself from one species of bacteria to another.
c. R-factors with many resistance genes are particularly common in hospital-acquired infections.
d. R-factor-mediated antibiotic resistance is a common factor leading to death by infectious disease.
e. To keep the incidence of R-factor-mediated antibiotic resistance down, it is desirable to apply a continuous dose of antibiotics to all hospital staff.