Chapter 1: Introduction

Multiple-Choice Questions:

Level I

1. Which two populations account for the greatest difference in reference intervals?
    a. Adults and 12-year-olds
    b. Newborns and 12-year-olds
    c. Newborns and adults
    d. Whites and blacks

Correct answer: C

(Objective 1)

2. What component of plasma assists in the transport of bilirubin?
    a. Enzymes
    b. Hydrogen
    c. Calcium
    d. Albumin

Correct answer: D

(Objective 3)

3. When bilirubin is increased above the reference range, what disease process should be suspected if liver disease is ruled out?
    a. Increased osmotic pressure
    b. Hormone imbalance
    c. Decreased albumin
    d. Increased metabolism of hemoglobin

Correct answer: D

(Objective 3)

4. Which of the following can explain a decrease of erythrocytes?
    a. Blood loss
    b. Infection
    c. Dehydration
    d. Neutropenia

Correct answer: A

(Objective 4)

5. Platelets and coagulation proteins are circulating components responsible for what process?
    a. Hemolysis
    b. Hemostasis
    c. Normal cell production
    d. Immune defense

Correct answer: B

(Objective 2)

6. The focus of a clinical pathway is on changing structure and processes to achieve what goal?
    a. Provide assistance in difficult diagnostic cases
    b. Provide better patient outcomes
    c. Develop better communication among the health care team

d. Decrease laboratory test utilization

Correct answer: B

(Objective 5)

7. Under Medicare for laboratory testing, what codes are used for billing purposes?

    a. Fee for service

    b. Prospective payment service

    c. Current procedural terminology

    d. Capitated payment plan

Correct answer: C

(Objective 5)

8. Under a capitated payment plan, the provider is decided upon by whom?

    a. The insurer

    b. The consumer or patient

    c. Health care organizations

    d. Physicians groups

Correct answer: A

(Objective 6)

9. Under managed cost plans, laboratory services must be considered as what?

    a. A source of revenue

    b. A managed resource

    c. A reimbursement source

    d. A cost

Correct answer: B

(Objective 6)

10. The predominant blood leukocyte found in children is the:

a. Monocyte.

b. Lymphocyte.

c. Neutrophil.

d. Eosinophil.

Correct answer: B

(Objective 1)

11. The cellular component of blood that is involved in hemostasis is:

a. Leukocyte.

b. Erythrocyte.

c. Thrombocyte.

d. Hemoglobin.

Correct answer: C

(Objective 2)

12. The protein found in erythrocytes that is responsible for oxygen transport is:

a. Albumin.

b. Gamma globulin.

c. Oxygen protein.

d. Hemoglobin.

Correct answer: D

(Objective 2)

13. Which of the following is NOT a cellular component of blood?

a. Leukocytes

b. Platelets

c. Erythrocytes

d. Albumin

Correct answer: D

(Objective 3)

14. The liquid portion of anticoagulated blood is called:

a. Serum.

b. Plasma.

c. Whole blood.

d. None of the above.

Correct answer: B

(Objective 3)

15. What percentage of the total blood volume is comprised of formed elements?

a. 55

b. 45

c. 100

d. 10

Correct answer: B

(Objective 3)

16. An abnormal test result is defined as:

a. The opposite of a normal test result.

b. A value that is outside the reference interval for a particular analyte.

c. A value that is below the reference range for multiple analytes.

d. A value that is above the reference range for a single analyte.

Correct answer: B

(Objective 4)

17. Payment for health care services under Medicare is based on:

a. PPS.

b. Fee for services.

c. Capitated pay.

d. None of the above.

Correct answer: A

(Objective 6)

18. In disease management, the term “practice guidelines” is synonymous with:

a. Critical pathway.

b. Clinical pathway.

c. Patient-focused approach.

d. Managed care.

Correct answer: B

(Objective 5)

19. Which of the following is NOT a role of the clinical laboratory professional?

a. Correlate lab results with appropriate disease states

b. Correlate lab results with disease pathophysiology

c. Correlate lab results with treatment

d. Order reflex tests

Correct answer: D

(Objective 5)

Level II

1. Which of the following is an expected finding in a newborn?

    a. WBC count = 2 x 10^9/L

    b. PLT count = 100 x 10^9/L

    c. Hemoglobin = 17.0 g/dL

    d. RBC count = 3.50 x 10^9/L

Correct answer: C

(Objective 1)

2. Which of the following blood cell components would be most influenced in a patient with tonsillitis?

    a. Leukocyte

    b. Erythrocyte

    c. Thrombocyte

    d. Hemoglobin

Correct answer: A

(Objective 2)

3. Which of the following formed elements could result in hypoxia if decreased?

    a. Leukocytes

    b. Erythrocytes

    c. Platelets

    d. None of the above

Correct answer: B

(Objective 2)

4. Which component of blood passes through blood vessel walls into surrounding tissues to defend the body against invading foreign antigens?

a. Red blood cells

b. Platelets

c. Leukocytes

d. Gamma globulin

Correct answer: C

(Objective 2)

5. Which of the following blood constituents is associated with increased red blood cell destruction?

a. Bilirubin

b. Albumin

c. Blood urea nitrogen

d. Immunoglobulins

Correct answer: A

(Objective 4)

6. All of the following must be taken into consideration when establishing a reference interval for a group of individuals EXCEPT:

a. The geographic area.

b. Age of the population.

c. Occupations of the population.

d. Sex of the population.

Correct answer: C

(Objective 4)

7. What is the main difference between capitated pay and fee-for-service pay?

a. Entity controlling the service and fees

b. Amount of reimbursement

c. Type of health care providers who can participate

d. The selection of beneficiaries by the insurer

Correct answer: A

(Objective 6)

8. What is the main difference between the clinical pathway and the critical pathway?

a. Nothing; they are the same thing.

b. The clinical pathway helps determine a method of diagnosis and treatment, whereas a critical pathway occurs after treatment has begun.

c. Physicians are reimbursed for services based on the clinical pathway used while the laboratory is reimbursed based on a critical pathway.

d. Critical pathways are developed by the physicians and clinical pathways are developed by the laboratory team.

Correct answer: B

(Objective 5)

9. Which of the following tests could be reflexed from an abnormal prothrombin time?

a. Molecular analysis of clotting factors

b. Complete blood count

c. Measurement of albumin

d. Hemoglobin analysis

Correct answer: A

(Objective 5)

10. Which of the following could be reflexed from an abnormal RBC count?

a. Prothrombin time

b. Blood urea nitrogen

c. Reticulocyte count

d. WBC count

Correct answer: C

(Objective 5)

Short-Answer Questions:

1. Explain how a reference interval is determined.

Answer: A reference interval for a given region is determined by calculating the mean for a group of "normal healthy" individuals. Conditions that must be considered include physiologic differences in a given population as well as the geographic area. Once the mean has been determined, a calculation to determine the standard deviation must be done. The range is calculated by taking the mean and 2 standard deviations above and below the mean value.

(Objective 1, Level II)

2. Name three blood analytes that show significantly different results in adults, children, and infants.

Answer: Hemoglobin is higher in infants and children than in adults. WBC counts are higher in infants than in children and adults. Differential results are different in children (inverted ratio of lymphs: neutrophils) than in infants and adults.

(Objective 1, Level I)

3. Explain how the hemostatic pathway is activated in times of need.

Answer: Traumatic events to body tissue stimulate the activation of repair mechanisms. As a result of both external and internal stimuli, the hemostatic pathway becomes activated in stages called primary, secondary hemostasis and fibrinolysis

(Objective 4, Level II)

4. List five ways to optimize laboratory test utilization to improve patient outcomes.

Answer: Five ways to optimize laboratory test utilization include: Development of critical pathways, managing the test ordering system, instituting sequential testing protocols, eliminating incorrect use of tests, and designing wellness panels.

(Objective 5, Level I)

5. Give two reasons for transfusing leukoreduced, irradiated, packed red blood cells.

Answer: Reasons for transfusing leukoreduced packed red blood cells are: to decrease the risk of febrile nonhemolytic transfusion reactions, to decrease risk of HLA sensitization, and to decrease the risk of CMV transmission. Irradiation is used to reduce the risk of graft-versus-host disease.

(Objective 3, Level II)

Chapter 2: Cellular Homeostasis

Multiple-Choice Questions:

Level I

1. Protein synthesis occurs predominantly in the:
    a. Cell membrane.
    b. Nucleus.
    c. Lysosome.
    d. Cytosol.

    Correct answer: D

(Objective 1)

2. The plasma membrane of blood cells is characterized by which of the following?
    a. Carbohydrate components (of glycolipids, glycoproteins) embeddeded in the lipid bilayer
    b. The asymmetric distribution of the phospholipids
    c. The hydrophilic ends of the phospholipids directed toward the inside of the lipid bilayer
    d. The absence of peripheral proteins

    Correct answer: B

(Objective 2)

3. Which phospholipids are found predominantly in the outer layer of the lipid bilayer?
    a. Phosphatidylethanolamine and phosphatidylserine
    b. Phosphatidylethanolamine and phosphatidylcholine
    c. Phosphatidylserine and sphingomyelin

d. Phosphatidylcholine and sphingomyelin

Correct answer: D

(Objective 3)

4. In which phase of the cell cycle is a cell quiescent?

    a. The G1 phase

    b. The G0 phase

    c. The R phase

    d. The S phase

    Correct answer: B

(Objective 3)

5. The point in the cell cycle after which cell division is complete but before the next round of DNA synthesis is:

    a. The G2 phase.

    b. The G0 phase.

    c. The G1 phase.

    d. The R phase.

    Correct answer: C

(Objective 3)

6. In order to maintain _____, terminally differentiated blood cells undergo _____.

    a. Cell cycle division; necrosis

    b. Tumor suppression; apoptosis

    c. Homeostasis; apoptosis

    d. Cell regeneration; necrosis

Correct answer: C

(Objective 5)

7. All of the following are promoters of apoptosis except:

    a. BCL-2.

    b. Caspases.

    c. TNF-alpha.

    d. Fas Ligand.

    Correct answer: A

(Objective 6)

8. Apoptosis play an role in human development in all of the following except:

    a. Removal of interdigital webs of the hands and feet.

    b. Formation of the blood vessels and the gastrointestinal tract.

    c. Differentiation (divergence) of mast cells and basophils.

    d. Selection of appropriate T and B lymphocyte clones.

    Correct answer: C

(Objective 5)

9. All of the following are mechanisms of apoptosis in hematopoiesis except:

    a. Elimination of B cell clonal populations after infection responses.

    b. Elimination of PMNs and eosinophils after an inflammatory response.

    c. Final stages of RBC maturation.

    d. Progression of acute leukemias.

    Correct answer: D

    (Objective 7)

10. Which cytoplasmic organelle's function is lipid synthesis?

    a. Smooth endoplasmic reticulum

    b. Golgi apparatus

    c. Mitochondria

    d. Ribosomes

Correct answer: A

(Objective 1)

11. Which phospholipids are predominantly found in the inner layer of the lipid bilayer?

    a. PE and PC

    b. PE and PS

    c. PS and SM

    d. PC and SM

Correct answer: B

(Objective 2)

12. In which phase of mitosis do the chromosomes align on opposite poles of the cell?

    a. Prophase

    b. Metaphase

    c. Anaphase and telophase

    d. Interphase

Correct answer: C

(Objective 3)

13. The (R) restriction point occurs during what phase in the cell cycle?

    a. S

b. G_2

c. G_1

d. M

Correct answer: C

(Objective 4)

14. If an organism fails to regulate apoptosis, resulting in excessive apoptosis, which of the following processes might result?

a. Neurodegenerative disorder

b. Autoimmune disorder

c. Lymphoma

d. Carcinoma

Correct answer: A

(Objective 5)

Level II

1. The sections of a gene which contain the coding sequences for the final protein product are:

a. Exons.

b. Introns.

c. UTRs.

d. Nucleosomes.

Correct answer: A

(Objective 1)

2. Which of the following influences the stability of the mRNA and the efficiency of translation?

    a. Introns

    b. Untranslated regions

    c. Single-nucleotide polymorphisms

    d. Exons

    Correct answer: B

    (Objective 1)

3. To be considered a true polymorphism, a SNP must occur with a frequency of:

    a. >1%

    b. >5%

    c. >10%

    d. >25%

    Correct answer: A

(Objective 1)

4. Structurally abnormal proteins can be eliminated from the body by tagging them with _____ and sending them to the _____.

    a. Caspase; apoptosis pathway

    b. Ubiquitin; proteosome

    c. Cyclins; necrosis pathway

    d. CDKs; apoptosis pathway

    Correct answer: B

(Objective 2)

5. Which cyclin component is predominant in the G1 phase of the cell cycle?

    a. Cyclin A

    b. Cyclin B1

    c. Cyclin E

    d. Cyclin D

    Correct answer: D

(Objective 3)

6. What protein is responsible for activating phosphorylation of all kinases involved in the cell cycle?

    a. Cdk

    b. CAK

    c. Cyclin

    d. Cdk inhibitor

    Correct answer: B

(Objective 4)

7. Predict the effect of p16 on the cell cycle of dividing cells.

    a. Increased cell cycle progression

    b. Decreased cell cycle progression

    c. No change in the cell cycle progression

    d. Initiate apoptosis

    Correct answer: B

(Objective 4)

8. At which checkpoint would detection of unreplicated DNA strands occur?

a. G1 checkpoint

b. G2/M checkpoint

c. S phase checkpoint

d. Metaphase checkpoint

Correct answer: B

(Objective 5)

9. Which regulatory protein is present in all stages of the cell cycle but has varying degrees of phosphorylation (activation) from phase to phase?

    a. p53

    b. Rb protein

    c. p21

    d. Cyclin D

    Correct answer: B

(Objective 6)

10. Initiation of apoptosis occurs primarily with:

    a. Activation of p53.

    b. Cleavage of appropriate caspases at timely intervals.

    c. Stimulus from an inflammatory response.

    d. Activation of BCL-2.

    Correct answer: B

(Objective 8)

11. Exposure to radiation would lead to activation of which caspase pathway?

    a. Extrinsic pathway

b. Intrinsic pathway

c. Common pathway

d. None of the above

Correct answer: B

(Objective 9)

12. Predict the effect of the Bax:Bcl-2 complex on the apoptotic pathway.

a. The pathway is activated by Bax: Bcl-2.

b. The pathway is inhibited by Bax: Bcl-2.

c. The pathway is not affected by Bax: Bcl-2.

d. The pathway will be activated and then inhibited by Bax:Bcl-2.

Correct answer: B

(Objective 11)

13. Which of the following are apoptosis activators?

a. BCL-2

b. Mcl-1

c. Bcl-X_L

d. Bak

Correct answer: D

(Objective 10)

14. Malignancies can result from which of the following?

a. Accelerated apoptosis

b. Inhibited apoptosis

c. Normal occurrence of apoptosis

d. None of the above

Correct answer: B

(Objective 12)

15. Clearance of cytotoxic T cells after an immune response results from:

a. Accelerated apoptosis.

b. Inhibited apoptosis.

c. Normal occurrence of apoptosis.

d. None of the above.

Correct answer: A

(Objective 12)

16. All of the following are potential proto-oncogenes except:

a. Proteins that function as growth factor receptors.

b. Proteins that bind DNA.

c. Growth factors.

d. Proteins that neutralize growth factor receptors.

Correct answer: D

(Objective 13)

17. UTRs constitute which segments of mRNA?

a. Exons

b. Introns

c. 3’ and 5’ ends

d. Heteronuclear RNA

Correct answer: C

(Objective 1)

18. Disposal of damaged or misfolded proteins is carried out by which cell component?

a. Lysosome

b. Ubiquitin/proteosome system

c. Caspase/apoptosis system

d. Molecular chaperones

Correct answer: B

(Objective 2)

19. Cdk or kinase must be complexed with what molecule to drive one cell to the next cell-cycle stage?

a. DNA

b. Phosphorylating enzymes

c. mRNA

d. Cyclin

Correct answer: D

(Objective 3)

20. Which two proteins are critical for the effective function of the G1 checkpoint?

a. Cdk4 and Cdk6

b. Cyclin E

c. P21 and p57

d. P53 and Rb

Correct answer: D

(Objective 3)

21. What feature distinguishes necrosis from apoptosis?

a. Necrosis requires ATP.

b. Necrosis is characterized by cellular shrinkage and chromatin condensation.

c. Necrosis induces inflammation.

d. Necrosis results in nuclear fragments of 185 base pairs.

Correct answer: C

(Objective 12)

Short-Answer Questions:

1. Explain in detail how p53 and Rb can contribute to the onset of malignancy.

Answer: Rb is the protein product of the retinoblastoma susceptibility gene, which predisposes individuals to retinoblastomas and other tumors when only one functional copy is present. Rb is present all throughout the cell cycle. Phosphorylations vary with each cell-cycle phase. In its hypophosphorylated (active) state, Rb has antiproliferative effects, inhibiting cell cycling. It does this by inhibiting transcription factors required for the transcription of genes needed for cell proliferation, rendering them nonfunctional. Hyperphosphorylation, on the other hand, neutralizes (inactivates) the Rb protein, thus promoting cell cycle division.

P53 acts as a molecular policeman; it monitors the integrity of the genome. It can activate and inhibit gene expression depending on the target gene. It is activated in response to DNA breakage, and slows cell-cycle division to initiate DNA repair or apoptosis. It functions as a tumor suppressor gene, and it is the most common mutated gene in tumors.

(Objective 7, Level II)

2. List three ways in which the caspase pathway can be activated. Explain the role of each, and also indicate which arm of the caspase pathway will be activated.

Answer: The extrinsic pathway of apoptosis is triggered by extracellular "death" signals (TNF, Fas Ligand, and CD95). The intrinsic pathway of apoptosis is triggered by intracellular signals in response to stress, exposure to cytotoxic agents, and radiation.

(Objective 9, Level II)

3. Describe the apoptotic pathway.

Answer: Death receptor binding of death receptor to cell receptor → caspase recruitment → activation of initiator caspases → activation of effector caspases → cleavage of crucial cellular proteins → cell death.

(Objective 5, Level I)

4. Explain the role of epigenetic alterations in cancer development.

Answer: The most common epigenetic change in the development of cancer involves a methylation/demethylation of CpG dinucleotide bases. Cancer may involve demethylation of promoter regions of genes making them transcriptionally ready. Methylation may result in transcriptional silencing of the gene and loss of function of tumor suppressor genes. Deacetylation of key histones may result in gene silencing which may favor growth over differentiation.

(Objective 13, Level II)

5. List the four major phospholipids found in the plasma membrane of hematopoietic cells, and explain their unique distribution.

Answer: The four major phospholipids that are found in the plasma membrane are phosphatidylethanolamine (PE), phosphatidylserine (PS), phosphatidylcholine (PC), and sphingomyelin (SM). Most blood cells have an asymmetric distribution of these

phospholipids, with PE and PS occurring in the inner layer and PC and SM occurring in the outer layer.

(Objective 2, Level I)