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MULTIPLE CHOICE

1. A drug is defined as a biologically active substance that can modify
   a. the environment.
   b. the pH of tissue.
   c. cellular function.
   d. immune response.

   ANS: C
   A drug can modify cellular function. A general understanding of drug action allows the dental hygienist to make informed decisions regarding possible drug interactions or adverse reactions for the patient. It is a concern that discarded drugs may be affecting the environment, but this is not the definition of a drug. Some drugs may have the capacity to modify body compartment pH; however, this is not the definition for a drug. Some drugs may have the capacity to modify the immune response, but this is not the definition of a drug.

   DIF: Recall REF: Introduction | p. 11 OBJ: 1
   TOP: NBDHE, 6.0. Pharmacology

2. In comparing two drugs, the dose-response curve for the drug that is more efficacious would
   a. be closer to the *y*-axis.
   b. be farther from the *y*-axis.
   c. have a greater curve height.
   d. have a higher median effective dose (ED_{50}).

   ANS: C
   Efficacy is an expression of maximum intensity of effect or response that can be produced by a drug. The other choices refer to indicators of drug potency, not efficacy. The potency of a drug is a function of the amount of drug required to produce an effect. The potency of drug is shown by the location of that drug's curve along the log-dose axis (*x*-axis).

   DIF: Comprehension REF: Characterization of Drug Action (Efficacy) | p. 11
   OBJ: 1 TOP: NBDHE, 6.0. Pharmacology

3. Administering a drug of greater potency is better *because* drugs of greater potency do not require as high a dose.
   a. Both parts of the statement are true.
   b. Both parts of the statement are false.
   c. The first part of the statement is true; the second part is false.
   d. The first part of the statement is false; the second part is true.

   ANS: D

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The first part of the statement is false, the second part is true. The absolute potency of a drug is immaterial as long as the appropriate dose is administered. If equally efficacious, both drugs will produce the same effect. Both meperidine and morphine, for example, have the ability to treat severe pain, but approximately 100 mg of meperidine would be required to produce the same action as 10 mg of morphine. The dose of meperidine needed to produce pain relief is larger than that for morphine. Less potent drugs require higher doses to produce therapeutic effects whereas more potent drugs can reach toxic levels at lower doses.

DIF: Application REF: Characterization of Drug Action (Potency) | p. 11
OBJ: 1 TOP: NBDHE, 6.0. Pharmacology

4. Which of the following statements is true regarding the therapeutic index (TI) of a drug?
   a. A drug with a large TI is more dangerous than a drug with a small TI.
   b. The formula for TI is ED_{50}/LD_{50}.
   c. ED_{50} is 50% of the effective clinical dose.
   d. TI is the ratio of the median lethal dose to the median effective dose.

ANS: D
LD_{50} is the dose causing death in 50% of test animals and ED50 is the dose required to produce the desired clinical effect in 50% of test animals. The greater the TI, the safer the drug. The formula is $TI = LD_{50}/ED_{50}$. The ED_{50} is the dose required to produce the desired clinical effect in 50% of test animals, not 50% of the effective clinical dose.

DIF: Comprehension
REF: Characterization of Drug Action (Therapeutic Index) | p. 12
OBJ: 1 TOP: NBDHE, 6.0. Pharmacology

5. Which of the following statements is true concerning the mechanism of action of drugs?
   a. Drugs are capable of imparting a new function to the organism.
   b. Drugs either produce the same action as an exogenous agent or block the action of an exogenous agent.
   c. Drugs either produce the same action as an exogenous agent or block the action of an endogenous agent.
   d. Drugs either produce the same action as an endogenous agent or block the action of an endogenous agent.

ANS: D
Drugs either produce the same action as an endogenous agent or block the action of an endogenous agent. Drugs do not impart a new function to the organism; they merely either produce the same action as an endogenous agent or block the action of an endogenous agent.

DIF: Comprehension REF: Mechanism of Action of Drugs | p. 12 & 13
OBJ: 2 TOP: NBDHE, 6.0. Pharmacology

6. When different drugs compete for the same receptor sites, the drug with the stronger affinity for the receptor will bind to
   a. more receptors than the drug with the weaker affinity.
   b. fewer receptors than the drug with the weaker affinity.
   c. all of the available receptors.
   d. none of the available receptors.

ANS: A

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When different drugs compete for the same receptor sites, the drug with the stronger affinity for the receptor will bind to more receptors than the drug with the weaker affinity. More of the drug with weaker affinity will be required to produce a pharmacologic response. Drugs with a stronger affinity for receptor sites are more potent than drugs with weaker affinities for the same site.

DIF: Recall REF: Mechanism of Action of Drugs (Receptors) | p. 13
OBJ: 2 TOP: NBDHE, 6.0. Pharmacology

7. When a drug has affinity for a receptor and produces no effect, it is called a(n)
   a. agonist.
   b. competitive antagonist.
   c. competitive agonist.
   d. physiologic agonist.

   ANS: B
   A competitive antagonist has affinity for a receptor, combines with the receptor, competes with the agonist for the receptor, and produces no effect. An agonist has affinity for a receptor, combines with the receptor, and produces an effect. Competitive agonist is nonsensical terminology. A physiologic antagonist has affinity for a site different from that of the agonist in question.

   DIF: Recall
   REF: Mechanism of Action of Drugs (Receptors [Agonists and Antagonists]) | p. 13
   OBJ: 2 TOP: NBDHE, 6.0. Pharmacology

8. A noncompetitive antagonist
   a. binds to the same receptor site as the binding site for the agonist.
   b. causes a shift to the right in the dose-response curve.
   c. enhances the maximal response of the agonist.
   d. reduces the maximal response of the agonist.

   ANS: D
   A noncompetitive antagonist reduces the maximal response of the agonist. Noncompetitive antagonists bind to a receptor site that is different from the binding site for the agonist. A competitive antagonist will cause a shift to the right in the dose-response curve.

   DIF: Recall
   REF: Mechanism of Action of Drugs (Receptors [Agonists and Antagonists]) | p. 13
   OBJ: 2 TOP: NBDHE, 6.0. Pharmacology

9. Which of the following is *not* a subject of pharmacokinetics?
   a. Physiologic action of drugs
   b. Metabolism of drugs
   c. Elimination of drugs
   d. Absorption of drugs

   ANS: A
   The physiologic action of drugs is a subject of pharmacology, not pharmacokinetics. Pharmacokinetics *does* have to do with the subjects of absorption, distribution, metabolism, and excretion of drugs.

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DIF: Comprehension REF: Pharmacokinetics | p. 14
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

10. Which of the following statements is (are) true concerning passage across body membranes?
    a. The membrane lipids make the membrane relatively permeable to ions and polar molecules.
    b. The lipid molecules orient themselves so that they form a fluid bimolecular leaflet structure with the hydrophobic ends of the molecules shielded from the surrounding aqueous environment.
    c. Membrane carbohydrates make up the structural components of the membrane and help move the molecules across the membrane during the transport process.
    d. Both A and B are true.
    e. Both B and C are true.

    ANS: B
    The lipid molecules orient themselves so that they form a fluid bimolecular leaflet structure with the hydrophobic ends of the molecules shielded from the surrounding aqueous environment. The hydrophilic ends are in contact with water. The membrane lipids make the membrane relatively impermeable to ions and polar molecules. Membrane proteins make up the structural components of the membrane and help move the molecules across the membrane during the transport process.

    DIF: Comprehension
    REF: Pharmacokinetics (Passage Across Body Membranes) | p. 14
    OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

11. Which of the following choices is the process by which a substance is transported against a concentration gradient?
    a. Passive transfer
    b. Active transport
    c. Facilitated diffusion
    d. Filtration

    ANS: B
    Active transport is a mechanism for movement of substances, often against a concentration gradient, that uses the energy of the cell to actively pump the substance from one side of a membrane to the other. Passive transfer and filtration entail the passage of substances in a manner proportional to their concentration on each side of the membrane. The substances move without any assistance. Facilitated transport uses a carrier protein but cannot transport substances against a gradient.

    DIF: Recall
    REF: Pharmacokinetics (Passage Across Body Membranes [Specialized Transport]) | p. 14
    OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

12. Drugs that are weak electrolytes will cross body membranes best when they are (1) nonionized, (2) ionized, (3) polar, (4) nonpolar, (5) lipid soluble, (6) water soluble.
    a. 1, 3, 5
    b. 1, 3, 6
    c. 1, 4, 5
    d. 1, 4, 6

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e. 2, 4, 5

ANS: C
Drugs that are weak electrolytes will cross body membranes best when they are nonionized, nonpolar, and lipid soluble. These drugs dissociate in solution and equilibrate into a nonionized form and an ionized form. The nonionized, or uncharged, portion acts as a nonpolar, lipid-soluble compound that readily crosses body membranes. The ionized portion of drugs that are weak electrolytes will traverse membranes with greater difficulty because they are less lipid soluble.

DIF: Comprehension
REF: Pharmacokinetics (Passage Across Body Membranes [Effect of Ionization]) | p. 15
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

13. Increasing the pH of a solution will cause
a. a greater percentage of a weak base in the solution to be in the ionized form.
b. a greater percentage of a weak acid in the solution to be in the un-ionized form.
c. the hydrogen ion concentration to increase.
d. a greater percentage of a weak base in the solution to be in the un-ionized form.
e. no change in the relative ionization of weak acids or weak bases.

ANS: D
Weak bases become ionized at low pH and un-ionized at higher pH. If the pH of the site rises, the hydrogen ion concentration will fall. For weak bases, this results in the un-ionized form (B), which can more easily penetrate tissues. Conversely, if the pH of the site falls, the hydrogen ion concentration will rise. This results in an increase in the ionized form (BH^+), which cannot easily penetrate tissues.

DIF: Comprehension
REF: Pharmacokinetics (Passage Across Body Membranes [Effect of Ionization]) | p. 15
OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

14. When the acidity of the tissue increases, as in instances of infection, the effect of a local anesthetic decreases; *therefore,* the local anesthetic is a weak acid.
a. Both parts of the statement are true.
b. Both parts of the statement are false.
c. The first part of the statement is true; the second part is false.
d. The first part of the statement is false; the second part is true.

ANS: C
The first part of the statement is true, the second part is false. Infections lead to an accumulation of acidic waste products, which lowers the pH of the local area. Local anesthetics must penetrate the nerve cell membrane to cause their action. They become more ionized as the pH drops. This property is a characteristic of weak bases, not weak acids. Local anesthetics are weak bases. Weak bases are better absorbed when the pH is greater than the pKa. A weak base is associated and ionized when the pH is less than the pKa.

DIF: Comprehension
REF: Pharmacokinetics (Passage Across Body Membranes [Effect of Ionization]) | p. 15
OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

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15. Which of the following is true regarding basic principles of drug distribution in the bloodstream?
    a. All drugs in the blood are either bound to plasma proteins or free.
    b. Only the drug that is bound to plasma proteins can exert the pharmacologic effect.
    c. Only the drug that is bound to plasma proteins can pass across cell membranes.
    d. The free drug is a reservoir for the drug.

    ANS: A
    All drugs in the blood are either bound to plasma proteins or free. Only the drug that is free can exert the pharmacologic effect. Only the free drug can pass across cell membranes. The bound drug is a reservoir for the drug.

    DIF: Comprehension
    REF: Pharmacokinetics (Distribution [Basic Principles]) | p. 15
    OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

16. The movement of a drug from one site in the body to other sites is called
    a. distribution.
    b. disruption.
    c. dispersion.
    d. active transport.

    ANS: A
    Distribution is the movement of a drug from the site of absorption or injection to other sites. Disruption is the initial destruction of a tablet coating or capsule during oral absorption. Dispersion is the spread of concentrated drug particles throughout the stomach or intestines. Active transport is a process involved in the passage of certain agents, including some drugs, across membrane barriers and may be involved in not only drug redistribution but also drug absorption, distribution, or excretion.

    DIF: Comprehension
    REF: Pharmacokinetics (Distribution [Basic Principles]) | p. 15
    OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

17. The distribution of a drug is determined by
    a. blood flow to the organ.
    b. presence of certain barriers.
    c. plasma protein–binding capacity.
    d. solubility of the drug.
    e. All of the above

    ANS: E
    All of the above choices are correct. If the blood circulation to an organ is low, it will receive less drug. The more membranes and barriers a drug needs to cross, the slower the rate at which it will reach the organ in question. The binding of drugs to plasma proteins reduces the concentration of drug that can leave the circulation and be taken up by an organ. The relative level of fat or water solubility of a drug will influence where and how rapidly a drug will distribute. The distribution of a drug is determined by several factors, such as the size of the organ, the blood flow to the organ, the solubility of the drug, the plasma protein–binding capacity, and the presence of certain barriers (e.g., blood-brain barrier, placenta).

    DIF: Recall REF: Pharmacokinetics (Distribution [Basic Principles]) | p. 15

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OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

18. If one dose of a drug is administered and the drug's half-life in the body is 3 hours, what percentage of the drug would be left after four half-lives?
    a. 50%
    b. 6.25%
    c. 2%
    d. Insufficient information to determine

    ANS: B
    The half-life is the time required for a drug level to fall to one half of its concentration. The drug concentration would go to 50% → 25% → 12.5% → 6.25% in four half-lives. The information given is more than sufficient to answer the question. One needs merely to count the number of half-lives and divide the percentage drug in half for every half-life passed since the drug was administered.

    DIF: Application REF: Clinical Pharmacokinetics (Half-Life) | p. 18
    OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

19. One dose of a drug is administered that has a half-life of 8 hours. Assuming first-order kinetics, how much time is needed for this drug to be over 96% eliminated from the body?
    a. 8 hours
    b. 40 hours
    c. 60 hours
    d. 120 hours

    ANS: B
    Assuming first-order kinetics, 40 hours would be required for this drug to be over 96% eliminated from the body. Five half-lives are needed to reduce the levels of a drug to 3.125% of the original levels, or eliminate over 96%. For a drug with an 8-hour half-life, this amounts to five half-lives × 8 hours per half-life, or 40 hours.

    DIF: Application REF: Clinical Pharmacokinetics (Kinetics) | p. 18
    OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

20. The half-life of a drug is most related to its
    a. onset.
    b. duration.
    c. safety.
    d. time to peak concentration.

    ANS: B
    Half-life is the amount of time required for a drug to fall to one half of its blood level. It is an expression of how long the drug lasts in the body. Onset is the time at which a drug starts to take effect. The half-life does not predict the relative safety of a drug; safe drugs can have long or short half-lives. Time to peak concentration refers to how much time is required for a drug to reach effective levels in the body, not how long a drug lasts in the body.

    DIF: Comprehension REF: Clinical Pharmacokinetics (Half-Life) | p. 18
    OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

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21. Enterohepatic circulation of a drug involves the secretion of a metabolized drug into the intestine. If enterohepatic circulation is blocked, the level of the drug in the serum will fall.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true, the second statement is false.
    d. The first statement is false, the second statement is true.

    ANS: A
    Both statements are true. Enterohepatic circulation involves the secretion of a metabolite, such as a conjugated drug, via the bile into the intestine. While in the intestine, the metabolite is broken down (deconjugated), and the active drug can be reabsorbed into the circulation. If this process is blocked, then the reactivated drug cannot reenter the circulation, and the serum level will fall accordingly. Both of the statements are true as written. The circular pattern continues with some drug escaping with each passing. This process prolongs the effect of a drug.

    DIF: Comprehension
    REF: Pharmacokinetics (Distribution [Enterohepatic Circulation]) | p. 16
    OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

22. If redistribution occurs between specific sites and nonspecific sites, a drug's action will be
    a. prolonged.
    b. extended.
    c. decreased.
    d. terminated.

    ANS: D
    If redistribution occurs between specific sites and nonspecific sites, a drug's action will be terminated. Redistribution of a drug is the movement of a drug from the site of action to nonspecific sites of action. A drug's duration of action can be affected by redistribution of the drug from one organ to another.

    DIF: Recall REF: Pharmacokinetics (Redistribution) | p. 16
    OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

23. The _____ is the most common site for biotransformation.
    a. kidney
    b. blood plasma
    c. liver
    d. small intestine

    ANS: C
    The liver is the most common site for biotransformation. Biotransformation is the body's way of changing a drug so that the kidneys can more easily excrete it. The liver rather than kidney, blood plasma, or small intestine is the most common site for biotransformation.

    DIF: Comprehension
    REF: Pharmacokinetics (Metabolism (Biotransformation)) | p. 16
    OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

24. The metabolite formed during metabolism (biotransformation) is usually _____ polar and _____ lipid soluble than its parent compound.

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a. more; more
b. more; less
c. less; more
d. less; less

ANS: B
The metabolite is usually more polar and less lipid soluble than its parent compound, meaning that renal tubular reabsorption of the metabolite will be reduced because reabsorption favors lipid-soluble compounds. Metabolites are also less likely to bind to plasma or tissue proteins and less likely to be stored in fat tissue. Drugs must pass through various membranes such as cellular membranes, blood capillary membranes, and intracellular membranes. The lipid in the membranes makes them relatively impermeable to ions and polar molecules. Decreased renal tubular absorption, decreased binding to the plasma or tissue proteins, and decreased fat storage cause the metabolite to be excreted more easily.

DIF: Recall REF: Pharmacokinetics (Metabolism (Biotransformation)) | p. 16
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

25. All of the following choices are true with regard to cytochrome P-450 hepatic microsomal enzymes *except* that they
a. can be induced to speed up drug metabolism.
b. can be inhibited to slow down drug metabolism.
c. exist as numerous isoenzymes.
d. inactivate drugs through conjugation reactions.

ANS: D
Cytochrome P-450 hepatic microsomal enzymes inactivate drugs but not through conjugation. They are involved in phase I metabolism and metabolize drugs through oxidation, reduction, and hydrolysis reactions. Phase II reactions involve conjugation with glucuronic acid, sulfuric acid, acetic acid, or an amino acid. Cytochrome P-450 hepatic microsomal enzymes can be induced to speed up drug metabolism or inhibited to reduce or slow down drug metabolism. They exist as numerous isozymes that have specificity for certain drugs. Examples of isoenzymes include cytochrome P-450 and 3A4.

DIF: Application
REF: Pharmacokinetics (Metabolism (Biotransformation) [First-Pass Effect]) | p. 17 | Pharmacokinetics (Metabolism (Biotransformation [Cytochrome P-450 Induction and Inhibition]) | p. 16 OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

26. Which of the following reactions is considered to be in the category of phase II drug metabolism?
a. Conjugation
b. Reduction
c. Hydrolysis
d. Oxidation

ANS: A
Phase II reactions involve conjugation with glucuronic acid, sulfuric acid, acetic acid, or an amino acid. The most common conjugation occurs with glucuronic acid. Reduction, hydrolysis, and oxidation are all examples of phase I drug metabolism.

DIF: Recall

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REF: Pharmacokinetics (Metabolism (Biotransformation) [First-Pass Effect]) | p. 16
OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

27. If a drug displays zero-order elimination kinetics
    a. elimination increases as the dose of the drug is increased.
    b. a constant amount is eliminated per unit time.
    c. the drug is not eliminated and is retained in the body.
    d. the elimination of the drug cannot be predicted mathematically.

ANS: B
With zero-order kinetics, the metabolism or excretion mechanisms for a drug in the body are saturated, meaning that they are at their maximal level. If more drug is given, then the body cannot keep up, and the drug levels will increase. The body cannot adjust to more drug, and elimination of a drug will remain the same as the dose of the drug is increased. If the drug is eliminated but a longer time is required, then it would for a first-order elimination. The elimination of the drug *can* be mathematically predicted.

DIF: Comprehension REF: Clinical Pharmacokinetics (Kinetics) | p. 18
OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

28. Which of the following processes in the kidney can result in retention of a drug in the body?
    a. Glomerular filtration
    b. Active tubular secretion
    c. Passive tubular diffusion
    d. All of the above

ANS: C
Passive tubular diffusion is a process whereby solutes such as drugs, which are concentrated in the renal tubular fluid, can diffuse out of the tubule and back into the circulation. The drugs must be un-ionized and lipid soluble to passively diffuse back to the circulation. Glomerular filtration and active tubular secretion are ways in which drugs and their metabolites enter the renal tubular fluid on their way to the collecting duct and the urine.

DIF: Application REF: Pharmacokinetics (Metabolism (Biotransformation) [Excretion]) | p. 17
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

29. Which is true regarding excretion when tubular urine is more alkaline?
    a. Both weak acids and weak bases are excreted more rapidly.
    b. Weak acids are excreted more rapidly, and weak bases are excreted more slowly.
    c. Weak acids are excreted more slowly, and weak bases are excreted more rapidly.
    d. Both weak acids and weak bases are excreted more slowly.

ANS: B
The process of passive tubular diffusion favors the reabsorption of nonionized, lipid-soluble compounds. The more ionized, less lipid-soluble metabolites have more difficulty penetrating the cell membranes of the renal tubules and are likely to be retained in the tubular fluid and eliminated in the urine. When tubular urine is more alkaline, weak acids are excreted more rapidly and weak bases are excreted more slowly. When the tubular urinary pH is more acid than the plasma, weak acids are excreted more rapidly and weak bases are excreted more slowly.

DIF: Recall REF: Pharmacokinetics (Metabolism (Biotransformation) [Excretion]) | p. 17

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OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

30. Which term refers to the time required for a drug to begin to have its effect?
    a. First pass
    b. Duration
    c. Onset
    d. Efficacy

    ANS: C
    Onset is the time at which a drug starts to take effect. First pass refers to the metabolism of drugs by the liver during their movement from the gastrointestinal tract to the systemic circulation via the portal circulation. Duration is the amount of time the drug is active in the body. Efficacy is an assessment of the effectiveness of a drug and does not refer to how quickly or how long a drug acts in the body.

    DIF: Recall
    REF: Routes of Administration and Dose Forms (Routes of Administration) | p. 19
    OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

31. An enteral route of administration would be
    a. intravenous.
    b. oral.
    c. sublingual.
    d. transdermal.

    ANS: B
    Enteral means *situated or occurring inside of the gastrointestinal tract (intestines).* Intravenous, sublingual, and transdermal routes of administration bypass the gastrointestinal tract.

    DIF: Recall
    REF: Routes of Administration and Dose Forms (Routes of Administration) | p. 19
    OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

32. What of the following choices is considered the safest, least expensive, and most convenient route for administering drugs?
    a. Inhalation
    b. Rectal
    c. Oral
    d. Subcutaneous

    ANS: C
    Oral administration requires no sophisticated devices, is slow enough in onset to gauge reactions and stop the next dose, and is easy for a patient to administer without assistance. Inhalation and subcutaneous administration require devices, such as inhalers and needles, and the drug is irretrievable once administered. Rectal dosing has lower patient acceptance, and absorption can be variable.

    DIF: Recall
    REF: Routes of Administration and Dose Forms (Routes of Administration) | p. 19
    OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

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33. Advantages of oral administration of a drug include all the following *except*
    a. large surface area for drug absorption.
    b. many different dose forms that may be administered orally.
    c. more predictable response than intravenous administration.
    d. the simplest way to introduce a drug into the body.

    ANS: C
    Intravenous administration offers a more predictable response than the oral route because the drug is injected directly into the bloodstream, bypassing many physiologic barriers, the hostile environment of the gastrointestinal tract, and drug-metabolizing enzymes that are encountered during oral absorption of a drug. Others are all characteristics of oral administration.

    DIF: Comprehension
    REF: Routes of Administration and Dose Forms (Routes of Administration [Oral Route]) | p. 19
    OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

34. Which organ is involved in the first-pass effect after oral administration of a drug?
    a. Kidney
    b. Lungs
    c. Liver
    d. Spleen

    ANS: C
    On oral administration, drugs are absorbed and are carried via the portal circulation to the liver, where a percentage of the drug may be metabolized before entering the systemic circulation. After oral dosing, drugs reach the kidney, lungs, and spleen *after* passing through the liver.

    DIF: Comprehension
    REF: Pharmacokinetics (Metabolism (Biotransformation [First-Pass Effect]) | p. 16
    OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

35. Which of the following routes of drug administration produces the most rapid drug response?
    a. Intravenous
    b. Intramuscular
    c. Subcutaneous
    d. Intradermal

    ANS: A
    Intravenous administration produces the most rapid drug response, with an almost immediate onset of action. Because the injection is made directly into the blood, the absorption phase is bypassed. The intramuscular route, subcutaneous route, and intradermal route all have slower drug response rates than intravenous drug administration.

    DIF: Recall
    REF: Routes of Administration and Dose Forms (Routes of Administration [Intravenous Route]) | p. 20 OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

36. What route is used to administer the tuberculosis skin test?
    a. Intramuscular
    b. Intradermal
    c. Intravenous

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d. Subcutaneous

ANS: B
Intradermal administration is used to provide local, rather than systemic, action. Local anesthetics are also given this way. The other routes are all chosen when systemic action is desired. Intramuscular, intradermal, and subcutaneous routes of administration are not used to administer the tuberculosis skin test.

DIF: Recall
REF: Routes of Administration and Dose Forms (Routes of Administration [Intradermal Route]) | p. 22 OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

37. What type of administration involves the injection of solutions into the spinal subarachnoid space?
a. Intrathecal route
b. Intraperitoneal route
c. Intravenous route
d. Intradermal route

ANS: A
The intrathecal route is used for injection of solutions into the spinal subarachnoid space. Intraperitoneal route refers to placing fluids into the peritoneal cavity. Intravenous route refers to administering drugs directly into the blood circulation. Intradermal route refers to injecting a drug just under the skin.

DIF: Recall
REF: Routes of Administration and Dose Forms (Routes of Administration [Intrathecal Route]) | p. 22 OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

38. Drug preparations may be administered for local or systemic effects. Which is an example of a dose form used for a local effect?
a. Sublingual tablet
b. Transdermal patch
c. Ophthalmic ointment
d. Subcutaneous injection

ANS: C
Ophthalmic ointments and drops are used specifically for treating the eye, not for treating a systemic disorder. Administration of a sublingual tablet leads to rapid entry of the drug into the systemic circulation. A transdermal patch is a specialized dose form for the controlled delivery of a drug into the systemic circulation. A subcutaneous injection is applied into the subcutaneous areolar tissue to gain access to the systemic circulation.

DIF: Comprehension REF: Table 2-2: Routes of Administration | p. 20
OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

39. Application of a transdermal patch is an example of parenteral administration *because* the drug is delivered in a manner that bypasses the gastrointestinal tract.
a. Both parts of the statements are true.
b. Both parts of the statements are false.
c. The first part of the statement is true; the second part is false.
d. The first part of the statement is false; the second part is true.

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ANS: A
Both parts of the statement are true. A transdermal patch is designed to provide continuous controlled release of medication through a semipermeable membrane over a given period after application to the intact skin. Drugs given by the enteral route are placed directly into the gastrointestinal tract by oral or rectal administration. *Parenteral* means *situated or occurring outside of the gastrointestinal tract (intestines)*. Examples of routes that bypass the gastrointestinal tract include various injection routes, inhalation, and topical administration. In practice, the term parenteral usually refers to an injection.

DIF: Comprehension
REF: Routes of Administration and Dose Forms (Routes of Administration) | p. 19
OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

40. A patient's perception that a pill without active ingredients is having a pharmacologic effect is termed
    a. tachyphylaxis.
    b. hypersensitivity.
    c. neurosis.
    d. compliance.
    e. placebo effect.

ANS: E
Placebo effect is the term used to report when a patient perceives a pharmacologic effect after administration of a medication without active ingredients. Tachyphylaxis is a rapid loss of drug sensitivity, akin to tolerance; the other choices are nonsensical answers. Compliance is the ability of a patient to adhere to the instructions of his or her physician.

DIF: Comprehension REF: Factors that Alter Drug Effects | p. 19
OBJ: 6 TOP: NBDHE, 6.0. Pharmacology

41. The need for an increasingly larger dose of a drug to obtain the same effects as the original dose is
    a. drug dependency.
    b. insufficiency.
    c. drug tolerance.
    d. craving.

ANS: C
Tolerance is a phenomenon in which the body changes in some way so that the same dose of drug has a weaker effect over time. Persons who display drug dependency may also display tolerance, but they are two different phenomena. *Insufficiency* is not a term used to describe the tolerance phenomenon. Craving, similar to tolerance, may occur alongside drug dependence, but the desire to have more drug is not synonymous with tolerance to a drug's effects.

DIF: Recall REF: Factors that Alter Drug Effects | p. 19
OBJ: 6 TOP: NBDHE, 6.0. Pharmacology

42. A prodrug is an example of which type mechanism of metabolism?
    a. Active to active
    b. Active to inactive

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c. Inactive to active
d. Inactive to inactive

ANS: C
An inactive parent drug (prodrug) may be transformed into an active compound. Active to active occurs when an active parent drug is converted to a second active compound, which is then converted to an inactive product. When an active metabolite is formed, the action of the drug is prolonged. Active to inactive is the most common type of reaction in drug biotransformation. Inactive to inactive is not one of the mechanisms of metabolism. A placebo may be an example.

DIF: Recall REF: Pharmacokinetics (Metabolism (Biotransformation)) | p. 16
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

43. Which is true of a drug with a stronger affinity for a receptor site versus a drug with a weaker affinity for the same site?
a. A drug with stronger affinity is more potent than a drug with weaker affinity.
b. A drug with stronger affinity will function as a competitive antagonist rather than as an agonist.
c. A drug with stronger affinity will function as a competitive antagonist rather than as an agonist.
d. A drug with stronger affinity will function as an agonist.

ANS: A
Drugs with stronger affinity for receptor sites are more potent than drugs with weaker affinities for the same sites. An antagonist counteracts the action of the agonist. There are three types of antagonists: competitive antagonist, noncompetitive antagonist, and physiologic antagonist. An agonist is a drug that has affinity for a receptor, combines with the receptor, and produces an effect.

DIF: Comprehension
REF: Pharmacokinetics (Metabolism (Biotransformation)) | p. 16
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

44. Most drugs are excreted through which mechanism?
a. Gastrointestinal tract
b. Glomerular filtration
c. Active tubular secretion
d. Passive tubular diffusion

ANS: B
Either the unchanged drug or its metabolites are filtered through the glomeruli and concentrated in the renal tubular fluid. This process depends on the amount of plasma protein binding and the glomerular filtration rate. The gastrointestinal tract is an extrarenal route of excretion, along with the lungs, bile, sweat, saliva, and breast milk. Active secretion transports the drug from the bloodstream across the renal tubular epithelial cells and into the renal tubular fluid. Passive tubular diffusion favors the reabsorption of un-ionized, lipid-soluble compounds.

DIF: Comprehension
REF: Pharmacokinetics (Metabolism (Biotransformation [Excretion]) | p. 17
OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

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45. The route of administration of a drug affects
    a. both the onset and duration of response.
    b. the onset, but not the duration of response.
    c. the duration, but not the onset of response.
    d. neither the onset nor the duration of response.

    ANS: A
    Onset refers to the time required for the drug to begin to have its effect. Duration is the length of a drug's effect. Both onset and response are affected by the route of administration. The routes of administration may be categorized as enteral when placed in the gastrointestinal tract, or parenteral, which usually means an injection.

    DIF: Comprehension
    REF: Routes of Administration and Dose Forms (Routes of Administration) | p. 19
    OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

46. How many half-lives of repeated dosing does it take to reach a steady state in the body?
    a. One
    b. Two or three
    c. Four or five
    d. Six or seven
    e. Eight or nine

    ANS: C
    It takes about four or five half-lives of repeated dosing for the level of a drug to build up to a steady state in the body. It takes approximately four to five half-lives for a drug to reach a steady state or to be considered eliminated from the body.

    DIF: Recall REF: Clinical Pharmacokinetics (Half-Life) | p. 18
    OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

47. Which drug is eliminated with zero-order kinetics?
    a. Probenecid
    b. Aspirin
    c. Allopurinol
    d. Penicillin
    e. Naproxyn sodium

    ANS: B
    A few drugs, such as aspirin and alcohol, exhibit zero-order kinetics. The enzymes that metabolize these drugs can become saturated at usual therapeutic doses. Small changes in the dosage of these drugs may produce a large change in concentration in blood serum. There are few drugs that are eliminated with zero-order kinetics, namely aspirin and alcohol.

    DIF: Recall REF: Clinical Pharmacokinetics (Kinetics) | p. 18
    OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

48. With zero-order kinetics, the
    a. same amount of drug is metabolized and eliminated from the body per unit of time regardless of dose.
    b. same percentage of drug is metabolized and eliminated from the body per unit of

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time.
c. drug is irreversibly bound to receptor sites.
d. drug is not bound to receptor sites.

ANS: A
With high doses, the metabolism of the drug cannot increase and the duration of action of the drug can be greatly prolonged. Zero-order kinetics occurs because the enzymes that metabolize these drugs can become saturated at usual therapeutic doses. If the dose of the drug is increased, the metabolism cannot increase above its maximum rate.

DIF: Comprehension REF: Clinical Pharmacokinetics (Kinetics) | p. 18
OBJ: 5 TOP: NBDHE, 6.0. Pharmacology

49. Tolerance is most closely associated with which category of drug?
a. Antibiotics
b. Angiotensin receptor blockers
c. Nonsteroidal anti-inflammatory drugs
d. Opioids
e. Anti-hypertensive drugs

ANS: D
Tolerance is associated with sedative-hypnotics and opioids. Tolerance is associated with narcotics.

DIF: Comprehension REF: Factors that Alter Drug Effects | p. 19
OBJ: 6 TOP: NBDHE, 6.0. Pharmacology

MULTIPLE RESPONSE

1. Which of the following statements are true regarding drug-receptor interactions? (*Select all that apply.*)
a. Drug receptors appear to consist of many large molecules that exist either on the cell membrane or within the cell itself.
b. A specific drug will usually bind with a specific receptor in a lock-and-key fashion.
c. Only a single receptor type is found at the site of action.
d. The energy formed by a drug-receptor interaction is very strong and the bond is difficult to break.

ANS: A, B
Drug receptors may exist either on the cell membrane or within the cell. Usually, a specific drug will bind with a specific receptor. More than one receptor type or identical receptors can be found at the site of action. Many drug-receptor interactions consist of weak chemical bonds, and the energy formed during the interaction is very low. As a result, the bonds can be formed and broken easily. Once a bond is broken, another drug molecule immediately binds to the receptor.

DIF: Comprehension REF: Mechanism of Action of Drugs (Receptors) | p. 13
OBJ: 2 TOP: NBDHE, 6.0. Pharmacology

TRUE/FALSE

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1. A prodrug is an inactive drug compound that becomes transformed into an active drug compound.

   ANS: T
   This statement represents an example of drug metabolism (converting a drug from inactive to active).

   DIF: Recall REF: Pharmacokinetics (Metabolism (Biotransformation)) | p. 16
   OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

2. Drugs, after undergoing phase I drug metabolism, are more likely to be distributed to fat tissue.

   ANS: F
   Phase I drug metabolism usually makes a drug more polar and with less affinity for fatty tissue.

   DIF: Recall REF: Pharmacokinetics (Metabolism (Biotransformation)) | p. 16
   OBJ: 3 TOP: NBDHE, 6.0. Pharmacology

3. If a drug is a weak base that is excreted via the kidneys, then acidifying the urine will enhance its excretion.

   ANS: T
   Weak bases will become ionized in an acid environment and will not be able to passively diffuse out of the kidney tubule.

   DIF: Recall REF: Pharmacokinetics (Metabolism (Biotransformation [Excretion]) | p. 17
   OBJ: 4 TOP: NBDHE, 6.0. Pharmacology

4. The route of administration of a drug affects both the onset and duration of response.

   ANS: T
   Onset refers to the time required the drug to begin to have its effect. Duration is the length of a drug's effect.

   DIF: Recall
   REF: Routes of Administration and Dose Forms (Routes of Administration) | p. 19
   OBJ: 7 TOP: NBDHE, 6.0. Pharmacology

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