Questions #1-30. 3.33 Points Each. Unless otherwise indicated, circle the letter of the single best answer.

1. Below is a graph depicting plasma drug concentration ($C_p$) vs. time. What is the half-life of this drug?

![Graph showing plasma drug concentration over time.]

A. 0.5 hour  
B. 1.0 hour  
C. 2.0 hours  
D. 3.0 hours  
E. 4.0 hours

2. If a drug with a half-life of 12 hours were to be given via a constant intravenous infusion to a drug-free patient, what would be the shortest time period below at which this drug would reach at least 90% of its final steady state concentration?

A. 6 hours  
B. 12 hours  
C. 24 hours  
D. 48 hours  
E. 96 hours
3. Indicate which of the following statements concerning *Phase I* drug biotransformation (metabolism) reactions are **CORRECT**:

A. Addition of a glucaronyl group to the drug is an example of a Phase I reaction  \(\text{F}\)
B. Addition of a hydroxyl group onto a drug aromatic benzene ring is an example of a  \(\text{T}\)  
   Phase I reaction
C. Drug biotransformations carried out by the cytochrome P\(_{450}\) system are examples of  \(\text{T}\)  
   Phase I reactions
D. A and B
E. B and C  \(\text{E}\)

4. Your patient is a 32 year-old female who has **asthma**. She complains of waking up in the middle of the night because of her asthma. Which of the \(\beta\) agonists below would be the **most appropriate** for her to take before bed time to **avoid** the asthma attacks that disturb her sleep?

A. Terbutaline
B. Salmeterol
C. Albuterol
D. Metaproterenol
E. Epinephrine

5. Indicate which of the following statements concerning **rifampin** treatment for *tuberculosis* are **CORRECT**:

A. Rifampin induces the production of cytochrome P\(_{450}\) metabolic enzymes in the liver  \(\text{T}\)
B. Rifampin’s therapeutic mechanism of action occurs via inhibition of mycolic acid uptake  \(\text{F}\)
C. A 2-week treatment with rifampin alone is usually sufficient to eradicate the disease  \(\text{F}\)
D. A and B
E. B and C

6. Your patient is a 25 year-old 70 kg male. He has received 40 mg of drug X. If the initial drug concentration in the plasma \(C_0\) is found to be 2.5 \(\mu\)g/ml, what is the **volume of distribution** \((V_d)\) of drug X?

\[ \text{Vol} = \frac{\text{Dose}}{\text{Conc}} \]

A. 0.5 Liters
B. 10 Liters
C. 16 Liters  \(\text{C}\)
D. 28 Liters
E. 100 Liters

\[ \text{Vol} = \frac{40 \text{ mg}}{2.5 \text{ \mu g/ml}} \]

\[ \text{Vol} = 16000 \text{ ml} \]
NAME

7. A reason for choosing albuterol over epinephrine for chronic treatment of asthma:

A. Albuterol can be administered via inhalation  
B. Albuterol has a higher ED_{50} for stimulating catecholamine β_{1} receptors 
C. Loss of drug sensitivity in the lungs with very frequent drug usage doesn’t occur with albuterol 
D. A and B 
E. B and C

8. A 42 year-old female is receiving isoniazid for tuberculosis therapy. Shortly after starting drug therapy she reports a feeling of burning or tingling in her fingers (i.e., paresthesia). This isoniazid-induced peripheral neuritis can be combated with administration of:

A. Ascorbic acid (Vitamin C)  
B. α-Tocopherol (Vitamin E)  
C. Thiamine (Vitamin B_{1})  
D. Pyridoxine (Vitamin B_{6})  
E. Phylloquinone (Vitamin K_{1})

9. A patient is taking a 20 mg tablet of Drug Y every 12 hours. The half-life of this drug is also 12 hours. After achieving steady state conditions, what will be the largest amount of drug Y that will be in this patient’s body at any given time?

A. 20 mg  
B. 30 mg  
C. 40 mg  
D. 60 mg  
E. 80 mg

10. All of the following statements concerning ipratropium are correct EXCEPT:

A. It is used in the treatment of chronic obstructive pulmonary disease (COPD) 
B. It causes less drying of respiratory secretions compared to atropine  
C. It inhibits acetylcholine-induced bronchial smooth muscle constriction 
D. It is generally a less effective bronchodilator compared to β agonists  
E. It is more effective in producing bronchodilation in upper airways compared to lower airways
11. The *rationale* for suggesting that aspirin *not be taken* by individuals with severe asthma:

A. Aspirin can increase leukotriene production in the lungs ✓
B. Aspirin is a direct blocker of the action of circulating epinephrine on bronchial smooth muscle
C. Aspirin is a direct bronchoconstrictor
D. Asthmatics are especially prone to aspirin-induced bleeding
E. Aspirin increases the concentration of cyclic AMP in the lungs

12. Indicate which of the following statements concerning the *half-life* of a drug are CORRECT:

A. It is inversely related to the volume of distribution (V_d) of the drug 
B. After stopping drug administration, the passage of 3 half-lives will reduce the plasma drug concentration by 87.5% ✓
C. It is inversely related to total body clearance (CL_total)  
D. A and B x
E. B and C 

13. Indicate which of the following statements concerning pyrazinamide are CORRECT:

A. It is a prodrug
B. It can function as an anti-tubercular agent in the low pH environment of the lysosome ✓
C. It is considered a 2nd line drug treatment for tuberculosis (as opposed to a 1st line treatment) ×
D. A and B ✓
E. A, B and C ❌

14. Drug Z has a half-life of 4 hours and a recommended infusion rate of 10 μg/min in a normal 70 kg male patient. Your patient is a 70 kg male who is suffering from renal failure, such that his total clearance is only one-fourth of normal. Indicate an appropriate infusion rate for drug Z in this individual:

A. 0.625 μg/min
B. 1.25 μg/min
C. 2.5 μg/min
D. 5 μg/min
E. 10 μg/min
15. Examples of drug therapies for asthma that are used primarily for prophylaxis, and therefore would not be recommended for immediate cessation of an asthmatic attack:

A. Zafirlukast ✓
B. Nedocromil ✓
C. Terbutaline ✗
D. A and B
E. B and C

16. Indicate which of the following statements are CORRECT concerning a weak acid such as aspirin (pKa = 3.5):

A. At the normal stomach pH (about 2), most of the aspirin will be in an ionized form
B. If an antacid is taken, this will reduce the amount of aspirin in an ionized form
C. If an antacid is taken, this will reduce the absorption of aspirin via the stomach
D. A and B
E. B and C

17. Examples of anti-tubercular drugs which will achieve therapeutic concentrations in the central nervous system following peripheral administration:

A. Ethambutol
B. Rifampin
C. Pyrazinamide
D. A and B
E. A, B and C

18. Indicate which of the following statements concerning glucocorticoid usage for treating asthma are CORRECT:

A. When used with a spacer, the delivery of the larger drug particles to the mouth is increased
B. Inhaled glucocorticoids often reduce or eliminate the need for oral glucocorticoids in patients with severe asthma
C. If glucocorticoids such as beclomethasone do get into the gastrointestinal tract following inhalation therapy, they will not be absorbed into the circulation
D. A and B
E. B and C
19. We want to calculate the appropriate infusion rate for drug Y. We know that the steady state concentration \(C_{ss}\) we wish to achieve is 10 ng/ml. The first-order rate constant for drug elimination from the total body \(k_e\) has been determined to be 0.10/hour. The volume of distribution \(V_d\) for drug Y is 15 liters. Trying not to drown in these numbers (!), what is the appropriate rate of infusion for drug Y?

A. 15 ng/min
B. 250 ng/min
C. 750 ng/min
D. 1.5 μg/min
E. 15 μg/min

\[
C_{ss} = \frac{K_{influsion}}{C_l} \Rightarrow 10 \text{ ng/ml} = \frac{K_{influsion}}{25 \text{ mm/min}}
\]
\[
C_l = \frac{K_e}{V_d} \Rightarrow V_d = 0.1 \cdot 15 = 1.5 \text{ L}
\]
\[
1500 \text{ mL} \cdot \frac{1}{25 \text{ mm/min}} = 25 \text{ mm/min}
\]

20. All of the following statements concerning theophylline are correct EXCEPT:

A. It is an agonist at adenosine receptors
B. One of its main side effects is cardiac arrhythmia
C. It is classified as a methylxanthine
D. Its mechanism of action in producing bronchodilation is mimicked by caffeine
E. Concurrent use of nicotine will decrease theophylline half-life

21. Below is a table showing 3 initial drug therapies for tuberculosis along with the resistance patterns in each case (A to C). Indicate which of these therapies is satisfactory, considering the resistance pattern. I = isoniazid; R = rifampin; Z = pyrazinamide; E = ethambutol; S = streptomycin.

<table>
<thead>
<tr>
<th>Ans. Choices</th>
<th>Drug Therapy Initiated</th>
<th>Drugs Patient Resistant To</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>IRZ</td>
<td>R, S</td>
</tr>
<tr>
<td>B.</td>
<td>IRZ</td>
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<tr>
<td>C.</td>
<td>IRE</td>
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<tr>
<td>D. A and B</td>
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<tr>
<td>E. B and C</td>
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22. If we wish to reach a therapeutic drug plasma level quickly we can give a loading dose. Suppose we want to give a loading dose of drug A to a 50 kg, 25 year-old female. We want to have a steady-state \(C_{ss}\) level of drug A of 100 ng/ml. Drug A has a volume of distribution \(V_d\) of 30 liters and a bioavailability \(F\) of 0.5. What would be the appropriate loading dose for drug A?

\[
Dose = \frac{C_{ss}}{F} = \frac{100 \text{ ng/ml} \cdot 30 \text{ L}}{0.5} = 6000 \text{ ng/ml}
\]
23. Drug W has a volume of distribution of 100 liters. Indicate which statements below you could infer from this information.

A. Drug W is not a substrate for cytochrome P₄₅₀ metabolic enzymes in the liver  
B. Drug W is significantly distributed into tissue compartments  
C. Drug W will have a half-life of greater than 6 hours  
D. A and B  
E. B and C

→ 24. Appropriate treatments for severe acute asthma (status asthmaticus):

A. Intravenous hydrocortisone  
B. Inhaled metaproterenol  
C. Intravenous albuterol  
D. A and B  
E. A, B and C

25. In tuberculosis therapy, if the chances of a mycobacterium being resistant to rifampin were $1 \text{ in } 2 \times 10^5$, and the chances of it being resistant to isoniazid were $1 \text{ in } 5 \times 10^7$, what would be the incidence of organisms resistant to both of these drugs?

A. $1 \text{ in } 7 \times 10^7$  
B. $1 \text{ in } 1 \times 10^{12}$  
C. $1 \text{ in } 1 \times 10^{13}$  
D. $1 \text{ in } 1 \times 10^{35}$  
E. $1 \text{ in } 1 \times 10^{36}$

→ 26. Indicate which of the following statements concerning how the body handles drugs are CORRECT:

A. The risk of acetaminophen-induced hepatic toxicity is increased by chronic, daily intake of ethyl alcohol  
B. In the Caucasian population, over 90% of individuals are characterized as “fast acetylators” of isoniazid  
C. The half-lives of most drugs that are mainly eliminated by the kidney are much shorter in neonates (1-28 days of age) compared to 20 year-old adults  
D. A and B  
E. B and C
27. Indicate which of the following drugs are considered 1st line drugs in treating tuberculosis:
A. Cycloserine
B. Ethionamide
C. p-Aminosalicylic acid
D. A, B and C
E. None of the above

28. Indicate the side effects associated with long term oral glucocorticoid treatment of asthma:
A. Hypertension
B. Osteoporosis
C. Peptic ulcers
D. A, B and C
E. None of the above

29. For which routes of drug administration can you be sure that the drug bioavailability will be 1.0?
A. Rectal
B. Intravenous
C. Intramuscular
D. A and B
E. B and C

30. Condition A: Drug X is being infused at a constant rate of 5 µg/min
Condition B: Drug X (same drug as in A) is being infused at a constant rate of 10 µg/min
Indicate which of the following statements are CORRECT:
A. The elimination of Drug X will change from first order kinetics under Condition A to zero order kinetics under Condition B
B. Condition B will achieve a steady-state plasma drug concentration in half the time it will take Condition A to achieve a steady-state
C. Condition B will produce a steady-state concentration that is twice that produced by Condition A
D. A and B
E. B and C

END OF PHARMACOLOGY EXAM!