**Question 1: Objective of Dosage forms**
- Primary Objectives of dosage form design
  - (1) Bioavailability: The drug must be bioavailable to exert its pharmacologic effect.
  - (2) Stability: The product must be reasonably stable for patient use and commercial shelf life. One form of stability is microbial stability.
  - (3) Compliance: Formulate the product to promote compliance – good taste, color, appearance.
  - (4) Marketing and Commercial Considerations: Dosage form design with trademarks, patent.

  **Sample Question 1**
  - Without fulfilling the dosage form objective of __________, the patient may not take the product and no positive therapeutic effects will be realized.

**Question 2: Pre-formulation studies**
- Preformulation studies include the determination of important physical and chemical properties of the API. They greatly impact the design of the dosage form and are used to determine the types of dosage forms able to be formulated. Formulation heavily relies on solubility and stability. This is the first step of product development.

  **Sample Question 2**
  - After discovering an API with pharmacologic activity, the first step in drug design is _______.

**Question 3: USP Routes of Administration**
- There are two major categories of dosage form administration: Parenteral and Non-Parenteral
  - Parenteral (Needle): IV, IM, SC, ID (intradermal)
  - Non-Parenteral (No Needle!): Gastrointestinal, Mucosal, Transdermal, Pulmonary

  **Sample Question 3**
  - Scopolamine patches are indicated for the treatment and prevention of motion sickness. This utilizes a __________ route of administration.

**Question 4: USP Categories of Dosage Forms**
The categories of dosage forms are identified in USP <1151>. The ones that we have worked with this semester include:
- Capsules: Metronidazole child capsules
- Emulsions: Dry gum, Wet gum, Forbes Bottle, methods
- Sprays: Methacholine Inhalation Solution (Bronchial CT)
- Liquids: Any….. Elixir Terpin Hydrate
- Lozenges: 100mg Caffeine gummys, bitter. Troches.
- Ointments: Psoriasis ointment (SA, Sulfur, Coal tar)
- Pastes: Levanisole dewarming paste (for our hogs)
- Powder: Captopril divided powders
- Solutions: Thymol 0.3% Alkaline Saline Mouth Rinse
- Sticks: 30% Beeswax Camphor lip balm
- Suppositories: Drug A Rectal Suppository 1% using Fattyblend as suppository base
- Suspensions: Metronidazole 100mg/5mL suspension (in methylcellulose, + cherry syrup)

  **Sample Question 4**
  - Petrolatum is used frequently used as a base in topicals. It is a __________ dosage form.

  **Extra Credit Question 4b**
  - A stiff semisolid preparation containing a high percentage (~25%) of solids is a _______ dosage form.
**Question 5: USP Release Dates**
The following information is referenced from the USP General Chapter <1121> - Dosage forms may be formulated such that the release is modified. There are two types of modified-release products → Delayed-Release, and Extended-Release - Delayed-Release: Product is *deliberately* modified to delay release of drug substance for some period of time after initial administration. It is often gastro-retentive technology, such as acid-resistant or enteric coatings. - Extended-Release: Products are formulated in such a manner as to make them available over an extended period of time. - **Sample Question 5**
  o In order to prevent adverse events in the stomach, sometimes tablet formulations are designed to be ________.

**Question 6: Components of Dosage forms**
- The dosage form components are fundamentally similar for all products – here’s your favorite set of words:
  - API: The active drug, the reason to take the medication
  - Excipients: Support the absorption or stability of the active drug, helping to accomplish the objective of the dosage form, or may simply be needed for manufacturing.  
  - Packaging: Packaging must protect the integrity of the dosage form, from stability issues or adverse effects
  - Administration Device: Materials and equipment necessary for administration of the drug
- **Sample Question 6**
  o Additional inactive ingredients used to aid the manufacturing process, such as lubricants, are______.

**Question 7: Inactive Ingredient Categories**
- Pharmaceutical excipients are often critical components in a formulation. They may be either functional or non-functional, and must be stable within the formulation throughout the product shelf life.
  - Filler: Bulking agent to provide tablet size (Inert, Non-functional) and carry the dose.
  - Binder/Solvent: The ‘glue’ to hold the formulation materials together
    o Ex: Povidone
  - Disintegrant: Swelling agent to facilitate dissolution and bioavailability ~ opens up the tablet to have its effect
    o Ex: Crospovidone
  - Glidant/Lubricant: Fatty acid salts and inert flow-able materials to facilitate flow.
    o Ex: Talc, Silicon dioxide, magnesium stearate
  - Diluent: Suspending agent or base.
    o Ex: Microcrystalline cellulose
  - Color: Dye or lake ~ usually adsorbed onto solid
  - Flavor: If needed
  - Coating: If needed. Usually a polymer, plasticizer, or color in solvent.
- **Sample Question 7**
  o A swelling agent that facilitates dissolution and bioavailability is known as a ____________.

**Question 8: What is the dosage form category?**
- The major routes of administration are parenteral and non-parenteral.
- **Sample Question 8**
  o Mucosal, Pulmonary, and Gastrointestinal are examples of ____________ routes.

**Question 9: What is the dosage form?**
- The categories of dosage forms are listed in USP <1151>, take some time to browse during your leisure time
- **Sample Question 9**
  o During the methacholine challenge test, patients use a nebulizer to diagnose the stage of their asthma. In this experiment, the methacholine is a _____________. (Dosage form)
**Question 10: Dosage form Description**

- Non-sterile products are dosage forms introduced into the body orally, topically, by inhalation, or by other non-injectable routes. In general, non-sterile products include solids such as tablets, capsules, and powders; liquids such as solutions, suspensions, and emulsions, and semisolids such as ointments, creams, and suppositories.

- **Solution**
  - Homogenous preparations in which all ingredients are **dissolved** in the solution vehicle. Solute. Solvent.

- **Suspensions**
  - Preps where at least one ingredient is **insoluble** and is uniformly dispersed throughout the vehicle.
  - Suspensions must be shaken to disperse insoluble ingredients and often require a viscous vehicle to maintain the insoluble ingredients in suspension.

- **Emulsions**
  - Liquid preps containing **water and oil** that are rendered homogenous by adding an emulsifying agent.
  - Emulsifying agent reduced the interfacial tension between the oil and water phases.

- **Creams**
  - An aqueous-based dosage form that is water-washable, non-greasy, and easily spread on the skin. They may be fully hydrophilic, containing soluble or insoluble ingredients, o/w emulsions, or semi-polar formulations.

- **Ointments**
  - A topical based in a hydrophobic vehicle. They are water-repellant, form a barrier on the skin, and are difficult to remove by washing.

- **Suppositories**
  - May provide local or systemic effects. Useful for administering drugs to infants and small children.
  - Dosage forms routes of administration may include rectal, vaginal, or urethral suppositories. In each case, the suppository base must **melt, liquefy, or dissolve** at approximate human body temperature.
  - Rectal: 2.5-4cm in length, approximately 2g. Have smaller sizes for children. Cylindrical-shape.
  - Vaginal: 3-5g, egg or cone-shaped.
  - Urethral: Male: 3-6mm in diameter, 140mm long. Female: 3-6mm diameter, 50-70mm long.

- **Sample Question 10**
  - Topical _______ dosage forms may be hydrophilic or hydrophobic, and contain a high percent content of compatible liquid vehicle to render them liquid in consistency.

- **Extra Credit Question 10b**
  - A dedicated Park Ranger, you have little tolerance for littering. On your rounds, across the ravine you see some mischief. You pull out your binoculars and locate the suspect. The individual is seen throwing a thin, pencil-shaped suppository into the grass. It is likely a _______ suppository.

**Question 11: Objective of the dosage form**

- **Sample Question 11**
  - A young child has trouble swallowing tablets. You design a troche dosage form that is gummy and tastes sweet. This design is helping achieve the _______ of the dosage form.

**Question 12: General Ingredients**

- **Sample Question 12**
  - You are designing a hydrating ointment that contains urea. To establish an occlusive layer, you select petrolatum as your ointment base. What levigating agent should you use after hydrating urea?

**Question 13: Unique Ingredients**

- **Sample Question 13**
  - An investigational new drug found in plants is to be extracted and formulated into capsules. The drug is hydrophobic, lipophilic, and has a distinct smell to it. What would serve as a valid extraction agent?

- **Extra Credit Question 13b**
  - To prepare you to be the pharmacists of the future, we are exposing you to techniques that will soon be utilized nationwide, potentially in the household pending legal litigation. The new investigational drug referenced in question 13 is representative of: __________________
**Question 14: General Manufacturing Process**
- During the manufacturing process, often times it is necessary for additional excipients to be added to the dosage form to aid formulation.
- The manufacturing processes for solid products are relatively complicated compared to other dosage forms. The basic manufacturing processes for non-liquid solid products includes:
  - Particle size reduction – to make all powders essentially the same size
  - Granulation: To eliminate dust and build agglomerates
  - Drying and Sizing as necessary: This will eliminate moisture and make the granules the appropriate size
  - Mixing/Blending: Mix all ingredients for uniformity.
  - Unit dosing: This may require compression, encapsulation, or powder filling to form tablets, capsules, bottles, or sachets.
  - Coating if needed: Coating may be functional or non-functional. Functional means it performs some action, such as acid protection, whereas non-functional is associated with appearance only.
    - Enteric coating on ASA 81mg = Functional.
- Manufacturing processes must provide a stable formulation throughout the product shelf-life.
- Regulations and Design Processes: Regulations and industry performance expectations enable dosage forms to be safe and reliable. The FDA approves specifications for all Rx dosage forms as part of the new product submission.
  - QbD: Quality by Design – promotes building quality into the manufacturing process rather than testing the end product. Requires identification and control of variation.
  - FDA: Monitors facilities for good manufacturing practices (GMP)
  - Product recalls occur because companies have GMP violations and validation violations.
  - Validation is documented evidence that things work as expected. This includes manufacturing processes, cleaning processes, equipment, facilities, utilities, control systems, computers, and so on.
- **Sample Question 14**
  - True/False: Manufacturing processes should provide a stable formulation up until patient use. _________
- **Extra Credit Question 14b**
  - “____________” means that companies have not followed GMP regulations

**Question 15: Dosage form counseling points**
- Emulsions (creams/lotions)
  - Product may break down if exposed to excessive heat or sudden changes in temperature. Shake before use
- Suppositories
  - Remove the wrapping before inserting.
- Topicals
  - Heat causes and increase in absorption of the active drug into the bloodstream. This can cause serious adverse effects for patients
  - Should never be applied over open wounds or broken skin unless it is labeled as a sterile product
  - Lotions should be shaken well prior to each use
- Troche
  - Be sure the patient knows how much to take for each dose
  - Allow the troche to dissolve completely in the mouth or buccal area
  - Do not swallow or chew - Hard/soft troche, patient should allow to dissolve in mouth for over 5-10 mins
  - Protect troches from heat and moisture, they can melt.
  - Intended use and the mechanism for absorption. Patient should not swallow a buccal tablet
    - Hard/soft troche, patient should allow it to dissolve in mouth for over 5-10 minutes
- **Sample Question 15**
  - A patient has just been dispensed a suspension product. Before they use it, you should advise them to _________ it to ensure the drug is uniformly dispersed.

**Question 16: Compounded dosage forms**
- **Sample Question 16**
  - In the continental (dry-gum) method for compounding emulsions what product is the 4 in 4:2:1? ____________
• Question 17: Key ingredients for compounding  See #7, though this ay refer to the real basic stuff
  - Emulsion = Oil, Water, Emulsifying Agent
  - Suppository = Suppository Base, Levigating agent, Lubricant, Maybe absorbant base.
  - **Sample Question 17**
    - You are compounding a polybase suppository in the lab. Before filling the suppository mold, ________________ should be applied via Q-tip to act as a lubricant.
  - **Extra Credit Question 17b**
    - What ingredient gives chewable troches their major characteristic? ________________

• Question 18: Key Processes/Techniques for Compounding
  Notable techniques from lab include
  - Mortar and Pestle (Incorporation)
    - Used in compounding of emulsions. Specifically, porcelain mortars to help break up oil globules and create particles of uniform size.
  - Emulsification
    - Dry Gum Method (4-2-1)  O → W/O → O/W
      - Add oil to mortar. Add emulsifying agent Add water to form primary emulsion
      - Add additional ingredients Add water qs to final volume
  - Comminution: A method of particle size reduction. The type of comminution depends on the formulation
    - Trituration: For dry materials
    - Levigation: For wet materials
    - Pulverization by Intervention: Dissolution and evaporation
    - Mechanical: Using an electric grinder, like a blender.
  - Suspending agent hydration
    - A commonly used suspending agent is methylcellulose. After triturating methylcellulose into a finely dispersed powder in a mortar, levigate with glycerin. We should try to use minimal glycerin, but we also do not want any non-wetted particles.
    - Add purified water in geometric proportions to half the Rx volume. Allow methylcellulose to sit for at least 15 minutes. Add remaining ingredients in geometric amounts.
  - Geometric mixing
    - The act of mixing equal amounts of materials beginning with the smallest amount. This helps guarantee equal dispersion It can be applied to solids, liquids, and semisolids. Often times, it is useful to include a dye or colored agent to allow for monitoring. Add the lighter colored agent to the darker one.
  - Suppository Wrapping: Use 3x3 inch foil-square
    - Place suppository in line with two corners of foil (along a diagonal)
    - Fold the bottom corner over the middle of the suppository
    - Fold one corner point over the end of the suppository
    - Fold the opposite corner point over end of the suppository
    - Roll the suppository over folded ends into remaining open foil
    - Dispense in box, remind patient to unwrap suppository before using
  - Double Pour – for when you are unsure how much space your drug will take up. It’s ok to not know some things.
    - The formulation is prepared by melting the vehicle, adding drug with mixing to half the vehicle amount
    - Pour vehicle+drug mixture into the mold cavities. When done there should still be room in the cavities
    - Pour Qs our remaining additional suppository base (no drug) to overfill the cavity. Discard excess
    - Cool the mixture. Now re-melt it (we need the dosage to be uniform, not like candy corn)
    - Pour, cool, wrap, dispense.
  - **Sample Question 18**
    - When we are unsure how much space our drug will take up when designing suppositories, we can use the ________________ technique. Initially, this involves using only half the mass of our base/vehicle.
**Question 19: Quality Control**
The quality control checks are specifically related to the objective of the product. They are tests to demonstrate the dosage form quality during and after completing the preparation prior to dispensing.

- Capsules: If all ingredients are white, use colored lactose
  - Weigh final product
- Divided: If all ingredients are white, use colored lactose, weigh divided powders
- Lotion: Pourable (squeezable if squeeze tube), QS volume, Grittiness check
- Ointment: Color uniformity/homogeneity, grittiness check, odor, texture
- Sticks: Weight, melting point, physical observation
- Suppositories: Uniformity of weight and texture, physical appearance
- Suspension: Pourable, QS volume, Grittiness
- Troches: Weight, Uniformity, Appearance, Odor, Hardness

**Sample Question 19**
- After compounding a solid product, a quality control technique to ensure proper dosage is __________

**Question 20: Compoundeda dosage form counseling points**

- **Sample Question 20**
  - For topical products, __________ causes an increase in absorption of the active drug into the bloodstream. This can cause serious adverse effects for patients.
1: Compliance  
2: Pre-formulation studies  
3: Transdermal  
4: Ointment  *Also accept ‘Hydrocarbon’ or ‘Oleaginous’*  
   - 4b: Paste  
5: Acceptable answers include: Delayed-Release, Enteric Coated, Acid-Resistant  
6: Excipients  
7: Disintegrant  
8: Non-parenteral  
9: Acceptable answer: Spray. Students will receive half-credit for solution.  
10: Lotion  
   - 10b: Urethral  
11: Objective. Due to poor wording, the student may write ‘Compliance’. They will be awarded half-credit.  
12: Mineral Oil  
13: Acceptable answers include: Coconut oil, Olive oil. No credit for butter, we are not making pancakes.  
   - 13b: Acceptable answers include: Marijuana, THC, Cannabinoids, Cannabidiol, Cannabigerol, weed, grass, bud  
14: False  
   - 14b: Adulterated  
15: Shake  
16: Oil, or oil product.  
17: Light mineral oil or vegetable oil spray  
   - 17b: Gelatin  
18: Double-Pour  
19: Weigh the product  
20: Heat