Texas A&M University (TAMU) ATMO201 Weather and Climate Exam 2 Practice (Sample)

Study Guide

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Questions

1. What type of fog is created when warm, moist air moves over a cold surface?

   A. Advection fog

   B. Radiation fog

   C. Upslope fog

   D. Evaporation fog

2. What is the typical size range of hail?

   A. 1 mm to 5 mm in diameter

   B. 5 mm to more than 15 cm in diameter

   C. 0.5 mm to 6 mm in diameter

   D. Up to 1 cm in diameter

3. At higher altitudes, how does the rate of air pressure decrease change?

   A. Increases constantly

   B. Decreases rapidly at first, then slows

   C. Decreases steadily

   D. Remains constant

4. What is the net force acting on the wind when centripetal force is involved?

   A. It must be directed outward

   B. It must be directed inward

   C. It has no specific direction

   D. It varies with the season

5. What is the relationship between the height of cold and warm air columns?

   A. Shorter cold column = shorter warm column

   B. Shorter cold column = taller warm column

   C. Both columns are equal

   D. Taller cold column = shorter warm column

6. What distinguishes graupel from regular snow?

A. It consists of water vapor deposits

B. It has a lump or curve shape and is heavily rimed

C. It forms at temperatures above freezing

D. It is smaller than traditional snowflakes

7. Which mechanism contributes to the growth of raindrops in warm water regions of clouds?

A. Vapor deposition

B. Condensation nuclei

C. Collision-coalescence

D. Water cycle condensation

8. What phenomenon causes air radiativity to cool near the surface on clear, calm nights?

A. Frontal inversion

B. Radiation inversion

C. Subsidence inversion

D. Thermal convection

9. How does surface wind behave differently from geostrophic wind?

A. It flows parallel to the isobars

B. It generally moves in a straight line

C. It crosses isobar flow due to friction

D. It is influenced by the Coriolis force exclusively

10. Why do not all cloud droplets fall out of the sky?

A. Wind drag acts downward

B. Gravity acts downward but is countered by wind drag

C. Cloud density keeps droplets suspended

D. Temperature variations lift droplets

Answers

1. A
2. B
3. B
4. B
5. B
6. B
7. C
8. B
9. C
10. B

Explanations

1. What type of fog is created when warm, moist air moves over a cold surface?

   A. Advection fog

   B. Radiation fog

   C. Upslope fog

   D. Evaporation fog

Advection fog forms when warm, moist air moves horizontally over a cooler surface, such as colder ocean water or land, leading to the cooling of the air and condensation of moisture. This process typically occurs when warmer, moisture-laden air from a source such as the ocean drifts over a region with a significantly lower temperature, causing the air to lose its capacity to hold water vapor, resulting in fog formation. In contrast, radiation fog occurs under clear skies at night when the ground loses heat rapidly through radiational cooling, which causes the air nearest the surface to cool and condense. Upslope fog forms when moist air is lifted as it moves up a slope, cooling and condensing as it rises. Evaporation fog, also known as steam fog, occurs when colder air moves over warmer water, causing water vapor to condense and create fog. The characteristics and conditions that define advection fog are essential for understanding various fog types and their implications in meteorology, particularly regarding visibility and weather patterns.

2. What is the typical size range of hail?

   A. 1 mm to 5 mm in diameter

   B. 5 mm to more than 15 cm in diameter

   C. 0.5 mm to 6 mm in diameter

   D. Up to 1 cm in diameter

Hail generally forms within strong thunderstorms and can vary significantly in size depending on the strength of the updrafts within those storms. The correct choice notes that hail can range from 5 mm to more than 15 cm in diameter. This range encompasses the common sizes of hailstones that can develop in severe weather conditions. Smaller hail typically occurs with weaker storms, but when conditions are right—specifically, when powerful updrafts can support larger ice particles in the cloud, allowing them to grow by collecting additional water and refreezing—hailstones can grow quite large. In fact, it is not unusual for severe thunderstorms to produce hailstones over 10 cm in diameter, which can cause significant damage to property, vehicles, and crops. The other options provide ranges that are too small or do not accurately reflect the potential size of hailstones found in severe weather events.

3. At higher altitudes, how does the rate of air pressure decrease change?

A. Increases constantly

B. Decreases rapidly at first, then slows

C. Decreases steadily

D. Remains constant

At higher altitudes, the rate of air pressure decrease is characterized by a rapid decrease initially, which then slows down as altitude increases. This behavior is a result of the changing density of the atmosphere. In the lower levels of the atmosphere, where pressure is higher, the air molecules are more densely packed, leading to a steeper gradient of pressure changes with altitude. As you ascend, the air becomes less dense, meaning that the number of air molecules that contribute to pressure decreases more gradually. Thus, the pressure decreases quickly initially due to the greater density and then begins to taper off as the density drops and the rate of pressure change becomes less pronounced. This phenomenon aligns with the barometric formula, which describes how pressure changes with altitude in the atmosphere. The relationship reflects both the physical characteristics of the atmosphere and how the gases interact with one another as altitude increases.

4. What is the net force acting on the wind when centripetal force is involved?

A. It must be directed outward

B. It must be directed inward

C. It has no specific direction

D. It varies with the season

When centripetal force is involved in the context of wind movement, the net force must be directed inward. This inward direction is essential for maintaining circular motion, which is common in meteorological phenomena like cyclones and hurricanes. Centripetal force is defined as the net force that acts on an object moving in a circular path, directed towards the center of the circle around which the object is moving. In the case of wind, which can exhibit circular patterns due to changes in pressure and other atmospheric conditions, the inward net force keeps the wind moving along the curvature of its path rather than moving off in a straight line. The inward net force is often the result of balance between various forces, such as pressure gradient force and Coriolis effect, but its essential nature remains: providing the necessary push towards the center to keep the wind in circular motion. This is a fundamental principle in atmospheric dynamics that helps explain how different systems, such as low-pressure areas, behave.

5. What is the relationship between the height of cold and warm air columns?

A. Shorter cold column = shorter warm column

B. Shorter cold column = taller warm column

C. Both columns are equal

D. Taller cold column = shorter warm column

The correct answer is centered on understanding how temperature impacts the density and height of air columns. Warm air is less dense than cold air, which means that a column of warm air will generally rise higher than a column of cold air when comparing equal pressures. When warm air heats up, it expands, causing it to occupy a larger volume. As a result, the height of the air column made up of warm air is greater compared to that of a cold air column at the same pressure level. Conversely, a column of cold air tends to be more compact and closer to the ground due to its higher density. In this context, when cold air is introduced into the conversation, it does not hold as much vertical height as warm air does. Therefore, when a column of cold air is shorter, a corresponding column of warm air will be taller to balance the overall atmospheric pressure. This relationship showcases the fundamental principles of atmospheric physics, where temperature and density play crucial roles in shaping the vertical structure of the atmosphere.

6. What distinguishes graupel from regular snow?

A. It consists of water vapor deposits

B. It has a lump or curve shape and is heavily rimed

C. It forms at temperatures above freezing

D. It is smaller than traditional snowflakes

Graupel is distinguished from regular snow primarily by its shape and its physical characteristics due to riming. Unlike traditional snowflakes, which are formed from ice crystal structures typically exhibiting a hexagonal shape, graupel forms from supercooled water droplets that collide and freeze onto the surface of a snow crystal. This process leads to the development of soft, rounded pellets that have a lumpier appearance. Graupel often appears larger and is heavier than regular snowflakes. Its formation involves significant riming, where the water droplets freeze onto existing ice crystals. This heavy coating gives graupel its characteristic shape—a rounded and sometimes irregular lump, as opposed to the intricate design of typical snowflakes. This key difference in both the process of formation and the resulting shape is what sets graupel apart from standard snow, making it easily recognizable in weather phenomena.

7. Which mechanism contributes to the growth of raindrops in warm water regions of clouds?

A. Vapor deposition

B. Condensation nuclei

C. Collision-coalescence

D. Water cycle condensation

The mechanism that contributes to the growth of raindrops in warm water regions of clouds is the collision-coalescence process. In warm clouds, which typically consist of droplets that can exist in a liquid state at temperatures above freezing, smaller water droplets collide with larger ones as they fall through the cloud. When these droplets collide, they can coalesce, or merge together, forming larger droplets. This process works effectively because the droplets are more likely to collide with and stick to one another due to the varying sizes and the downward motion of the falling droplets. This method of raindrop formation is prevalent in warm clouds, where higher temperatures enable the droplets to remain liquid despite having larger sizes. Collision-coalescence is particularly important in the tropics, where warm clouds are abundant and the conditions favor larger raindrop development. In contrast, vapor deposition involves water vapor changing directly into ice and is more relevant in cold cloud processes; condensation nuclei serve as the surfaces on which water vapor condenses but do not directly relate to the growth of raindrops in warm clouds; and the water cycle condensation, while a general process within the broader framework of the water cycle, does not specifically address the mechanism of raindrop growth in the warm cloud context.

8. What phenomenon causes air radiativity to cool near the surface on clear, calm nights?

A. Frontal inversion

B. Radiation inversion

C. Subsidence inversion

D. Thermal convection

The phenomenon that causes air radiatively to cool near the surface on clear, calm nights is radiation inversion. During these nights, the surface loses heat through radiation, particularly in the absence of clouds, which otherwise would trap heat. As the ground cools, the air right above the surface also loses heat and becomes cooler than the air higher up. This creates a temperature inversion, where typically cooler air is situated beneath warmer air. Under clear conditions, the lack of clouds allows for a more significant loss of infrared radiation, enhancing the cooling effect. Calm winds also play a significant role by minimizing the mixing of air layers, which helps maintain the cooler air close to the ground. This leads to the development of a stable layer of air, preventing vertical mixing and trapping the cooler air near the surface until the sun rises and heating begins again.

9. How does surface wind behave differently from geostrophic wind?

A. It flows parallel to the isobars

B. It generally moves in a straight line

C. It crosses isobar flow due to friction

D. It is influenced by the Coriolis force exclusively

Surface wind behaves differently from geostrophic wind primarily due to the influence of friction. At the surface, various roughness elements such as trees, buildings, and topography create drag on the wind, which causes it to deviate from the straight-line path that geostrophic wind would follow. The surface wind does not flow parallel to the isobars; instead, it crosses them at an angle due to the reduction in wind speed caused by friction. In contrast, geostrophic wind, which occurs at higher altitudes where friction is negligible, tends to flow parallel to the isobars. This is because at those altitudes, the forces acting on the wind (the pressure gradient force and the Coriolis force) are balanced, allowing for smooth, straight-line airflow. Therefore, the correct choice captures this essential principle of how wind behaves at the surface compared to the geostrophic wind.

10. Why do not all cloud droplets fall out of the sky?

A. Wind drag acts downward

B. Gravity acts downward but is countered by wind drag

C. Cloud density keeps droplets suspended

D. Temperature variations lift droplets

The correct answer highlights the balance between gravitational pull and the upward force exerted by wind drag on cloud droplets. When cloud droplets form, they are very small, often on the order of a few micrometers in diameter. Their mass is light enough that, although gravity pulls them downward, the drag force created by the surrounding air can counteract this gravitational force. As droplets begin to fall, the resistance from the air (wind drag) increases with their velocity. For very small droplets, the drag force can equal and even exceed the force of gravity due to this balance, allowing them to remain suspended in the cloud rather than falling to the ground. This phenomenon is more pronounced in clouds where updrafts and turbulent wind conditions exist, keeping many droplets aloft, despite the gravitational force acting on them. Other options do not capture the complexity of this balance. While wind drag is mentioned, the nuances of cloud density and how temperature variations affect droplet behavior do not directly address why not all droplets fall out of the sky. Understanding this balance is essential for comprehending phenomena like cloud formation, precipitation processes, and weather systems.