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QUESTION NO: 1

Commercial airline pilots seek out stable atmospheric conditions to ensure a smooth flight.

Which layers of the atmosphere are of most interest to airline pilots?

Choose 2 answers.

A. Mesosphere

B. Stratosphere

C. Troposphere

D. Thermosphere

ANSWER: B C

Explanation:

Commercial airline operations are most concerned with the troposphere and stratosphere because airline cruising altitudes occur near the boundary between these two layers, known as the tropopause. The troposphere is the lowest atmospheric layer and contains nearly all familiar weather, including clouds, precipitation, thunderstorms, and much of the turbulence that can affect aircraft. Pilots and dispatchers therefore monitor its conditions closely when selecting routes, altitudes, and alternates. The stratosphere begins above the tropopause and is generally more stably layered, with less vertical mixing and relatively little weather. Jet aircraft commonly cruise in the upper troposphere and, depending on latitude and conditions, can operate near or just within the lower stratosphere to take advantage of smoother air and efficient winds. This makes both the troposphere and stratosphere directly relevant to flight planning and passenger comfort. The U.S. National Weather Service describes the troposphere as the layer where weather occurs and identifies the stratosphere as the layer above it: NWS JetStream: Layers of the Atmosphere. The FAA also explains how atmospheric weather hazards, including turbulence, are central to aviation decision-making: FAA Aviation Weather (AC 00-6B).

QUESTION NO: 2

Kepler discovered that planets move in elliptical paths around the sun. Repeated observations have confirmed Kepler's finding.

Which type of scientific statement is Kepler's discovery?

A. Inference

B. Theory

C. Law

D. Hypothesis

ANSWER: C

Explanation:

Law is correct because Kepler's finding describes a consistent, observable pattern in nature: planets orbit the Sun in elliptical paths, with the Sun located at one focus of the ellipse. A scientific law summarizes what reliably happens in the natural world, based on repeated observation and measurement. The statement in the question emphasizes that continued observations have confirmed the same orbital relationship, which is characteristic of a scientific law.

Kepler's first law of planetary motion is specifically known as the Law of Ellipses. It provides a mathematical and descriptive account of planetary orbits that can be used to predict planetary positions and motion. The law arose from Kepler's analysis of precise astronomical observations, especially measurements collected by Tycho Brahe, and it remains a foundational principle in astronomy. NASA describes Kepler's laws as the rules that govern planetary motion: NASA: Kepler's Laws. Further background on the elliptical-orbit law is available from Encyclopaedia Britannica: Kepler's laws of planetary motion.

QUESTION NO: 3

Numerous experiments have confirmed that if the distance between a light source and an observer is doubled, the intensity of the light as viewed by the observer decreases by a factor of four.

Which type of scientific statement is this?

A. Law

B. Hypothesis

C. Theory

D. Inference

ANSWER: A

Explanation:

Law is correct because the statement summarizes a repeatedly observed, quantitative relationship in nature: light intensity is inversely proportional to the square of the distance from a source. Thus, when the distance is doubled, the same light is spread across four times as much area, so the observed intensity becomes one-fourth as great. This relationship is known as the inverse-square law for light. Scientific laws describe reliable patterns or relationships that have been consistently confirmed through observation and experiment, often using mathematical language. The wording in the question emphasizes that numerous experiments have confirmed the relationship, which is characteristic of a scientific law. A law does not need to provide the underlying mechanism for the pattern; its role is to accurately state what happens under specified conditions. The inverse-square relationship is widely used in physical science to describe how radiation from an ideal point source distributes through space. The OpenStax physics text discusses the inverse-square behavior of light intensity and irradiance, while NASA explains that the intensity of radiation from a source decreases with the square of distance. See OpenStax Physics and NASA Science.

QUESTION NO: 4

Which phase changes release thermal energy to the surroundings?

Choose 2 answers.

A. Water vapor changing to liquid water

B. Ice changing to liquid water

C. Liquid water changing to ice

D. Liquid water changing to water vapor

ANSWER: A C

Explanation:

Water vapor changing to liquid water and **liquid water changing to ice** are correct because condensation and freezing release latent heat. During these changes, particles move into arrangements with lower potential energy, and the excess energy is transferred to the surroundings.

Melting and evaporation require an input of energy to overcome attractive forces between particles. They are therefore phase changes in which the substance absorbs energy from its surroundings.

QUESTION NO: 5

Which time of the year Is it In Fargo, North Dakota, when Earth is facing the sun as shown in the diagram?

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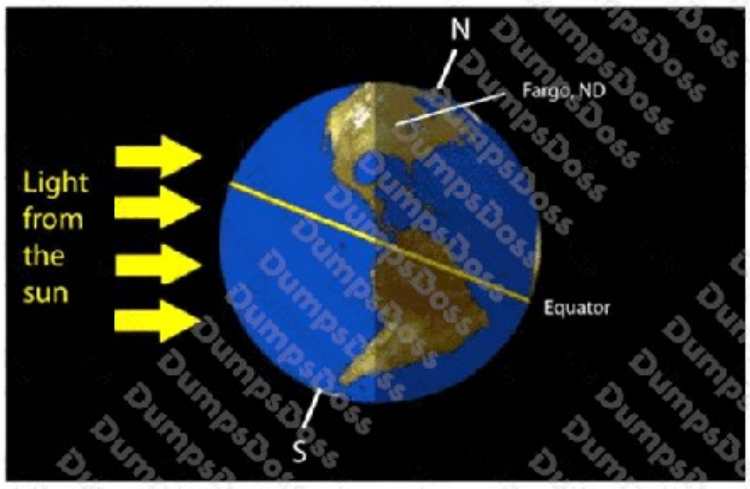

A. Fall

B. Spring

C. Summer

D. Winter

ANSWER: C

Explanation:

Summer is correct because the diagram places Earth so that the Northern Hemisphere is tilted toward the Sun. Fargo, North Dakota, is in the Northern Hemisphere, so at this point in Earth's orbit it receives sunlight at a more direct angle and for more hours each day. More concentrated incoming solar energy and longer daylight periods produce the warmer conditions associated with summer. Earth's seasons are caused primarily by the 23.5-degree tilt of its rotational axis, not by a major change in Earth's distance from the Sun. As Earth travels around the Sun, the hemisphere tilted toward the Sun experiences its summer season, while the hemisphere tilted away experiences winter. The position depicted corresponds to the time near the June solstice, when the Northern Hemisphere has its greatest seasonal exposure to direct sunlight. NASA explains that the axial tilt changes the angle and duration of sunlight received by each hemisphere over the course of a year: NASA: What Causes the Seasons?. Additional seasonal and solstice background is available from the National Weather Service: National Weather Service: Seasons.

QUESTION NO: 6

A pet store worker prepares a saltwater tank for fish by pouring ocean salt into a tank of pure water.

How is the mass of the ingredients affected, according to the law of conservation of matter?

A. The mass of the salt equals the mass of the salt water mixture.

B. The mass of the salt equals the mass of the pure water.

C. The mass of the pure water equals the mass of the salt water mixture.

D. The mass of the pure water and salt equals the mass of the salt water mixture.

ANSWER: D

Explanation:

The mass of the pure water and salt equals the mass of the salt water mixture. The law of conservation of matter states that matter is not created or destroyed during a physical change or chemical process in a closed system. Dissolving ocean salt in pure water is a physical mixing process: the salt separates into dissolved particles and becomes evenly distributed

throughout the water, but both the water and the salt remain present. Therefore, if the mass of the water is measured before the salt is added and the mass of the salt is measured separately, their combined mass will equal the mass of the completed saltwater mixture, provided none of the material is spilled, evaporates, or otherwise leaves the system. This principle is useful in solution calculations because the mass of a solution is the sum of the masses of its solvent and dissolved solute. The mixture may have different properties from the original water, such as increased salinity and density, but its total mass still reflects all of the matter that was combined. See Encyclopaedia Britannica: law of conservation of mass and OpenStax Chemistry: mass relationships in substances.

QUESTION NO: 7

A student wants to investigate whether the length of a ramp affects the speed of a toy car at the bottom of the ramp.

Which actions would help the student conduct a controlled experiment?

Choose 2 answers.

A. Use the same toy car for every trial.

B. Release the car from the same vertical height for every trial.

C. Use a heavier toy car on each longer ramp.

D. Release the car with a stronger push on each longer ramp.

E. Measure the speed at different locations on each ramp.

ANSWER: A B

Explanation:

The student should change only the ramp length and measure the car's speed using the same procedure for every trial. Ramp length is the independent variable, while speed at the bottom is the dependent variable. Using the same toy car controls mass, wheel condition, and shape. Releasing the car from a different height would change gravitational potential energy as well as ramp length, making it impossible to attribute a difference in speed to ramp length alone.