

2024 Earth and Space Scrimmage

Single Elimination 2

August 17th, 1:00 - 1:30 PT

TOSS-UP

1) Space science – *Multiple Choice* The 21-centimeter radiation line originates from which of the following gases?

- W) Neutral hydrogen
- X) Ionized hydrogen
- Y) Neutral helium
- Z) Ionized helium

ANSWER: W) Neutral hydrogen

BONUS

1) Space science – *Short Answer* Order the following three materials from first to last to condense in the solar system condensation sequence: 1) Ammonia; 2) Metal oxides; 3) Olivine.

ANSWER: 2, 3, 1

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### TOSS-UP

2) Earth science – *Multiple Choice* Which of the following minerals does NOT have three cleavage planes?

- W) Calcite
- X) Fluorite
- Y) Galena [*ga-LEE-nuh*]
- Z) Halite

ANSWER: X) Fluorite

### BONUS

2) Earth science – *Multiple Choice* During the positive phase of the North Atlantic Oscillation, the Greenland low pressure trough deepens, leading to major climate effects around the globe. Which of the following is NOT an associated effect of a positive North Atlantic Oscillation phase?

- W) Wetter winters in England
- X) Colder winters on the East Coast of America
- Y) Higher pressure at the Bermuda High
- Z) Stronger Atlantic jet stream

ANSWER: X) Colder winters on the East Coast of America

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TOSS-UP

3) Space science – *Short Answer* Jupiter is estimated to be shrinking at a rate of 1 millimeter per year as a result of what process, which converts Jupiter's gravitational potential energy into heat?

ANSWER: Kelvin-Helmholtz mechanism

BONUS

3) Space science – *Short Answer* Identify all of the following three statements that are true regarding the Henyey [**HEN-yay**] and Hayashi [**hai-YAH-shee**] tracks: 1) The Hayashi track is a vertical branch on an HR diagram; 2) The Henyey track represents the slow collapse of a protostar almost in hydrostatic equilibrium; 3) The Henyey and Hayashi tracks end with the creation of T Tauri stars.

ANSWER: 1 and 2

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**TOSS-UP**

4) Earth science – *Short Answer* Identify all of the following three phenomena that typically promote cyclogenesis: 1) Stable atmosphere; 2) Strong wind shear; 3) Deep thermocline.

ANSWER: 3 only

**BONUS**

4) Earth science – *Multiple Choice* Which of the following best describes the conditions in the lower layer of a holomictic [**hall-oh-MIC-tic**] and oligotrophic [**oh-lig-oh-TROH-fic**] lake?

- W) Oxygen-rich and nutrient-rich
- X) Oxygen-rich and nutrient-poor
- Y) Oxygen-poor and nutrient-rich
- Z) Oxygen-poor and nutrient-poor

ANSWER: X) Oxygen-rich and nutrient-poor

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TOSS-UP

5) Earth science – *Multiple Choice* Which of the following statements is true regarding the formation of large hail particles?

- W) Hailstones accumulate supercooled water
- X) Peak hail formation is in the winter
- Y) Supercell rotation leads to smaller hail particles
- Z) High wind shear leads to smaller hail particles

ANSWER: W) Hailstones accumulate supercooled water

BONUS

5) Earth science – *Short Answer* Order the following three oceanic boundaries in terms of increasing depth: 1) Thermocline; 2) Lysocline; 3) Carbonate compensation depth.

ANSWER: 1, 2, 3

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**TOSS-UP**

6) Space science – *Short Answer* A majority of Pluto's surface, including the glaciated basin Sputnik Planitia [**pluh-NISH-uh**], is composed of the solid form of what element?

ANSWER: Nitrogen

**BONUS**

6) Space Science – *Short Answer* Order the following four locations in the solar system from closest to farthest from the Sun: 1) Heliopause; 2) Oort cloud; 3) Bow shock; 4) Termination shock.

ANSWER: 4, 1, 3, 2

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TOSS-UP

7) Earth science – *Multiple Choice* Which of the following best characterizes the general temperature and salinity of deep water relative to surface water in the Eastern Mediterranean Sea?

- W) Lower temperature and salinity
- X) Lower temperature and higher salinity
- Y) Higher temperature and lower salinity
- Z) Higher temperature and salinity

ANSWER: W) Lower temperature and salinity

BONUS

7) Earth science – *Short Answer* While conducting research, Peter finds a reverse fault that has recently shifted. Identify all of the following three geologic features that could have been created by this reverse fault: 1) Mélange [**meh-LANJ**]; 2) Grabens [**GRAH-bins**]; 3) Mylonite.

ANSWER: 1 and 3

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**TOSS-UP**

8) Space science – *Short Answer* Identify all of the following three surface features that can be found on Mercury: 1) Polar ice; 2) Shield volcanoes; 3) Coronae [**kah-ROH-nee**].

ANSWER: 1 and 2

**BONUS**

8) Space science – *Short Answer* According to the kappa mechanism, changes in the opacity of a star's ionized helium cause the star to expand and contract over time. A certain star can be modeled as a body mostly transparent to light with a partially opaque outer layer. If the equilibrium pressure on this outer layer does not change, by what factor would the star's opacity need to be multiplied in order to cause an expansion of 20%?

ANSWER: 1.44 (ACCEPT: 36/25)

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TOSS-UP

9) Earth science – *Multiple Choice* Diamictite appears most similar to which of the following rocks?

- W) Arkose
- X) Breccia [**BRECH-ee-uh**]
- Y) Siltstone
- Z) Travertine

ANSWER: X) Breccia

BONUS

9) Earth science – *Short Answer* Identify all of the following three factors which can affect the intensity of an earthquake on the moment magnitude scale: 1) Quality of local infrastructure; 2) Fault displacement; 3) Epicenter depth.

ANSWER: 2 only

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**TOSS-UP**

10) Earth science – *Multiple Choice* Which of the following types of fog forms when cool, dry air moves over warm water, often occurring over lakes during the fall?

- W) Steam fog
- X) Frontal fog
- Y) Radiation fog
- Z) Tule [**TOO-lee**] fog

ANSWER: W) Steam fog

### BONUS

10) Earth science – *Short Answer* Identify all of the following three metamorphic facies [**FAY-shees**] that can commonly be found in both stable continents and volcanic arcs: 1) Blueschists; 2) Greenschists; 3) Hornfels.

ANSWER: 2 only

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TOSS-UP

11) Earth science – *Multiple Choice* Which of the following statements is FALSE regarding seismic waves?

- W) P waves are transverse waves
- X) S waves create shear stress
- Y) Love waves are surface waves
- Z) Rayleigh waves move in an elliptical motion

ANSWER: W) P waves are transverse waves

BONUS

11) Earth science – *Multiple Choice* Which of the following best describes the effect Ekman transport has on ocean water beneath cyclones?

- W) Upwelling in both hemispheres
- X) Downwelling in both hemispheres
- Y) Upwelling in the Northern Hemisphere and downwelling in the Southern Hemisphere
- Z) Downwelling in the Northern Hemisphere and upwelling in the Southern Hemisphere

ANSWER: W) Upwelling in both hemispheres

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**TOSS-UP**

12) Space science – *Short Answer* Order the following three variable star types in terms of increasing average period of oscillation: 1) Mira variables; 2) Cepheid [**SEH-fee-id**] variables; 3) RR Lyrae [**LIE-rah**] variables.

ANSWER: 3, 2, 1

**BONUS**

12) Space Science – *Short Answer* Similar to the Trojan asteroids of Jupiter, what term describes the large concentrations of dust that orbit at the L4 and L5 Lagrangian points of the Earth-Moon system?

ANSWER: Kordylewski clouds

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TOSS-UP

13) Earth science – *Short Answer* Marine cloud brightening is a geoengineering technique used to increase Earth's average albedo. The technique primarily relies on what effect, which describes how an increase in cloud condensation nuclei can increase the reflectiveness of clouds?

ANSWER: Twomey [**TWO-mee**] effect

BONUS

13) Earth science – *Multiple Choice* Your friend Anna is at the beach and notes that she just missed low tide. She will need to come back tomorrow at a similar time to experience the next low tide. In which of the following states is Anna most likely in?

- W) California
- X) Maine
- Y) Louisiana
- Z) Hawaii

ANSWER: Y) Louisiana


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**TOSS-UP**

14) Space science – *Multiple Choice* The deep-red hydrogen-alpha line used in astronomy is part of which of the following series of spectral lines?

- W) Lyman [**LIE-man**]
- X) Balmer
- Y) Paschen [**PASH-uhn**]
- Z) Brackett

ANSWER: X) Balmer

**BONUS**

14) Space science – *Short Answer* Order the following four structures in terms of increasing distance from Saturn: 1) A ring; 2) B ring; 3) Cassini division; 4) Titan.

ANSWER: 2, 3, 1, 4

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TOSS-UP

15) Earth science – *Multiple Choice* Which of the following minerals or mineral groups makes up the majority of syenite and trachyte?

- W) Micas
- X) Alkali feldspars
- Y) Plagioclase feldspars
- Z) Feldspathoids

ANSWER: X) Alkali feldspars

BONUS

15) Earth science – *Short Answer* Mollisols are typically characterized by an unusually thick presence of which soil horizon?

ANSWER: A