TOSSUP

1. Biology - *Multiple Choice* In a given population, which of the following factors is NOT a requirement for the establishment of Hardy-Weinberg equilibrium?
W) Large population
X) Absence of natural selection
Y) Random mating
Z) Gene flow

Answer: Z) GENE FLOW [AT]

BONUS

1. Biology - *Short Answer* The Casparian strip, a waxy layer responsible for regulating substance transport into roots, is primarily made of what compound?

Answer: SUBERIN [SO]

TOSSUP

2. Math - *Short Answer* What is the sum of the roots of the equation x^4-3x^3+2x+1=0 (x to the fourth minus three x cubed plus two x plus one equals zero)?

Answer: 3

BONUS

2. Math - *Short Answer* How many ways are there to place 7 identical balls in 4 distinct boxes?

Answer: 56 WAYS

TOSSUP

3. Earth and Space - *Short Answer* Cinders and loose sediment can pile up in a hill only to the point where the sides are at a specific angle. What name is given to this angle?

Answer: ANGLE OF REPOSE [RE]

BONUS

3. Earth and Space - *Short Answer* What type of drainage pattern is likely to form in an area of alternating ridges and valleys?

Answer: TRELLIS [RE]

TOSSUP

4. Chemistry - *Multiple Choice* How many calories are needed to raise one quarter of a liter of water from 10 degrees celsius to 15 degrees celsius?
W) 800
X) 1000
Y) 1250
Z) 1500

ANSWER: Y) 1250 [SO]

BONUS

4. Chemistry - *Multiple Choice* Which of the following compounds will be the most soluble in water?
W) Ammonium chloride
X) Calcium sulfate
Y) Magnesium oxalate
Z) Silver bromide

ANSWER: W) Ammonium chloride

TOSSUP

5. Physics - *Short Answer* What subatomic carrier of the weak nuclear force is uncharged?

Answer: Z BOSON [RE]

BONUS

Commented [1]: This is kind of unclear, as the question seems to imply that there is only one carrier, maybe a better way to phrase would be "Which of the particles that act as a carrier for the weak nuclear force are uncharged"

5. Physics - *Short Answer* What name is given to the farthest point an orbiting body gets from the object it orbits around?

Answer: APOAPSIS (accept: APOGEE) [RE]

TOSSUP

6. Energy - *Short Answer* Researchers at the Alternative Fuels Data Center are studying applications of photosynthesis. What is the term for the splitting of water by photosystem II in photosynthesis?

ANSWER: PHOTOLYSIS [SO]

BONUS

6. Energy - *Short Answer* Researchers at Pacific Northwest National Lab are using ultra-sensitive radiation detectors to explore the behavior of groundwater. What name is given to the area with a lower water table due to groundwater withdrawal from a well?

ANSWER: CONE OF DEPRESSION [RE]

TOSSUP

7. Biology - *Multiple Choice* Which of the following autoimmune diseases is caused by damage to thyroid tissue?
W) Hashimoto's disease
X) Lupus erythematosus
Y) Multiple sclerosis
Z) Type I diabetes

Answer: W) HASHIMOTO'S DISEASE [SO]

BONUS

7. Biology - *Short Answer* Identify all of the following three groups that would have a dominant gametophyte stage:
1. Gymnosperms

Commented [2]: Apogee should be accepted for this IMO

Commented [3]: what about aphelion

Commented [4]: No aphelion is sun specifically but apogee is used for general (gee technically means earth but most textbooks ive seen use apogee)

Commented [5]: that's fair; it seems apogee is pretty specific tho

2. Lycophytes
3. Liverworts

Answer: 3 ONLY [SO]

TOSSUP

8. Math - *Short Answer* What is the largest number of chicken nuggets you can not buy if you buy the chicken nuggets in packs of 10 and 13?

Answer: 107

BONUS

8. Math - *Short Answer* What is the inradius of a 9-40-41 triangle?

Answer: 4

TOSSUP

9. Earth and Space - *Multiple Choice* Which part of a spiral galaxy hosts the youngest stars?
W) Spiral Arms
X) Central bulge
Y) Black hole
Z) Halo

ANSWER: W) Spiral Arms [ESS-OA]

BONUS

9. Earth and Space - *Short Answer* A solar eclipse begins at 9:04am local time for an observer on Earth. From the reference point of the sun, at what time did the moon first begin to pass in front of it?

ANSWER: 8:56 AM [EB; EDE ESS-OA]

TOSSUP

10. Chemistry - *Short Answer* Identify all of the following 3 substances that are network solids:

1) Boron nitride
2) Silicon carbide
3) Diamond

ANSWER: ALL OF THEM

BONUS

10. Chemistry - *Short Answer* What is the term for colloids with a liquid phase dispersed among a gaseous medium?

ANSWER: AEROSOL [SO]

TOSSUP

11. Physics - *Short Answer* What name is given to the type of fluid flow with a particularly low Reynolds number displaying smooth flow without lateral mixing?

Answer: LAMINAR [RE]

BONUS

11. Physics - *Short Answer* You create a graph with time on the x-axis and plot a line along the graph. If the slope of this line gives the acceleration of an object, what quantity must be placed on the y-axis?

Answer: VELOCITY [RE]

TOSSUP

12. Energy - *Multiple Choice* Scientists at NASA are investigating the cosmos using telescopes. The James Webb Space Telescope, launched in 2021, primarily sees in what region of the electromagnetic spectrum?

W) Visible
X) Radio

Y) X-ray
Z) Infrared

ANSWER: Z) INFRARED [SO]

BONUS

12. Energy - *Short Answer* Researchers at SLAC National Accelerator Lab are working to discover new particles predicted by the standard model. What name is given to the group of particles with half-integer spin that are unaffected by the strong nuclear force?

ANSWER: LEPTONS [SO]

TOSSUP

13. Biology - *Multiple Choice* Which of the following hormones would not increase blood glucose levels?
W) Epinephrine
X) Cortisol
Y) Parathyroid hormone
Z) Growth hormone

Answer: Y) PARATHYROID HORMONE [EH]

BONUS

13. Biology - *Short Answer* Identify all of the following 3 types of kingdoms that would contain organisms which would be affected negatively by exposure to cyanide: I. Eubacteria; II. Plantae; III. Animalia

Answer: ALL OF THEM [RE]

TOSSUP

14. Math - *Short Answer* If the row with only one term in Pascal's triangle is the 0th row, then what is the sum of the terms in the 6th row of Pascal's triangle?

Answer: 64

BONUS

14. Math - *Short Answer* How many ways are there to seat Alfredo, Bernardo, Carlos, Diego, Eduardo, and Fuego at a linear table if Alfredo insists on sitting next to Bernardo?

Answer: 240 WAYS

TOSSUP

15. Earth and Space - *Short Answer* The eastern, windward side of Oahu receives drastically more rainfall than the leeward western side. What effect is responsible for this?

Answer: RAIN SHADOW EFFECT

BONUS

15. Earth and Space - *Multiple Choice* The Doldrums, characterized by near zero surface winds, occurs at which of the following latitudes?
W) 90 degrees north and south
X) 60 degrees north and south
Y) 23.5 degrees north and south
Z) 0 degrees

Answer: Z) 0 DEGREES [RE]

TOSSUP

16. Chemistry - *Short Answer* The stability of life on Earth is in part due to the presence of liquid, solid, and gaseous water at standard conditions. What is the name for the temperature and pressure conditions at which all three of these phases of a given molecule are present?

ANSWER: TRIPLE POINT [SO]

BONUS

16. Chemistry - *Short Answer* How many atoms are in one molecule of pentyne?

ANSWER: 13 [SO]

TOSSUP

17. Physics - *Short Answer* Identify all of the following three quantities that are conserved when light travels from one medium to another. I. Energy; II. Frequency; III. Wavelength

Answer: 1 AND 2 [RE; MDE Phys-OS]

BONUS

17. Physics - *Short Answer* If the coefficient of thermal expansion of steel is 10^-5 per degree celsius, then by how many meters would you expect a 10,000 meter long piece of steel to expand if its temperature is raised by 10 degrees celsius?

ANSWER: 1 [RE; MDE Phys-OS]

TOSSUP

18. Energy - *Multiple Choice* Thanks to the Inflation Reduction Act, the DOE's Loan Programs Office has been able to issue about 12 billion dollars of new loans for the development of clean energy technology. Which of the following units is not a unit of energy?
W) Joule
X) British thermal unit
Y) Ampere
Z) Electron volt

ANSWER: Y) AMPERE [SO]

BONUS

18. Energy - *Short Answer* Researchers at DOE are studying the applications of logic. What is the mathematical converse of the statement "if the sky is grey, it is raining"?

ANSWER: IF IT IS RAINING, THE SKY IS GREY [SO]

TOSSUP

19. Biology - *Multiple Choice* In humans, B cells mature in which of the following parts of the body?
W) Zona reticularis
X) Thymus
Y) Bone marrow
Z) Bursa of fabricius

ANSWER: Y) BONE MARROW [AT]

BONUS

19. Biology - *Short Answer* Identify all of the three following statements that are true of ribosomes. I. They are made of a large and small subunit; II. They contain snRNA; III. Proteins in the ribosome act as a catalyst of peptide bond formation.

ANSWER: I only [RE]

TOSSUP

20. Math - *Short Answer* Find the shortest distance between the point (7, 2) and a point on the line 3x+4y-5=0

Answer: 24/5

BONUS

20. Math - *Short Answer* What is the probability of rolling 3 dice such that they sum to 15?

Answer: 5/108

TOSSUP

21. Earth and Space - *Short Answer* What distance-measuring technique, used primarily for objects like alpha centauri, uses the angular distance between two measurements taken approximately six months apart?

ANSWER: PARALLAX [EB; LDE ESS-OA]

BONUS

21. Earth and Space - *Short Answer* Identify all of the following three bodies that are types of neutron stars. I. Pulsar; II. Blazar; III. Magnetar

Answer: I and III [AE]

TOSSUP

22. Chemistry - *Short Answer* Identify all of the following three compounds which are polymers:
1) Nylon
2) Cellulose
3) Keratin

Commented [6]: can we make this harder?

ANSWER: ALL OF THEM [SO]

BONUS

22. Chemistry - *Multiple Choice* In which of the following compounds would the central atom not have a lone pair?
W) Xenon tetrafluoride
X) Sulfur dioxide
Y) Boron trifluoride
Z) Ammonia

ANSWER: Y) Boron trifluoride [RE]

TOSSUP

23. Physics - *Short Answer* What exotic state of matter is exhibited by helium at extremely low temperatures and is characterized by a fluid with near zero viscosity?

ANSWER: SUPERFLUID [EB; EDE Phys-MC]

BONUS

23. Physics - *Short Answer* Identify all of the following four elements that are ferromagnetic: I. Iron; II. Magnesium; III. Copper IV. Chromium

ANSWER: 1 ONLY [EB; EDE Phys-EM]