NNHS ROUND 1

TOSS-UP

1) Physics – *Short Answer* What principle in fluid mechanics states that an increase in the speed of a fluid corresponds to a decrease in its pressure?

ANSWER: BERNOULLI'S PRINCIPLE (ACCEPT: BERNOULLI)

BONUS

1) Physics – *Short Answer* A car that is initially moving at a speed of 20 meters per second uniformly accelerates to a speed of 30 meters per second over the course of 5 seconds. How far, in meters, does the car travel during this interval?

ANSWER: 125

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TOSS-UP

2) Biology – *Multiple Choice* Which of the following terms describes two solutions that have the same solute concentration?

W) Equivalent
X) Hypertonic
Y) Hypotonic
Z) Isotonic

ANSWER: Z) ISOTONIC

BONUS

2) Biology – *Short Answer* Plants stockpile excess glucose by synthesizing what polymer?

ANSWER: STARCH (ACCEPT: AMYLOSE)
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TOSS-UP

3) Earth and Space – *Short Answer* What is the name of the aura of plasma that surrounds the Sun and other stars?

ANSWER: CORONA

BONUS

3) Earth and Space – *Multiple Choice* Which of the following is the main factor that distinguishes a total solar eclipse from an annular solar eclipse?

W) The distance between the moon and the Earth
X) The position of the moon relative to the Earth
Y) The time of year
Z) The position on Earth from which the eclipse is being viewed from

ANSWER: W) THE DISTANCE BETWEEN THE MOON AND THE EARTH

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TOSS-UP

4) Math – *Short Answer* What is the equation of the horizontal asymptote of the function *f* of *x* equals the fraction with numerator $4x$ cubed plus $6x$ squared minus 9 and denominator x cubed plus $10x$ squared minus 5?

ANSWER: $y = 4$ (DO NOT ACCEPT: 4)

BONUS

4) Math – *Short Answer* Find f of g of 4 if $f(x) = 3x - 2$ and $g(x) = x^2$.

ANSWER: 46
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TOSS-UP

5) Chemistry – *Short Answer* What is the pH of a 0.01 molar sodium hydroxide solution?

ANSWER: 12

BONUS

5) Chemistry – *Short Answer* How many moles of oxygen gas are required to completely combust 1 mole of propane?

ANSWER: 5

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TOSS-UP

6) Energy – *Short Answer* Researchers at Ames National Lab are studying skyrmions ***[sker-ME-ins]***, which are quasiparticles that could be used for efficient data storage. They discovered that skymirons replicate similarity to what asexual cell division process that occurs in eukaryotes?

ANSWER: MITOSIS (DO NOT ACCEPT: MEIOSIS; BINARY FISSION)

BONUS

6) Energy – *Multiple Choice* Researchers at Ames National Lab are studying skyrmion crystals. In order to determine the interior structure of small skyrmion crystals, the researchers used which of the following types of microscopes?

W) Light
X) Confocal
Y) Scanning electron
Z) Transmission electron

ANSWER: Z) TRANSMISSION ELECTRON

Commented [1]: is it actually pronounced skyrMIons?

Commented [2]: it turns out that reliable pronunciation data is hard to find, but from what I could find the pronunciation should be close
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TOSS-UP

7) Physics – *Short Answer* What is the power, in watts, dissipated by a 5-ohm resistor when 4 amps of current pass through it?

ANSWER: 80

BONUS

7) Physics – *Short Answer* A 4-ohm, 6-ohm, and 12-ohm resistor are connected in parallel to a 12-volt battery. What is the equivalent resistance of the circuit?

ANSWER: 2 OHMS

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TOSS-UP

8) Biology – *Short Answer* What type of covalent bond is formed between two monosaccharides in a dehydration reaction?

ANSWER: GLYCOSIDIC BOND (ACCEPT: GLYCOSIDIC LINKAGE)

BONUS

8) Biology – *Multiple Choice* Which of the following nucleotide bases is NOT a pyrimidine?

W) Cytosine
X) Guanine
Y) Thymine
Z) Uracil

ANSWER: X) GUANINE
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TOSS-UP

9) Earth and Space – *Short Answer* What is the name of the shadow zone that only allows observers to see a partial solar eclipse?

ANSWER: PENUMBRA

BONUS

9) Earth and Space – *Multiple Choice* Which of the following is NOT a characteristic of most minerals?

W) Naturally occuring
X) Crystalline
Y) Organic
Z) Specific chemical composition

ANSWER: Y) ORGANIC

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TOSS-UP

10) Math – *Short Answer* A drawer contains three blue socks, eight white socks, and two green socks. How many socks must be pulled out of the drawer, without replacement, to guarantee a pair of socks of the same color?

ANSWER: 4

BONUS

10) Math – *Short Answer* What are the roots of the polynomial $2x^2 + 3x - 2$?

ANSWER: –2 AND 1/2
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TOSS-UP

11) Chemistry – *Short Answer* What is the oxidation number of phosphorus in P_4?

ANSWER: 0

BONUS

11) Chemistry – *Multiple Choice* Which of the following gases has the slowest effusion rate?

W) Chlorine
X) Fluorine
Y) Argon
Z) Neon

ANSWER: W) CHLORINE

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TOSS-UP

12) Energy – *Short Answer* Researchers at the National Energy Technology Laboratory are developing alternative energy sources by capturing what common greenhouse gas?

ANSWER: CARBON DIOXIDE (ACCEPT: CO_2)

BONUS

12) Energy – *Short Answer* Researchers at the National Energy Technology Laboratory are using carbon dioxide to develop alternative energy sources in the STEP program. In this program, carbon dioxide is in what phase, where the distinction between liquid and gas disappears?

ANSWER: SUPERCRITICAL FLUID (ACCEPT: SUPERCRITICAL)

Commented [3]: careful not to make too many of your TU/bonus pairs related
DOE rarely does this anymore

Commented [4]: ah okay - I think the tu is more environmental, while the bonus is strictly chemistry

Commented [5]: Yeah just a note for the future
We had a team that made all their pairs about the same subjects sooo
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TOSS-UP

13) Physics – *Multiple Choice* Which of the following quantities is a scalar?

W) Velocity
X) Length
Y) Force
Z) Acceleration

ANSWER: X) LENGTH

BONUS

13) Physics – *Short Answer* The second harmonic of a note has a frequency of 220 hertz. In hertz, what is the frequency of the fifth harmonic of this note?

ANSWER: 550

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TOSS-UP

14) Biology – *Short Answer* What is the term for when a pair of homologous chromosomes or sister chromatids fail to separate properly in meiosis?

ANSWER: NONDISJUNCTION

BONUS

14) Biology – *Multiple Choice* Which of the following proteins assist in the proper folding of other proteins?

W) Helper proteins
X) Chaperonins
Y) Globular proteins
Z) Albumins

ANSWER: X) CHAPERONINS
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TOSS-UP

15) Earth and Space – *Short Answer* What was the first planet to be discovered using a telescope?

ANSWER: URANUS

BONUS

15) Earth and Space – *Multiple Choice* Which of the following best describes the distribution of water on Europa?

W) Liquid water on the surface
X) Water vapor dominating most of the atmosphere
Y) Liquid water underneath a layer of frozen ice
Z) Core of frozen ice

ANSWER: Y) LIQUID WATER UNDERNEATH A LAYER OF FROZEN ICE

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TOSS-UP

16) Math – *Short Answer* You roll four fair, standard six-sided dice. What is the most probable sum of the four numbers rolled?

ANSWER: 14

BONUS

16) Math – *Short Answer* A right triangle has a hypotenuse of length 25 and a side of length 24. What is the perimeter of the triangle?

ANSWER: 56
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TOSS-UP

17) Chemistry – *Short Answer* What color does lithium emit in a flame test?

ANSWER: RED

BONUS

17) Chemistry – *Short Answer* Rank the following three compounds in terms of increasing reactivity with water: 1) Lithium; 2) Sodium; 3) Potassium.

ANSWER: 1, 2, 3

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TOSS-UP

18) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab are studying cuprates, which are high temperature superconductors. These materials exhibit what effect, which causes a superconductor to expel magnetic fields when it is cooled below its critical temperature?

ANSWER: MEISSNER EFFECT

BONUS

18) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab are studying the XPG protein, which binds to and reshapes damaged DNA. They also discovered that XPG has a role in what type of recombination, where nucleotide sequences are exchanged between two similar or identical molecules of DNA?

ANSWER: HOMOLOGOUS RECOMBINATION (ACCEPT: HOMOLOGOUS)
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TOSS-UP

19) Physics – *Multiple Choice* Which of the following equals the amount of work done on a planet as it makes one full orbit around the Sun?

W) The total kinetic energy of the planet
X) The total potential energy of the planet
Y) The total mechanical energy of the planet
Z) No work is done on the planet

ANSWER: Z) NO WORK IS DONE ON THE PLANET

BONUS

19) Physics – *Short Answer* Object A is moving towards Object B at 0.6 times the speed of light. Object A emits a beam of light directly towards B. In terms of the speed of light, c, what is the speed of the emitted photons in B's reference frame?

ANSWER: c

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TOSS-UP

20) Biology – *Multiple Choice* Which of the following is an example of temporal reproductive isolation?

W) Two species have different courtship rituals
X) Two species live in different habitats
Y) Two species only come in contact with each other during the summer
Z) Two species breed during different seasons

ANSWER: Z) TWO SPECIES BREED DURING DIFFERENT SEASONS

BONUS

20) Biology – *Short Answer* A lichen ***[LAI-ken]*** is a symbiotic relationship between what two types of organisms?

ANSWER: ALGAE AND FUNGI (ACCEPT: CYANOBACTERIA AND FUNGI)
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TOSS-UP

21) Earth and Space – *Multiple Choice* Which of the following is an accurate description of Kepler's second law?

W) A line connecting the Sun to any planet sweeps out equal areas in equal intervals of time
X) The square of a planet's orbital period is proportional to the cube of its semimajor axis
Y) The orbital paths of planets are elliptical, with the Sun at one focus
Z) The total kinetic energy of a planet is equal to negative one-half times the total potential energy of the planet

ANSWER: W) A LINE CONNECTING THE SUN TO ANY PLANET SWEEPS OUT EQUAL AREAS IN EQUAL INTERVALS OF TIME

BONUS

21) Earth and Space – *Short Answer* What process is characterized by the accumulation of small particles into more massive objects through gravitational attraction?

ANSWER: ACCRETION

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TOSS-UP

22) Math – *Multiple Choice* Which of the following numbers is divisible by both 3 and 5?

W) 10
X) 25
Y) 33
Z) 45

ANSWER: Z) 45

BONUS

22) Math – *Short Answer* How many positive integer factors does the number 110 have?

ANSWER: 8
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TOSS-UP

23) Chemistry – *Multiple Choice* Which of the following is the IUPAC systematic name of the compound $FeCr_2O_7$?

W) Iron(II) dichromate
X) Iron(II) chromate
Y) Iron(III) dichromate
Z) Iron(III) chromate

ANSWER: W) IRON(II) DICHROMATE

BONUS

23) Chemistry – *Short Answer* To the nearest degree, what is the bond angle in sulfur trioxide?

ANSWER: 120