TOSS-UP

1) Biology - *Short Answer* In most insects, what excretory system carries out regulation of hemolymph and eliminates nitrogenous wastes?

ANSWER: MALPIGHIAN TUBULES (ACCEPT: MALPIGHIAN TUBULE SYSTEM)

BONUS

1) Biology - *Short Answer* Name the common promoter sequence found in most eukaryotes, responsible for the formation of the transcription initiation complex.

ANSWER: TATA BOX (ACCEPT: GOLDBERG-HOGNESS BOX)

TOSS-UP

2) Physics - *Short Answer* Big Bob, a sumo wrestler with mass 100 kg is moving to the left at 5 m/s and collides with tiny Tim, who is initially at rest. If the collision can be modelled as perfectly inelastic, and their final velocity is 4 m/s to the left, what is the mass of tiny Tim?

ANSWER: 25 kg

BONUS

2) Physics - *Short Answer* A ball of mass 10 kg is stationary inside a box of mass 40 kg (without friction) and side length 1 m, which is also initially at rest. At time t equals 0, a force is applied to the ball, giving it a velocity of 10 m/s. Every time the ball bounces off of the box, one sixteenth of the total mechanical energy of the system is lost in the form of heat. Assume friction is negligible throughout the problem. To the nearest ten meters, what is the displacement of the small ball at t = 5 minutes?

ANSWER: 600 m

Commented [1]: in general for scibowl you want to frame questions as like questions grammatically (a notable difference from quizbowl)

Commented [2R1]: so instead of like "name this thing" it would be like "what thing...?"

Commented [3R1]: the content itself is fine although a bit easy for this difficulty--maybe ask something else about the tata box? idk

Commented [4]: 1) this is. quite a long bonus. to the point where i would strongly encourage you to trim it if at all possible and/or simply use another bonus

Commented [5R4]: 2) i don't really understand the setup. is the box in an environment with gravity? is the box 2d or 3d? where does the ball start and in which direction is the original force applied? how can displacement inside a box with side length 1 meter exceed sqrt3 meters?

Commented [6R4]: i think this question has potential but it needs to be reworked/clarified

TOSS-UP

3) Chemistry - *Short Answer* What type of reagent can be added to a ketone to form a tertiary alcohol, and is characterized by containing Magnesium and a halogen?

ANSWER: GRIGNARD REAGENT

BONUS

3) Chemistry - *Multiple Choice* Which of the following compounds DOES NOT form ionic bonds?

W) $MgBr_2$
X) AlN
Y) $AlCl_3$
Z) NaI

ANSWER: Y

TOSS-UP

4) Math - *Short Answer* What important theorem of calculus relates definite integrals to antiderivatives?

ANSWER: FUNDAMENTAL THEOREM OF CALCULUS (ACCEPT: FTC)

Commented [7]: eeeee i don't really like this tossup

Commented [8R7]: like. i guess it's fine as in i can't think of anything that's specifically wrong with it? idk

BONUS

4) Math - *Short Answer* The point P at (3,2) is reflected across the line y-2x=1 to point P' (read: p-prime). What are the coordinates of P'?

ANSWER: (-1,4)

TOSS-UP

5) Earth and Space - *Short Answer* By name or number, arrange the following 3 cloud types in increasing order of the altitude at which they form: Altocumulus, cirrus, stratus

ANSWER: 3,1,2

BONUS

5) Earth and Space - *Short Answer* By name or number, identify all of the following 3 processes that lift air:~~Which of the following processes lift air?~~ 1. Orographic lifting 2. Frontal wedging 3. Convergence

ANSWER: All (1,2,3)

TOSS-UP

6) Energy - *Multiple Choice* Which of the following is the closest to the percentage of energy produced in the United States that is derived from nuclear energy?

W) 5%
X) 10%
Y) 15%
Z) 20%

ANSWER: Z) 20%

BONUS

6) Energy - *Short Answer* What is the mass number of most common isotope that is used in nuclear power plants?

ANSWER: 235

Commented [9]: for any serious ess main, this might be a bit easy.

Commented [10]: so all of these energy questions are in the old DOE style of energy--in new sets, DOE has switched over to asking questions tailored to the research that national labs have done. please look at a couple energy questions from e.g. sample set 12 and get a feel for their new style

TOSS-UP

7) Biology – *Multiple Choice* What pathway of DNA repair incorporates enzymes known as DNA glycosylases, which utilize a method of "flipping-out" to remove errors in strands?

W) Mismatch Repair
X) Non-homologous End Joining
Y) Base Excision Repair
Z) Nucleotide Excision Repair

ANSWER: Y) BASE EXCISION REPAIR

BONUS

7) Biology - *Short Answer* Which follicular organ located in the basilar membrane contains mechanoreceptors responsible for sound transduction?

ANSWER: ORGAN OF CORTI

TOSS-UP

8) Physics - *Short Answer* What theorem states that the average kinetic energy of an orbital system equals the negative of half the average potential energy?

ANSWER: Virial theorem

BONUS

8) Physics - *Short Answer* What is the term for the velocity an object must attain for it to leave the gravitational field of the solar system?

Answer: Third cosmic velocity

Commented [11]: mention that the object starts from earth somewhere, i think

Commented [12R11]: ...if i'm reading this definition correctly, at least

TOSS-UP

9) Chemistry - *Short Answer* What equation relates the pH of a solution to the pKa plus the logarithm of the ratio of the concentration of the conjugate base to the concentration of the acid?

ANSWER: HENDERSON HASSELBALCH EQUATION

BONUS

9) Chemistry - *Short Answer* What law states that a cyclic, planar molecule is aromatic if it has 4n+2 delocalized π electrons?

Answer: HUCKEL'S RULE

TOSS-UP

10) Math - *Short Answer* Evaluate the 15th derivative of cos(x) dx.

ANSWER: sin(x)

BONUS

10) Math - *Short Answer* When does the function x^(1/x) reach its maximum value, assuming x is greater than 0?

ANSWER: e (ACCEPT: EULER'S CONSTANT)

Commented [13]: alright i'm starting to see a trend of just like asking for definitional stuff, and while definition based questions definitely have their place in science bowl, it's starting to get overdone here. i'd strongly advise you to replace some of the "name this thing" questions with more application-based questions like calculations, "why does X happen", etc.

Commented [14]: can be a bit more creative. what is with all the calculus btw

TOSS-UP

11) Earth and Space - *Multiple Choice* Which of the following rocks would be classified as felsic?

W) Gabbro
X) Rhyolite
Y) Andesite
Z) Diorite

ANSWER: X) Rhyolite

Commented [15]: these answer choices should be improved. more creativity

BONUS

11) Earth and Space - *Multiple Choice* Which of the following is not an iron ore mineral?

W) Hematite
X) Magnetite
Y) Bauxite
Z) Limonite

ANSWER: Y) Bauxite

Commented [16]: too much of a 50/50 between y/z, and most people will know what bauxite is. too easy for bonus.

TOSS-UP

12) Energy - *Multiple Choice* Ecosystems tend to have large transfers of energy, when organisms consume each other and are are consumed in turn. Approximately what percent of energy is transferred from one trophic level to the next?

Commented [17]: Have some indication beforehand that this is a bio energy question. Maybe a sentence about something related to ecosystems

W) 5%
X) 10%
Y) 25%
Z) 50%

ANSWER: X) 10%

BONUS

12) Energy - *Short Answer* What hydrocarbon is defined to have both a Research Octane Number and Motor Octane Number of 0?

Commented [18]: cringe

Commented [19R18]: tru

ANSWER: Heptane (ACCEPT: n-heptane)

TOSS-UP

13) Biology - *Multiple Choice* Which of the following is not involved in the formation of a blood clot?

W) Christmas factor
X) Fibrin
Y) Heparin
Z) Thrombin

ANSWER: Y) HEPARIN

BONUS

13) Biology – *Short Answer* Identify all of the following 4 receptors that ~~Which of the following~~ are NOT pattern recognition receptors?
1) Toll like receptors; 2) C3A receptors; 3) C-type lectin receptors; 4) NOD-like receptors

ANSWER: 2 ONLY

TOSS-UP

14) Physics - *Short Answer* Heisenburg's uncertainty principle states that the product of the uncertainties of which two physical quantities is equal to half the reduced Planck constant?

ANSWER: Momentum and position

BONUS

14) Physics - *Short Answer* Identify~~Name~~ all of the following that are state functions: Pressure, heat, work, enthalpy.

ANSWER: Pressure and enthalpy

Commented [20]: wow this seems really cool but I kinda never heard of it before

Commented [21R20]: at least imo it's p esoteric for a bonus

Commented [22R20]: good knowledge tho

Commented [23R20]: shoudl i remove this chocie then and make it 3?

Commented [24]: this is too easy, i would just straight up replace this question

TOSS-UP

15) Chemistry - *Multiple Choice* What experiment used silver atoms to determine that angular momentum is quantized?

W) Geiger-Marsden experiment
X) Stern-Gerlach experiment
Y) Millikan Oil Drop experiment
Z) Rutherford gold foil experiment

ANSWER: X) Stern-Gerlach experiment

BONUS

15) Chemistry - *Short Answer* What is the only optically active isomer of C4H9Cl? Give your answer in IUPAC nomenclature.

ANSWER: 2-Chlorobutane

TOSS-UP

16) Math - *Short Answer* Titu's lemma is a direct consequence of what famous mathematical inequality, named after a man who helped pioneer the field of complex analysis?

ANSWER: Cauchy-Schwarz Inequality

BONUS

16) Math - *Short Answer* Expressed as a common fraction, what is the circumradius of a triangle with sides 13, 14, and 15?

ANSWER: 65/8

Commented [25]: i would not include this part lol

Commented [26R25]: again i said to reduce the amount of definition based questions but if you really want to ask about cauchy schwarz in that way just directly ask what it is

TOSS-UP

17) Earth and Space - *Short Answer* What is the name for the long grooves left at the bottom of glaciers by large moving rock fragments?

ANSWER: Glacial striations

BONUS

17) Earth and Space - *Multiple Choice* Which of the following is not a feature left behind by a retreating glacier?

W) Guyot
X) Kettles
Y) Drumlin fields
Z) Eskers

ANSWER: W) Guyot

TOSS-UP

18) Energy - *Short Answer* By name or number, order the following coal types in increasing carbon content: Bituminous, lignite, peat, anthracite

Commented [27]: old energy,,,,

ANSWER: Peat, lignite, bituminous, anthracite

BONUS

18) Energy - *Multiple Choice* What is the name of the grey, hard, and porous fuel, derived from coal or petroleum, that has high carbon content and is often used to smelt iron ore?

ANSWER: Coke

TOSS-UP

19) Biology - *Short Answer* What vitamin is a part of acetyl coenzyme A?

Commented [28]: kinda short.

ANSWER: VITAMIN B5(ACCEPT: PANTOTHENIC ACID)

BONUS

19) Biology - *Short Answer* In the RAAS pathway, what protein promotes the secretion of aldosterone, playing a key role in blood pressure regulation?

ANSWER: ANGIOTENSIN(ACCEPT: ANGIOTENSIN II)

TOSS-UP

20) Physics - *Short Answer* What theorem or law gives the relationship between the rate of change in magnetic flux and the induced current?

ANSWER: Faraday's Law

BONUS

20) Physics - *Short Answer* A 10 volt battery is hooked up to a circuit with a resistor. The current through this wire is 5 Amperes. If the width of the resistor is doubled and the length is also doubled, what is the new current through the resistor?

ANSWER: 10 A

TOSS-UP

21) Chemistry - *Short Answer* What is the name of the carbonyl condensation reaction that occurs when two esters are treated with a base such as sodium ethoxide?

ANSWER: Claisen Condensation

BONUS

21) Chemistry - *Short Answer* Order the following acids in terms of increasing strength: $HMnO_4$, H_2SO_4, H_2SO_3

ANSWER: H_2SO_3, H_2SO_4, $HMnO_4$ (ACCEPT: 3, 2, 1)

TOSS-UP

22) Math - *Short Answer* How many numbers less than 100 are relatively prime to 100?

ANSWER: 40

BONUS

22) Math - *Short Answer* What is the remainder when 12^{22} is divided by 10?

ANSWER: 4

Commented [29]: p sure this is wrong

Commented [30R29]: quick google search confirms

Commented [31R29]: H2SO4 pKa ~ -10
HMnO4 pKa ~ -4.6 to -2.3

Commented [32R29]: Wait JPH taught that HMnO4 is stronger wtf

Commented [33R29]: L

TOSSUP

23) Earth and Space - *Short Answer* What crystal structure has 3 axes of unequal length and unequal intersection angles?

ANSWER: TRICLINIC

BONUS

23) Earth and Space - *Multiple Choice* Which of the following is a reason to not use the mineral streak test?

W) The mineral color is very light
X) The mineral color is very dark
Y) The mineral is very soft or brittle
Z) The mineral is harder than the streak plate

ANSWER: Z