Winter Science Bowl Tournament 2022-2023

Finals 2

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TOSS-UP

1)Biology - *Short Answer* By name or number, order the following components of the brain stem in increasing distance away from the spinal cord:

1) Pons;
2) Midbrain;
3) Medulla Oblongata.

ANSWER: 3, 1, 2

BONUS

1) Biology - *Short Answer* What is the name of the layer between two adjacent primary cell walls of plant cells, which are rich in pectins and adhere these cells together?

ANSWER: Middle Lamella

TOSS-UP

2) Earth and Space – *Short Answer* Armaan is pursuing his lifelong passion for astrophotography. In order to fixate his camera on a certain area of the sky, he mounts it at the equator and rotates it along an axis parallel to Earth's axis of rotation. What type of mounting does this exemplify?

ANSWER: EQUATORIAL [3, MISC] Tony

BONUS

2) Earth and Space – *Short Answer* Order the following three celestial bodies by increasing albedo: 1) Enceladus; 2)
Ganymede; 3) Callisto.

ANSWER: 3 2 1 [3, SPACE] Tony

TOSSUP

3) Math – *Short Answer* What is the smallest positive even integer n such that there are no primitive roots modulo n?
Answer: 8

BONUS

3) Math – *Short Answer* If line segment AB is 10 units long, define the locus of points L as all points P such that $\angle APB = 90^\circ$. Find the area of L.

Answer: 25

TOSS-UP

4) Physics - *Short Answer* Identify all of the following 4 particles that could be Weyl fermions:

1) Selectron
2) Sup squark
3) Tau neutrino
4) Sterile neutrino

ANSWER: None
dannyridel#2256

BONUS

4) Physics - *Short Answer* A circuit has an infinite number of resistors in parallel. If the resistance of each resistor is twice the resistance of the previous, and the first resistor has resistance O, what is the equivalent resistance in the circuit in terms of O?

ANSWER: O/2
dannyridel#2256

TOSS-UP

5) Chemistry - *Short Answer* Rank the following three compounds by increasing covalent character between the Mn --O bond; 1) MnO2; 2) MnO4-; 3) MnO.

ANSWER: 3,1,2

BONUS

5) Chemistry - *Short Answer* Identify all of the following three coordination complexes which are paramagnetic 1) Pt(Cl4)-2 2) AuF4- 3) Co(NO3)2

ANSWER: 3 ONLY

TOSS-UP

6) Energy – *Short Answer* What human organ, which is gradually replaced by fatty tissue as the human matures, is made of immature T cells?

ANSWER: Thymus

BONUS

6) Energy – *Short Answer* Which of the following are NOT endogenous agonists of androgen receptors in humans? 1) Nandrolone 2) Dihydrotestosterone 3) Testosterone

ANSWER: 1 only

TOSS-UP

7) Biology - *Multiple Choice* Which of the following amino acids is most likely to be conserved in a histone to interact with the DNA backbone?

W) Alanine
X) Lysine
Y) Glutamine
Z) Glycine

ANSWER: X) LYSINE

BONUS

7) Biology - *Short Answer* Identify all of the following 3 groups of cells which would be primarily affected by increased levels of CSFs. 1) Granulocytes; 2) Monocytes; 3) Leukocytes.

ANSWER: 1 AND 2

TOSS-UP

8) Earth and Space – *Multiple Choice* Which of the following depositional landforms is best described as a bar connected to land on one end and extending out to sea on the other?

W) Spit
X) Baymouth Bar
Y) Barrier Island
Z) Tombolo

ANSWER: W) SPIT [3, GEO] Tony

BONUS

8) Earth and Space – *Multiple Choice* Which of the following best describes the formation of xenoliths?

W) Certain substances clump together while magma cools
X) Rising magma knocks off and engulfs material from magma pipes, leaving the broken pieces inside while it cools
Y) Erupted lava cools rapidly around rocks on the Earth's surface
Z) Convection within magma chambers bring rocks to cooling magma where they become trapped inside

ANSWER: X) RISING MAGMA KNOCKS OFF AND ENGULFS MATERIAL FROM MAGMA PIPES, LEAVING THE BROKEN PIECES INSIDE WHILE IT COOLS [3, GEO] Tony

TOSSUP

9) Math – *Short Answer* If e1 , e2 , e3 , and e4 are the identity elements for addition, subtraction, multiplication, and division, then evaluate e1 e2 e3 e4

Answer: 0

BONUS

9) Math – *Multiple Choice* For any Abelian group G, which of the following is not necessarily true?
W) G is commutative
X) G is associative
Y) G has an identity element
Z) G is cyclic

Answer: Z

TOSS-UP

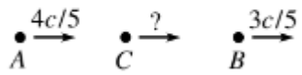
10) Physics - *Multiple Choice* A sphere of radius R is rolling without slipping, and its center of mass is moving to the right at speed v. What is the relative speed between the ground and the very top of the sphere?
W) 0
X) v/2
Y) v
Z) 2v
ANSWER: Z) 2v
dannyridel#2256

VISUAL BONUS

10) Physics - *Short Answer* Once again spaceships A and B are moving as indicated in the figure below. When C is moving at 5c/7, it appears that A and B are approaching it at the same speed. Find this speed of approach in terms of c.

ANSWER: c/5

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TOSS-UP

11) Chemistry - *Short Answer* Identify all of the following three gases that would be produced at the anode in a galvanic cell with a Copper (II) Sulfate electrolyte: 1) Oxygen gas; 2) Hydrogen gas; 3) Sulfur dioxide

ANSWER: 1 only

BONUS

11) Chemistry - *Multiple Choice* Which of the following would be the most stable conformation of 1-chloro 3-t-butyl trans cyclohexane?

W) Chlorine and tert butyl are equatorial
X) Chlorine is equatorial and tert butyl is axial
Y) Chlorine is axial and tert butyl is equatorial
Z) Chlorine and tert butyl are equatorial

ANSWER: Y) CHLORINE IS AXIAL AND TERT BUTYL IS EQUATORIAL

TOSS-UP

12) Energy – *Short Answer* What is the law which gives the breakdown voltage between two electrodes in a gas as a function of pressure and gap length?

ANSWER: Paschen's law

BONUS

12) Energy – *Short Answer* What term refers to the ionization process for gases where free electrons are accelerated by an electric field, collide with gas molecules, and free additional electrons, forming a chain reaction which allows electrical conduction through the gas?

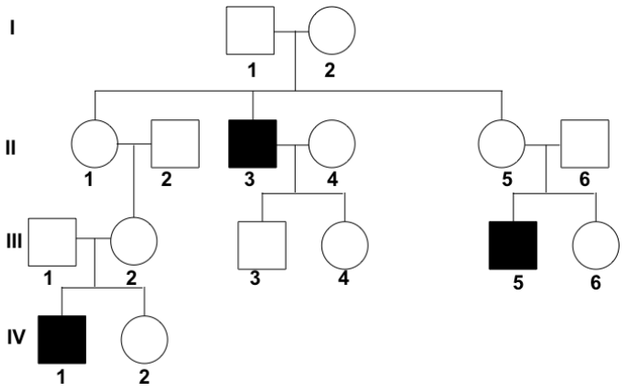
ANSWER: Townsend discharge

TOSS-UP

13) Biology - *Short Answer* Identify all of the following three statements that are correct regarding how increased loads affect isotonic contraction: 1) Latent period increases; 2) Shortening velocity is increased; 3) Length of muscle contraction increases.

ANSWER: 1 ONLY

VISUAL BONUS



13) Biology - *Multiple Choice* Which of the following diseases would most likely be associated with this pedigree?

W) Huntington's Disease
X) Tay-Sachs Disease
Y) Hemophilia A
Z) Cystic Fibrosis

ANSWER: X) Hemophilia A

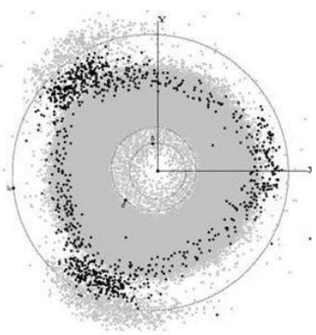
TOSS-UP

14) Earth and Space – *Short Answer* Identify all of the following three substances that are abundant in L-type stars: 1) Iron Hydride; 2) Ammonia; 3) Methane.

ANSWER: 1 ONLY [3, SPACE] Tony

VISUAL BONUS

14) Earth and Space – *Short Answer* The diagram below highlights a solar system asteroid group beyond the main belt. What is the name of this asteroid group and what type of resonance do these asteroids share with Jupiter?



ANSWER: 1) HILDAS; 2) 3:2 [4, SPACE] Tony

TOSSUP

15) Math – *Multiple Choice* Which of the following correctly compares the cardinalities of the set natural numbers , the set of real numbers , and the set of rational numbers $\mathbb{Q}$? (read options as "The cardinality of _____ is less than …")

W) $|\aleph| < |\mathbb{Q}| < |\mathfrak{R}|$

X) $|\aleph| = |\mathbb{Q}| < |\mathfrak{R}|$

Y) $|\mathbb{Q}| < |\aleph| = |\mathfrak{R}|$

Z) $|\mathbb{Q}| = |\aleph|=|\Re|$

Answer: X

BONUS

15) Math – *Short Answer* In triangle ABC, M is the midpoint of BC and K is the midpoint of AB, and the lines AM and CK Intersect at the point P. If AB=BC=12 and AM=9, then determine APPM.

Answer: 2

TOSS-UP

16) Physics - *Short Answer* A moldable blob of matter of mass M is to be situated between the planes z = 0 and z = 1 so that the moment of inertia around the z-axis is as small as possible. What shape shall the bob take to achieve this?
ANSWER: cylinder
dannyridel#2256

BONUS

16) Physics - *Short Answer* If the height of a cylinder is h, what must its radius be in terms of h so that every axis is a principal axis with its center of mass as the origin?
ANSWER: sqrt(3)/3 h
dannyridel#2256

TOSS-UP

17) Biology – *Multiple Choice* Which of the following is not a derivative of the mesoderm in vertebrates?

W) Skeletal and Muscular Systems
X) Nervous System
Y) Reproductive System
Z) Adrenal Cortex

ANSWER: X) Nervous System

BONUS

17) Biology – *Multiple Choice* Which of the following hormones is released by the juxtaglomerular apparatus in response to low volume and pressure?

W) Aldosterone
X) Angiotensin I
Y) Angiotensinogen
Z) Renin

ANSWER: Z) Renin

TOSS-UP

18) Energy – *Short Answer* What device used to create nuclear fusion conditions induces a voltage between two metal cages in a vacuum, colliding ions together?

ANSWER: Fusor

TOSS-UP

19) Chemistry - *Short Answer* Order the following 3 organic compounds in terms of increasing boiling point: 1) Propane; 2) Dipropyl ether; 3) Dimethyl ether.

ANSWER: 1, 3, 2

TOSS-UP

19) Chemistry - *Short Answer* Identify all of the following components that could be present in a SN2 reaction, regarding the substrate and reagent properties, respectively: 1) Primary substrate, strong base, weak nucleophile; 2) Tertiary substrate, weak base, strong nucleophile; 3) Tertiary substrate, strong base, strong nucleophile

ANSWER: NONE

TOSS-UP

20) Earth and Space – *Multiple Choice* Which of the following minerals do not exhibit a monoclinic crystal system?

W) Gypsum
X) Orthoclase
Y) Cryolite
Z) Andalusite

ANSWER: Z) ANDALUSITE [3, GEO] Tony

BONUS

20) Earth and Space – *Short Answer* Staurolite is often found twinned into a cross shape in which one rectangular crystal passes through the middle of another. What type of crystal twinning does this exhibit?

ANSWER: PENETRATION TWINNING [4, GEO] Tony

TOSSUP

21) Math – *Multiple Choice* Which of the following accurately describes the Weierstrass function?

W) Continuous and differentiable
X) Continuous but not differentiable
Y) Differentiable but not continuous
Z) Not differentiable and not continuous

Answer: X

BONUS

21) Math – *Multiple Choice* For a positive integer n, define f(n) as the sum of the digits of n in base 10. Find the sum of all integers n such that n-f(n)=180.

Answer: 1945

TOSS-UP

22) Physics - *Multiple Choice* The reduced Plank's constant can also be referred to as the
W) Fermi constant
X) Faraday constant
Y) Zeeman constant
Z) Dirac constant
ANSWER: Z) dirac constant
dannyridel#2256

BONUS

22) Physics - *Short Answer* If the height of a cylinder is h, what must its radius be in terms of h so that every axis is a principal axis with its center of mass as the origin?
ANSWER: sqrt(3)/3
dannyridel#2256

TOSS-UP

23) Chemistry - *Short Answer* Rank the following three bonds by increasing bond dissociation energy; 1) Oxygen sp2 bonded to hydrogen; 2) Carbon sp2 bonded to Hydrogen; 3) Carbon sp bonded to Hydrogen;

ANSWER: 2, 3, 1

BONUS

23) Chemistry- *Short Answer* Identify all of the following three reactions that proceed via a carbon anion intermediate 1) Williamson's ether synthesis; 2) E2 substitution; 3) Oxymercuration-Demercuration

ANSWER: NONE