Andrew Chen

Assorted Round 10-1

# Tossup

PHYSICS – MULTIPLE CHOICE

An observer viewing an object moving past it at relativistic speed would notice that:

w. The object grows longer along its axis of motion

x. The object grows longer perpendicular to its axis of motion

y. The object grows shorter along its axis of motion

z. The object grows shorter perpendicular to its axis of motion

Answer: y. The object grows shorter along its axis of motion

# Bonus

PHYSICS – SHORT ANSWER

Calculate the observed length of an object moving at 0.6c if its original length along its axis of motion was 50 meters.

Answer: 40 meters

# Tossup

CHEMISTRY – MULTIPLE CHOICE

Which of the following statements BEST explains why the 2p-sigma energy level decreases below the 2p-pi energy level when moving across the period 2 elements?

w. As the 2p subshell fills up, the 2s orbital interacts with the 2p-z orbital.

x. As the number of electrons increases, the Coulomb force encourages sigma bonding.

y. Repulsion between 2p orbital electrons gives higher energy to 2p-pi MOs.

z. The 2p-sigma energy level does not decrease across the 2nd period.

Answer: w. As the 2p subshell fills up, the 2s orbital interacts with the 2p-z orbital.

# Bonus

CHEMISTRY – SHORT ANSWER

In the triplet state of dioxygen, how many electrons are in antibonding sigma orbitals?

Answer: 4

# Tossup

BIOLOGY – SHORT ANSWER

What are single-stranded RNA molecules of 21-24 nucleotides in length, which regulate gene expression like siRNA, but are processed from single-stranded RNA precursors and show only partial  complementarity to mRNA targets?

Answer: miRNA (MicroRNAs)

**Bonus**

BIOLOGY – SHORT ANSWER

What endoribonuclease in the RNaseIII family cleaves dsRNA and pre-miRNA into siRNA for use in argonautes?

Answer: Dicer

**Tossup**

ASTRONOMY – SHORT ANSWER

As a subgiant begins helium fusion, what explosive event occurs as fusion begins, which may be more powerful than an entire galaxy for an instant?

Answer: helium flash

**Bonus**

ASTRONOMY – MULTIPLE CHOICE

In most mature red giants, what and where is fusion occurring?

w. core helium fusion only

x. core helium fusion and shell hydrogen fusion

y. shell helium fusion only

z. shell helium fusion and shell hydrogen fusion

Answer: z. shell helium fusion and shell hydrogen fusion

**Tossup**

EARTH SCIENCE – SHORT ANSWER

What mineral, second most abundant in the Earth’s continental crust, is made of continuous framework of silica, has a conchoidal fracture, and ranks 7 on Moh’s Hardness Scale?

Answer: quartz

**Bonus**

EARTH SCIENCE – MULTIPLE CHOICE

Which rare variety of quartz, whose color varies from yellow to brown, has ferric impurities, is artificially made from heating amethyst, and, when cut, looks very similar to yellow topaz?

w. agate

x. citrine

y. heliotrope

z. jasper

Answer: x. citrine

**Tossup**

GENERAL SCIENCE – MULTIPLE CHOICE

Which of the following expected consequences of climate change will clearly act as a negative feedback against global warming?

w. water vapor feedback

x. lapse rate feedback

y. ice-albedo feedback

z. Arctic methane feedback

Answer: x. lapse rate feedback

**Bonus**

GENERAL SCIENCE – SHORT ANSWER

The IPCC, the Intergovernmental Panel on Climate Change, is the primary evaluator of the risks of climate change. When is the next official report, the Fifth Assessment Report, due for finalization?

Answer: 2014

**Tossup**

MATH – SHORT ANSWER

What is the indefinite integral of f(x) = 2e^(2x)?

Answer: e^(2x) + C

**Bonus**

MATH – SHORT ANSWER

Evaluate the area bounded the functions: f(x) = 2e^(2x), y=0, and x=ln4.

Answer: 16

**Tossup**

PHYSICS – MULTIPLE CHOICE

According to Ohm’s law, as voltage increases in a circuit, current flow will be directly proportional. But in most appliances, such as in light bulbs, how does current vary with voltage?

w. exponential increase

x. saturated increase

y. voltage does not affect current

z. gradually decreases to zero

Answer: x. saturated increase

**Bonus**

PHYSICS – SHORT ANSWER

If a wire’s resistivity is 1.0×10−7 ohm-meters, its length is 5 meters, and its cross-sectional area is 1 millimeter^2, what is its resistance?

Answer: 0.5 milliohms (accept equivalent)

**Tossup**

CHEMISTRY – MULTIPLE CHOICE

In a charged transition metal complex, a simple, non-coordinated ionic species accompanying the complex is termed what?

w. ligand

x. spectator ion

y. counterion

z. radical

Answer: y. counterion

**Bonus**

CHEMISTRY – SHORT ANSWER

A coordination complex with a coordination number of eight would most likely have what idealized geometry?

Answer: square antiprismatic

**Tossup**

BIOLOGY – SHORT ANSWER

What concept used by proponents of intelligent design to argue with natural selection describes a system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning?

Answer: irreducible complexity

**Bonus**

BIOLOGY – SHORT ANSWER

The flagship case of irreducible complexity, what structure was later found to be reducible into the Type III secretion system in bacteria like Yersinia pestis?

Answer: bacterial flagellum

**Tossup**

ASTRONOMY – SHORT ANSWER

What type of variable star involves a two-star system which orbits in our line of sight so that periodically, one star occludes another and decreases the overall brightness?

Answer: eclipsing binary

**Bonus**

ASTRONOMY – SHORT ANSWER

A prominent star in the constellation of Perseus, what is perhaps the most famous eclipsing binary system known and is sometimes called the ‘Demon Star’?

Answer: Algol

**Tossup**

EARTH SCIENCE – SHORT ANSWER

What is a very localized column of sinking air, producing damaging divergent and straight-line winds at the surface and dangerous wind shear aloft?

Answer: microburst

**Bonus**

EARTH SCIENCE – SHORT ANSWER

What phenomenon is said to happen when a shaft of precipitation falls from a cloud but evaporates before touching the ground, such as in dry microbursts?

Answer: virga

**Tossup**

GENERAL SCIENCE – SHORT ANSWER

Under the Mars Scout Program, what robotic spacecraft landed on Mars in 2008 to search for microbial life and the history of Mars’ water?

Answer: Phoenix

**Bonus**

GENERAL SCIENCE – MULTIPLE CHOICE

Of the 38 missions to Mars sent from Earth, about what percent of were considered successes?

w. 25%

x. 50%

y. 75%

z. 100%

Answer: x. 50%

**Tossup**

MATH – SHORT ANSWER

What is the second number, after 6, whose proper factors add up to the number itself?

Answer: 28

**Bonus**

MATH – SHORT ANSWER

Express the decimal number 28 in binary.

Answer: 11100

**Tossup**

PHYSICS – MULTIPLE CHOICE

What formulation of mechanics describes the relationship between the forces that act on a body and the motion of that body?

w. Hamiltonian

x. Lagrangian

y. Newtonian

z. relativistic

Answer: y. Newtonian

**Bonus**

PHYSICS – SHORT ANSWER

According to Newton’s Third law of motion, if a book rests on a table, what is the proper reaction force to the book’s weight?

Answer: the gravitational force of the book upon the Earth (or similar)

**Tossup**

CHEMISTRY – SHORT ANSWER

Also known as carbolic acid, what toxic solid has the formula C6H5OH and comprises of a hydroxyl group bonded to a phenyl ring?

Answer: phenol

**Bonus**

CHEMISTRY – MULTIPLE CHOICE

How many sigma bonds are present in a molecule of phenol?

w. 6

x. 7

y. 12

z. 13

Answer: z. 13

**Tossup**

BIOLOGY – MULTIPLE CHOICE

In glycolysis, which of the following enzymes removes a phosphate from ATP to phosphorylate a substrate?

w. hexokinase

x. aldolase

y. phosphoglycerate kinase

z. enolase

Answer: w. hexokinase

**Bonus**

BIOLOGY – SHORT ANSWER

In anaerobes, what are the two main possible endproducts of pyruvate after glycolysis?

Answer: lactic acid and ethanol (in any order)

**Tossup**

ASTRONOMY – MULTIPLE CHOICE

What are the brightest, farthest, yet very accurate standard candles that we may observe today?

w. novae

x. supernovae

y. Cepheids

z. the Tully-Fisher relation

Answer: x. supernovae

**Bonus**

ASTRONOMY – SHORT ANSWER

Almost all Type Ia supernova have a precisely characteristic light curve and absolute magnitude. However, in 2003, what supernova proved this to not always uphold, especially if the parent white dwarf has a large rotational velocity?

Answer: Champagne Supernova

**Tossup**

EARTH SCIENCE – MULTIPLE CHOICE

What geologic time period lasted from approximately 440-415 mya, and saw the first vascular plants, jawed fishes, and abundant invertebrates?

w. Cambrian

x. Ordovician

y. Silurian

z. Devonian

Answer: y. Silurian

**Bonus**

EARTH SCIENCE – SHORT ANSWER

The concept of a geologic period in geochronology is likened to what unit of strata in chronostratigraphy?

Answer: system

**Tossup**

GENERAL SCIENCE – MULTIPLE CHOICE

Who was the only person to win two Nobel Prizes both in the field of physics?

w. Marie Curie

x. Linus Pauling

y. Fred Sanger

z. John Bardeen

Answer: z. John Bardeen

**Bonus**

GENERAL SCIENCE – SHORT ANSWER

For what two accomplishments was John Bardeen awarded his two Nobel Prizes in Physics?

Answer: invention of the transistor and the theory of superconductivity (in any order, or similar)

**Tossup**

MATH – MULTIPLE CHOICE

Which of the following sets of lengths for a triangle is not geometrically possible on a flat plane?

w.10-6-4

x. 25-17-18

y. 6-6-6

z. 9-5-7

Answer: w.10-6-4

**Bonus**

MATH – SHORT ANSWER

If a triangle has side lengths a, b, and c, what is the value of the angle opposite to side c?

Answer: arccos[-(c^2 – a^2 – b^2)/2ab]

**Tossup**

PHYSICS – SHORT ANSWER

What law in electromagnetism states that the integral of magnetic field across any closed surface is always zero?

Answer: Gauss’s law for magnetism (accept: unnamed law)

**Bonus**

PHYSICS – MULTIPLE CHOICE

In the differential form of Gauss’s law for magnetism, what operator on the magnetic field is equal to zero?

w. curl

x. divergence

y. gradient

z. del

Answer: x. divergence

**Tossup**

CHEMISTRY – SHORT ANSWER

What is the common name for a galvanic cell with electrodes of zinc and copper submerged in zinc sulfate and copper sulfate solution respectively?

Answer: Daniell cell

**Bonus**

CHEMISTRY – SHORT ANSWER

Knowing that the standard reduction potential for Zinc is -0.76 and that of Copper is 0.34, what is the theoretical voltage of the Daniell cell under standard conditions?

Answer: 1.10 volts

**Tossup**

BIOLOGY – MULTIPLE CHOICE

In DNA replication, what enzyme removes the RNA primers from the replicated strand and replaces it with DNA bases?

w. DNA polymerase I

x. DNA polymerase II

y. DNA polymerase III

z. DNA helicase

Answer: w. DNA polymerase I

**Bonus**

BIOLOGY – MULTIPLE CHOICE

DNA ligase is necessary to DNA replication after DNA polymerase I to join together what two segments?

w. The beginning of the primer segment to the previous Okazaki fragment

x. The middle of the primer segment

y. The end of the primer segment to the next Okazaki fragment

z. Two ajoining Okazaki fragments

Answer: y. The end of the primer segment to the next Okazaki fragment

**Tossup**

ASTRONOMY – SHORT ANSWER

What bright star in the constellation of Leo nearly crosses the ecliptic, and lies approximately 80 light years away as a multiple star system?

Answer: Regulus

**Bonus**

ASTRONOMY – SHORT ANSWER

What prominent asterism does Regulus and five other bright stars of Leo form in the night sky?

Answer: The Sickle