

Round 3

1. PHYSICS

Writer: Centennial

Toss Up: Short Answer

What is the resonant frequency, to the nearest hertz, of an LC circuit with $L=0.1\text{H}$ and $C=150\mu\text{F}$?

Bonus Answer: 41 Hz

Bonus: Short Answer

An RLC circuit has $R=200\Omega$, $L=0.5\text{H}$, and $C=50\mu\text{F}$. Is this circuit (1) overdamped, (2) underdamped, or (3) critically damped?

Bonus Answer: (3) critically damped

2. PHYSICS

Writer: Centennial

Toss Up: Short Answer

A body orbits another with a pericenter of 100km and an apocenter of 500km, and travels 40m/s at the apocenter. To the nearest m/s, what is the speed at the pericenter?

Bonus Answer: 200 m/s

Bonus: Short Answer

The central body is changed to one with double the mass, and the shape and size of the orbit are kept constant. By what factor will the speed of the orbiting object change?

Bonus Answer: $\sqrt{2}$ times faster

3. PHYSICS

Writer: Centennial

Toss Up: Short Answer

According to Darcy's law, by what factor will the fluid velocity change if the pressure gradient is doubled?

Bonus Answer: It will double

Bonus: Short Answer

In turbulent flow, if the velocity of an object doubles and the object is scaled down by a factor of $1/3$, by what factor will the drag force change?

Bonus Answer: $4/9$

4. MATHEMATICS

Writer: Granada Hills

Toss Up: Short Answer

What is the sum of coefficients of the expression $(x+1)^3$ (cubed)

Bonus Answer: 8

Bonus: Short Answer

A student is riding a roller coaster. The track resembles the equation $y = \sin(t)$, where y is the height and t is the time elapsed in seconds. At what time, rounded to the nearest second, does the student reach the first peak of the roller coaster? Assume degrees.

Bonus Answer: 90

5. MATHEMATICS

Writer: Granada Hills

Toss Up: Short Answer

Assuming random chance decides admission, and the acceptance rate for University A is 10% and the acceptance rate for University B is 20%, what is the probability that a student will be rejected from both to the nearest hundredth.

Bonus Answer: 0.72 (Accept 72%)

Bonus: Multiple Choice

A teacher wants to buy pizza for the very hardworking kids of Science Bowl. Which of the following options will provide the least square inches of pizza per dollar?

- W) 2 10 inch diameter pizzas for \$15
- X) 2 square pizzas with side length 10 inches for \$20
- Y) 1 14 inch diameter pizza for \$12
- Z) 1 12 inch diameter pizza for \$10

Bonus Answer: X

6. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Short Answer

In a triangle, the sides are 13, 14, and 15. Find the altitude of the triangle.

Bonus Answer: 12

Bonus: Multiple Choice

What is 2017 to the second power?

- W) 4068290
- X) 4068269
- Y) 4068279
- Z) 4068289

Bonus Answer: Z

7. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Multiple Choice

What is 10 factorial

- W) 370431
- X) 390216
- Y) 429764
- Z) 3628800

Toss Up Answer: Z

Bonus: Multiple Choice

what type of series is this 1,1,2,3....

- W) geometric
- X) arithmetic

- Y) taylor
Z) none

Bonus Answer: Z

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8. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Short Answer

$(1 + (1/X))^2 + 6(1 + (1/X)) + 8 = 0$ solve for x

Bonus Answer: $1/(1 \pm \sqrt{8/5})$

Explanation: substitute $(1 + (1/X))$ for another variable like y. Then it's just a simple quadratic that you can factor

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Bonus: Multiple Choice

$2(X^{5/3}) + 64 = 0$ solve for X

- W) 8
X) 4^5
Y) $(-2)^3$
Z) 3^3

Bonus Answer: Y

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9. BIOLOGY

Writer: Granada Hills

Toss Up: Multiple Choice

One mantis shrimp has how many more sets of photoreceptors than one dog?

- W) 2
X) 4
Y) 14
Z) 27

Toss Up Answer: Y

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Bonus: Short Answer

By name or number, name all of the following species that produce insulin in the Brockmann body.

- I) Salmon
II) Chimpanzee
III) Horse
IV) Tilapia
V) Octopus

Bonus Answer: I and IV only

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10. BIOLOGY

Writer: Granada Hills

Toss Up: Short Answer

Red-green color blindness is a sex-linked recessive disorder. If a color blind father has children with a carrier mother, what percentage of their daughters should be red-green colorblind?

Bonus Answer: 25%

Bonus: Short Answer

Shaggy fur is dominant over straight fur and white fur is dominant over brown fur. If a hamster with straight, white (homozygous) fur is mated with a heterozygous shaggy, white hamster, what percentage of their offspring should have straight, white fur?

Bonus Answer: 50%

11. BIOLOGY

Writer: Centennial

Toss Up: Short Answer

What is the name for the vessel network that supplies the large blood vessels?

Bonus Answer: vasa vasorum

Bonus: Short Answer

Order the following sinuses in the human skull from superior to inferior: maxillary, frontal, ethmoid

Bonus Answer: Frontal, ethmoid, maxillary

12. BIOLOGY

Writer: Brooklyn Tech

Toss Up: Short Answer

What is the name of the enzyme that makes ATP from ADP and inorganic phosphate?

Bonus Answer: ATP synthase

Bonus: Short Answer

What is the result of an extra chromosome 21, so that each body cell has a total of 47 chromosomes?

Bonus Answer: Down Syndrome/trisomy 21

13. BIOLOGY

Writer: Brooklyn Tech

Toss Up: Short Answer

What is the largest venomous organism?

Bonus Answer: Komodo Dragon (or Komodo Monitor)

Bonus: Multiple Choice

What composes marine snow?

- W) Discarded manmade products like plastics
- X) Light as it passes through the photic zones in a body of water
- Y) Organic matter such as waste and dead cells
- Z) Sulfides and other minerals ejected from hydrothermal vents

Bonus Answer: Y

14. CHEMISTRY

Writer: Granada Hills

Toss Up: Short Answer

What element has one electron in the 4f subshell?

Bonus Answer: Lanthanum

Bonus: Multiple Choice

The compound NbCl_5 would have which of the following shapes?

- W) octahedral
- X) seesaw
- Y) square planar
- Z) trigonal bipyramidal

Bonus Answer: W

15. CHEMISTRY

Writer: Centennial

Toss Up: Short Answer

How many alkenes have the formula of C_4H_8 ?

Bonus Answer: four

Bonus: Short Answer

Rank the following elements in increasing order of melting point: vanadium, iron, cobalt, tantalum

Bonus Answer: cobalt, iron, vanadium, tantalum

16. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Short Answer

What type of energy release allows the formation of ionic bonds to be an exothermic process?

Bonus Answer: lattice energy

Bonus: Short Answer

How many electrons fill the f orbital?

Bonus Answer: 14

17. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Multiple Choice

Which of the following two compounds will react in an aqueous solution to form a precipitate?

- W) Ammonium Nitrate and Sodium Chloride
- X) Potassium Hydroxide and Calcium Acetate
- Y) Magnesium Bromide and Sodium Chromate
- Z) Lead Chlorate and Potassium Sulfide

Toss Up Answer: Z

Bonus: Short Answer

Which isotope of Uranium is fissile?

Bonus Answer: Uranium-235

18. CHEMISTRY

Writer: Brooklyn Tech

Toss Up: Multiple Choice

Bromine is a

- W) black solid
- X) red liquid
- Y) colorless gas
- Z) highly inflammable gas

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is not an isotope of hydrogen?

- W) Tritium
- X) Deuterium
- Y) Protium
- Z) Yttrium

Bonus Answer: Z

19. EARTH and SPACE

Writer: Centennial

Toss Up: Multiple Choice

Which of the giant planets has the least massive moon system?

- W) Jupiter
- X) Saturn
- Y) Uranus
- Z) Neptune

Toss Up Answer: Y

Bonus: Short Answer

Which moon is the only one in the Solar System to have a retrograde orbit?

Bonus Answer: Triton

20. EARTH and SPACE

Writer: Granada Hills

Toss Up: Short Answer

Tahiti, an archipelago in the South Pacific, is an example of what type of island?

Bonus Answer: Oceanic

Bonus: Short Answer

CuFeS₂, one of the most common ores for mining copper, is the chemical formula for what mineral?

Bonus Answer: Chalcopyrite

21. EARTH and SPACE

Writer: Granada Hills

Toss Up: Multiple Choice

Which of the following elements exist in the highest concentration on the surface of the moon?

- W) Aluminum

- X) Nickel
- Y) Silicon
- Z) Iron

Toss Up Answer: Y

Bonus: Short Answer

A sun-like star has an apparent magnitude of 8, and an absolute magnitude of 3. Approximately how far away is the star in kiloparsecs?

Bonus Answer: 0.1

22. EARTH and SPACE

Writer: Granada Hills

Toss Up: Short Answer

What two isotopes of hydrogen are used to produce helium in nuclear fusion?

Bonus Answer: Deuterium and Tritium

Bonus: Multiple Choice

Which of the following types of Martian Meteorites are the most commonly found on Earth?

- W) Nakhla
- X) Shergottite
- Y) Zagami
- Z) Chassignite

Bonus Answer: X

23. ENERGY

Writer: Centennial

Toss Up: Multiple Choice

Which of the following compounds is not usually a major component of fly ash?

- W) Silicon dioxide
- X) Aluminum oxide
- Y) Magnesium oxide
- Z) Calcium oxide

Toss Up Answer: Y

Bonus: Short Answer

What is the name for the ash that, unlike fly ash, does not escape up the chimney?

Bonus Answer: Bottom ash

24. ENERGY

Writer: Centennial

Toss Up: Multiple Choice

Which of the following is closest to the capacity of the largest offshore wind farm?

- W) 60 MW
- X) 600 MW
- Y) 6000 MW

Z) 60000 MW

Toss Up Answer: X

Bonus: Short Answer

In which country is the largest offshore wind farm?

Bonus Answer: The United Kingdom

25. ENERGY

Writer: Centennial

Toss Up: Short Answer

What is the name of the theoretical maximum proportion of energy that can be extracted from an airflow?

Bonus Answer: Betz's law or the Betz limit

Bonus: Short Answer

What is the exact value of the Betz limit?

Bonus Answer: 16/27
