

Round 4

1. MATHEMATICS

Writer: Mohammed Jamil

Toss Up: Short Answer

Find how many different 4-digit numbers can be formed from the digits 1, 3, 5, 6, 8 and 9 if each digit may be used only once.

Bonus Answer: 360

Bonus: Short Answer

A true or false test has six questions. If a person guesses the answers, how many different ways are there to answer the test?

Bonus Answer: 64

2. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

What will happen solubility of oxygen gas as temperature increases?

Bonus Answer: Decrease

Bonus: Short Answer

Which elements are found in the form of diatomic gases at room temperature?

Bonus Answer: Hydrogen, oxygen, fluorine, chlorine, nitrogen

3. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Insulin release results in all of the following physiological effects EXCEPT:

- W) Decreased glycogen stores in liver cells.
- X) Activation of glycogen synthase.
- Y) Inhibition of glycogen phosphorylase.
- Z) Increased fat production from glycerol and fatty acids in adipose tissue.

Toss Up Answer: W

Bonus: Multiple Choice

All of the following are stimulated by the sympathetic nervous system EXCEPT:

- W) increased heart rate.
- X) increase secretion of the sweat glands.
- Y) constriction of blood vessels
- Z) increased peristalsis in the gastrointestinal tract.

Bonus Answer: Z

4. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Where is the sea of tranquility?

- W) Near the bermuda triangle
- X) In the Atlantic Ocean

Y) In the Pacific Ocean

Z) On the Moon

Toss Up Answer: Z

Bonus: Multiple Choice

The outermost layer of the sun is called the:

W) Ionosphere

X) Chromosphere

Y) Corona

Z) Photosphere

Bonus Answer: Y

5. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Polarity in the developing *Drosophila* embryo is determined by:

W) a protein gradient of the segmentation protein engrailed

X) a protein gradient of the bicoid protein expressed from maternal mRNA

Y) a protein gradient of the gap protein hunchback

Z) expression of the segmentation protein engrailed throughout the embryo

Toss Up Answer: X

Bonus: Multiple Choice

When a four-cell *Xenopus* embryo is divided into ventral and dorsal halves, the half containing the Nieuwkoop center will develop:

W) ventralized features

X) dorsalized features

Y) as a normal embryo

Z) only to the 8-cell stage

Bonus Answer: X

6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If $A+B+C=10$ and $A-B-C=-6$, compute $B+C$

Bonus Answer: 8

Bonus: Short Answer

Given a right triangle with legs 12 and 16, find the length of the altitude to the hypotenuse.

Bonus Answer: 48/5 or 9.6

7. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Which of the following would lead to a DECREASE in activity of the Anterior Pituitary gland?

- W) A lack of receptors for Cortisol on the Hypothalamus.
- X) A lack of receptors for Cortisol on the Anterior Pituitary.
- Y) Intravenous injection of a large amount of ACTH.
- Z) A tumor of the Hypothalamus causing it to secrete excess Corticotropin- Releasing Hormone

Toss Up Answer: Y

Bonus: Multiple Choice

What would happen if the Adrenal Cortex was artificially stimulated to produce large amounts of Cortisol?

- W) Less Corticotropin-Releasing Hormone would be released.
- X) More ACTH would be released.
- Y) The activity of the Hypothalamus would increase.
- Z) The activity of the Anterior Pituitary would increase.

Bonus Answer: W

8. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

For natural numbers m and n , if 6 divides m evenly and 8 divides n evenly, what is the largest integer that divides mn evenly?

Bonus Answer: 48

Bonus: Short Answer

For natural numbers m and n , if mn is divisible by 48 and m is divisible by 6, what is the largest integer n is divisible by.

Bonus Answer: 1

9. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What fatal, degenerative disease caused by a prion is most commonly found in sheep and goats?

Bonus Answer: scrapie

Bonus: Short Answer

What fatal, degenerative disease caused by a prion is most commonly found in people?

Bonus Answer: Creutzfeldt-Jakob disease

10. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

What is the thrust of a rocket ejecting fuel at 200 kg/s and with an exhaust velocity of 1500 m/s?

- W) 30000 newton meters
- X) 60000 newton meters
- Y) 90000 newton meters
- Z) 300000 newton meters

Toss Up Answer: W

Bonus: Multiple Choice

A solid disk with a rotational inertia of $5 \text{ kg}\cdot\text{m}^2$ (READ AS: kilogram meters squared) and a radius of 0.25 m rotates on a fixed axis perpendicular to the disk and through its center. If a force of 2 N is applied tangentially to the disk, what is the work done by the force after half of a revolution to the nearest tenth?

- W) 0.4 J
- X) 0.8 J
- Y) 1.6 J
- Z) 3.1 J

Bonus Answer: Y

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11. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the probability, in fractions, that after rolling two six-sided die, the sum of the numbers shown on top is 7?

Bonus Answer: 1/6 (one-sixth or one over six is acceptable)

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Bonus: Short Answer

Mr. SciBowl flips 2017 coins. What is the probability that exactly 50% of the coins show a heads?

Bonus Answer: 0

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12. EARTH and SPACE

Writer: Nicholas Adit

Toss Up: Multiple Choice

What is the main source of energy for the Sun?

- W) Hydrogen fusion
- X) Internal combustion
- Y) Nuclear fission of metals
- Z) Burning of solar gases

Toss Up Answer: W

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Bonus: Multiple Choice

The Long Valley Caldera in east-central California was formed by a massive volcanic eruption about 760,000 years ago. Since then, it has erupted several times. Of the following, which would be least likely to indicate that another eruption will soon occur?

- W) Recurring earthquakes in the vicinity
- X) decreases of precipitation in the area
- Y) changes of emissions from the caldera
- Z) uplifting of the floor of the caldera

Bonus Answer: X

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13. PHYSICS

Writer: Ashneel Das

Toss Up: Multiple Choice

A car drives 3 blocks west and 4 blocks north. What is the total displacement of the car?

- W) 7 blocks northwest
- X) 5 blocks northwest
- Y) 1 block northwest

Z) 4 blocks northwest

Toss Up Answer: X

Bonus: Short Answer

A cart has a mass of 3 kg and moves with a velocity of 2 m/s towards another cart with mass 3 kg. Find the velocity of the two carts after the first cart collides with the second.

Bonus Answer: 1 m/s

14. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What is the repeated 6-base DNA sequence of a human telomere?

Bonus Answer: TTAGGG

Bonus: Multiple Choice

Which histone is involved in the formation of the 30-nm chromatin fiber during chromatin packing?

W) H3

X) H2B

Y) H4

Z) H1

Bonus Answer: Z

15. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

By name or number, which of these is a non-newtonian fluid?

1. Ketchup

2. Water

3. Custard

4. Toothpaste

Bonus Answer: 1,3,4

Bonus: Multiple Choice

What two parts comprise a semiconductor crystal?

W) Lattice and Symmetry

X) Motif and Basis

Y) Motif and Symmetry

Z) Basis and Lattice

Bonus Answer: Z

16. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

A time difference of 5 hours separates London and New York City. What is the longitude of New York City?

Bonus Answer: 75 degrees west

Bonus: Short Answer

Any location north of the equator has latitude equal to the angle what star makes above the horizon at said location?

Bonus Answer: Polaris (accept: The North Star)

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17. CHEMISTRY

Writer: Ashneel Das

Toss Up: Short Answer

What intermolecular force is responsible for the high melting point and boiling point of water?

Bonus Answer: Hydrogen bonds

Bonus: Short Answer

What is the pOH of a solution with hydrogen ion concentration of 1.0×10^{-6}

Bonus Answer: 8

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18. PHYSICS

Writer: Ashneel Das

Toss Up: Short Answer

Given that the acceleration due to gravity on earth is 9.8 m/s, what is the velocity of a ball 1 second after it is dropped (neglect air resistance)?

Bonus Answer: 9.8 m/s

Bonus: Short Answer

If a ball is thrown directly upwards with a velocity of 49 m/s, after how many seconds will the ball be at the top of its path?

Bonus Answer: 5 seconds

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19. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

Which of the following is least reactive with water at room temperature?

W) Sodium

X) Potassium

Y) Rubidium

Z) Cesium

Toss Up Answer: W

Bonus: Short Answer

What is the most abundant alkali metal on earth?

Bonus Answer: Sodium

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20. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Whose law defines the relationship between angle of incidence and of refraction?

W) Snell's

X) DeBroglie's

Y) Kepler's

Z) Carnot's

Toss Up Answer: W

Bonus: Short Answer

What are the names of Hydrogen's three isotopes?

Bonus Answer: Protium, Deuterium, Tritium (accept: Hydrogen, Deuterium, Tritium)

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21. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

Mixing 250 mL of 2.0 M sulfuric acid with 2 liters of 0.5 M sodium hydroxide will produce a solution with what pH?

Bonus Answer: 7

Bonus: Short Answer

Which of the following are strong bases: lithium hydroxide, strontium hydroxide, cesium hydroxide, barium hydroxide?

Bonus Answer: All except cesium hydroxide

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22. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What model of DNA replication did Watson and Crick propose?

Bonus Answer: Semiconservative model

Bonus: Multiple Choice

What enzyme replaces RNA primers with DNA during DNA replication?

W) DNA polymerase I

X) DNA polymerase III

Y) Primase

Z) DNA ligase

Bonus Answer: W

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23. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

How many neutrons does carbon-14 have?

W) 14

X) 8

Y) 6

Z) 2

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is the decay mode of Uranium-238?

W) Alpha

X) Beta

Y) Gamma

Z) Proton Emission

Bonus Answer: W

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24. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

Chronic myelogenous leukemia can occur when a portion of chromosome 9 translocated with chromosome 22. What is this abnormal version of chromosome 22 commonly called?

Bonus Answer: Philadelphia chromosome

Bonus: Multiple Choice

If nondisjunction occurs in a cell during meiosis I, how many of the 4 daughter cells will have an abnormal chromosome number?

W) 1

X) 2

Y) 3

Z) 4

Bonus Answer: Z

25. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

Which one of the following is hexaploid?

W) apple

X) wheat

Y) strawberry

Z) banana

Toss Up Answer: X

Bonus: Short Answer

What is the only animal known to reproduce asexually?

Bonus Answer: Bdelloid rotifer
