

Round 27

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. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A bulldozer does 30,000 joules of work to push another boulder a distance of 20 meters. How much force is applied to push the boulder?

Bonus Answer: 1,500 N

Bonus: Short Answer

A 450-newton gymnast jumps upward a distance of 0.50 meters to reach the uneven parallel bars. How much work, in joules, did she do before she even began her routine ?

Bonus Answer: 225

3. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

Rounded to the nearest thousand, what is the circumference of the globe?

W) 25,000

X) 26,000

Y) 27,000

Z) 28,000

Toss Up Answer: W

Bonus: Short Answer

In which country are the oldest rocks on Earth located?

Bonus Answer: Canada

4. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A conveyor-belt, horizontally, moves a 600Kg bag a distance of 100 meters through the airport. How much work was done?

Bonus Answer: No work was done

Bonus: Short Answer

A dryer has a power rating of 2500 watts. To dry a few towels this dryer uses 6,750,000 joules of energy. How long will it take to dry these towels, in minutes

Bonus Answer: 45 minutes

5. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

How many miles per hour is the Earth moving?

W) 65,000

X) 67,000

Y) 69,000

Z) 70,000

Toss Up Answer: X

Bonus: Short Answer

When magma hardens into rock, which type of rock is it?

Bonus Answer: Igneous

6. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

Triangle ABC is similar to triangle DEF. If triangle ABC has an area of 27, triangle DEF has an area of 3, and AC=12, then compute DF.

W) 9

X) 36

Y) $2\sqrt{3}$

Z) 4

Toss Up Answer: Z

Bonus: Multiple Choice

What is the area, in terms of pi, of a cone if the slant height is 13 and the radius of the base is 5.

W) 10 pi

X) 20 pi

Y) 30 pi

Z) $10\sqrt{3}$ pi + 20

Bonus Answer: X

7. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

Moonquakes occur due to

W) Asteriods

X) Tidal stresses

Y) Rotation irregularities

Z) Moonquakes do not happen

Toss Up Answer: X

Bonus: Short Answer

Where did the largest earthquake ever happen?

Bonus Answer: Alaska

8. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

For real numbers x and y on the closed interval from 0 to 1, let $a=xy$ and $b=(1-x)(1-y)$. Find the maximum value over all choices of x and y for the minimum of a and b .

- W) 0
- X) $1/4$
- Y) $1/2$
- Z) 1

Toss Up Answer: X

Bonus: Short Answer

One definition of the Cantor set is the set of all numbers x between 0 and 1 such that x has only the digits 0 and 2 in it's base 3 representation. Which of the following numbers is in the Cantor set.

- I. $1/4$
- II. $1/2$
- III. $5/26$
- IV. $7/10$

Bonus Answer: 4 only

9. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the most abundant element in the human body by mass?

Bonus Answer: Oxygen

Bonus: Short Answer

What naturally occurring radioactive element is so common in homes that testing for its presence is often advisable?

Bonus Answer: Radon (accept: Rn)

10. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

What is a fluid analogous to blood in most vertebrates

- W) Interstitial fluid
- X) Hemolymphs
- Y) Hemocyanin
- Z) Plasma

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following do not have a double circulatory system

- W) Lizard
- X) Human
- Y) A bird
- Z) A fish

Bonus Answer: Z

11. CHEMISTRY

Writer: Shantanu Jha

Toss Up: Multiple Choice

What term describes a particular way that ions and molecules bind metal ions?

- W) Chelation
- X) Supposition
- Y) Coordination
- Z) Fluxing

Toss Up Answer: W

Bonus: Multiple Choice

Crystals which acquire a charge when compressed, twisted or distorted are said to be what?

- W) Ceramic
- X) Transduced
- Y) Magnetostricted
- Z) Piezoelectric

Bonus Answer: Z

12. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which buffer system prevent large changes in pH in the blood during gas exchange

- W) Hemoglobin
- X) Phosphate
- Y) Protein
- Z) Bicarbonate

Toss Up Answer: Z

Bonus: Multiple Choice

How many ml of a 0.4 M HCl solution are required to bring the pH of 10 ml of a 0.4 M NaOH solution to 7.0 (neutral pH)?

- W) 4
- X) 40
- Y) 10
- Z) 20

Bonus Answer: Y

13. 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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14. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which statement about carbohydrate biosynthesis during the dark reactions of photosynthesis (i.e. the Calvin cycle reactions) is NOT TRUE?

- W) RUBISCO is a an enzyme required for carbon dioxide fixation.
- X) NADPH is the source of electrons for glucose synthesis.
- Y) ATP is the energy source for glucose synthesis.
- Z) The reactions occur in the photosynthetic membranes of chloroplasts.

Toss Up Answer: Z

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Bonus: Short Answer

In the basic equation of photosynthesis for the synthesis of one molecule of a sugar such as glucose, how many molecules of carbon dioxide are required and how many molecules of oxygen are produced?

Bonus Answer: 6,6

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15. 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

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Bonus: Short Answer

What is the most abundant alkali metal on earth?

Bonus Answer: Sodium

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16. BIOLOGY

Writer: Benjamin Avrahami

Toss Up: Short Answer

What type of immune disease is SCID?

Bonus Answer: Immune deficiency disease

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Bonus: Multiple Choice

Which one of the following classes of organisms has a pseudocoelom (pronounce soo-do-cee-lum)?

- W) Calcarea
- X) Ceriantharia
- Y) Chromadorea
- Z) Clitellata

Bonus Answer: Y

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17. 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

18. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

When outside of the lymph vessel, the lymph is called

- W) Interstitial Fluid
- X) Hemocel
- Y) Plasma
- Z) Blood

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following is not true about platelets

- W) They are involved in blood clotti
- X) They are present in blood
- Y) They are cells that broke away from megakaryocytes
- Z) They have cytoplasm

Bonus Answer: Y

19. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A 1-kilogram ball is thrown into the air with an initial velocity of 30 m/sec. How high in the air did it travel ?

Bonus Answer: 46 meters

Bonus: Short Answer

What is the velocity of an 500-kilogram elevator that has 4,000 joules of energy?

Bonus Answer: 4 m/sec

20. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The amino acid sequences encoded by the red and green visual pigment genes in humans are 96% identical. These two loci are found close together on the X chromosome. What mechanism most likely led to the evolution of these two genes?

- W) Horizontal gene transfer followed by sequence divergence
- X) Gene duplication followed by sequence divergence
- Y) Inversion of the human X chromosome
- Z) Polyploidization

Toss Up Answer: X

Bonus: Multiple Choice

Genetic drift is best described as:

- W) evolutionary change due to natural selection.
- X) changes in the proportion of homozygous recessive individuals due to random mating.
- Y) a random change in allele frequencies that benefits the population.
- Z) evolutionary change due to random events.

Bonus Answer: Z

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21. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What was the first object created by people that produces a sonic boom (albeit a very small one)?

- W) Bullet
- X) Bullwhip
- Y) Slingshot
- Z) Jet Plane

Toss Up Answer: X

Bonus: Multiple Choice

What kind of semiconductors are essentially all pure semiconductor material?

- W) p-type
- X) n-type
- Y) intrinsic
- Z) extrinsic

Bonus Answer: Y

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22. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

SNPs can be characterized by all of the following EXCEPT for:

- W) always causing diseases.
- X) being common in a population.
- Y) acting as a point mutation.
- Z) acting as a transition mutation.

Toss Up Answer: W

Bonus: Short Answer

Which of the following cells are phagocytic?

1. Megakaryocyte
2. Dendritic cells
3. Natural killer cells
4. Neutrophils
5. Monocytes

Bonus Answer: 2, 4, 5

(Dendritic cells, Neutrophils, Monocytes)

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23. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What French physicist, living from 1623-1662, discovered the basic principles of pressures on fluids?

- W) Andre Marie Ampere
- X) Charles-Augustin de Coulomb
- Y) Joseph-Louis Lagrange
- Z) Blaise Pascal

Toss Up Answer: Z

Bonus: Multiple Choice

Supersymmetry is a proposed extension of space-time symmetry relating what 2 basic classes of elementary particles?

- W) Bosons and Fermions
- X) Hadrons and Leptons
- Y) Leptons and Mesons
- Z) Fermions and Mesons

Bonus Answer: W

24. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

A female lizard washes ashore on an island after riding a floating log for hundreds of miles across the sea. She is the only member of her species to have ever made it to the island. After arriving, she lays 20 fertile eggs that hatch and form the basis of a lizard population on the island. Which of the following is NOT a likely result?

- W) The new island population will have less genetic diversity than the ancestral population.
- X) Mutation will add new alleles to the new population and thus increase its genetic diversity over time.
- Y) There will be little or no gene exchange between the new population and the ancestral population.
- Z) The new island population will have greater genetic diversity than the ancestral population.

Toss Up Answer: Z

Bonus: Multiple Choice

Loss of heterozygosity can be caused by all of the following EXCEPT:

- W) genetic drift.
- X) positive frequency-dependent selection.
- Y) heterozygote advantage.
- Z) inbreeding.

Bonus Answer: Y

25. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What did Ernest Orlando Lawrence develop in 1932?

- W) Nuclear Reactor
- X) The Microwave
- Y) Cyclotron

Z) X-Ray Machine

Toss Up Answer: Y

Bonus: Short Answer

What theory first appeared in a 1905 paper called "On the Electrodynamics of Moving Bodies"?

Bonus Answer: Special Theory of Relativity
