

# Lakeside

## 1. Physics

### Toss Up: Short Answer

Name this subset of fermions that do not interact via the strong interaction, have antiparticles that are only opposite in charge and number, and contain the set of neutral particles known as neutrinos.

**Toss Up Answer: Leptons**

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### Bonus: Short Answer

In the Davisson-Germer experiment, electrons were fired at nickel crystals and a diffraction pattern was observed, proving what principle or equation?

**Bonus Answer: De Broglie Equation**

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## 2. Physics

### Toss Up: Short Answer

What is the term referring to an electronic circuit with two stable states, often also called a bistable multivibrator, which can serve as one bit of memory?

**Toss Up Answer: FLIP-FLOP**

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### Bonus: Short Answer

Name the following property: It is believed to be caused by fields of electron spins in combination with exchange coupling and substances exhibit this property below the Curie temperature.

**Bonus Answer: FERROMAGNETISM**

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## 3. Physics

### Toss Up: Short Answer

The reason that microscopic black holes that could be created by collisions in particle accelerators are not feared to consume the Earth is because of what hypothesized black body radiation due to quantum effects?

**Toss Up Answer: HAWKING RADIATION**

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### Bonus: Short Answer

Which law in electromagnetism describes the magnetic field generated by a steady current and results in a B field consistent with both Ampere's law and Gauss' law for magnetism?

**Bonus Answer: BIOT-SAVART LAW**

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## 4. Mathematics

### Toss Up: Short Answer

Consider a function  $f(x)$  (read: eff of ex). If  $f(x)$  is a positive monotone decreasing function on the interval from 1 to infinity and the integral from one to infinity of  $f(x)$  equals a finite number, what can be said about the convergence of an infinite series defined by the summation of the values of  $f(x)$  from 1 to infinity?

**Toss Up Answer: IT CONVERGES**

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### Bonus: Multiple Choice

Which of the following eccentricities describes a circle?

W)  $e=0$

X)  $0 < e < 1$

Y)  $e=1$

Z)  $e > 1$

**Bonus Answer: W**

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## 5. Mathematics

### Toss Up: Short Answer

What theorem states that there are no integer solutions for the equation  $x^n + y^n = z^n$  when  $n$  is greater than 2, famously proposed in the margins of a book by its namesake?

**Toss Up Answer: FERMAT'S LAST THEOREM**

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### Bonus: Short Answer

What is the name given an  $n$ th root of a number which often yields an irrational number?

**Bonus Answer: SURD**

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## 6. Mathematics

### Toss Up: Short Answer

What is the probability of getting at least one tails when flipping 5 fair coins?

**Toss Up Answer: 31/32 (Accept: .96875)**

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### Bonus: Multiple Choice

Multiple Choice At  $x = -1/2$ , the graph of  $y = x^3$  is:

- W) increasing and concave up
- X) increasing and concave down
- Y) decreasing and concave up
- Z) decreasing and concave down

**Bonus Answer: X**

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## 7. Earth and Space Science

### Toss Up: Short Answer

The Age of Reptiles followed which mass extinction event?

**Toss Up Answer: PERMIAN-TRIASSIC (Accept: PERMIAN)**

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### Bonus: Multiple Choice

The most abundant deposits of coal date from what period?

- W) Permian
- X) Hadean
- Y) Devonian
- Z) Carboniferous

**Bonus Answer: Z**

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## 8. Earth and Space Science

### Toss Up: Short Answer

Which glacial structures, similar to roche moutonnees but opposite in orientation, are formed when glaciers retreat over an area that contains a particularly hard rock core?

**Toss Up Answer: DRUMLINS**

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### Bonus: Multiple Choice

Which of the following glacial landforms is created by a braided stream flowing from the front end of a glacier?

- W) eskers
- X) kames
- Y) moraines

Z) outwash fans

**Bonus Answer: Z**

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## 9. Earth and Space Science

**Toss Up: Short Answer**

Order the following four substances from least to greatest in terms of hardness: fluorite, topaz, corundum, and tooth enamel.

**Toss Up Answer: FLUORITE, TOOTH ENAMEL, TOPAZ, CORUNDUM**

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**Bonus: Short Answer**

Evidence supporting which hypothesized process, whose name was coined by Robert Dietz, includes an observed upper age limit of 200 million years for the associated material? This process produces zebra-stripe lineations in combination with reversals of the Earth's magnetic field reversals.

**Bonus Answer: SEAFLOOR SPREADING**

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## 10. Biology

**Toss Up: Short Answer**

Name the ground tissue in a leaf that is sandwiched between the epidermal layers and is split into sections named palisade and spongy.

**Toss Up Answer: MESOPHYLL**

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**Bonus: Short Answer**

Plants such as grasses are able to continue growing vertically after have their tops cut off because of the presence of which plant organ?

**Bonus Answer: AXILLARY MERISTEMS**

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## 11. Biology

**Toss Up: Short Answer**

Which well-known transcription factor, named for its size, is activated by DNA damage and serves to halt the cell cycle?

**Toss Up Answer: p53**

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**Bonus: Short Answer**

The transition from mitosis to interphase is regulated by the compound cyclin D, which is degraded. What process regulates the degradation of cyclin D via proteasomes?

**Bonus Answer: UBIQUITINATION**

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## 12. Biology

**Toss Up: Short Answer**

In 1990, Michael Menaker conducted an experiment using hamsters with mutations that changed their circadian rhythms to observe the effects on which part of the hypothalamus?

**Toss Up Answer: SUPERCHIASMATIC NUCLEUS (Accept: SCN)**

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**Bonus: Short Answer**

Which disease is characterized by neurofibrillary tangles made up primarily of the tau protein?

**Bonus Answer: ALZHEIMER'S DISEASE**

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## 13. Chemistry

**Toss Up: Short Answer**

Order the following three gases from least to greatest in terms of value of  $b$  in the Van der Waals equation: Benzene, Neon, and Hydrogen.

**Toss Up Answer: HYDROGEN, NEON, BENZENE**

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**Bonus: Multiple Choice**

Adding an inert gas into a gas-phase equilibrium at constant volume will result in an equilibrium shift in which direction?

- W) the equilibrium will shift towards the side with fewer moles of gas
- X) the equilibrium will shift towards the side with more moles of gas
- Y) the equilibrium will not shift
- Z) it depends on the gas

**Bonus Answer: Y**

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## 14. Chemistry

**Toss Up: Short Answer**

What is the hybridization and the molecular geometry about the central atom in the molecule phosphorous pentachloride?

**Toss Up Answer: DSP3 AND TRIGONAL BIPYRAMIDAL**

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**Bonus: Short Answer**

What is the bond order for diatomic oxygen?

**Bonus Answer: TWO**

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## 15. Chemistry

**Toss Up: Multiple Choice**

Which of the following is true about Raoult's Law?

- W) total vapor pressure of a solution is based on the vapor pressures and mole fractions of the constituents
- X) there is no such thing as a nonideal solution when using Raoult's law
- Y) low boiling azeotropes can be fractionally distilled via addition of another chemical
- Z) ideal solutions contain constituents that have stronger intermolecular interactions with the each other than themselves

**Toss Up Answer: W**

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**Bonus: Short Answer**

Because Gibbs free energy is limited to isobaric reactions, which thermodynamic potential is used instead, which assumes constant temperature and volume?

**Bonus Answer: HELMHOLTZ FREE ENERGY**

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## 16. Energy

**Toss Up: Multiple Choice**

About how many nuclear power plants are currently in the US?

- W) 57
- X) 104
- Y) 233
- Z) 312

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

What developed country was the first to follow through on the agreements to destroy nuclear weapon stockpiles and cease production of nuclear weapons?

- W) France
- X) USA
- Y) Hungary
- Z) South Africa

**Bonus Answer: Z**

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## 17. Energy

**Toss Up: Multiple Choice**

Which US state consumes the most coal annually?

- W) California
- X) Wyoming
- Y) Texas
- Z) New York

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What byproduct of coal combustion is used as filler for tennis rackets, golf balls, and linoleum?

**Bonus Answer: COAL ASH**

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## 18. Energy

**Toss Up: Multiple Choice**

About how much solar power does the Earth receive in its upper atmosphere?

- W) 569 Gigawatts
- X) 174 Petawatts
- Y) 298 Exawatts
- Z) 40 Zetawatts

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

In which US state is the world's largest solar power plant found?

- W) California
- X) Arizona
- Y) Texas
- Z) North Carolina

**Bonus Answer: W**

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