

Round 14

1. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

In a compound gearing arrangement where a 40-tooth gear drives an 80-tooth gear which is directly connected to a 50-tooth gear that drives a 100-tooth gear, the total reduction is a factor of:

- W) 2
- X) 6
- Y) 4
- Z) 21

Toss Up Answer: Y

Bonus: Multiple Choice

Elastic deformation is BEST described as ...

- W) the linear portion of a stress/strain curve
- X) 99% elongation
- Y) strength of a material
- Z) deformation

Bonus Answer: W

2. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the sum of coefficients of $(1+x^7)^7$?

Bonus Answer: 128

Bonus: Short Answer

Find x if $\log_{\text{base } 5}(x) = -2$.

Bonus Answer: 1/25

3. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

The process in which an atom reradiates a photon after interacting with an incident photon of the same energy is called:

- W) Cooleo Theorem
- X) the Cherenkov effect
- Y) Bragg's Law
- Z) Thomson scattering

Toss Up Answer: Z

Bonus: Multiple Choice

A protanomalous person has decreased sensitivity of the red cones in his or her eyes. Which of the following color pairs will this person have difficulty distinguishing between:

- W) black and yellow
- X) blue green

- Y) purple blue
Z) red and yellow

Bonus Answer: Y

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4. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

The figure represented by the equation $\frac{x^2}{36} + \frac{y^2}{16} = 1$ is centered about what x-y coordinate point?

Bonus Answer: (0,0)

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Bonus: Short Answer

In a right triangle, $\sin(A)$ is $\frac{3}{5}$, what is $\tan(A)$?

Bonus Answer: $\frac{3}{4}$

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5. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

e Often some of the strongest spectral lines in cold interstellar gas are produced by

W) neutral lithium

X) ionized iron

Y) carbon and iron

Z) calcium and sodium

Toss Up Answer: Z

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Bonus: Short Answer

The cosmic background radiation discovered by Penzias and Wilson closely matches the radiation from a black body with what temperature Kelvin, to the nearest whole number?

Bonus Answer: 3

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6. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the center of a circle with the equation $X^2 + Y^2 = 69$?

Bonus Answer: (0,0)

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Bonus: Short Answer

What is the area of an ellipse with axis lengths of 5 and 3, in terms of pi?

Bonus Answer: 15 pi

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7. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

How many nodes are there in the first overtone in a standing wave of a vibrating guitar string?

Bonus Answer: 3

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Bonus: Short Answer

If $g = 9.8$ meters per second squared, to the first decimal place and in

newtons, how many newtons of force are required to keep a 450 kilogram slab of granite moving across a horizontal surface at constant speed if there is a kinetic frictional coefficient of 0.20 between the surface and the slab?

Bonus Answer: 882 N

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8. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the volume of a sphere?

Bonus Answer: $\frac{4}{3} \pi r^3$

Bonus: Short Answer

what is the sum of the 7th row of Pascal's triangle?

Bonus Answer: 128

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9. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If the atomic mass of carbon-12 is exactly 12 atomic mass units, why is the atomic mass of carbon not exactly 12 when listed on the Periodic Table?

W) mass deficit

X) neutrons are not the same mass as protons

Y) it adds mass of electrons

Z) the presence in nature of about 1.1% carbon-13

Toss Up Answer: Z

Bonus: Short Answer

If 2500 pounds is applied to a spring with spring constant of 100 pounds per inch on top of a hydraulic piston, how many pounds of force is transferred to the piston:

Bonus Answer: 2500

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10. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

Blood headed toward the lungs exits which chamber of the heart, and through into what blood vessel?

Bonus Answer: Exits the Right ventricle into the pulmonary artery

Bonus: Short Answer

how many chambers do the hearts of bony fish and frogs have, respectively?

Bonus Answer: 2 and 3

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11. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which of the following is a weaker oxidizer than oxygen?

W) ozone

X) carbon dioxide

Y) hydrogen peroxide

Z) dioxygen difluoride

Toss Up Answer: X

Bonus: Short Answer

What is the coordination number of the hexagonal close packed crystal structure?

Bonus Answer: 12

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12. BIOLOGY

Writer: Aaron Gee

Toss Up: Multiple Choice

Which of the following tissues is MOST directly responsible for the increased diameter of a tree trunk from year to year?

- W) apical meristem
- X) pericycle
- Y) vascular cambium
- Z) pith

Toss Up Answer: Y

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Bonus: Short Answer

Name all of the following 3 metabolic processes which directly require oxygen: glycolysis; alcohol fermentation; electron transport system

Bonus Answer: Electron transport system

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13. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which element reacts vigorously with water, producing a purple color?

- W) sodium
- X) chromium
- Y) potassium
- Z) barium

Toss Up Answer: Y

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Bonus: Multiple Choice

Which of the following doesn't dissolve in aqua regia?

- W) lead
- X) gold
- Y) titanium
- Z) zinc

Bonus Answer: Y

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14. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

This genetic condition results in developmental delays and a flattened facial profile. It is caused by trisomy of the 21st chromosome in humans.

Bonus Answer: Down Syndrome

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Bonus: Short Answer

What is the name of the genetic condition in which a person has two X chromosomes and one Y chromosome?

Bonus Answer: Klinefelter syndrome

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15. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

What is the flame test result of boric acid?

Bonus Answer: green

Bonus: Multiple Choice

Which of the following metal ions appears green in solution?

W) nickel two

X) iron three

Y) copper two

Z) silver

Bonus Answer: W

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16. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

What stimulates root branching in plants?

W) Gibberellin

X) Auxin

Y) Ethylene

Z) Cytokinin

Toss Up Answer: X

Bonus: Multiple Choice

A plant with low levels of gibberellin will have:

W) high levels of ethylene

X) decreased levels of lignin

Y) undeveloped leaves

Z) decreased growth

Bonus Answer: Z

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17. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

What is the term for a substance that yields a mechanical response upon application of electricity?

Bonus Answer: piezoelectric

Bonus: Multiple Choice

At the yield point of a material, what happens?

W) the material breaks into two pieces

X) the material cracks

Y) the material begins to deform plastically

Z) the material begins to neck, or narrow

Bonus Answer: Y

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18. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Where are short tandem repeats usually located?

Bonus Answer: Accept introns OR noncoding DNA

Bonus: Short Answer

Why do DNA molecules travel through the gel in gel electrophoresis?

Bonus Answer: DNA has a negative charge

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19. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Heating ferrite above 1000 kelvin yields what phase of steel?

W) cementite

X) austenite

Y) martensite

Z) ceramic steel

Toss Up Answer: X

Bonus: Short Answer

Cooling white tin below 13 degrees Celsius turns it into what?

Bonus Answer: gray tin

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20. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Who discovered that DNA has equal amounts of adenine and thymine as well as equal amounts of guanine and cytosine?

Bonus Answer: Accept Erwin Chargaff OR Chargaff

Bonus: Short Answer

What method was used to obtain Photograph 51, which was used to determine the structure of DNA?

Bonus Answer: X-ray diffraction

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21. EARTH and SPACE

Writer: Mohammed Jamil

Toss Up: Multiple Choice

The seasons we experience on the Earth are caused by

W) the change in the Earth's distance from the sun during the year

X) the precession of the Earth's pole

Y) the tilt of the Earth's axis with respect to the ecliptic pole

Z) the change in the Moon's distance from the Earth during the year

Toss Up Answer: Y

Bonus: Multiple Choice

If we compare two stars of different temperature, the hotter star

- W) will appear redder
- X) emits more energy from each unit area of surface
- Y) will have a brighter apparent magnitude
- Z) will have a brighter absolute magnitude

Bonus Answer: X

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22. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Which two scientists proved that DNA replication was semi-conservative?

Bonus Answer: Meselson and Stahl

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Bonus: Short Answer

Meselson and Stahl replaced an element in DNA with an isotope in order to tag the original DNA molecule. Which element did they replace?

Bonus Answer: Nitrogen

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23. EARTH and SPACE

Writer: Aryan Bhatt

Toss Up: Short Answer

When the planets of our solar system are listed in order from most moons to least moons, which planet is fourth in the list?

Bonus Answer: Neptune

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Bonus: Short Answer

Name the Galilean moons.

Bonus Answer: Io, Ganymede, Callisto, Europa

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24. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

In DNA, to which carbon of the sugar is the nitrogenous base bonded?

Bonus Answer: Accept one OR one prime

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Bonus: Short Answer

On which carbon of the sugar is the hydroxyl group located?

Bonus Answer: Accept three OR three prime

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25. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Multiple Choice

How much of the total mass of the solar system is found in the Sun?

- W) between 60.0% and 60.1%
- X) between 78.5% and 78.6%
- Y) between 98.2% and 98.3%
- Z) between 99.8% and 99.9%

Toss Up Answer: Z

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Bonus: Multiple Choice

What is the temperature at the Sun's core?

- W) 5 million degrees Celsius
- X) 10 million degrees Celsius
- Y) 15 million degrees Celsius
- Z) 20 million degrees Celsius

Bonus Answer: Y

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