

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. 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

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. 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

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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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

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 sum of coefficients of $(1+x^7)^{17}$?

Bonus Answer: 128

Bonus: Short Answer

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

Bonus Answer: 1/25

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

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

8. 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

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. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

The figure represented by the equation $[x^2/36] + [y^2/16] = 1$ is centered about what x-y coordinate point?

Bonus Answer: (0,0)

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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11. 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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12. 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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13. 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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14. 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)

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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15. 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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16. 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

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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17. 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

Bonus: Short Answer

Name the Galilean moons.

Bonus Answer: Io, Ganymede, Callisto, Europa

18. 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

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

19. 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

20. 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

21. 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

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

22. 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

23. 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

Bonus: Short Answer

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

Bonus Answer: Accept three OR three prime

24. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

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

Bonus Answer: Meselson and Stahl

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

25. 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
