

Round 31

1. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A heated 8 kg ring with a radius of 4m cools as it rotates, causing it to shrink to a radius of 2m. If it was initially rotating at 6 rad/s, what is it's final angular velocity?

Bonus Answer: 24 rad/s

Bonus: Short Answer

A 120-N child sits on a light swing and is pulled back and held with a horizontal force of 90 N. What is the magnitude of the tension force in each of the two supporting ropes?

Bonus Answer: 75 N

2. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

To determine if a rigid body is in equilibrium the vector sum of the gravitational forces acting on the particles of the body can be replaced by a single force acting at which point?

- W) the center of mass
- X) the geometrical center
- Y) the center of gravity
- Z) a point on the boundary

Toss Up Answer: Y

Bonus: Short Answer

A uniform 120-N plank is supported by two forces acting at one end and at a point halfway to the plank center. What are the magnitudes of these two forces?

Bonus Answer: 80, 160

3. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A cube with 2-m sides and a bulk modulus of $4 \times 10^5 \text{ N/m}^2$ (READ 4 times 10 to the sixth newton meters squared). When it's subjected to a pressure of $2 \times 10^5 \text{ Pa}$, what is the resulting volume of the cube?

- W) 0.5 m^3
- X) 2 m^3
- Y) 3 m^3
- Z) 4 m^3

Toss Up Answer: Z

Bonus: Multiple Choice

A 4.0-m long steel beam with a cross-sectional area of $1.0 \times 10^{-2} \text{ m}^2$ and a Young's modulus of $2.0 \times 10^{11} \text{ N/m}^2$ is wedged horizontally between two vertical walls. In order to wedge the beam, it is compressed by 0.020mm. If the coefficient of static friction between the beam and the walls is 0.70, what is the maximum mass (including its own) it can bear without slipping?

- W) 700kg
- X) 710kg
- Y) 900kg
- Z) 910kg

Bonus Answer: X

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4. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The mass of the planet Yor'Ectum is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would he weigh on Yor'Rectum?

Bonus Answer: 96N

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Bonus: Multiple Choice

The escape speed at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

- W) 2
- X) 4
- Y) 8
- Z) 1/2

Bonus Answer: Y

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5. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

What is the magnitude of the quantity $(i + 1)^{10}$?

Bonus Answer: 32

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Bonus: Short Answer

If the sum of the interior angles of a polygon is 18 thousand degrees, how many sides does it have?

Bonus Answer: 102

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6. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

Alice flips a coin until it lands up heads. To the nearest tenth, what is the expected number of flips she will make?

Bonus Answer: 2

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Bonus: Multiple Choice

What is the name of the curve traced by a fixed point on a circle that is rolling around fixed circle of the same radius? It also appears in the Mandelbrot set.

- W) cardioid
- X) nephroid
- Y) cycloid
- Z) hyperellipse

Bonus Answer: W

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7. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

What is the area of the ellipse given by the formula $x^2 + 1/4 \text{ quantity } y^2 = 1$?

Bonus Answer: 2pi

Bonus: Short Answer

How many faces does the dual polyhedron of the octahedron have?

Bonus Answer: 6

8. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

How many zeros are at the end of the number 25 factorial?

Bonus Answer: 6

Bonus: Short Answer

What is the largest amount of money one can have, in cents, without being able to make change for a dollar? Half dollars don't count.

Bonus Answer: 119

9. BIOLOGY

Writer: Larry Wong

Toss Up: Short Answer

What branch of biology deals with the study of insects?

Bonus Answer: Etomology

Bonus: Multiple Choice

Which animal does not belong to phylum chordata?

W) Alligator

X) ostrich

Y) octopus

Z) shark

Bonus Answer: Y

10. BIOLOGY

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

The chromosomes responsible for characteristics other than sex are known by what name?

Bonus Answer: Autosomes

Bonus: Short Answer

What is the term given to enzymes whose action is modulated by binding of a molecule to a site other than the active site?

Bonus Answer: allosteric enzymes

11. BIOLOGY

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name given to the jellylike substance filling the chamber behind the lens of the human eye?

Bonus Answer: vitreous humor

Bonus: Short Answer

Name the clear watery liquid that surrounds the brain and spinal cord and fills the four cavities or ventricles of the brain.

Bonus Answer: Cerebrospinal Fluid

12. BIOLOGY

Writer: Banpreet Singh

Toss Up: Short Answer

The Jabberwock lived in what wood?

Bonus Answer: tulgey wood

Bonus: Short Answer

Ancient insects were sometimes trapped in amber, a fossil resin from cone-bearing, evergreen, needle-leaved trees collectively known as

Bonus Answer: conifers

13. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

In what region of the upper digestive tract does food become chyme?

W) The esophagus

X) The stomach

Y) The sublingual salivary glands

Z) The mouth

Toss Up Answer: X

Bonus: Short Answer

A codon in an mRNA sequence is 5'-AAC-3'. What is the corresponding tRNA anticodon?

Bonus Answer: 3'-GUU-5' (Note: do not accept GUU and ' stands for prime)

14. BIOLOGY

Writer: Banpreet Singh

Toss Up: Short Answer

When you alphabetize the major body systems, which is last?

Bonus Answer: skeletal

Bonus: Short Answer

Fill in the blank. The medulla oblongata controls blank muscle action

Bonus Answer: involuntary

15. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

What type of mutation does not change an organism's phenotype despite changing its genotype

W) Missense

X) Frameshift

Y) Silent

Z) Nonsense

Toss Up Answer: Y

Bonus: Multiple Choice

Which enzyme is not involved in DNA replication?

- W) Lipase
- X) Gyrase
- Y) Helicase
- Z) DNA polymerase

Bonus Answer: W

16. BIOLOGY

Writer: Nten Nylam

Toss Up: Short Answer

What is the name of the process in which an RNA copy of a gene sequence is made, involving the enzyme RNA polymerase

Bonus Answer: Transcription

Bonus: Short Answer

What type of bonding is found in a disulfide bridge?

Bonus Answer: Covalent bonding (also accept covalent)

17. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which of the following is not one of the basic tastes

- W) sweetness
- X) saltiness
- Y) umami
- Z) spiciness

Toss Up Answer: Z

Bonus: Multiple Choice

In classical conditioning, an unlearned, inborn reaction to an unconditioned stimulus is a(n)

- W) unconditioned stimulus
- X) conditioned stimulus
- Y) conditioned response
- Z) unconditioned response

Bonus Answer: Z

18. CHEMISTRY

Writer: Nten Nylam

Toss Up: Multiple Choice

Which of the following is true regarding activation energy?

- W) Activation energy is dependent on the pressure of a system
- X) Catalysts increase the activation energy of a reaction
- Y) The reaction rate decreases as the activation energy increases
- Z) If the activation energy of the forward reaction is greater than that of the reverse reaction then the reaction is

exothermic

Toss Up Answer: Y

Bonus: Short Answer

What types of covalent bonds are present in CH₂O?

Bonus Answer: Single and double covalent bonds

19. CHEMISTRY

Writer: Brian Lim

Toss Up: Multiple Choice

Iron is in which category of elements?

W) alkali metals

X) alkaline metals

Y) transition metals

Z) metalloids

Toss Up Answer: Y

Bonus: Short Answer

What is the term for the temperature and pressure at which a substance exists at three phases at once in thermal equilibrium?

Bonus Answer: triple point

20. CHEMISTRY

Writer: Nten Nylam

Toss Up: Short Answer

Boyle's Law describes the relationship between what qualities of a gas/container?

Bonus Answer: Pressure and volume (accept in any order)

Bonus: Short Answer

What are acids with more than 2 ionizable hydrogens called?

Bonus Answer: polyprotic acids

21. CHEMISTRY

Writer: Brian Lim

Toss Up: Short Answer

What is the term for the conditions at which a substance begins to behave as a supercritical fluid?

Bonus Answer: critical point

Bonus: Multiple Choice

For a sample of a liquid, what is true about the relationship between temperature and vapor pressure?

W) the relationship depends on the substance

X) vapor pressure increases with temperature

Y) vapor pressure decreases with temperature

Z) vapor pressure is unaffected by changes in temperature

Bonus Answer: X

22. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Short Answer

Copper sulfate can be made by warming copper oxide with sulfuric acid. The equation for the reaction is:



Calculate the maximum mass of copper oxide which can react with 9.8 g of sulfuric acid in this reaction.

(Relative atomic masses: H=1, O=16, Cu=64)

Bonus Answer: 8g

Bonus: Short Answer

It takes 83ml of a 0.45M NaOH solution to neutralize 235mL of an HCl solution. What is the concentration of the HCl solution ?

Bonus Answer: 0.16 M

23. EARTH and SPACE

Writer: Henry Zheng

Toss Up: Short Answer

What is the most abundant gas in the atmosphere?

Bonus Answer: Nitrogen

Bonus: Multiple Choice

An example of a density-dependent factor is

W) weather

X) climate

Y) air

Z) food

Bonus Answer: Z

24. EARTH and SPACE

Writer: Mohammed Haque

Toss Up: Multiple Choice

Which of the 3 following components needed for the formation of a star?

W) Helium, lithium, and pressure.

X) Helium, pressure, and time.

Y) Hydrogen, pressure, and time.

Z) Magnesium, pressure, and time.

Toss Up Answer: Y

Bonus: Multiple Choice

What gas is Venus's atmosphere mainly composed of?

W) Carbon Monoxide

X) Hydrogen Gas

Y) Carbon Dioxide

Z) Carbon is a gaseous form

Bonus Answer: Y

25. EARTH and SPACE

Writer: Mohammed Haque

Toss Up: Multiple Choice

What metal is Mercury mainly comprised of ?

- W) Lithium
- X) Magnesium
- Y) Iron
- Z) Lead

Toss Up Answer: Y

Bonus: Multiple Choice

How long is Mercury's orbital period (Earth days)?

- W) 88 days
- X) 165 days
- Y) 49 days
- Z) 57 days

Bonus Answer: W
