

Round 10

1. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A 2 kg ball is dropped from 10m. Another 2 kg ball is thrown upwards at 5 m/s. What is the acceleration of the center of mass of these two balls?

- W) 2g
- X) g
- Y) 5g
- Z) 10g

Toss Up Answer: X

Bonus: Multiple Choice

Two astronauts are in gravity-free space. Astronaut A is 120 kg and Astronaut B is 90 kg. If A pushes B away, with B moving at 0.5 m/s, what is Astronaut A's final speed rounded to the tenth?

- W) 0
- X) 0.38
- Y) 0.5
- Z) 0.68

Bonus Answer: X

2. PHYSICS

Writer: George Zhou

Toss Up: Multiple Choice

A metallic cylindrical conductor is used to produce some heat by applying a constant voltage between its two ends. You want to double the heat released. Which of the following is the most appropriate thing to be done?

- W) The length should be doubled
- X) The radius should be doubled
- Y) Both the length as well as the radius should be halved
- Z) Both the length as well as the radius should be doubled

Toss Up Answer: Z

Bonus: Short Answer

A parallel plate capacitor of capacitance 10 micro F is charged to 50 micro C using a battery, and is then disconnected from the circuit. How much energy in micro joules is required to pull apart the plates such that the distance between them is doubled?

Bonus Answer: 125

3. PHYSICS

Writer: Seiji Yawata

Toss Up: Short Answer

A Tesla is an SI derived unit that can be expressed as $\text{kg}^a \cdot \text{C}^b \cdot \text{s}^c$. What are the values of a, b and c?

Bonus Answer: 1, -1, -1

Bonus: Short Answer

A positron moves through a region in which the electric field is uniform in the x-direction and the magnetic field is uniform in the y-direction. What is the direction of the terminal velocity of the positron?

Bonus Answer: Positive z direction

4. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following is the most correct statement of the equivalence principle?

W) General relativity is equivalent to Newtonian gravity under certain conditions

X) All kinds of energy are equivalent

Y) The effects of accelerating a frame are indistinguishable from gravitational forces

Z) The acceleration due to gravity is equivalent to GM/r under Newtonian conditions

Toss Up Answer: Y

Bonus: Short Answer

When a particle collides with its corresponding antiparticle, they annihilate, producing photons with energy equal to their rest mass energy. Imagine that you had 1 g of hydrogen and 1 g of anti-hydrogen. If the energy released when they collide is in the form $[a \times 10^k \text{ Joules}]$, what's the value of k?

Bonus Answer: 14

5. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name for the rule that states that when you have a limit of indeterminate form as a fraction, it is equal to the limit of the derivative of the numerator over the derivative of the denominator?

Bonus Answer: L'hospital's rule

Bonus: Short Answer

What famous function, named after a mathematician, takes the infinite sum of the reciprocals of the natural numbers raised to an argument?

Bonus Answer: Riemann zeta function

6. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What type of number is defined as a number that is not a root of a polynomial with rational coefficients?

Bonus Answer: Transcendental numbers

Bonus: Short Answer

Of the following, which of these numbers of transcendental? π , e , i , ϕ , $e \times i$, $2^{\sqrt{2}}$

Bonus Answer: π , e , $e \times i$, $2^{\sqrt{2}}$

7. MATHEMATICS

Writer: Siam Muquit

Toss Up: Short Answer

Given $y = |x - 6|$, what is the derivative at $x = 6$?

Bonus Answer: The derivative does not exist

Bonus: Short Answer

Find the derivative of x^3 / x^2

Bonus Answer: 1

8. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Find the derivative of: $4x^3 + 18x + 2$

Bonus Answer: $8x^2 + 18$

Bonus: Short Answer

At what point is the slope of the tangent line to the parabola $y = 3x^2 + 5x + 23$ equal to 0?

Bonus Answer: $(-5/6, 441/36)$

9. BIOLOGY

Writer: Henry Zheng

Toss Up: Short Answer

Rough endoplasmic reticulum is named rough because it possesses what cellular structures?

Bonus Answer: ribosomes

Bonus: Short Answer

What is the anatomical term for the specific section of the small intestine into which the pancreatic duct delivers its digestive enzymes?

Bonus Answer: duodenum

10. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

Robert Hooke coined the term 'cell' mostly because of

- W) his observations of red blood cells
- X) his observations of cork cells
- Y) his analysis of hundreds of different protozoans
- Z) his readings of the works of other early microscopists

Toss Up Answer: X

Bonus: Multiple Choice

Who is known as the "father of microbiology"?

- W) Hans Jansen
- X) Robert Hooke
- Y) Antony van Leeuwenhoek
- Z) Hans Solo

Bonus Answer: Y

11. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

The adult human of average age and size has approximately how many quarts of blood?

- W) 4
- X) 6
- Y) 8
- Z) 10

Toss Up Answer: X

Bonus: Multiple Choice

When a human donor gives a pint of blood, it usually requires how many weeks for the body RESERVE of red corpuscles to be replaced?

- W) 1 week
- X) 3 weeks
- Y) 7 weeks
- Z) 21 weeks

Bonus Answer: Y

12. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

The several types of white blood cells are sometime collectively referred to as:

- W) erythrocytes (pron: eh-rith-row-cites)
- X) leukocytes (pron: lew-kah-cites)
- Y) erythroblasts (pron: eh-rith-rah-blast)
- Z) thrombocytes (pron: throm-bow-cites)

Toss Up Answer: X

Bonus: Short Answer

There are three substances found in human blood which carry oxygen and which begin with the letter "H". Name two of these substances.

Bonus Answer: Any 2 of the following: Hemoglobin, Hemocyanin, Hemerythrin

13. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

The smallest of the FORMED elements of the blood are the:

- W) white cells
- X) red cells
- Y) platelets
- Z) erythrocytes (pron: eh-rith-row-cites)

Toss Up Answer: Y

Bonus: Multiple Choice

The condition in which there is a DECREASE in the number of white blood cells in humans is known as:

- W) leukocytosis (pron: lew-kO-sigh-toe-sis)
- X) leukopenia (pron: lew-kO-pea-nee-ah)
- Y) leukemia (pron: lew-kee-me-ah)
- Z) leukohyperia (pron: lew-kO-high-per-e-ah)

Bonus Answer: X

14. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

In the human brain, body temperature, metabolism, heart rate, sexual development, sleep and the body's use of fat and water are influenced by this region of the brain. This region of the brain is the:

- W) hypothalamus
- X) midbrain
- Y) corpus callosum
- Z) cerebellum

Toss Up Answer: W

Bonus: Multiple Choice

When a wound occurs in humans, the platelets in the blood activate a substance which starts the clotting process. The substance which starts the clotting is:

- W) adenosine (pron: ah-den-ah-seen)
- X) histamine
- Y) lecithin (pron: less-ah-thin)
- Z) thrombin

Bonus Answer: Z

15. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

In most axons, the myelin sheath is interrupted at intervals of about 1 millimeter or more. These interruptions are called the:

- W) glial
- X) nodes of Ranvier (pron: ron-vee-ay)
- Y) collaterals
- Z) nodes of Banbinet

Toss Up Answer: X

Bonus: Multiple Choice

Cariology is the study of?

- W) human hearts
- X) tooth decay
- Y) kidneys
- Z) liver

Bonus Answer: X

16. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

In cell division, what is the phase that follows metaphase?

- W) prophase
- X) anaphase
- Y) telophase
- Z) extophase

Toss Up Answer: X

Bonus: Short Answer

All cells of an organism find their lineage from a single fertilized cell. This single fertilized cell is called what?

Bonus Answer: zygote

17. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

This major protein component of connective tissue in mammals comprises most of the organic matter of skin, tendons, bones, and teeth, and occurs as fibrous inclusions in most other body structures. What is this protein component called?

W) elastin

X) collagen

Y) fatty acids

Z) keratin

Toss Up Answer: X

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

18. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which is the strongest type of intermolecular force?

W) Hydrogen bonding

X) Dipole-dipole

Y) Van der Waals

Z) Metallic bonding

Toss Up Answer: X

Bonus: Short Answer

By name or number, which of the following elements can form hydrogen bonds?

Oxygen, Chlorine, Fluorine, Nitrogen, Sulfur

Bonus Answer: Oxygen, Fluorine, Nitrogen or (1, 3, and 4)

19. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the principal quantum number of Sodium?

W) 0

X) 1

Y) 2

Z) 3

Toss Up Answer: Z

Bonus: Short Answer

What are the possible angular momentum quantum numbers for sodium?

Bonus Answer: 0, 1, 2

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20. CHEMISTRY

Writer: George Papastefanou

Toss Up: Short Answer

What is the common name of the chemical with formula $C_9H_8O_4$

Bonus Answer: Aspirin

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Bonus: Short Answer

What is the molar mass, to the nearest whole number, of three molecules of the above chemical?

Bonus Answer: 540 g/mol

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21. CHEMISTRY

Writer: Shihab Karim

Toss Up: Multiple Choice

Which of the one of the following salts is insoluble?

W) NH_4Cl

X) $Ca(NO_3)_2$

Y) $BaCO_3$

Z) Na_2S

Toss Up Answer: Y

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Bonus: Short Answer

What is the empirical formula for glucose?

Bonus Answer: CH_2O

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22. CHEMISTRY

Writer: Shihab Karim

Toss Up: Short Answer

What is the common oxidation state of Oxygen?

Bonus Answer: -2

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Bonus: Multiple Choice

Which of the following elements is a halogen?

W) Lithium

X) Potassium

Y) Neon

Z) Chlorine

Bonus Answer: Z

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23. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Multiple Choice

Where is the Great Rift Valley located?

W) Western Africa

X) Eastern Asia

Y) Eastern Africa

Z) Western Asia

Toss Up Answer: Y

Bonus: Multiple Choice

Which of these countries does the Great Rift Valley not run through?

W) Tanzania

X) Kenya

Y) Burundi

Z) Angola

Bonus Answer: Z

24. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Short Answer

The Ring of Fire surrounds which ocean?

Bonus Answer: Pacific Ocean

Bonus: Multiple Choice

What kind of volcano is Mauna Loa?

W) cone

X) shield

Y) subglacial

Z) stratovolcano

Bonus Answer: X

25. EARTH and SPACE

Writer: George Papastefanou

Toss Up: Multiple Choice

How is the ISS powered?

W) Solar Energy from photovoltaic cells

X) Nuclear Power

Y) A combination of solar energy and nuclear power

Z) Rocket fuel

Toss Up Answer: W

Bonus: Short Answer

Who was the first American astronaut in space?

Bonus Answer: Alan Shepard
