

Round 29

1. 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

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: 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

4. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

There are two small, thermally isolated rooms A and B. The heat capacitance of room A is 40 units of energy and room A contains 32 units of energy. The heat capacitance of room B is 100 units of energy and room B contains 50 units of energy. When the two rooms are thermally connected, in which direction will energy flow, on average?

- W) Energy will not flow
- X) Can't tell
- Y) Room A to Room B
- Z) Room B to Room A

Toss Up Answer: Y

Bonus: Short Answer

A piece of aluminium with mass 800 g is heated up to 1000 degrees C. Given the specific heat capacity of aluminium is 900 J/(kg K), calculate the amount of heat (in Joules) given out if the piece is cooled down to 200 degrees C.

Bonus Answer: 576,000 J

5. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

What kind of friction will act on a rolling, round object at an instant if the surface is horizontal and rough and no other force acts in the horizontal direction?

- W) Static Friction
- X) Kinetic Friction
- Y) Rolling Friction
- Z) No Friction

Toss Up Answer: Y

Bonus: Short Answer

If the acceleration due to gravity is 10 m/s^2 , find the force required to move an object of mass 200 kilograms up an incline of 1 in 50 with an acceleration of 2 m/s^2 and a frictional force of 20 N.

Bonus Answer: 420 N

6. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

What is the 5th term in the geometric progression whose first three terms are 64, 16, 4?

Bonus Answer: $1/4$ or 0.25

Bonus: Short Answer

Giving your answer in centimeters to the nearest whole number, if one leg of an isosceles right triangle is 100 centimeters long, how long is the hypotenuse?

Bonus Answer: 141

7. MATHEMATICS

Writer: Shihab Karim

Toss Up: Short Answer

What is the imaginary unit "i" when raised to the power 30?

Bonus Answer: -1

Bonus: Short Answer

What is the sum of the first 50 positive integers?

Bonus Answer: 1275

8. MATHEMATICS

Writer: Shihab Karim

Toss Up: Multiple Choice

If the diameter of a circle is 6 inches, what is the area of the circle?

W) 36π

X) 9π

Y) 12π

Z) 6π

Toss Up Answer: X

Bonus: Short Answer

Find the equation of the line that passes through the point (3,4) and is perpendicular to the line $y = 3x - 2$?

Bonus Answer: $y = -(1/3)x + 5$

9. MATHEMATICS

Writer: Siam Muquit

Toss Up: Multiple Choice

How many roots (real or complex) does $x^4 - x^3 - 9x^2 + 7x + 14 = 0$ have?

W) 1

X) 2

Y) 3

Z) 4

Toss Up Answer: Z

Bonus: Short Answer

Find all real roots of $x^4 - x^3 - 9x^2 + 7x + 14 = 0$

Bonus Answer: -1, 2, $\pm\sqrt{7}$

10. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What is class of proteins "unzips" the DNA strands into two?

Bonus Answer: DNA helicase

Bonus: Short Answer

What is the probability that a cross between two parents with the same genotype of AaBbCcDd will result in an offspring of the same genotype as their parents?

Bonus Answer: 1/16

11. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Polio is caused by which type of microbe?

W) Bacteria

X) Fungus

Y) Prion

Z) Virus

Toss Up Answer: Z

Bonus: Short Answer

Which human body system does polio most directly affect?

Bonus Answer: Nervous system (accept Central nervous system)

12. BIOLOGY

Writer: Elias Milborn

Toss Up: Short Answer

What is the largest internal organ in the human body

Bonus Answer: liver

Bonus: Multiple Choice

Plants that grow under average temperature and moisture are called:

W) halophytes

X) xerophytes

Y) hydrophytes

Z) mesophytes

Bonus Answer: Z

13. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of the following is not a strong acid?

W) H_2SO_4

X) HNO_3

Y) HClO

Z) HClO_4

Toss Up Answer: Y

Bonus: Short Answer

In a 1M solution of HClO_4 , what are the two ions and what are their concentrations?

Bonus Answer: 1 M H^+ , 1 M ClO_4^-

14. BIOLOGY

Writer: Henry Zheng

Toss Up: Short Answer

Glucose is stored as what molecule in plants?

Bonus Answer: starch

Bonus: Short Answer

What is the most common name of the protein that synthesizes DNA?

Bonus Answer: DNA polymerase (ACCEPT: polymerase)

15. BIOLOGY

Writer: Henry Zheng

Toss Up: Short Answer

How many chromosomes per cell does a Down's Syndrome (trisomy 21) victim have?

Bonus Answer: 47

Bonus: Short Answer

If a male who is heterozygous for an autosomal trait mates with a female who is also heterozygous for that trait, what percent of their offspring are likely to be heterozygous for this trait as well?

Bonus Answer: 50%

16. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

During which phase of the cell cycle are normal components of the cell synthesized and assembled?

- W) the M phase
- X) the G1 phase
- Y) the S phase
- Z) the G2 phase

Toss Up Answer: X

Bonus: Short Answer

If an individual has two dissimilar alleles for a trait, with regard to that trait he is said to be:

Bonus Answer: heterozygous

17. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

Fertilization of the ovum by the sperm usually occurs in the:

- W) oviduct
- X) vagina
- Y) uterus
- Z) ovary

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following structures is directly attached to the ovary?

- W) oviduct
- X) uterus
- Y) suspensory ligaments
- Z) vagina

Bonus Answer: Y

18. CHEMISTRY

Writer: Shihab Karim

Toss Up: Short Answer

What is the common oxidation state of Oxygen?

Bonus Answer: -2

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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19. CHEMISTRY

Writer: Shihab Karim

Toss Up: Multiple Choice

Which of the one of the following salts is insoluble?

- W) NH_4Cl
- X) $\text{Ca}(\text{NO}_3)_2$
- 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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20. CHEMISTRY

Writer: George Papastefanou

Toss Up: Short Answer

What is the common name of the chemical with formula $\text{C}(\text{sub})9\text{-H}(\text{sub})8\text{-O}(\text{sub})4$

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: 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

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Bonus: Short Answer

What are the possible angular momentum quantum numbers for sodium?

Bonus Answer: 0, 1, 2

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22. 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)

23. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Which is the new satellite/telescope replacing Hubble?

Bonus Answer: James Webb Space Telescope

Bonus: Short Answer

Why is Mars red?

Bonus Answer: Oxidised iron on Mars' surface

24. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Name 3 dwarf planets

Bonus Answer: Pluto, Ceres, Makemake, Eris, Haumea (any 3)

Bonus: Short Answer

Which coloured stars are the hottest?

Bonus Answer: Blue

25. EARTH and SPACE

Writer: Nten Nylam

Toss Up: Multiple Choice

The greatest distance from a planet to the sun is called?

W) aphelion

X) perihelion

Y) perigee

Z) eccentricity

Toss Up Answer: W

Bonus: Short Answer

What device was used to prove that the Earth rotates on its axis?

Bonus Answer: Foucault Pendulum
