

Round 9

1. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Suppose all the resistors in the world were only 10,000 Ohm resistors. What is the minimum number of resistors needed to make an equivalent resistance of 600 Ohms.

W) 8

X) 6

Y) 4

Z) 3

Toss Up Answer: Y

Bonus: Short Answer

Two wires of the same material and equal length are joined in parallel. If one of them has half the thickness of the other, and the thinner wire has a resistance of 8 Ohms, what is the resistance of the parallel combination?

Bonus Answer: 1.6 Ohms

2. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A Carnot heat engine operates between 400K and 500 K. What is its efficiency?

Bonus Answer: 20%

Bonus: Multiple Choice

A Carnot heat engine and an irreversible heat engine both operate between the same high temperature and low temperature reservoirs. They absorb the same energy from the high temperature reservoir as heat. Which statement is true?

W) The irreversible engine does more work.

X) The Carnot engine transfers less energy to the low temperature reservoir as heat.

Y) The irreversible engine has the greater efficiency.

Z) The irreversible engine cannot absorb the same energy from the high temperature reservoir as heat without violating the second law of thermodynamics.

Bonus Answer: X

3. 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

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. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the slope of a line parallel to $45x=9y+5$?

Bonus Answer: 5

Bonus: Multiple Choice

How many vertical asymptotes does $f(x)=(x^2+2x+1)/(x^3-x)$ have?

- W) 0
- X) 1
- Y) 2
- Z) 3

Bonus Answer: Y

6. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is true?

- W) -1 is congruent to 1 modulo 5
- X) -1 is congruent to 2 modulo 5
- Y) -1 is congruent to 3 modulo 5
- Z) -1 is congruent to 4 modulo 5

Toss Up Answer: Z

Bonus: Short Answer

Which is larger, 8^{10} or 3^{30} ?

Bonus Answer: 3^{30}

7. MATHEMATICS

Writer: George Zhou

Toss Up: Short Answer

What is the solution for square root of the quantity $x+5$ equals $x+3$

Bonus Answer: -1 *(do not except: [-1 and -4] or [-3])

Bonus: Short Answer

In a certain language of a certain people of a certain world, to frack a number is to find the average of the number and its square. For example, the frack of 2 is 3 since it is the average of 2 and 2 squared. what is the frack of 100?

Bonus Answer: 2020

8. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

The sum $(1+3+3^2+\dots+3^n)$ is equal to which of the following?

W) $2 \cdot 3^n$

X) $4 \cdot 3^n$

Y) $(3^{(n+1)}+1)/2$

Z) $(3^{(n+1)}-1)/2$

Toss Up Answer: Z

Bonus: Short Answer

In space, what is the graph of the equation $x^2 = y$?

Bonus Answer: A parabolic cylinder

9. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

What term describes the number of times a normal human cell population can divide?

Bonus Answer: Hayflick limit

Bonus: Multiple Choice

What controls the Hayflick limit?

W) apoptosis

X) length of telomeres

Y) genomic instability

Z) genetic drift

Bonus Answer: X

10. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Which two monosaccharides make up lactose?

Bonus Answer: Glucose and galactose

Bonus: Short Answer

Which two monosaccharides make up sucrose?

Bonus Answer: Glucose and fructose

11. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

What are the purine bases in DNA?

Bonus Answer: Adenine and guanine

Bonus: Short Answer

What are the pyrimidine bases in RNA?

Bonus Answer: Cytosine and uracil

12. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

The purpose of Glial cells is to

- W) insulate and protect neurons
- X) insulate and protect endothelial cells
- Y) protect the body from viral diseases
- Z) reinforce smooth muscle

Toss Up Answer: W

Bonus: Short Answer

Blood is to the circulatory system as hemolymph is to the

Bonus Answer: hemocoel

13. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Platelets are pieces of what type of cell?

Bonus Answer: Megakaryocytes

Bonus: Multiple Choice

Where do erythrocytes develop?

- W) spleen
- X) trabecular bone
- Y) cortical bone
- Z) bone marrow

Bonus Answer: Z

14. BIOLOGY

Writer: George Papastefanou

Toss Up: Multiple Choice

Rett syndrome displays which of the following inheritance patterns?

- W) Autosomal Dominant
- X) Autosomal Recessive
- Y) X-Linked Dominant
- Z) X-Linked Recessive

Toss Up Answer: Y

Bonus: Short Answer

In the genetic disorder known as cri-du-chat, what chromosome is affected?

Bonus Answer: Chromosome 5

15. BIOLOGY

Writer: George Papastefanou

Toss Up: Multiple Choice

What kind of typing is used to identify tissue-specific gene expression?

- W) Southern Blot
- X) Northern Blot
- Y) Western Blot
- Z) Radioactive Tracer

Toss Up Answer: X

Bonus: Multiple Choice

Which genetic disorder is mainly characterized by an onset in middle age?

- W) Huntington's Disease
- X) Schizophrenia
- Y) Prader-Willi syndrome
- Z) Tay-Sachs Syndrome

Bonus Answer: W

16. BIOLOGY

Writer: William Xiang

Toss Up: Multiple Choice

Which of the following enzymes are not utilized by the human body to break down carbohydrates?

- W) Amylase
- X) Maltase
- Y) Lactase
- Z) Lipase

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is a valid difference between animal and plant cells?

- W) Animal cells have a cell membrane whereas plant cells do not.
- X) Animal cells contain mitochondria whereas plant cells cannot.
- Y) Animal cells can contain multiple vacuoles whereas plant cells cannot.
- Z) Animal cells are larger than plant cells.

Bonus Answer: Y

17. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

The myofilaments of muscles consist primarily of two proteins. These two proteins are called

- W) actin and myosin
- X) progesterone and testosterone
- Y) progesterone and estrogen
- Z) estrogen and testosterone

Toss Up Answer: W

Bonus: Short Answer

The alternative forms of gene at the same locus on homologous chromosomes are called what?

Bonus Answer: alleles

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18. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

A molecule is considered a lewis acid if

W) accepts a pair of electrons to form a bond

X) accepts a proton from water

Y) donates a pair of electrons to form a bond

Z) donates a proton to water

Toss Up Answer: W

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Bonus: Multiple Choice

Which of the following is a binary compound?

W) Hydrogen Sulfate

X) Hydrogen Sulfide

Y) Ammonium Sulfide

Z) Ammonium Sulfate

Bonus Answer: X

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19. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

What is the name for a molecule with tetrahedral electron geometry but only three substituent groups?

Bonus Answer: trigonal pyramidal

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Bonus: Multiple Choice

Which of the following is not an ionic compound?

W) NaCl

X) HF

Y) FeCl₃

Z) H₂SO₄

Bonus Answer: X

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20. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

cis 1,2 chloro-ethene and trans 1,2 chloro-ethene differ in which of the following?

W) electron geometry

X) enthalpy

Y) entropy

Z) boiling point

Toss Up Answer: Z

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Bonus: Short Answer

In an acid/base reaction, which (acid or base) is the electrophile?

Bonus Answer: acid

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21. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the oxidation state of Manganese in the permanganate ion?

W) +5

X) +7

Y) +2

Z) -2

Toss Up Answer: X

Bonus: Short Answer

What is the oxidation state of molecular oxygen?

Bonus Answer: 0

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22. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following hydrocarbons have the highest boiling point.

W) CH₄

X) C₂H₆

Y) C₃H₈

Z) C₄H₁₀

Toss Up Answer: Z

Bonus: Multiple Choice

Alloys are mixtures of metallic substances. Which of the following pairs are matched INCORRECTLY?

W) Steel - iron and copper

X) Brass - copper and zinc

Y) Pewter - tin, copper, bismuth, and antimony

Z) Sterling silver - silver and copper

Bonus Answer: W

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23. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What spectral type does the star Betelgeuse fall into?

Bonus Answer: M

Bonus: Multiple Choice

When was the last major supernova in the Milky Way detected?

W) 1604

X) 1863

Y) 1973

Z) 1989

Bonus Answer: W

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24. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

In which atmospheric level does the "good" ozone preside?

Bonus Answer: Stratosphere

Bonus: Short Answer

In which atmospheric level does the "bad" ozone preside?

Bonus Answer: Troposphere

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25. EARTH and SPACE

Writer: Sean Vaysburd

Toss Up: Multiple Choice

Which is not a type of rock?

W) sedimentary

X) metamorphic

Y) igneous

Z) elementary

Toss Up Answer: Z

Bonus: Short Answer

Which type of rock is formed from magma?

Bonus Answer: igneous rock

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