Round 30

1. 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

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2. 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

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3. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

The driver of a car moving at a speed of 10 m/s sees a child and immediately applies brakes to bring the car to rest in 150 meters. If the combined mass of the car and the driver is 1200 kg, the magnitude of the retarding force on the vehicle is:

W) 300 N

X) 350 N

Y) 400 N

Z) 450 N

Toss Up Answer: Y

Bonus: Short Answer

A body is projected upwards with twice the escape velocity on Earth, 11.2 km/s. Ignoring the presence of other heavenly bodies, what is the speed of the body at infinity? Give your answer in km/s rounded to one decimal point.

Bonus Answer: 19.4 km/s

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4. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is stated by Kirchhoff's First Law?

W) The description of the force interacting between static electrically charged particles.

X) The algebraic sum of currents in a network of conductors meeting at a point is zero.

Y) The algebraic sum of the products of the resistances of the conductors and the currents in them in a closed loop is equal to the total emf available in that loop.

Z) The net electric flux through any closed surface is equal to 1⁄ε times the net electric charge within that closed surface.

Toss Up Answer: X

Bonus: Multiple Choice

If two 4-Farad capacitors and one 6-Farad are connected in parallel, what is the equivalent capacitance three capacitors?

W) 14 Farads

X) 4.66 Farads

Y) 1.5 Farads

Z) 1 Farad

Bonus Answer: W

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5. PHYSICS

Writer: Henry Zheng

Toss Up: Short Answer

What is the term for change in velocity per unit time?

Bonus Answer: acceleration

Bonus: Short Answer

What is the common term in physics for the product of mass times acceleration?

Bonus Answer: force

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6. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Describe the experession 2 log3 x + log3 5 as a single logarithmic expression

Bonus Answer: log3 (5x^2)

Bonus: Short Answer

Solve the equation 2|3x - 2| - 3 = 7

Bonus Answer: x = (7/3) , -1

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7. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

Using an x-y coordinate axis, a parabola is represented by the equation x2 = 6y. The vertex of this parabola is at what coordinate point?

Bonus Answer: (0,0)

Bonus: Short Answer

For a right triangle, the sin(A) is 3/5. To what value is the tan(A) equal?

Bonus Answer: 3/4

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8. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

What is the volume of a sphere of radius "R"?

Bonus Answer: (4/3) p R3

Bonus: Short Answer

Using an x-y coordinate axis, a parabola is given by the equation y = x2. Give the x-y coordinates of the focal point for this parabola.

Bonus Answer: (0, 1/4)

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9. MATHEMATICS

Writer: George Zhou

Toss Up: Multiple Choice

Donald Trump has 10x+5 apples where x=3. How many apples does he have if he eats two of them?

W) 35

X) 39

Y) 30

Z) 33

Toss Up Answer: Z

Bonus: Short Answer

Donald Trump has a tower consisting of 0.00405*10^45 grams of gold. How many kilograms of gold is in his tower? Express in scientific notation.

Bonus Answer: 4.05*10^39 (kilograms of gold)

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10. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

Melatonin (pron: mel-eh-toe-nin) is produced by the:

W) skin

X) pineal gland

Y) liver

Z) pituitary gland

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following statements is TRUE of insulin?

W) secreted by the pancreas

X) involved in the metabolism of glucose
Y) a protein
Z) all of the above

Bonus Answer: Z

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11. BIOLOGY

Writer: Henry Zheng

Toss Up: Multiple Choice

The resting potential of a neuron is dependent on what two ions?
W) lead and calcium ions
X) calcium and phosphate ions
Y) sodium and potassium ions
Z) potassium and phosphate ions

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is NOT a type of neuron?
W) sensory
X) motor
Y) association
Z) stimulatory

Bonus Answer: Z

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12. 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

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13. 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

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14. 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

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15. 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

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16. 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

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17. 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

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18. 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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19. 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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20. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

The Standard Gibb's free energy, $\Delta G°$, is
W) the residual energy present in the reactants at equilibrium
X) the residual energy present in the products at equilibrium
Y) the energy required to convert one mole of reactants to one mole of products
Z) the difference in the residual energy of reactants and products at equilibrium

Toss Up Answer: X

Bonus: Multiple Choice

If the enthalpy change for a reaction is zero, $\Delta G°$ is equal to
W) $T\Delta S°$
X) $T\Delta S°$
Y) $-\Delta H°$
Z) $\ln Keq$

Bonus Answer: X

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21. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

For the unfolding reaction of Protein G, $\Delta H° = 210.6$ kJ/mol, this means that
W) unfolding is favored enthalpically
X) unfolding is favored enthalpically
Y) the entropy is positive at all temperatures
Z) the entropy is negative at all temperatures

Toss Up Answer: X

Bonus: Multiple Choice

At the midpoint of a temperature transition curve,

W) half of the protein is denatured
X) Keq = 1.0 and ΔG = 0
Y) [Native] = [Unfolded] (Read as concentration of Native = concentration of Unfolded)
Z) All of these

Bonus Answer: Z

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22. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Short Answer

During glycolysis, electrons removed from glucose are passed to

Bonus Answer: NAD+

Bonus: Multiple Choice

A biological redox reaction always involves
W) an oxidizing agent
X) a gain of electrons
Y) a reducing agent
Z) All of the Above

Bonus Answer: Z

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23. EARTH and SPACE

Writer: Nten Nylam

Toss Up: Short Answer

Which rock has a bioclastic texture, is composed of carbon, and is formed from the compaction of plant remains.

Bonus Answer: coal

Bonus: Multiple Choice

Which of these periods came first?
W) Cretaceous
X) Cambrian
Y) Jurassic
Z) Quaternary

Bonus Answer: Z

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24. EARTH and SPACE

Writer: Kerwin Chen

Toss Up: Short Answer

On the moh's scale of mineral hardness, how hard is corundum?

Bonus Answer: 9

Bonus: Short Answer

On the moh's scale of mineral hardness, how hard is orthoclase feldspar?

Bonus Answer: 6

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25. EARTH and SPACE

Writer: Justin Lam

Toss Up: Short Answer

What is the shape of the path planets take around the sun?

Bonus Answer: Elliptical

Bonus: Short Answer

Name three of the closest stars to Earth.

Bonus Answer: Three of the following: Sun, Alpha Centauri, Barnard, Wolf, Luyten, Sirius

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