Round 6

1. PHYSICS

Toss Up: Multiple Choice

A closed hemispherical shell of radius R is filled with fluid at uniform pressure p. The net force of the fluid on the curved portion of the shell is given by:

W) 2πR^2p (read as 2 pi times R squared times p)

X) 4πR^2p (read as 4 pi times R squared times p)

Y) πR^2p (read as pi times R squared times p)

Z) (4/3)πR^2p (read as 4 over 3 times pi times R squared times p)

Toss Up Answer: Y

Bonus: Short Answer

A boat floating in fresh water displaces 16, 000N of water. How many newtons of saltwater would it displace if it floats in saltwater of specific gravity 1.17?

Bonus Answer: 16, 000

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2. PHYSICS

Toss Up: Short Answer

Given G as the gravitational constant and there exists an equilateral triangle with side length "a" and identical objects with mass of "x" what is the total gravitational potential energy of an object with mass "y" that is located at the center?

Bonus Answer: - G*(xy) 3*sqrt(3)/a

Bonus: Multiple Choice

Given G as the gravitational constant and there exists an equilateral triangle with side length "a" and identical objects with mass of "x" what is the total gravitational potential energy of this system?

W) - 9*sqrt(3)*G*(xy)/a (read as negative nine times square root of 3 times G times the second power of x divided by a)

X) - 3*sqrt(3)*G*(x^2)/a (read as negative three times square root of 3 times G times the second power of x divided by a)

Y) - 3*G*(x^2)/a (read as negative three times G times the second power of x divided by a)

Z) - sqrt(3)*G*(x^2)/a (read as negative square root of 3 times G times the second power of x divided by a)

Bonus Answer: Y

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3. PHYSICS

Toss Up: Multiple Choice

What's the critical angle in radians when a ray passes from a medium with index of refraction of 1.4 to a medium with index of refraction of 0.7?

W) PI/2

X) PI/3

Y) PI/6

Z) PI

Toss Up Answer: Y

Bonus: Short Answer

A concave spherical mirror has a focal length of 12 cm. If an object is placed 6 cm in front of it the image position is:

Bonus Answer: 12cm behind the mirror (accept -12cm)

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4. PHYSICS

Toss Up: Short Answer

The Kondo effect describes this quantity's divergence at low temperatures. Strain gauges operate by detecting changes in this quantity, because it is proportional to length and inversely proportional to cross-sectional area. Its AC-circuit extension is the complex quantity impedance, and its inverse, measured in siemens, is the conductance. Equal to voltage divided by current, according to Ohm's law, it is high for insulators and low for conductors.Name this measure of how much an object opposes electric current.

Bonus Answer: Resistance

Bonus: Short Answer

What's the emf in volts produced by an inductor with an inductance of 0.3 henry and a current with equation I(t)=2t^2+2 after 3 seconds of operation?

Bonus Answer: 3.6 volts

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5. MATHEMATICS

Toss Up: Multiple Choice

If x+(1/x)=2, find x^128+(1/x)^128

W) 256

X) 128

Y) 64

Z) 2

Toss Up Answer: Z

Bonus: Short Answer

Given the quadratic x^2-20x+9 and its roots p and q, find (1/p)^2+(1/q)^2

Bonus Answer: 382/81

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6. MATHEMATICS

Toss Up: Multiple Choice

To test products, there is a test that identifies 95% of defective products as defective, but also labels 10% of all working products as defective. If 85% of the products made are not defective, what probability of products the test determines to be defective are actually defective?

W) 39%

X) 84%

Y) 67%

Z) 42%

Toss Up Answer: Y

Bonus: Short Answer

Compute the surface area of a cylinder with radius 8 and height 2

Bonus Answer: 160pi

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7. MATHEMATICS

Toss Up: Short Answer

Tim is 5 times older than his younger brother. In 3 years Tim will be 3 times older than his younger brother. Compute the difference in the ages of Tim and his younger brother.

Bonus Answer: 12

Bonus: Short Answer

How many positive integers n have no solutions to the following equation where a and b are nonnegative integers?

3a+7b=n

Bonus Answer: 6

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8. MATHEMATICS

Toss Up: Multiple Choice

What mathematician proved the existence of a straight edge and compass construction of a regular 17-gon?

W) Euler

X) Euclid

Y) Gauss

Z) Galois [Gal-wah]

Toss Up Answer: Y

Bonus: Short Answer

Given sinX=1/3 [sine of x equals one third], compute cos^2(3X) [co-sine squared of three x].

Bonus Answer: -23/27

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9. BIOLOGY

Toss Up: Multiple Choice

What hormone is an antioxidant, forms cadmium with other metals, and is produced to help regulate the circadian cycle for animals?

W) Epinephrine

X) Thyroxine

Y) Calcitonin

Z) Melatonin

Toss Up Answer: Z

Bonus: Short Answer

Myasthenia gravis is a disease characterized by muscle weakness and fatigue, and is caused when antibodies inhibit a chemical in the human body. What is this chemical?

Bonus Answer: Acetylcholine

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10. BIOLOGY

Toss Up: Multiple Choice

Oogenesis in humans begins

W) during embryonic development

X) at birth

Y) at puberty

Z) monthly during the menstrual cycle

Toss Up Answer: W

Bonus: Multiple Choice

In birds and mammals, gastrulation begins at the

W) trophoblast

X) blastodisc

Y) blastocyst

Z) primitive streak

Bonus Answer: Z

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11. BIOLOGY

Toss Up: Multiple Choice

Which of the following is an example of an excretory mechanism?

W) Antibodies

X) Flame cells

Y) Neurosecretory cells

Z) The sarcomere

Toss Up Answer: X

Bonus: Multiple Choice

Body temperature can be increased by all of the following EXCEPT:

W) muscle contractions

X) drinking alcohol, which results in vasodilation

Y) puffing up feathers or hair

Z) reducing blood flow to ears

Bonus Answer: X

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12. BIOLOGY

Toss Up: Multiple Choice

All of the following are found in both roots and stems EXCEPT:

W) Casparian strip

X) primary phloem

Y) primary xylem

Z) secondary xylem

Toss Up Answer: W

Bonus: Multiple Choice

All of the following occur in a phototropic response EXCEPT:

W) Shoots bend toward light

X) Auxin is produced at the shoot tip and diffuses down the stem

Y) Auxin accumulates on the shady side of the shoot

Z) Auxin transport is unidirectional

Bonus Answer: X

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13. BIOLOGY

Toss Up: Multiple Choice

In plants, male gametes are produced by the

W) ovary

X) pistil

Y) antheridium

Z) archegonium

Toss Up Answer: Y

Bonus: Multiple Choice

The deuterostomes differ from protostomes in all of the following respects EXCEPT:

W) early cleavage of the zygote
X) ultimate function of the opening to the archenteron
Y) number of germ layers in the developing embryo
Z) embryonic origin of the mouth

Bonus Answer: Y

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14. CHEMISTRY

Toss Up: Short Answer

How many nodes does a 3p orbital have?

Bonus Answer: 2

Bonus: Short Answer

Name any amino acid that contains a phenyl group.

Bonus Answer: Phenylalanine, Tyrosine, Tryptophan

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15. CHEMISTRY

Toss Up: Multiple Choice

Which element has the lowest atomic number with no stable isotopes?
W) Bismuth
X) Technetium
Y) Uranium
Z) Radium

Toss Up Answer: X

Bonus: Short Answer

What color is the H-alpha spectral line?

Bonus Answer: Red

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16. CHEMISTRY

Toss Up: Short Answer

Which form of coal has the highest percentage of carbon?

Bonus Answer: anthracite

Bonus: Multiple Choice

Which of the following is a salt?
W) Water
X) Soap
Y) Plastic
Z) Rust

Bonus Answer: X

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17. CHEMISTRY

Toss Up: Multiple Choice

Which type of nuclear reactor does not require a moderator?
W) Light Water Reactor
X) Heavy Water Reactor
Y) Graphite Moderated Reactor
Z) Fast Breeder Reactor

Toss Up Answer: Z

Bonus: Short Answer

Which types of fuel cells mainly use platinum catalysts?

PEMFC

PAFC

DMFC

MCFC

Bonus Answer: 1 and 3

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18. CHEMISTRY

Toss Up: Multiple Choice

Although water molecules are locked together by strong hydrogen bonds, they can reconfigure themselves through which phenomena:

W) Adhesion

X) Brownian Motion

Y) Quantum Tunneling

Z) The Mpemba Effect

Toss Up Answer: Y

Bonus: Short Answer

Superfluidity is a state of matter which exhibits which of the following properties:

Extreme surface tension

Near-zero viscosity

High electrical conductivity

High thermal conductivity

Bonus Answer: 2 and 4

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19. CHEMISTRY

Toss Up: Multiple Choice

Vacuum systems require materials with very low outgassing rates. Which of these metals would be suitable for use in a vacuum chamber?

W) Cadmium

X) Zinc

Y) Magnesium

Z) Aluminum

Toss Up Answer: Z

Bonus: Multiple Choice

Which one of these crystal lattice structures best describes the networking of Ti, Zn, and Mg?

W) BCC

X) FCC

Y) HCP

Z) LFC

Bonus Answer: Y

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20. EARTH and SPACE

Toss Up: Short Answer

What is the name of the plane on which the planets and Sun of the solar system move?

Bonus Answer: The ecliptic

Bonus: Short Answer

"Planet" means "wanderer", as the ancients saw that planets, unlike stars, sometimes move forward with the stars through the sky and sometimes change direction and move in the opposite direction. What are the names of these two types of motion through the sky?

Bonus Answer: Retrograde and prograde

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21. EARTH and SPACE

Toss Up: Multiple Choice

What type of star has characteristics similar to Jupiter and does not necessarily perform nuclear fusion?

W) Red dwarf

X) White dwarf

Y) Brown dwarf

Z) Hot Jupiter

Toss Up Answer: Y

Bonus: Short Answer

What mechanism occurs in Jupiter and in brown dwarfs, and is responsible for Jupiter radiating more energy than it receives from the Sun?

Bonus Answer: Kelvin–Helmholtz mechanism (accept: the outer layers cool and the object compresses, which then heats up the core)

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22. EARTH and SPACE

Toss Up: Short Answer

What behavior of Mercury could not be explained by Newtonian mechanics, and perplexed the astronomical community until it was explained by General Relativity?

Bonus Answer: Precession of its orbit (accept: advance of its perihelion; advance of its periapsis)

Bonus: Short Answer

The space race between the United States and the Soviet Union was a big deal for the two nations in the 1960's and early 1970's. In 1971, NASA deployed the first spacecraft ever to orbit a another planet, and beat the USSR's deployment by a month. What planet did the NASA mission orbit?

Bonus Answer: Mars

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23. EARTH and SPACE

Toss Up: Short Answer

What body is the most volcanic in the solar system?

Bonus Answer: Io

Bonus: Short Answer

What effect gives Io the energy for this volcanic activity?

Bonus Answer: Tidal heating (accept: tidal friction, tidal forces, tidal forces by Jupiter, tidal forces by Jupiter and its moons)

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24. EARTH and SPACE

Toss Up: Short Answer

From what body do astronomers believe most comets originate?

Bonus Answer: The Oort Cloud

Bonus: Short Answer

Which tail of a comet is always directed in the opposite direction of the Sun?

Bonus Answer: The ion tail (accept: gas tail. Reject dust tail as incorrect.)

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25. ENERGY

Toss Up: Short Answer

What is energy of motion?

Bonus Answer: KE

Bonus: Short Answer

What is energy of location?

Bonus Answer: PE

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