Round 5

1. PHYSICS

Writer: Charles Zhang

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

Writer: Charles Zhang

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

Writer: Charles Zhang

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

Writer: Charles Zhang

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. PHYSICS

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

A constant force acting on a body experiencing no change in its environment will give the body:

W) constant acceleration
X) constant speed
Y) constant velocity
Z) zero acceleration

Toss Up Answer: W

Bonus: Multiple Choice

What is the MOST common term for the inwardly directed force exerted on an object to keep the object moving in a circle?

W) Centripetal Acceleration
X) Friction
Y) Normal Force
Z) Centripetal Force

Bonus Answer: Z

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6. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

Give the range for the following six values 2, 7, 11, 19, 25, 33:

W) 2
X) 31
Y) 33
Z) 15

Toss Up Answer: X

Bonus: Short Answer

Convert 6/5 pi radians to degrees

Bonus Answer: 216

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7. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

In a normal distribution, approximately what percentage of the sample, to the nearest whole number, falls within 4 standard deviations of the mean:

Bonus Answer: 100%

Bonus: Multiple Choice

Which of the following properties would you use to compute the chances of rolling either a 7 or an 11 with a pair of dice:

W) multiplicative
X) conditional
Y) independent
Z) additive

Bonus Answer: Z

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8. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

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

Bonus Answer: (4/3)piR^3

Bonus: Short Answer

What is the degree of a vertex in a complete graph K_n (K sub n)?

Bonus Answer: (0,0) ; the origin

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9. MATHEMATICS

Writer: Raafiul Hossain

Toss Up: Short Answer

What shape is the graph of y=X^2+1

Bonus Answer: parabola

Bonus: Short Answer

What is the name of the curve that is one possible inverse of a parabola, its shape resembling a heart, and that also appears in the Mandelbrot set?

Bonus Answer: cardioid

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10. BIOLOGY

Writer: Shamaul Dilmohamed

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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11. BIOLOGY

Writer: William Chan

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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12. BIOLOGY

Writer: William Chan

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

Writer: William Chan

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

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

If the molecules in a tank of hydrogen have the same rms speed as the molecules in a tank of oxygen, we may be sure that:

W) the pressures are the same

X) the hydrogen is at the greater pressure

Y) the temperatures are the same

Z) the oxygen is at the higher temperature

Toss Up Answer: Z

Bonus: Multiple Choice

The number of degrees of freedom of a rigid diatomic molecule is

W) 2

X) 3

Y) 4

Z) 5

Bonus Answer: Z

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15. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

An adiabatic process for an ideal gas is represented on a p-V diagram by:

W) a horizontal line

X) a vertical line

Y) a hyperbola

Z) a curve connecting isotherms

Toss Up Answer: Z

Bonus: Multiple Choice

Evidence that molecules of a gas are in constant motion is:

W) winds exert pressure

X) two gases interdiffuse quickly

Y) warm air rises

Z) gases are easily compressed

Bonus Answer: X

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16. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

Which one of the following has the greatest tendency to lose an electron?

W) Zn

X) Cl-

Y) Br2

Z) A mixture of PbSO4 and H2O

Toss Up Answer: W

Bonus: Short Answer

The wavelength of yellow light is 600 nanometers. What is the wavelength in centimeters: (use scientific notation

Bonus Answer: 6.0 X 10^-5

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17. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

The ideal fuel for fuel cell use is:

W) compressed natural gas

X) reformulated gasoline

Y) hydrogen

Z) Methanol

Toss Up Answer: Y

Bonus: Short Answer

Which is the correct name for N2O3

Bonus Answer: Dinitrogen Trioxide

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18. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

What relation does Charles's law describe?

Bonus Answer: V1 / T1 = V2 / T2 (Accept V over T or Volume and temperature)

Bonus: Short Answer

According to VSEPR bonding theory, what type of geometry does a molecule have when the central atom is surrounded by 4 bonded groups, such as in methane?

Bonus Answer: TETRAHEDRAL

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19. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

What is the general name for a hypothetical gas that obeys Boyles's law at all temperatures and pressures?

Bonus Answer: Ideal

Bonus: Short Answer

Knowing that the chemical name for gypsum is calcium sulfate dihydrate, gypsum is what percent water by weight? Assume the atomic masses of calcium = 40; sulfur = 32 and oxygen = 16.

Bonus Answer: 21

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20. EARTH and SPACE

Writer: William Chan

Toss Up: Multiple Choice

The time between two successive passages of the Sun across a given meridian is called a

W) civil day

X) conventional day

Y) mean solar day

Z) solar day

Toss Up Answer: Z

Bonus: Short Answer

What is the time from when a star crosses an observers meridian until the same star next crosses the observer's meridian called?

Bonus Answer: sidereal day

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21. EARTH and SPACE

Writer: William Chan

Toss Up: Multiple Choice

The best evidence of Earth's nearly spherical shape is obtained through

W) telescopic observations of other planets

X) photographs of Earth from an orbiting satellite

Y) observations of the Sun's altitude made during the day

Z) observations of the Moon made during solar eclipses

Toss Up Answer: X

Bonus: Short Answer

Earth's spherical shape "bulges" very slightly at the Equator and is very slightly "flattened" at the poles. What is this shape called?

Bonus Answer: oblate spheroid

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22. EARTH and SPACE

Writer: William Chan

Toss Up: Multiple Choice

Which observation provides the best evidence that Earth rotates?

W) The position of the planets among the stars changes during the year.

X) The location of the constellations in relationship to Polaris changes from month to month.

Y) The length of the shadow cast by a flagpole at noontime changes from season to season.

Z) The direction of swing of a freely swinging pendulum changes during the day.

Toss Up Answer: Z

Bonus: Multiple Choice

Earth's axis of rotation is tilted twenty three and a half degrees from a line perpendicular to the plane of its orbit. What would be the result if the tilt was increased to thirty three and a half degrees?

W) an increase in the amount of solar radiation received by Earth.

X) colder winters and warmer summers in New York State

Y) less difference between winter and summer temperatures in New York State

Z) shorter days and longer nights at the Equator

Bonus Answer: X

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23. EARTH and SPACE

Writer: William Chan

Toss Up: Multiple Choice

Earth is farthest from the Sun during the Northern Hemisphere's summer, and Earth is closest to the Sun during the Northern Hemisphere's winter. During which season in the Northern Hemisphere is Earth's orbital velocity greatest?

W) Winter

X) Spring

Y) Summer

Z) Fall

Toss Up Answer: W

Bonus: Multiple Choice

Which information about a nearby star must be known to determine its distance from an observer?

W) size

X) color

Y) temperature

Z) parallax

Bonus Answer: Z

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24. EARTH and SPACE

Writer: Wilson Berkow

Toss Up: Short Answer

Observation of the phases of which planet gave Galileo evidence for the Copernican model.

Bonus Answer: Venus

Bonus: Short Answer

Name the four Galilean Satellites

Bonus Answer: Io, Europa, Ganymede, Callisto

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25. ENERGY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Oil, coal, and natural gas supply what percent of energy used in the US?

W) 10

X) 35

Y) 55

Z) 90

Toss Up Answer: Z

Bonus: Multiple Choice

A permeable rock that contains hydrocarbon fluids and gasses is called:

W) An oil trap

X) A source bed

Y) An oil reservoir

Z) An oil pocket

Bonus Answer: Y

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