Round 22

1. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

If a 5000 kg truck is traveling at 30 m/s, how high must a ramp be to bring the truck to a complete stop?

Bonus Answer: 45 m

Bonus: Short Answer

A 1 kg radio controlled car is traveling at 10 m/s. When the car is 5 m from a cliff, the operator hits the brakes. How much force is required to stop the car?

Bonus Answer: 10 N

==========

2. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If an arc of 60° on circle 1 has the same length as an arc of 45° on
circle 2, what is the ratio of the area of circle 1 to the area of circle 2?

W) 9:16

X) 9:15

Y) 4:3

Z) 2:5

Toss Up Answer: W

Bonus: Short Answer

What is the reciprocal of the complex number 2 + i?

Bonus Answer: (2/5) – (1/5)i

==========

3. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A bullet with mass 0.01 kg and a velocity of 300 m/s is aimed at a wood block on a table. If the mass of the block is 1 kg and the bullet is embedded in the wood block, what is the final velocity of the system?

Bonus Answer: 3 m/s

Bonus: Short Answer

A 0.400 kg soccer ball approaches a player horizontally with a speed of 15 m/s. The player illegally strikes the ball with her hand and causes it to move in the opposite direction with a speed of 22 m/s. What impulse was delivered to the ball by the player to the nearest whole number?

Bonus Answer: -15 kgm/s

==========

4. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

A 1081 degree angle will lie in which quadrant in the Cartesian coordinate system?

Bonus Answer: Quadrant 1 (also accept 1 or first)

Bonus: Short Answer

Multiply $3x^2 – 4xy + y^2$ by $-3xy^2$

Bonus Answer: $–9x^3 y^2 + 12x^2 y^3 – 3xy^4$

==========

5. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

In a food fight, a 0.1 kg apple is given a velocity of 10 m/s. Before reaching its target, the apple is traveling at 5 m/s. What is the impulse exerted on the apple by air resistance?

Bonus Answer: 0.5 kgm/s

Bonus: Short Answer

A 0.1 kg pinball is fired horizontally by a spring with a force constant of 40 N/m. If the spring is depressed 10 cm and the ball collides with a 0.3 kg ball elastically, what is the post collision velocity of the 0.3 kg ball?

Bonus Answer: 1 m/s

==========

6. MATHEMATICS

Writer: Janine Goh

Toss Up: Short Answer

What is the quadratic formula?

Bonus Answer: x = (-b +/- sqrt (b^2 - 4ac))/2a

Bonus: Short Answer

Solve for y if x = 5/6 y + 116/3 y + 4/2 in terms of x

Bonus Answer: y = (x-2)/78

==========

7. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A ball with mass 0.2 kg is thrown at a wall with velocity 20 m/s and rebounds with a velocity of 15 m/s. What is the impulse of the net force imposed on the ball?

Bonus Answer: 7 kgm/s

Bonus: Short Answer

In a jousting game, a student of 60 kg with velocity 5 m/s is rolled towards a student of 30 kg at rest. When they collide, their poles conserve all of their kinetic energy as potential energy and redistribute it. What is the final velocity of the 30 kg student to the tenth place?

Bonus Answer: 6.6 m/s

==========

8. MATHEMATICS

Writer: Nten Nylam

Toss Up: Multiple Choice

What is the sum of 5 - 3i and the conjugate of 3 + 2i ?

W) 2-i

X) 2-5i

Y) 8-i

Z) 8-5i

Toss Up Answer: Z

Bonus: Short Answer

Multiply the following complex numbers, giving the product in a+bi form: (2 + 3i) and (4 + 5i)

Bonus Answer: -7 + 22i

==========

9. PHYSICS

Writer: Prangon Ghose

Toss Up: Multiple Choice

In a hockey game, a 0.1 kg puck is slide on the ice at 40 m/s horizontally towards a goalie. If the goalie slides the puck back in the direction in which it came with a speed of 30 m/s, what is the impulse experienced by the puck?

W) 1 kgm/s

X) 7 kgm/s

Y) 3 kgm/s

Z) 120 kgm/s

Toss Up Answer: X

Bonus: Multiple Choice

A block sliding on a frictionless surface at 10 m/s hits a spring which returns the block at the same speed. If the block's mass is 5 kg, what is the impulse the block experiences?

W) 0.5 kgm/s

X) 50 kgm/s

Y) 2 kgm/s

Z) 100 kgm/s

Bonus Answer: Z

==========

10. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The function of an electron in the electron transport chain is to:

W) transfer energy from complex II to complex I.

X) pump hydrogen ions using complex II.

Y) use its free energy to pump protons against the concentration gradient.

Z) combine with phosphate when ATP is synthesized.

Toss Up Answer: Y

Bonus: Multiple Choice

Fatigue in iron deficiency anemia may be explained in part by all of the following EXCEPT:

W) a lack of functional hemoglobin in the blood.

X) the inability to synthesize ATP.

Y) a lack of functional cytochromes in the electron transport chain.

Z) a lack of functional Coenzyme Q.

Bonus Answer: Z

==========

11. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the most electronegative element?

W) Carbon

X) Vanadium

Y) Selenium

Z) Fluorine

Toss Up Answer: Z

Bonus: Short Answer

What is the name given to the hybrid orbital created with a steric number of 3?

Bonus Answer: 2sp^2

==========

12. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

What causes acid rain?

Bonus Answer: Factories produce sulfer and nitrogen as wastes, and it gets into the air and mixes with rain.

Bonus: Short Answer

Which organism takes in the most CO2 (collectively)?

Bonus Answer: Photoplankton.

==========

13. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

The modified form of the Ideal Gas Law includes which of the following?

W) Higher pressure, Higher Volume

X) Higher pressure, Lower volume

Y) Lower Pressure, Higher volume

Z) Lower pressure, Lower volume

Toss Up Answer: Y

Bonus: Short Answer

Rank the following gases in order from least ideal to most ideal: He, N2, HCl, SF6

Bonus Answer: He, N2, SF6, HCl (accept 1,2,4,3)

==========

14. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

What hormone is released from the thyroid?

Bonus Answer: Thyroxin.

Bonus: Short Answer

What is the compacted glucose in mammals called?

Bonus Answer: Glycogen.

==========

15. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following is a strong nucleophile?

W) ethanol

X) butanol

Y) Bromide

Z) t-butoxide

Toss Up Answer: Y

Bonus: Multiple Choice

What causes Coordination compounds to be different colors

W) ∆E

X) s orbital overlap

Y) VESPR

Z) p orbital overlap

Bonus Answer: W

==========

16. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

Name three structures in cells that have double membranes.

Bonus Answer: Chloroplasts, mitochondria, and the nucleus.

Bonus: Short Answer

What do we call bacteria with double membranes?

Bonus Answer: Gram-negative bacteria.

==========

17. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

In organisms, the bonds in polypeptide chains are formed between which two ends of the amino acid?

Bonus Answer: Carboxyl, amino OR the side with the NH2 group, the side with the COOH group

---

Bonus: Short Answer

Fatty acids have three carbon chains attached to what type of molecule?

Bonus Answer: glycerol

==========

18. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

Name three structures that are in animal cells but not plant cells.

Bonus Answer: Centrioles, Flagella

Bonus: Short Answer

What do invasive species do to the ecosystem they disrupt?

Bonus Answer: They don't have natural predators, so they crowd out the native species, effectively killing them off.

==========

19. CHEMISTRY

Writer: Janine Goh

Toss Up: Multiple Choice

Who discovered electronegativity?

W) Linus Pauling

X) Ernest Rutherford

Y) Harold Urey

Z) Carl Bosch

Toss Up Answer: W

Bonus: Short Answer

List 2 gases used in the Miller-Urey experiment

Bonus Answer: Hydrogen, Water, Ammonia, Methane

==========

20. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

What do CFC's do to the environment?

Bonus Answer: They destroy the ozone layer.

Bonus: Short Answer

Name three structures that are in plant cells but not animal cells.

Bonus Answer: Chloroplasts, cell wall, and central vacuole.

==========

21. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

What element accounts for the second-most percentage of volume of the Earth's crust?

W) Oxygen

X) Calcium

Y) Potassium

Z) Silicon

Toss Up Answer: Y

Bonus: Short Answer

Give four pieces of information that would be present on a typical weather map.

Bonus Answer: Any four of the following: Temperature, visibility, weather or weather conditions, dew point, wind speed, wind direction, pressure or barometric pressure, precipitation, and cloud cover

==========

22. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

In the 1920's, the Russian scientist Ivan Pavlov performed a famous set of experiments on dogs. What was the experiment?

Bonus Answer: Conditioning the dogs to salivate when a bell was rung.

Bonus: Short Answer

What hormone maintains the thick lining of the uterus?

Bonus Answer: Progestrone

==========

23. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Which of these is not equivalent to Euclid's parallel postulate?

W) There exist 2 triangles which are similar but not congruent

X) The Pythagorean Theorem

Y) The interior angles of a quadrilateral add up to 360 degrees

Z) The exterior angles of a polygon add up to 360 degrees

Toss Up Answer: Z

Bonus: Short Answer

If there are two strings that are a fifth apart in pitch, what is the ratio of their lengths?

Bonus Answer: 2:3 or 3:2

==========

24. BIOLOGY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Photorespiration occurs the most under which conditions?

W) High Levels of Carbon Dioxide, Low levels of Oxygen

X) in CAM plants

Y) low levels of carbon dioxide, high levels of oxygen

Z) in C4 plants

Toss Up Answer: Y

Bonus: Short Answer

How many carbons does ribulose bisphosphate have?

Bonus Answer: 5

==========

25. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What are lines on a topographic map that connect points at the same elevation called?

Bonus Answer: Contour lines

Bonus: Multiple Choice

In which state is the most bituminous coal produced?

W) Kentucky

X) Pennsylvania

Y) Wyoming

Z) West Virginia

Bonus Answer: Z

==========