Round 12

TOSSUP

1) CHEMISTRY *Short Answer* What is the enthalpy of a system with internal energy 100 J, pressure of 10 N/m^2, and a volume of 100 m^3

ANSWER: 1100 J

BONUS

1) CHEMISTRY *Multiple Choice* Which of the following solvents, at 85 degrees Celsius, will dissolve the highest mass of sucrose?

W) Pyrazine
X) Dimethylformamide
Y) Dioxane
Z) Pyridine

ANSWER: X) DIMETHYLFORMAMIDE

TOSSUP

2) MATH *Multiple Choice* In how many ways can the letters in the word CANADIAN, spelled C A N A D I A N, be arranged?

W) 40320
X) 20160
Y) 6720
Z) 3360

ANSWER: Z) 3360

BONUS

2) MATH *Short Answer* Rounded to the nearest tenths place, what is the probability that exactly 4 births are girls if there are 10 births?

ANSWER: 0.2

TOSSUP

3) ENERGY *Short Answer* Engineers at Monash University in Australia have developed a diagnostic test using glass, teflon film, and a strip of paper to detect fibrinogen concentrations in the blood. Fibrinogen is vital to what process, which occurs following a wound or injury to the blood vessels?

ANSWER: CLOTTING (ACCEPT: COAGULATION)

BONUS

3) ENERGY *Short Answer* Platelets, which play a crucial role in the clotting process by forming platelet plugs that stop blood loss from a wound, are cytoplasmic fragments of what large bone marrow cells?

ANSWER: MEGAKARYOCYTES

TOSSUP

4) PHYSICS *Multiple Choice* What type of particles could not exist on their own due to color confinement?

W) Neutrinos
X) Elementary Bosons
Y) Quarks
Z) Leptons

ANSWER: Y) QUARKS

BONUS

4) PHYSICS *Multiple Choice* A 750 g peregrine falcon dives straight down towards a 400 g pigeon, which is flying level to the ground. Just before the falcon makes impact its velocity is 35 m/s. The velocity of the falcon and the pigeon in its talons immediately after impact is most nearly

W) 35 m/s
X) 31.95 m/s
Y) 28.9 m/s
Z) 22.8 m/s

ANSWER: Z) 22.8 M/S

TOSSUP

5) EARTH AND SPACE *Short Answer* What phenomena occurs in the water table when water is drawn from an aquifer rapidly?

ANSWER: CONE OF DEPRESSION

BONUS

5) EARTH AND SPACE *Short Answer* What are the percentages of sand, silt, and clay, respectively, in the best type of loam?

ANSWER: 40% (SAND), 40% (SILT), 20% (CLAY)

TOSSUP

6) BIOLOGY *Short Answer* What group of monoamine hormones is derived from tyrosine?

ANSWER: CATECHOLAMINES

BONUS

6) BIOLOGY *Multiple Choice* What is the name for pollination by wind?

W) autogamy
X) entomophily
Y) anemophily
Z) ornithophily

ANSWER: Y) ANEMOPHILY

TOSSUP

7) MATH *Multiple Choice* What is the limit of x*sin (1/x) as x approaches 0

W) 1
X) -1
Y) 0
Z) Does not exist

ANSWER: Y) 0

BONUS

7) MATH *Multiple Choice* Given quadrilateral ABCD where AB = 6, BC = 5, CD = 5, DA = x, angle BCA = 50°, and angle ACD = 60°, which of the following is TRUE about x?

W) $x > 6$
X) $x = 6$
Y) $5 < x < 6$
Z) $x < 6$

ANSWER: W) $X > 6$

TOSSUP

8) CHEMISTRY *Multiple Choice* For what value of zeta potential, in millivolts, is a colloid most likely to flocculate?

W) 5
X) 20
Y) 50
Z) 100

ANSWER: W) 5

BONUS

8) CHEMISTRY *Multiple Choice* Which of the following elements exemplifies the inert pair effect?

W) Chromium
X) Antimony
Y) Radon
Z) Boron

ANSWER: X) ANTIMONY

TOSSUP

9) BIOLOGY *Short Answer* This layer is a combination of palisade and spongy parenchyma. This layer contains the chloroplasts in a plant leaf. Name this layer in plant leaves in which photosynthesis takes place.

ANSWER: MESOPHYLL

BONUS

9) BIOLOGY *Multiple Choice* Which of the following techniques could be used to demonstrate protein binding to specific DNA sequences?

W) western blot hybridization
X) northern blot hybridization
Y) southern blot hybridization
Z) electrophoretic mobility shift assay

ANSWER: Z) ELECTROPHORETIC MOBILITY SHIFT ASSAY

TOSSUP

10) PHYSICS *Multiple Choice* A charged particle moving through a magnetic field will experience the largest force when

W) moving with the field.
X) moving against the field.
Y) moving at a 45° angle to the field.
Z) moving at a 90° angle to the field.

ANSWER: Z) MOVING AT A 90° ANGLE TO THE FIELD.

BONUS

10) PHYSICS *Multiple Choice* How many different types of elementary bosons have been discovered?

W) 3
X) 9
Y) 6
Z) 5

ANSWER: Z) 5

TOSSUP

11) EARTH AND SPACE *Multiple Choice* Oxygen represents how much of the Earth's crust?

W) 0.28
X) 0.21
Y) 0.46
Z) 0.39

ANSWER: Y) 0.46

BONUS

11) EARTH AND SPACE *Multiple Choice* Astronomical distances are often measured in parsecs (pc). What is a distance of 1 pc equal to?

W) 3.26 light years
X) 4.55 light years
Y) 9.46 light years
Z) None of the above

ANSWER: W) 3.26 LIGHT YEARS

TOSSUP

12) BIOLOGY *Short Answer* The mycelia of the organisms in this phylum are divided into three types of hyphae. The rhizoids function in food absorption. The sporangiophores bear the spore-producing sporangia. Rhizoids and sporangiophores are connected by stolons. What phylum contains all of these structures?

ANSWER: ZYGOMYCOTA

BONUS

12) BIOLOGY *Short Answer* What is the biological term for the structure in the human embryo from which the forebrain, including the cerebral cortex and basal ganglia, is developed?

ANSWER: TELENCEPHALON

TOSSUP

13) CHEMISTRY *Multiple Choice* Which of the following is a true statement about Isomers?

W) Cis-isomers for compounds with 2 central carbon atoms are non-polar
X) Alkanes only have trans-isomers
Y) Isomers result when a molecule cannot rotate around a Carbon-Carbon double bond.
Z) The trans-dicloroethane molecule has a higher boiling point than the cis-dicloroethane molecule.

ANSWER: Y) ISOMERS RESULT WHEN A MOLECULE CANNOT ROTATE AROUND A CARBON-CARBON DOUBLE BOND.

BONUS

13) CHEMISTRY *Short Answer* How many unpaired electrons does a ground-state gas-phase Tungsten 2+ ion have?

ANSWER: 4

TOSSUP

14) EARTH AND SPACE *Multiple Choice* What is the most abundant greenhouse gas in the earth's atmosphere?

W) Carbon dioxide
X) Methane

Y) Water Vapor
Z) Nitrous oxide

ANSWER: Y) WATER VAPOR

BONUS

14) EARTH AND SPACE *Short Answer* This ability for a soil to attract mineral cations and adsorb them, keeping them on the surface of the soil particles for the plants to use is called?

ANSWER: CATION EXCHANGE CAPACITY (CEC)

TOSSUP

15) ENERGY *Short Answer* The Magnetorotational Instability, or MRI, Experiment aims to explain one possible method of the formation of stars and planets. The instabilities predicted by MRI theory occur in what ring of dust and other matter around an infant star, which also contains the materials from which planets may be made.

ANSWER: ACCRETION DISC

BONUS

15) ENERGY *Short Answer* Researchers at Los Alamos National Lab are studying a way to protect cars, boats, and aircraft from long term oxygen corrosion. The wish to accomplish this by depositing a microscopically thin layer onto the metal surfaces of these objects made from what futuristic material.

ANSWER: GRAPHENE

TOSSUP

16) PHYSICS *Short Answer* What ratio is described when a material is subjected to a positive strain in a longitudinal axis, and the transverse strain is also positive?

ANSWER: NEGATIVE POISSON RATIO

BONUS

16) PHYSICS *Multiple Choice* According to the Lyman Series, what energy state will an electron move to if hit by light with a wavelength of 102.57 nm?

W) The second state
X) The fourth state
Y) The third state

Z) The first state

ANSWER: Y) THE THIRD STATE

TOSSUP

17) MATH *Short answer* Two real numbers x and y each between -1 and 1 are chosen randomly. What's the probability that x^2+y^2<1?

ANSWER: PI/4 (ACCEPT 0.79)

BONUS

17) MATH *Short Answer* What is the value of the sum 1/2 + 3/4 + 7/8 + 15/16 + ... + 127/128?

ANSWER: 769/128

TOSSUP

18) BIOLOGY *Short Answer* These fibers that make up the cytoskeleton of a cell are fine, thread-like, 3-6 nm in diameter. Name this fiber which is predominantly composed of actin, which is the most abundant cellular protein.

ANSWER: MICROFILAMENTS

BONUS

18) BIOLOGY *Multiple Choice* These organisms obtain energy by the oxidation of electron donors in their environments. Most organisms of this type are extremophiles. Name this type of organism which includes nitrogen-fixing bacteria?

W) Photoautotroph
X) Chemoautotroph
Y) Organotroph
Z) Chemolithotroph

ANSWER: X) CHEMOAUTOTROPH

TOSSUP

19) ENERGY *Short Answer* Scientists at Berkeley National Lab are studying interaction involving a certain novel particle, which is very important in the Standard Model of

particle physics. What is this particle whose namesake field is responsible for imparting mass to fermions?

ANSWER: HIGGS BOSON

BONUS

19) ENERGY *Short Answer* Researchers at Brookhaven National Lab are researching the proton spin puzzle, which examines how the constituent particles of a proton affect its spin. What are the three constituent particles of a proton?

ANSWER: UP QUARK, DOWN QUARK, AND GLUON (NUMBER AND ORDER DO NOT MATTER)

TOSSUP

20) CHEMISTRY *Short Answer* What element is produced when Uranium - 238 undergoes alpha decay and then a beta decay?

ANSWER: PROTACTINUM - 234

BONUS

20) CHEMISTRY *Multiple Choice* A beaker contains a saturated solution of copper(I) chloride, a slightly soluble salt with a solubility product of 1.2 × 10^–6. The addition of which of the salts listed below to the solution would cause the precipitation of copper(I) chloride?

W) Sodium chloride
X) Potassium bromide
Y) Silver(I) nitrate
Z) Lead(II) acetate

ANSWER: W) SODIUM CHLORIDE

TOSSUP

21) PHYSICS *Short Answer* What is the name of a circuit that converts alternating current to direct current?

ANSWER: RECTIFIER (DO NOT ACCEPT: INVERTER)

BONUS

21) PHYSICS *Multiple Choice* Assuming a sinusoidal input current waveform, the output waveform of a full wave rectifier is the equivalent of the output of what function given an input of sin(x)?

ANSWER: ABSOLUTE VALUE

TOSSUP

22) MATH *Short Answer* Find the exact value of cos(80) * cos(70) - sin(80) * sin(70).

ANSWER: -squareroot(3)/2 (ACCEPT: -3/(2*sqrt(3)) or equivalent forms)

BONUS

22) MATH *Multiple Choice* What is the minimum distance between the line -x + y - 1 = 0 and the point (3, 7)?

W) 3/sqrt(2) [READ: 3 OVER THE SQUARE ROOT OF 2]

X) 4/sqrt(2) [READ: 4 OVER THE SQUARE ROOT OF 2]

Y) 5/sqrt(2) [READ: 5 OVER THE SQUARE ROOT OF 2]

Z) 2sqrt(10) [READ: 2 TIMES THE SQUARE ROOT OF 10]

ANSWER: W) 3/sqrt(2)

TOSSUP

23) EARTH AND SPACE *Short Answer* Spiral galaxies with small, highly luminous nuclei containing broad emission lines can be classified as what specific kind of spiral galaxy?

ANSWER: SEYFERT GALAXIES

BONUS

23) EARTH AND SPACE *Short Answer* What term describes the process by which gases from a planet’s interior accumulate to form an atmosphere?

ANSWER: OUTGASSING