Round 6

TOSSUP

1) ENERGY *Short Answer* Scientists at the Princeton Plasma Physics Lab have created a way to create cold plasma for disinfection utilizing the piezoelectric effect. What common piezoelectric mineral is used to keep time in watches?

ANSWER: Quartz

BONUS

1) ENERGY *Multiple Choice* Scientists at the Princeton Plasma Physics Lab have been researching the possibility of a rocket propulsion system that utilizes fusion. Which of the following is one of the primary advantages of such a propulsion method?

W) Very light weight propulsion source
X) Eliminates the need to bring fuel on space flights
Y) Fusion plasma has a very high expansion coefficient
Z) This method provides constant acceleration to the rocket

ANSWER: Z) THIS METHOD PROVIDES CONSTANT ACCELERATION TO THE ROCKET

TOSSUP

2) EARTH AND SPACE *Multiple Choice* Which of the following is the most common way mercury gets into the atmosphere?

W) Evaporation from lakes and oceans
X) The eruption of volcanoes
Y) Exhaust from automobiles
Z) Exhaust from coal-burning power plants

ANSWER: Z) EXHAUST FROM COAL-BURNING POWER PLANTS

BONUS

2) EARTH AND SPACE *Short Answer* Give, by name or number, each of the following 6 gases which are considered direct greenhouse gases: 1) carbon dioxide; 2) methane; 3) sulfur dioxide; 4) water vapor; 5) sulfur hexafluoride; 6) nitrogen dioxide

ANSWER: 1,2,4,5 (ACCEPT: CARBON DIOXIDE, METHANE, WATER VAPOR, SULFUR HEXAFLUORIDE)

TOSSUP

3) CHEMISTRY *Multiple Choice* What law states that the change in enthalpy in a chemical reaction is independent of the pathway between the initial and final states?

ANSWER: HESS'S LAW

BONUS

3) CHEMISTRY *Short Answer* Name all of the following quantities by name or number that are path functions.

1) Heat
2) Enthalpy
3) Work
4) Reaction Order

ANSWER: 1, 3 (ACCEPT: HEAT, WORK)

TOSSUP

4) BIOLOGY *Short Answer* The radioisotope of which element is most commonly used in Positron Emission Tomography?

ANSWER: FLUORINE (ACCEPT: F)

BONUS

4) BIOLOGY *Multiple Choice* In a PET scan, a patient's lungs show an increased FDG uptake. This is most likely the result of which of the following conditions?

W) Asthma
X) Emphysema (Em-fe-si-ma)

Y) Bronchitis
Z) Lung Cancer

ANSWER: Z) LUNG CANCER

TOSSUP

5) MATH *Short Answer* If $x + (1/x) = 5$, what is the value of $x^2 + (1/x^2)$?

ANSWER: 23

BONUS

5) MATH *Short Answer* If $x = 3 + (4/(3+(4/(3+4/...))))$ (pronounced: X EQUALS 3 PLUS QUANTITY 4 OVER 3 PLUS QUANTITY 4 OVER 3 PLUS QUANTITY 4 OVER CONTINUED INFINITELY), what is the value of x?

ANSWER: 4

TOSSUP

6) PHYSICS *Multiple Choice* A tether ball with a mass of 3 kg is spinning around the pole on a rope of 4 meters with the rope at an angle of 30° with the normal. If the rope's length is doubled, by what factor will the acceleration of the tether ball be changed?

W) 1/4
X) 1/2
Y) 2
Z) 4

ANSWER: W) 1/4

BONUS

6) PHYSICS *Multiple Choice* A box of mass m slides down a frictionless inclined plane of length L and vertical height h. What is the change in its gravitational potential energy?

W) -mgL
X) -mgh
Y) mgL + mgh
Z) mgL - mgh

ANSWER: X) -MGH

TOSSUP

7) ENERGY *Short Answer* Scientists at the National Renewable Energy Lab are researching how to better harness solar energy. What sort of mirrors are often used at large scale solar power stations?

ANSWER: PARABOLIC

BONUS

7) ENERGY *Multiple Choice* Scientists at the National Renewable Energy Lab are studying how to improve the efficiency of wind turbines. However the efficiency of wind turbines is limited by Betz's Law. Which of the following is closest to the maximum efficiency possible for a wind turbine as stated by Betz's Law?

W) 50

X) 60

Y) 70

Z) 80

ANSWER: X) 60

TOSSUP

8) EARTH AND SPACE *Multiple Choice* Which of the following is NOT true about mafic igneous rocks?

W) They are generally dark in color.
X) They contain low amounts of silicon, sodium, aluminum, and potassium.
Y) They contain low amounts of iron, magnesium, and calcium.
Z) An example is basalt.

ANSWER: Y) THEY CONTAIN LOW AMOUNTS OF IRON, MAGNESIUM, AND CALCIUM.

BONUS

8) EARTH AND SPACE *Short Answer* Give, by name or number, each of the following which are felsic igneous rocks: 1) basalt; 2) granite; 3) obsidian; 4) gabbro; 5) pumice

ANSWER: 2, 3, 5 (ACCEPT: GRANITE, OBSIDIAN, PUMICE)

TOSSUP

9) CHEMISTRY *Short Answer* What term refers to how light interacts with the surface of a rock or mineral?

ANSWER: LUSTER (ACCEPT WORD FORMS)

BONUS

9) CHEMISTRY *Multiple Choice* Which of the following is NOT a type of luster?

W) Greasy
X) Dull
Y) Bright
Z) Metallic

ANSWER: Y) BRIGHT

TOSSUP

10) BIOLOGY *Short Answer* What is the name for an organic, non-protein molecule that assists an enzyme in catalyzing a chemical reaction?

ANSWER: COENZYME OR COFACTOR (DO NOT ACCEPT: SUBSTRATE)

BONUS

10) BIOLOGY *Short Answer* The presence of what metal cofactor is vital for the transport of oxygen in molluscs?

ANSWER: COPPER (ACCEPT CU BUT NOT CO)

TOSSUP

11) MATH *Short Answer* If f(x) = cos(x) (pronounced: F OF X IS EQUAL TO THE COSINE OF X), what is the 52nd derivative of f?

ANSWER: COS(X) (READ AS COSINE OF X)

BONUS

11) MATH *Short Answer* Angle A in triangle ABC is 30 degrees, and the side opposite to A measures 5 ft. If angle B in the triangle measures 30 degrees, what is the area of the triangle. Express your answer in simplest radical form.

ANSWER: $25\frac{\sqrt{3}}{4}$

TOSSUP

12) PHYSICS *Short Answer* Although inertia doesn't have any units, this quantity is often used as a representation of how much inertia an object has. What is this quantity?

ANSWER: MASS

BONUS

12) PHYSICS *Short Answer* Order the following electromagnetic waves from shortest wavelength to longest wavelength by name or number: 1. X-rays, 2. Infrared rays, 3. Radio waves, 4. Microwaves

ANSWER: 1, 2, 4, 3 (ACCEPT: X-RAYS, INFRARED RAYS, MICROWAVES, RADIO WAVES)

TOSSUP

13) ENERGY *Short Answer* A transformer has 10 turns in its primary coil and 100 turns in its secondary coil. If the secondary voltage is 12 Volts, what is the primary voltage?

ANSWER: 1.2 Volts

BONUS

13) ENERGY *Short Answer* As electricity is transmitted, some of it is lost as heat. What effect explains why this happens?

ANSWER: JOULE HEATING (ACCEPT: OHMIC HEATING OR RESISTIVE HEATING)

TOSSUP

14) EARTH AND SPACE *Multiple Choice* Which of the following planets in our solar system has retrograde rotation?

W) Venus
X) Saturn
Y) Jupiter
Z) Mars

ANSWER: W) VENUS

BONUS

14) EARTH AND SPACE *Short Answer* Using name or number, order the following stars from most to least bright in the night sky.

1) Vega
2) Sirius
3) Canopus
4) Capella

ANSWER: 2, 3, 1, 4 (ACCEPT: SIRIUS, CANOPUS, VEGA, CAPELLA)

TOSSUP

15) CHEMISTRY *Short Answer* What is the common name of the explosive 2,4,6-trinitrotoluene?

ANSWER: TNT

BONUS

15) CHEMISTRY *Short Answer* The toluene present in TNT is derived from benzene by adding what group?

ANSWER: METHYL (ACCEPT: METHANE)

TOSSUP

16) BIOLOGY *Multiple Choice* How does an increase in temperature affect hemoglobin affinity for O2 assuming there are no other changing variables?

W) Decreases
X) Does not affect
Y) Increases
Z) The answer varies on the degree of temperature change

ANSWER: W) DECREASES

BONUS

16) BIOLOGY *Short Answer* An arterial pH that is lower than normal (homeostatic) conditions would have what effect on the rate of respiration?

ANSWER: INCREASES

TOSSUP

17) MATH *Short Answer* If you have 5 red socks, 8 blue socks, and 7 green socks, what is the most number of socks you can draw before you get a pair of each color?

ANSWER: 16

BONUS

17) MATH *Multiple Choice* How many ways can you divide 8 students into 2 groups of 4?

ANSWER: 35

TOSSUP

18) PHYSICS *Short Answer* What is another name for blackbody radiation that is emitted from a black hole?

ANSWER: HAWKING RADIATION

BONUS

18) PHYSICS *Multiple Choice* In Hawking radiation, particle pairs are separated to emit energy, but in the Penrose process an object is split into two parts - one of which escapes into space, while the other falls into the black hole. The escaping piece has more mass-energy than it initially did. The difference is supplied by the black hole which loses energy in what form?

W) Charge
X) Angular momentum
Y) Mass
Z) Electromagnetic energy

ANSWER: X) ANGULAR MOMENTUM

TOSSUP

19) BIOLOGY *Multiple Choice* Which endocrine gland is responsible for the secretion and synthesis of human growth hormone?

W) Hypothalamus
X) Thyroid
Y) Posterior pituitary
Z) Anterior pituitary

ANSWER: Z) ANTERIOR PITUITARY

BONUS

19) BIOLOGY *Short Answer* Name the organ of the human body above which the adrenal glands are located.

ANSWER: KIDNEY(S)

TOSSUP

20) CHEMISTRY *Multiple Choice* Which of the following molecules has a permanent dipole moment?

W) Molecular Bromide
X) Methane
Y) Hydrogen Fluoride
Z) Carbon Dioxide

ANSWER: Y) HYDROGEN FLUORIDE

BONUS

20) CHEMISTRY *Short Answer* Which stable halogen has the highest London dispersion force?

ANSWER: IODINE (ACCEPT I)

TOSSUP

21) MATH *Multiple Choice* For which of the following polynomials does the product of its roots not equal -2?

W) x^2 + 2x - 2
X) 2x^3 + 3x + 4
Y) 4x^5+ 3x^2 + 4x - 8
Z) 6x^6 + 3x^3 - 14x - 12

ANSWER: Y) 4x^5+ 3x^2 + 4x - 8

BONUS

21) MATH *Short Answer* You start at your home and bicycle at 12 kmph. Half-way through your journey, your tire goes flat and you walk the rest of the way at 3 kmph. It took you a total of 30 minutes to get to your destination. What is the total distance you walked, in kilometers and in decimal form?

ANSWER: 2.4

TOSSUP

22) PHYSICS *Short Answer* What is the amplitude of an object, in meters, in simple harmonic motion given that at this instance it has 25 Joules of potential energy, 75 Joules of kinetic energy, and the spring constant is 2 N/m.

ANSWER: 10 m

BONUS

22) PHYSICS *Short Answer* Given that an object is in simple harmonic motion and its period is pi and its amplitude is 3 meters, what is the magnitude of the maximum acceleration of the block?

ANSWER: 12 m/s^2

TOSSUP

23) EARTH AND SPACE *Multiple Choice* What glacial landform occurs when a stagnant piece of ice becomes buried in the glacial drift, later melting and leaving a pit in the glacial sediment?

W) Kettle
X) Drumlin
Y) Esker
Z) Kame

ANSWER: W) KETTLE

BONUS

23) EARTH AND SPACE *Short Answer* What tectonic process leads to the creation of deep-ocean trenches?

ANSWER: SUBDUCTION