

TOSS-UP

1) BIOLOGY *Multiple Choice* Which of the following terms BEST describes the cells of the inner cell mass produced in the blastocyst stage, and the cells' ability to give rise to different types of cells?

- W) totipotent
- X) pluripotent
- Y) multipotent
- Z) unipotent

ANSWER: X) PLURIPOTENT

TOSS-UP

2) PHYSICS *Short Answer* A 2-kg ball is thrown at a wall with an initial velocity of 10 ms^{-1} and rebounds from the wall with a final velocity of 6 ms^{-1} . If this collision lasted for 0.2 seconds, what is the average force exerted on the ball?

ANSWER: 160 N

TOSS-UP

3) EARTH AND SPACE SCIENCE *Multiple Choice* Which of the following compounds are prevalent in the spectra of L dwarf stars, which were discovered in 1998?

- W) TiO
- X) FeH
- Y) CH₄
- Z) H₂O

ANSWER: X) FeH

TOSS-UP

4) MATHEMATICS *Short Answer* Evaluate $\int 2^x dx$.

ANSWER: $\frac{2^x}{\ln 2} + C$

TOSS-UP

5) ENERGY *Multiple Choice* Which of the following processes can be predicted to have a positive change in entropy, ΔS ?

- W) dissolving gaseous oxygen in liquid water
- X) dissolving gaseous carbon dioxide in liquid water
- Y) dissolving solid ammonium nitrate in liquid water
- Z) condensing water vapor into liquid water

ANSWER: Y) DISSOLVING SOLID AMMONIUM NITRATE IN LIQUID WATER

TOSS-UP

6) CHEMISTRY *Multiple Choice* Which of the following compounds has bonds with greatest ionic character?

- W) HI
- X) HBr
- Y) HCl
- Z) HF

ANSWER: Z) HF

TOSS-UP

7) BIOLOGY *Multiple Choice* Which of the following statements is NOT true regarding the hormone prolactin?

- W) it is structurally similar to growth hormone, GH
- X) it stimulates milk production in humans
- Y) prolactin-inhibiting hormone, or dopamine, prevents prolactin secretion
- Z) high levels of prolactin correspond to high levels of sex hormones in males and females

ANSWER: Z) HIGH LEVELS OF PROLACTIN CORRESPOND TO HIGH LEVELS OF SEX HORMONES IN MALES AND FEMALES

TOSS-UP

8) PHYSICS *Short Answer* What shunt resistance is required to make a 2 A, 20 Ω current-measuring meter into an ammeter with a range of 0 to 50 A?

ANSWER: 0.4 OHMS

TOSS-UP

9) EARTH AND SPACE SCIENCE *Multiple Choice* Which of the following types of moraines is formed as two joined glaciers merge their lateral moraines below their junction, and forms a ridge parallel to the valley walls?

- W) ground
- X) terminal
- Y) end
- Z) medial

ANSWER: Z) MEDIAL

TOSS-UP

10) MATHEMATICS *Short Answer* What is $\log(\ln(e))$?

ANSWER: 0

TOSS-UP

11) ENERGY *Short Answer* Indicate, by name or number, all of the following 3 metabolic processes which is/are endergonic reactions:

- 1: oxidation of glucose to carbon dioxide and water
- 2: formation of ATP from ADP
- 3: attachment of a phosphate group to a glucose molecule

ANSWER: 2 AND 3

TOSS-UP

12) CHEMISTRY *Short Answer* How many sigma and pi bonds, respectively, are present in a molecule of CCl₄?

ANSWER: 4 SIGMA, 0 PI

TOSS-UP

13) BIOLOGY *Short Answer* What process, which is the first in the polymerase chain reaction, involves the heating of excess primer and DNA fragments to dissociate the DNA into single strands?

ANSWER: DENATURATION

TOSS-UP

14) PHYSICS *Short Answer* What term is used for situations in which a point source of light, obstacle, and viewing screen are relatively far apart, such that all light rays are considered to be parallel when diffracted by the obstacle?

ANSWER: FRAUNHOFER DIFFRACTION

TOSS-UP

15) EARTH AND SPACE SCIENCE *Short Answer* By name or number, indicate all of the following 3 statements which is/are TRUE concerning coronal gas in the interstellar medium:

- 1: it appears to originate in a supernova
- 2: it is known to produce ultraviolet radiation
- 3: it is denser than interstellar matter near the Sun

ANSWER: 1 AND 3

TOSS-UP

16) MATHEMATICS *Multiple Choice* If two chickens lay eight eggs in three days, how many eggs do five chickens lay in six days?

- W) 20 eggs
- X) 24 eggs
- Y) 36 eggs
- Z) 40 eggs

ANSWER: Z) 40 EGGS

TOSS-UP

17) ENERGY *Short Answer* What is the molar heat capacity at constant pressure of gaseous acetylene, C_2H_2 ?

ANSWER: $(7/2)R$

TOSS-UP

18) CHEMISTRY *Multiple Choice* Which of the following statements is NOT true regarding proton exchange between water molecules?

- W) the autoprotolysis reaction is endothermic
- X) the autoprotolysis constant increases with temperature
- Y) the product of the concentrations of H_3O^+ and OH^- is always the autoprotolysis constant
- Z) the concentrations of H_3O^+ and OH^- are great in pure water

ANSWER: Z) THE CONCENTRATIONS OF H_3O^+ AND OH^- ARE GREAT IN PURE WATER

TOSS-UP

19) BIOLOGY *Short Answer* Indicate, by name or number, all of the following 4 monosaccharides that are aldoses:

- 1: ribose
- 2: ribulose
- 3: fructose
- 4: galactose

ANSWER: 1 AND 4

TOSS-UP

20) PHYSICS *Short Answer* John makes a primitive yo-yo by tying a massless string around a solid cylinder, with mass m and radius r . He holds the free end of the string stationary and lets the cylinder go from rest. The string does not slip or stretch as it unwinds, and the cylinder descends and rotates. In terms of m , v , and/or r , what is the

kinetic energy of the center of mass of the cylinder after it has descended a distance h , assuming that the moment of inertia is $I = (1/2)mr^2$?

ANSWER: $(3/4)mv^2$

TOSS-UP

21) EARTH AND SPACE SCIENCE *Short Answer* What process, which is important geologically with respect to the chemical differentiation of crustal rocks, is responsible for formation of basaltic rock from peridotite, and is the basis for the location of basalt and peridotite within the Earth?

ANSWER: PARTIAL MELTING

TOSS-UP

22) MATHEMATICS *Short Answer* Evaluate $\sum_{i=1}^5 i^2$.

ANSWER: 55

TOSS-UP

23) ENERGY *Short Answer* What method of shale gas production uses water, silica, and chemical compounds piped several thousand feet below the Earth's surface and creates cracks in shale formations, allowing natural gas to be released and flow into the well?

ANSWER: HYDRAULIC FRACTURING (ACCEPT: FRACKING)

TOSS-UP

24) CHEMISTRY *Multiple Choice* What is the molecular geometry of BrF_5 ?

- W) square pyramidal
- X) trigonal bipyramidal
- Y) square planar
- Z) seesaw

ANSWER: W) SQUARE PYRAMIDAL

TOSS-UP

25) BIOLOGY *Short Answer* What is the collection of abiotically produced molecules surrounded by a membrane-like structure, exhibiting some properties of life including metabolism, simple reproduction, and the maintenance of an internal environment independent of the surroundings, which is generally considered to be the precursor to prokaryotic cells?

ANSWER: PROTOBIONTS