Assorted Tossups

TOSS UP

1. ASTRONOMY *Short answer*: Jim the astronomer has two telescopes, one with a circular lens diameter of 1 meter, and the other with a diameter of 3 meters. How much more light can the second telescope gather compared to the first?  
  
ANSWER: 36 times

BONUS

1. ASTRONOMY *Multiple Choice:* Which of the following is the main reason that telescopes must either have an equatorial or alt-azimuth mounting

W) the mounting must be able to move to focus on different groups of stars

X) the mounting must be able to move to compensate for the rotation of earth

Y) the mounting helps focus starlight to improve the light-collecting ability of the telescope

Z) the mounting keeps the mirror of the telescope from sagging and improve resolving power

ANSWER: Y) the mounting helps focus starlight to improve the light-collecting ability of the telescope

TOSS UP

2. ASTRONOMY *Multiple Choice:* The spectral lines of which of the following substances is strongest at stars of the coolest temperatures?

W) Titanium oxide

X) Hydrogen  
Y) Ionized helium  
Z) Ionized iron

ANSWER: W) Titanium oxide

BONUS

2. ASTRONOMY *Short Answer:* By name or number, identify all of the following 4 stars which under normal conditions would be expected to have a lifespan GREATER than that of the sun.

1. Barnard's Star

2. Alpha Centauri

3. Rigel A

4. Betelgeuse

ANSWER: 1 only

TOSS UP

3. ASTRONOMY *Short Answer:* Astronomers classify stars by their absolute visual magnitude. However, this does not take into account stars which radiate most of their energy in the non-visual spectrum, such as very hot or cool stars. What is the evaluation of a star's luminosity at all wavelengths called, which corrects for this discrepancy?

ANSWER: ABSOLUTE BOLOMETRIC MAGNITUDE

BONUS

3. ASTRONOMY *Short Answer:* Pioneer 10 was the first spacecraft to achieve escape velocity from the Solar System. Before loss of communication in 2003, scientists monitoring its trajectory found that the spacecraft was slowing more than expected if gravitational influence from the sun was the only force acting upon it. The deviation was resolved in 2011, when it was attributed to thermal radiation pressure forces. What is the name of this anomaly?  
  
ANSWER: PIONEER ANOMOLY

TOSS UP

4. ASTRONOMY *Short Answer:* Messier 16 is a young open cluster of stars in the constellation Serpens. It is part of a H II region, with one large region of star formation being the subject of a famous Hubble Space Telescope photograph. The photograph shows interstellar gas and dust "pillars" in which evaporating gaseous globules hide young protostars. Name the nebula.

ANSWER: EAGLE NEBULA

BONUS

4. ASTRONOMY *Multiple Choice:* A main sequence star has a mass three times that of the sun. Rounded to the nearest whole number, how much more luminous would you expect the star to be, compared to the sun?  
  
W) 12 times

X) 25 times

Y) 47 times

Z) 81 times

ANSWER: Y) 47 TIMES

TOSS UP

5. ASTRONOMY *Short Answer:* Astronomers studying eclipsing binary systems often make a graph of time vs. the brightness of a system. The data given by the graph can then be interpreted to find various attributes of the star system, such as the radius of the stars. What is this graph called?  
  
ANSWER: LIGHT CURVE

BONUS

5. ASTRONOMY *Multiple Choice:* Which of the following statements is NOT TRUE about eclipsing binary systems?  
  
W) the light curve for an eclipsing binary can be used to calculate the masses of the two stars

X) due to orbital inclinations, the true orbital velocity of each star is usually hard to find in an eclipsing binary

Y) Algol, located in the constellation Perseus, is an example of an eclipsing binary system

Z) the most massive star ever found in a binary star system has a mass of over 100 solar masses, with a companion star that is almost equal in mass

ANSWER: X) due to orbital inclinations, the true orbital velocity of each star is usually hard to find in an eclipsing binary

TOSS UP

6. PHYSICS *Short Answer:* A block with mass 8 kilograms rests on top of a ramp with inclination 60 degrees. If the surface of the ramp has a coefficient of friction of 0.2, what is the force of friction acting upon the block?  
  
ANSWER: 0.8 N

BONUS

6. PHYSICS *Short Answer:* Three vials of solutions containing quantum dots are placed on a table, with colors blue, red, and green. Order the vials from the color with the lowest band gap to the highest band gap.   
  
ANSWER: RED, GREEN, BLUE

TOSS UP

7. ASTRONOMY *Multiple Choice:* Massive stars have shorter stellar lifespans because they  
  
W) have less hydrogen to use as starting fuel

X) fuse their fuel faster to overcome their own weight

Y) are less efficient at fusing hydrogen because they are so massive

Z) are not hot enough to reach the CNO cycle

ANSWER: X) fuse their fuel faster to overcome their own weight

BONUS

7. ASTRONOMY *Multiple Choice:* Which of the following statements regarding the cores and envelopes of stars is false?

W) massive stars such as those with 10 solar masses generate most of their energy in less than 5% of their mass

X) a 5 solar mass star would have a large radioactive envelope with a relatively small convective core

Y) larger stars have convective cores because the star cannot radiate away the energy produced fast enough

Z) lower-mass stars such as those of less than 0.2 solar masses are radiative throughout

ANSWER: Z) lower-mass stars such as those of less than 0.2 solar masses are radiative throughout

TOSS UP

8. ASTRONOMY *Short Answer:* Order the following five spectral classes from hottest to coolest

A, O, K, G

ANSWER: O, A, G, K (2, 1, 4, 3)

BONUS

8. ASTRONOMY *Short Answer* Giving your answer in Jupiter masses, what is the cutoff point at which a brown dwarf becomes massive enough to fuse hydrogen and become a red dwarf star?  
  
ANSWER: 80 JUPITER MASSES

TOSS UP

9. ASTRONOMY *Short Answer:* By name or number, name all of the following 4 factors which contribute to the dispersion of a protostellar disk:

1. stellar wind

2. angular momentum

3. radiation pressure

4. hydrostatic equilibrium  
  
ANSWER: 1 and 3

BONUS

9. ASTRONOMY *Short Answer:* What is the lower edge of the main sequence called, where stars which have begin their stable life fusing hydrogen found?  
  
ANSWER: ZERO AGE MAIN-SEQUENCE

TOSS UP

10. ASTRONOMY *Multiple Choice:* Our sun is expected to be on the main sequence for  
  
W) 10 million years

X) 100 million years

Y) 10 billion years

Z) 100 billion years

ANSWER: Y) 10 billion years

BONUS

10. ASTRONOMY *Multiple Choice* Red dwarfs use up their fuel so slowly that astronomers expect them to survive for  
  
W) tens of millions of years

X) billions of years  
Y) hundreds of billions of years  
Z) trillions of years

ANSWER: Y) hundreds of billions of years

TOSS UP

11. ASTRONOMY *Short Answer:* What is the process by which stars fuse helium to produce carbon called?  
  
ANSWER: TRIPLE-ALHPA PROCESS

BONUS

11. ASTRONOMY *Multiple Choice:* Which of the following statements is NOT TRUE about the triple-alpha process?  
  
W) the first step usually involves the fusion of two helium nuclei, which absorbs some of the star's energy

X) two helium fuse to produce a beryllium atom and gamma radiation

Y) gamma radiation is produced by both steps of the triple-alpha process

Z) the complete triple alpha process results in the production of an oxygen atom

ANSWER: Z) the complete triple alpha process results in the production of an oxygen atom

TOSS UP

12. ASTRONOMY *Short Answer:* This event in the lifetime of some stars results in a runaway explosion so violent that for a brief period of time 100 times more energy than all of the stars in the Milky Way is produced. Name this event which is marked by the beginning of helium fusion.

ANSWER: HELIUM FLASH

BONUS

12. ASTRONOMY *Short Answer:* By name or number, denote all of the following four statements that are true regarding helium flash

1. Helium flash typically last for several hours

2. The energy produced by a helium flash causes the envelope of a star to expand into a giant

3. Stars less than 0.4 solar masses do not experience a helium flash because they fuse helium before their cores become degenerate

4. Our sun will eventually experience a helium flash  
  
ANSWER: 4 only

TOSS UP

13. ASTRONOMY *Multiple Choice:* To determine the age of a star cluster, astronomers examine the

W) turnoff point

X) globularity

Y) horizontal branch  
Z) size of the star cluster  
  
ANSWER: W) turnoff point

BONUS

14. ASTRONOMY *Short Answer:* By name or number, denote all of the following four characteristics that are TRUE regarding globular clusters in comparison to open clusters

1. contain older stars

2. stars are closer together than in an open cluster

3. mostly spherical

4. greater star density than open clusters

ANSWER: ALL OF THE ABOVE

TOSS UP

15. EARTH SCIENCE *Multiple Choice:* Which of the following minerals is most resistant to weathering?  
  
W) quartz

X) feldspar

Y) amphibole

Z) olivine

ANSWER: W) QUARTZ

BONUS

15. EARTH SCIENCE *Short Answer:* Match the following three residual products of weathering with their respective minerals  
  
PRODUCTS: clay minerals, iron oxides, quartz grains

MINERALS: quartz, feldspar, olivine

ANSWER: clay - feldspar, iron - olivine, quartz - quartz

TOSS UP

16. EARTH SCIENCE *Multiple Choice:* Mass wasting is a process by which rock, regolith, ad soil move under the direct influence of gravity. Which of the following statements is NOT TRUE regarding mass wasting?  
  
W) slump is a common form of mass wasting where rock or unconsolidated material moves along a curved surface

X) earthflows most commonly form on hillsides in humid areas during times of heavy precipitation

Y) material in slumps typically moves along well-defined surfaces

Z) debris flow is considered to move along well-defined surfaces by sliding

ANSWER: Z) debris flow is considered to move along well-defined surfaces by sliding

BONUS

17. EARTH SCIENCE *Short Answer:* Debris flows composed mostly of volcanic materials on the flanks of volcanoes are called what term of Indonesian origin? It takes place when ash and debris become saturated with water and often follow existing stream channels.

ANSWER: LAHAR

TOSS UP

18. EARTH SCIENCE *Short Answer:* Classify the following five types of mass wasting as either rapid or slow  
  
creep, earthflow, liquefaction, rockslide, solifluction

ANSWER: slow, rapid, rapid, rapid, slow

BONUS

18. EARTH SCIENCE *Short Answer:* What is the maximum angle at which unconsolidated, granular material can maintain a stable slope called?  
  
ANSWER: ANGEL OF REPOSE

TOSS UP

19. EARTH SCIENCE *Short Answer:* The idealized cooling progression of minerals produced by cooling magma, starting with olivine and calcium-rich plagioclase feldspar, and ending with quartz was the discovery of petrologist Norman L. Bowen. Name this crystallization model.

ANSWER: BOWEN'S REACTION SERIES

BONUS

19. EARTH SCIENCE *Short Answer:* Classify the following 4 minerals as being dominant in ultramafic, basaltic, andesitic, or granitic rocks: olivine, pyroxene, quartz, amphibole

ANSWER: ultramafic, basaltic, granitic, andesitic

TOSS UP

20. EARTH SCIENCE *Short Answer:* By name or number, denote all of the following three processes that can result in magmatic differentiation:  
  
1. crystal settling

2. magma mixing

3. assimilation

ANSWER: ALL OF THEM

BONUS

20. EARTH SCIENCE *Multiple Choice:* Which of the following statements regarding sedimentary rocks is NOT TRUE?  
  
W) 75% of all continental rock outcrops are sedimentary

X) By volume, sedimentary rocks account for about 5% of the earth's crust

Y) Shale is a sedimentary rock similar in composition to siltstone, but with smaller, finer sediment particles

Z) Breccia is a chemical sedimentary rock composed of rounded coarse gravel particles

ANSWER: Z) Breccia is a chemical sedimentary rock composed of rounded coarse gravel particles

TOSS UP

21. EARTH SCIENCE *Short Answer:* Classify the following three metamorphic rocks as either foliated or nonfoliated: slate, schist, marble  
  
ANSWER: FOLATED, FOLIATED, NONFOLIATED

BONUS

21. EARTH SCIENCE *Multiple Choice:* Which of the following the not a way that particles in the bed load of a stream move?  
  
W) suspension

X) saltation  
Y) rolling

Z) sliding

ANSWER: W) suspension

TOSS UP

22. EARTH SCIENCE: *Multiple Choice:* In which of the following locations would you find a hanging valley?  
  
W) the Grand Canyon, Arizona

X) Yosemite, California  
Y) the Mississippi River Delta, Louisiana

Z) Black Hills, South Dakota  
  
ANSWER: X) Yosemite, California

BONUS

22. EARTH SCIENCE *Short Answer:* What term is applied to any situation in which groundwater rises in a well above the level where it was initially encountered?  
  
ANSWER: ARTESIAN

TOSS UP

23. EARTH SCIENCE *Short Answer:* The net loss of ice that occurs in the zone of wastage of a glacier is known as what term?  
  
ANSWER: ABLATION

BONUS

23. EARTH SCIENCE: *Short Answer:* What massive prehistoric proglacial lake existed in western Montana during the close of the Pleistocene ice age resulting from an ice dam that flooded the valleys of western Montana?  
  
ANSWER: LAKE MISSOULA

TOSS UP

24. EARTH AND SPACE SCIENCE: *Short Answer:* The Milankovich Hypothesis, which has been used to explain the climate oscillations that characterized the Pleistocene incorporates all of but which of the following elements:  
  
W) variations in the ecentricity of Earth's orbit

X) variations in total solar flux falling upon Earth

Y) changes in obliquity of Earth's orbit

Z) wobbling of Earth's axis  
  
ANSWER: X) variations in total solar flux falling upon Earth

BONUS

24. EARTH AND SPACE SCIENCE: *Short Answer:* What weathering process accounts for the majority of the erosional work in deserts?  
  
ANSWER: RUNNING WATER

TOSS UP

25. PHYSICS: *Multiple Choice:* In 1921, Einstein won the Nobel Prize in physics for

W) his explanation of the photovoltaic effect

X) his mass-energy equivalence formula, E = mc2

Y) his explanation of the photoelectric effect

Z) the development of the theory of general relativity

ANSWER: Y) his explanation of the photoelectric effect

BONUS

25. PHYSICS: *Short Answer:* What is the minimum energy, usually measured in electron volts, needed the eject an electron from the solid surface of an object?  
  
ANSWER: WORK FUNCTION