Indiana Academic Super Bowl

Science Round

2015 – Senior Division Coaches Practice

A Program of the Indiana Association of School Principals
Students:
Throughout this competition, foreign names and words will be used. If there are any discrepancies between how a word/phrase should be pronounced and what you see on the screen, the screen supersedes what is spoken.
CHEMISTRY
Which of the following processes occurs during tertiary treatment of sewage?

A. Sedimentation
B. Flocculation
C. Reverse osmosis
D. Chlorination
The first step in sewage treatment is usually _______________.

A. Aeration  
B. Digestion  
C. Chlorination  
D. Screening
Romans generally used which of the compounds listed below to clean wastewater?

A. Alum  
B. Potash  
C. Muriatic acid  
D. Activated carbon
In newer treatment plants, disinfection is accomplished by using which technique/treatment?

A. Chlorine
B. Ultraviolet light
C. Sulfur dioxide
D. Anaerobic bacteria
Grease and scum would be removed during which step of sewage treatment listed below?

A. Screening  
B. Primary settling  
C. Final settling  
D. aeration
Glass is classified as _______________.

A. an element
B. an alloy
C. a mixture
D. a compound
Which term does NOT describe glass?

A. brittle
B. amorphous solid
C. transparent
D. crystalline
The most familiar type of glass is _________.

A. Soda-lime glass  
B. Potassium glass  
C. Sand glass  
D. Polymer glass
One of the reasons glass is recycled is because __________.

A. the materials used in making it are expensive
B. the materials used are difficult to obtain
C. the energy used to recycle glass is much less than manufacturing new glass
D. used glass is rare
The main material used in making glass is ____________.

A. Sodium oxide
B. Potassium oxide
C. Aluminum oxide
D. Silicon dioxide
PHYSICS
A ray of light goes from one transparent material into another, as shown in the figure. What can you conclude about the indices of refraction of these two materials?

A. \( n_1 < n_2 \)
B. \( n_1 = n_2 \)
C. \( n_2 \geq n_1 \)
D. \( n_2 < n_1 \)
When light goes from one material into another material having a HIGHER index of refraction ___________.

A. its speed, wavelength, and frequency all decrease

B. its speed and wavelength decrease, but its frequency stays the same

C. its speed decreases but its wavelength and frequency both increase

D. its speed decreases but its frequency and wavelength stay the same.
A ray of light strikes a boundary between two transparent materials, and there is no transmitted ray, as shown in the figure. What can you conclude about the indices of refraction of these two materials?

A. $n_1 > n_2$
B. $n_1 = n_2$
C. $n_2 \geq n_1$
D. $n_2 > n_1$
The speed of light in a material is 0.5 c. What is the critical angle of a light ray at the interface between the material and a vacuum?

A. 20°
B. 30°
C. 45°
D. 60°
What is the critical angle for light traveling from crown glass \((n = 1.52)\) into water \((n = 1.33)\)?

A. 42°  
B. 48°  
C. 61°  
D. 57°
The critical angle in air for a particular type of glass is 39.0°. What is the speed of light in this glass? \((c = 3.00 \times 10^8 \text{ m/s})\)

A. \(1.97 \times 10^8 \text{ m/s}\)
B. \(1.94 \times 10^8 \text{ m/s}\)
C. \(1.91 \times 10^8 \text{ m/s}\)
D. \(1.89 \times 10^8 \text{ m/s}\)
An optic fiber is made of clear plastic with index of refraction of 1.50, surrounded by air. For what angles of incidence $\theta$ will light remain within the plastic fiber?

A. $\theta < 38.3^\circ$
B. $\theta > 38.3^\circ$
C. $\theta < 41.8^\circ$
D. $\theta > 38.3^\circ$
An optical fiber made of glass with an index of refraction 1.50 is coated with a plastic with index of refraction 1.30. What is the critical angle of this fiber at the glass-plastic interface?

A. 90.0°
B. 41.8°
C. 60.1°
D. 50.2°
A ray of light traveling in air strikes the surface of a certain plastic slab at 60° with respect to the normal in air. It travels in the plastic slab at a 30° angle with respect to the normal. What is the refractive index of the plastic?

A. 1.73
B. 1.50
C. 2.00
D. 0.50
Light strikes a thick sheet of glass at an angle of incidence in air of 50°. The glass has an index of refraction 1.50. What is the angle of refraction in the glass?

A. 25.0°  
B. 33.5°  
C. 41.8°  
D. 30.7°
The refractive index of diamond is 2.7. What is the critical angle for diamond in air?

A. 41.8°
B. 21.7°
C. 30.0°
D. 50.2°
Fluid fills the container shown in the figure. At which of the indicated points is the pressure greatest?

A. A
B. B
C. C
D. The pressure is the same at each of the labeled points
At a certain depth in the ocean, the absolute pressure is $p$. If you go to twice that depth (treating the water as incompressible) 

A. the absolute pressure will be $2p$
B. the absolute pressure will be less than $2p$
C. the absolute pressure will be greater than $2p$
D. the absolute pressure will be $p$
An incompressible fluid flows steadily through a pipe that has a change in diameter. The fluid speed at a location where the pipe diameter is 8.0 cm is 1.28 m/s. What is the fluid speed at a location where the diameter has narrowed to 4.0 cm?

A. 0.64 m/s
B. 1.28 m/s
C. 2.56 m/s
D. 5.12 m/s
Water flowing through a pipe suddenly comes to a section of pipe where the pipe diameter decreases to 86% of its previous value. If the speed of the water in the larger section of the pipe was 36 m/s, what is its speed in this smaller section?

A. 49 m/s  
B. 42 m/s  
C. 31 m/s  
D. 27 m/s
Water is flowing in a horizontal pipe of diameter $d$. If you want to change the diameter of this pipe so that the speed of the water would be half as great as it was, what should be the new diameter?

A. $d/4$
B. $d/2$
C. $d/\sqrt{2}$
D. $d\sqrt{2}$
Incompressible water flows out of a large reservoir through a pipe that opens to the atmosphere 5.70 m below the level of the water in the reservoir. What is the speed of the water as it comes out of the pipe?

A. 1.72 m/s  
B. 7.47 m/s  
C. 55.8 m/s  
D. 10.6 m/s
On planet $X$, the absolute pressure at a depth of 2.00 m below the surface of a liquid water lake is $5.00 \times 10^5$ N/m$^2$. At a depth of 5.00 m below the surface, the absolute pressure is $8.00 \times 10^5$ N/m$^2$. What is the atmospheric pressure on planet $X$?

A. $3.00 \times 10^5$ N/m$^2$
B. $2.00 \times 10^5$ N/m$^2$
C. $1.00 \times 10^5$ N/m$^2$
D. $4.00 \times 10^5$ N/m$^2$
Inverted siphons were used by the Romans to cross some valleys. If the height difference between the top of the valley and the bottom is 10 meters, the pressure in the pipe at the bottom of the valley will be _____.

A. 1 atmosphere  
B. 2 atmospheres  
C. 3 atmospheres  
D. 0 atmospheres
The elevation change for a long section of an open channel aqueduct is 10 meters. If the water enters the upper end of the channel at 0 meters/sec, its speed at the lower end of the aqueduct will be __________.

A. 10 meters/sec
B. 20 meters/sec
C. 14 meters/sec
D. 5 meters/sec
Bernoulli’s equation relating velocity and pressure of fluid flowing in pipes is based on conservation of _________.

A. momentum  
B. force  
C. charge  
D. energy
Open storage basins were used to hold the water that flowed through the aqueducts into Rome. If a storage basin was 5 meters deep, the pressure at the bottom of the completely filled basin would be __________.

A. 0.5 atmospheres
B. 1.0 atmospheres
C. 1.5 atmospheres
D. 2.0 atmospheres
BIOLOGY AND EARTH SCIENCE
The infamous volcano that erupted during our study period was Mount __________, and wiped out the city of ____________.

A. Herculaneum; Pergamum
B. Pompeii; Herculaneum
C. Stromboli; Pinotubuo
D. Vesuvius; Pompeii
The rapid flow of lava, rock, and ejected gasses from a volcano is also known as __________.

A. pyrotechnic flow
B. cladistic flow
C. pyroclastic flow
D. effusive flow
Most of the immediate deaths from the eruption of Vesuvius were apparently the result of
_____________.

A. victims being incinerated by lava flow or lava bombs
B. people being trapped in their dwellings by encroaching lava
C. suffocation and heat damage from falling ash and/or rapid mudflows
D. pyroclastic debris crushing dwellings with people still inside.
Vesuvius is generally classified as which kind of volcano?

A. Shield
B. Pyroclastic depression
C. Stratovolcano
D. Cinder cone
The thick, ropey lava shown in the photo is known as __________.

A. pahoehoe
B. aa
C. kahlua
D. Lehe Lehe
Lava domes are characterized by what type of lava flow?

A. low viscosity
B. high viscosity
C. pyroclastic
D. pyrotechnic
When tectonic plates run into one another, one plate is often shoved under the other. Volcanoes that form above the region where one plate is sliding under another are known, generally, as _____.

A. tectonic volcanoes
B. colligative volcanoes
C. subduction volcanoes
D. mid-Atlantic Ridge volcanoes
You see a cloud of smoke and steam rising from the sea far offshore of the North Atlantic mainland on which you are standing. In a relatively brief time, you see solid material emerging from the water and now visible through the smoke and vapor. In a few days, a small island is formed. The type of volcano you have been observing is known as a

A. Strombolian volcano
B. Hawaiian volcano
C. Lava dome volcano
D. Surtseyan volcano
The term given to fragments of volcanic rock and lava that is blasted into the air by the volcano’s explosion and then carried upward and outward by the hot gasses in the eruption columns is known as __________.

A. tufa
B. pyroclasm
C. tephra
D. pumice
The person who wrote two epistles on the eruption of Mount Vesuvius, as seen from his position at a safe distance, was ______.

A. Pliny the Younger
B. Pliny the Elder
C. Galen the Navigator
D. Paracles the Recorder
Who was the author of *The Natural History*, a major work of this Roman era?

A. Pliny the Younger  
B. Pliny the Elder  
C. Galen the Naturalist  
D. Paracelsus the Physician
Because of his keen attention to detail in the descriptions of the eruption of Mount Vesuvius, modern volcanologists named a type of volcano after whom?

A. Plinian eruptions named for Pliny the Elder
B. Plinian eruptions named for Pliny the Younger
C. Galilean eruptions named for Galen the Naturalist
D. Herculean eruptions named for Celsius of the city of Herculaneum
The eruptions of Mount Vesuvius and Mount St. Helens are both classified as 5 on the Volcanic Explosivity Index (VEI). When compared to a VEI of 8, as in the Yellowstone eruption around 640,000 BC (BCE), the eruption of Mount Vesuvius or Mount St. Helens would be considered about how many times as explosive as Yellowstone?

A. 1/3
B. 3 times
C. 1/1000
D. 1000 times
Galen’s anatomical works were primarily based upon __________.

A. dissections of human cadavers
B. his observations on the battlefields of the Peloponnesian wars
C. dissections of animals, such as the Barbary macaque and pigs
D. the works of Aristotle, written many years before
“The Best Doctor is also a Philosopher” was a statement (and a treatise) written by ___________.

A. Pliny the Younger
B. Pliny the Elder
C. Paracelsus
D. Galen
Galen’s practice of medicine was greatly influenced by the philosophy and practice _________.

A. of Hippocrates and the philosophy of the Four Humors
B. of Pliny the Elder and the Stochastic School of Medicine
C. that he originated himself through years of study
D. of Commodus, whom he lived with for many years as a servant
The work, *The Natural History*, can best be thought of as ________.

A. an autobiography of Pliny the Younger  
B. an autobiography of Pliny the Elder  
C. a description of the scientific method to be used to understand the world  
D. an encyclopedia of then current knowledge
In his work, *The Natural History*, Pliny the Elder provides some information about mice. Two interesting facts he believed are _____.

A. mice are wingless bats, and mice are clumsy  
B. elephants are afraid of mice, and rubbing mouse feces on a head can cure baldness  
C. mice got to Europe by swimming from Africa, and eating a live mouse can cure a “wasting disease” (cancer)  
D. mice are responsible for spreading the plague, and for spreading Lyme disease
Pliny the Elder spent the greater part of his life employed __________.

A. as a physician
B. as an architect
C. as a scientist
D. in the military
One of the most remarkable things about the work, The Natural History, is _______.

A. the breadth of knowledge contained in 37 books
B. it was one of the first works to properly cite authors
C. it was one of the first works to include an exhaustive index
D. all of the above
When compared to modern medical instruments and tools, the surgical instruments designed and built by the Romans are considered ________.

A. Crude and inefficient
B. Highly decorative, but highly impractical
C. Remarkably similar and quite useful
D. No ancient Roman surgical tools have been preserved
End of Science Round

2015 Senior Super Bowl Area Contest
April 21, 2015
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