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QUESTION 1

Sickle cell disease (SCD) affects millions of individuals worldwide, and the Sickle Cell Disease Association of America estimates that 70,000 to 100,000 individuals have SCD and 3 million individuals have the sickle cell trait. While SCD is known to primarily affect individuals of African American descent, individuals from South America, the Caribbean, Central America, the Middle East, and the Mediterranean can also have SCD or the SCD trait. SCD is estimated to affect 1 in 500 African American infants, and 1 in 12 African Americans are estimated to have the sickle cell trait. SCD is characterized by episodes of acute and chronic pain. By increasing awareness about SCD and promoting patient education, health care professionals can help patients and their families cope with SCD and better manage the associated pain. Recurring episodes of acute and/or severe pain are hallmarks of SCD. SCD pain can often be debilitating, and episodes of pain vary from patient to patient in both frequency and intensity. SCD pain can be classified as acute, chronic, or mixed. At some point, most SCD patients experience episodes of pain often referred to as vaso-occlusive crisis (sickle cell crisis), the duration of which may range from hours to days. Some patients seldom have a sickle cell crisis, while others may experience crises several times a year. Some episodes may be so severe that hospitalization is warranted to manage the pain. An acute pain event is the most common type of pain, and the onset is typically abrupt. It is often the result of an ischemic tissue injury, which is due to the occlusion of microvascular beds by sickled erythrocytes during an acute crisis. Acute pain episodes can also be triggered by factors including extreme temperature changes, changes in altitude, physical and emotional stress, illnesses, infections, dehydration, cold climates, menstruation, and fatigue. Chronic pain is pain that lasts for 3 to 6 months or longer. Chronic pain often results from the destruction of bones, joints, and visceral organs due to recurrent crises. Sources of chronic sickle cell pain include aseptic necrosis, leg ulcerations, and osteomyelitis. Unfortunately, acute and chronic pain associated with SCD are commonly undertreated or inappropriately managed due to patient fear of potential addiction and adverse effects. Many studies report that some health care professionals are also concerned about the potential for addiction. When appropriate, pharmacologic management of SCD pain may involve the use of 3 major pharmacologic classes: nonopioids, opioids, and adjuvants.

The passage as a whole can best be described as a:

- A. Narrative
- B. Persuasive essay
- C. Expository essay
- D. Scientific article

Correct Answer: C

An expository essay is also known as an informative essay. Expository essays provide clear and concise descriptions of a particular topic. In this case, the essay is an exposition on sickle cell disease and its variants. The passage lacks the formality of a scientific article, does not tell a story, and is not attempting to persuade opinion on an issue.

QUESTION 2

What are the critical points of $y = 4x^2 + 3x$?

- A. 0
- B. $-3/8$
- C. 0 and $-3/8$
- D. 0 and $3/8$

Correct Answer: B

A critical point of a function is a point where the derivative of the function is equal to 0 or is undefined. Evaluate the derivative with respect to x, set it equal to 0, and solve for x:

$$0 = 8x + 3 \Rightarrow x = -3/8$$

QUESTION 3

Which effect does remove a solute have?

- A. increases the boiling point
- B. increases the melting point
- C. increases the freezing point
- D. decreases the vapor pressure

Correct Answer: C

The addition of a solute to a solvent lowers the freezing point of the solution due to the pressure added to the solvent. Consequently, the removal of a solute from a solvent must have the opposite effect and increase the freezing point.

QUESTION 4

Lead is non-biodegradable, soft, malleable, as well as heat and corrosion resistant and is environmentally omnipresent. Its known properties make it an ideal metal for automobiles, paint, smelting, ceramics, and plastics. Not many years ago, it was also utilized in the toy industry. Unfortunately, lead is toxic to humans. Humans neither need lead nor derive benefits from it. Although lead toxicity has been a global concern since the industrial revolution in the late 1800s, civilization has been unable to prevent or control it satisfactorily. Overall incidence of lead poisoning among American children has fallen from 4.4% in the early 1990s to 1.4% in 2004. In 2002, around 10 out of every 100,000 of adults had lead toxicity. Venous blood lead levels (BLLs) of 10 mcg/dL and 25 mcg/dL were considered toxic in children and adults, respectively. But, since any level of lead can cause toxicity, the CDC announced a new, lower reference value for children in June 2012: 5 mcg/dL. Infants and children absorb a higher fraction of lead than adults do when exposed, increasing their vulnerability. Approximately 450,000 American children have BLLs >5 mcg/dL. Consequently, lead poisoning is still a problem. Lead exposure can start with prenatal maternal-fetal transmission. Outside the womb, children may inhale (or eat) lead dust, often present in street debris, soil, and most frequently, aged house paint. Lead-based paint was phased out in the 1970s, lowering, but not eliminating, risk of exposure. Old pipes sometimes leach lead into drinking water. Lead hazards are disproportionately found in low-income housing. Adults rarely develop lead poisoning, but risk is increased for industrial workers who use or manufacture lead-based products. Health care providers use many tests to identify lead poisoning. In addition to the BLL, a blood smear may show basophilic stippling ribosomal clusters. Increased urinary aminolaevulinic acid concentrations are also reliable indicators. Plain film radiographs can reveal visible lead lines in patients' long bones. Astute clinicians sometimes diagnose lead poisoning after seeing a blue line along patients' gums (Burton's line) that forms when lead reacts with sulfur ions released by oral bacteria. Lead affects every organ system and causes an unpredictable variety of symptoms. The nervous system is most sensitive (centrally in children, peripherally in adults), but lead affects hematopoietic, hepatic, and renal systems, producing serious disorders. Acute lead poisoning's classic symptoms include colic, encephalopathy, anemia, neuropathy, and Fanconi syndrome (abnormal glucose, phosphates, and amino acid excretion). Sometimes, classic signs and symptoms are absent, confusing the clinical picture.

What is NOT a test to detect lead poisoning?

- A. aminolaevulinic
- B. blood smear
- C. BLL
- D. radiographs

Correct Answer: A

This is not the name of a test or a method for detecting lead poisoning. It may be a word from the passage, but it does not answer the specific question posed. The other answer choices are all mentioned as tests for detecting lead poisoning.

QUESTION 5

What is the x-intercept of $y = e^{5x} + 2$?

- A. 2
- B. 0
- C. $\ln 2$
- D. no x-intercept

Correct Answer: D

The x-intercept is where the function crosses the x-axis and can be found by setting the function equal to 0 and solving for x:

$$0 = e^{5x} + 2 \quad ?gt; \quad -2 = e^{5x}$$

To isolate the variable, take the natural log of both sides; however, $\ln -2$ is undefined, so this function does not cross the x-axis.

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