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QUESTION 1

At what time will an object be at rest if its position function is given by: $x(t) = t^3 - 9t^2 + 24t$

- A. $t = 0$
- B. $t = 3$
- C. $t = 4$
- D. $t = 8$

Correct Answer: C

QUESTION 2

In which of the following stages of embryo development are the three primary germ layers first present?

- A. Blastula
- B. Zygote
- C. Gastrula
- D. Coelomate
- E. Morula

Correct Answer: C

The gastrula is formed from the blastocyst, which contains a bilayered embryonic disc. One layer of this disc's inner cell mass further subdivides into the epiblast and the hypoblast, resulting in the three primary germ layers (endoderm, mesoderm, ectoderm).

QUESTION 3

Rank the following amino acids by increasing pI (isoelectric point):

- I. Lys
- II. Leu
- III. Asp

A.

I



B.

III

C.

II

D.

III

Correct Answer: B

The pI of a molecule is its isoelectric point, or the point at which, in this case, the amino acid will have no overall charge. Categorizing the amino acids: (I) is positively charged and basic; (II) is non polar and neutral; (III) is polar and acidic. Acidic amino acids on average have the lowest pI, nonpolar amino acids have a higher pI, and basic amino acids carry the largest pI.

QUESTION 4

Which of the following alcohols is the most easily dehydrated?

A. $(\text{CH}_3)_3\text{C-OH}$

B. $(\text{CH}_3)_2\text{CH-OH}$

C. $\text{CH}_3\text{CH}_2\text{-OH}$

D. $\text{CH}_3\text{-OH}$

Correct Answer: A

Classify the alcohols as primary, secondary, or tertiary: $(\text{CH}_3)_3\text{C-OH}$ is tertiary because the -OH group is directly attached to 3 alkyl groups; $(\text{CH}_3)_2\text{CH-OH}$ is secondary because the carbon attached to the -OH is connected to 2 carbon atoms; $\text{CH}_3\text{CH}_2\text{-OH}$ is primary because the carbon connected to the -OH group is connected to 1 carbon atom; and although $\text{CH}_3\text{-OH}$ lacks an attached alkyl group, it is considered primary. As tertiary alcohols form the most stable carbocations.

QUESTION 5

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. In response to a doctor's question, a patient says, "It usually occurs all of a sudden, but I've noticed it happen when I'm stressed out and tired from work. And I'd say that it's been ongoing for a few months now."

Of the following, which is this patient probably describing?

- A. Acute pain
- B. Chronic pain
- C. Mixed pain
- D. Severe pain

Correct Answer: C

The passage describes 3 types of pain associated with SCD: acute, chronic, and mixed. The patient describes an abrupt onset of pain that is linked with stress and fatigue, both of which are features of acute pain, but the patient is also goes on to state that the pain has been ongoing for a few months, which is indicative of chronic pain. Consequently, mixed pain best describes the patient's pain.

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