

Môn thi: Hoá học đại cương I

Mã môn học: CHE1094

Số tín chỉ: 3

Đề số: 01

Dành cho sinh viên lớp môn học: K60 Tiên tiến Hoá học, CHE1094 TTH

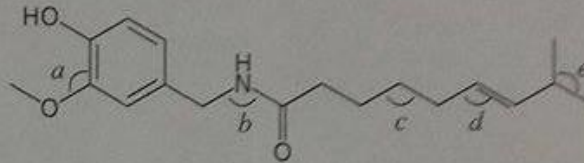
Thời gian làm bài: 90 phút (không kể thời gian phát đề)

Question 1 (2.0 pts) An ion having a 2+ charge and a mass of 57.9 amu has two electrons with $n = 1$, eight electrons with $n = 2$, and sixteen electrons with $n = 3$.

- Determine the number of protons and the number of neutrons in the nucleus.
- How many electrons in the ion have $m_l = +1$ as one of their quantum numbers?
- How many electrons in the ion have $l = 2$ as one of their quantum numbers?
- Write the ground-state electron configuration of the neutral atom.

Question 2 (2.0 pts) Capsaicin is an active component of chilli peppers which stimulates pain-detecting nerve endings.

- Complete the Lewis structure for capsaicin, showing all the lone pairs of electrons.
- Identify the hybridization of all the carbon atoms in the molecule.
- How many σ bonds and π bonds are in the molecule?
- Give approximate values for the bond angles marked a through e .



Question 3 (2.0 pts) Argon crystallizes in the face-centered cubic arrangement at 40 K.

- Derive the relationship between the length of an edge of the unit cell and the atomic radius of argon.
- Given that the atomic radius of argon is 191 pm, calculate the density of solid argon.

Question 4 (2.0 pts) Lysozyme is an enzyme that cleaves bacterial cell walls. A sample of lysozyme extracted from egg white has a molar mass of 13,930 g. A quantity of 0.100 g of this enzyme is dissolved in 150 g of water at 25 °C. Calculate (i) the vapor-pressure lowering, (ii) the depression in freezing point, (iii) the elevation in boiling point, and (iv) the osmotic pressure of this solution. (Given that the vapor pressure of water at 25°C is 23.76 mmHg; and for water $K_f = 1.86 \text{ }^\circ\text{C}\cdot\text{m}^{-1}$; $K_b = 0.52 \text{ }^\circ\text{C}\cdot\text{m}^{-1}$)

Question 5 (2.0 pts) Octane, a component of gasoline, is a hydrocarbon and an alkane with the chemical formula C_8H_{18} . As with all low molecular weight hydrocarbons, octane is volatile and very flammable.

- Calculate the standard enthalpy of combustion of octane, given the standard enthalpy of formation of the following compounds: $\Delta H_f^\circ \text{C}_8\text{H}_{18}(l) = -249.9 \text{ kJ/mol}$; $\Delta H_f^\circ \text{CO}_2(g) = -393.5 \text{ kJ/mol}$, $\Delta H_f^\circ \text{H}_2\text{O}(l) = -285.8 \text{ kJ/mol}$.
- Calculate the energy produced by the combustion of a gallon of octane, given that the density of octane is 2.66 kg/gal.
- The so-called hydrogen economy is based on hydrogen produced from water using solar energy. The gas is then burned as a fuel: $2\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(l)$
A primary advantage of hydrogen as a fuel is that it is nonpolluting. A major disadvantage is that it is a gas and therefore is harder to store than liquids or solids. Calculate the volume of hydrogen gas at 25 °C and 1.00 atm required to produce an amount of energy equivalent to that produced by the combustion of a gallon of octane.

(Atomic masses ($\text{g}\cdot\text{mol}^{-1}$): C = 12.011; O = 15.999; H = 1.008)

($R = 0.082 \text{ atm}\cdot\text{L}\cdot\text{K}^{-1}\cdot\text{mol}^{-1} = 8.314 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$; 1 atm = 760 torr = 760 mmHg; 1 pm = 10^{-12} m)

Đề thi gồm 01 trang. Sinh viên không được sử dụng tài liệu.

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Cán bộ coi thi không giải thích gì thêm./.