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Process engineering department قسم هندسة الطرائق

2nd year Process Engineering – Mineral Chemistry مقياس: الكيمياء المعدنية

***First Exam***

***Exercise 1 (8 points):***

***01/*** In the 3D crystal lattice with lattice parameters *a*, *b*, *c*, Draw the crystallographic planes: (each correct answer 1point)

01 / أرسم المستويات البلورية التالية

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **(110)** | $(\overbar{2}$**1**$\overbar{2}$**)** | **(011)** | **(3**$\overbar{1}$**3)** |

***02/*** In the 3D crystal lattice with lattice parameters *a*, *b*, *c*, the crystallographic planes are drawn, Provide the Miller indices for the following planes: (each correct answer 1point)

02/ أعط مؤشرات ميلر في الحالات التالية

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **(110)** | **(012)** | **(00**$\overbar{1}$**)** | **(22**$\overbar{1}$**)** |

***Exercise 2 (8 points):***

**1. The equation of the reaction:**

2NH3​(*g*)+3CuO(*s*)→3Cu(*s*)+3H2​O(*g*)+N2​(*g*) (1pnt)

**2. The limiting reactant:**

|  |  |
| --- | --- |
|  | 2NH3​(*g*) +3CuO(*s*) →3Cu(*s*) +3H2​O(*g*)+ N2​(*g*) |
| **t=0** | **n0,NH3** | **n0,cuo** | **0** | **0** |
| **T** | **n0,NH3 -2x** | **n0,cuo-3x** | **3x** | **x** |
| **tmax** | **n0,NH3 -2xmax (0,25)** | **n0,cuo-3xmax (0,25)** | **3xmax (0,25)** | **xmax (0,25)** |

$$n\_{0,NH3}=\frac{m}{M}=\frac{20}{14+3}=1,176mol (0,25)$$

$$n\_{0,NH3}-2X\_{max}=0=> X\_{max}=\frac{n\_{0,NH3}}{2}\left(0,25\right)=\frac{1,176}{2}=0,588mol(0,25)$$

$$n\_{0,CuO}=\frac{m}{M}=\frac{80}{63,55+16}=1,006mol(0,25)$$

$$n\_{0,CuO}-3X\_{max}=0=> X\_{max}=\frac{n\_{0,CuO}}{3}(0,25)=\frac{1,006}{3}=0,335mol(0,25)$$

The limitant reactant is CuO$(0,5)$

3. **Molar volume of N₂ obtained in standard conditions:**

* + Molar volume of any gas at STP = **22.4 L/mol (0,5)**

4. **The percentage conversion of each reactant.**

The mass of Cu produced is 59, 32 g

$$n\_{Cu}=\frac{m}{M}=\frac{59,32}{63,55}=0,993mol (0,25)$$

$$x\_{fin}=\frac{n\_{Cu}}{3}= \frac{0,993}{3}=0,331mol(0,25)$$

$ncuo= n\_{0,CuO}\_{}-3x\_{fin}=1,006-3×0,331=0,013mol$ *(0,5)*

$$X\_{CuO}=\frac{n\_{0,CuO}-n\_{i}}{n\_{0,CuO}}×100(0,25)=\frac{1,006-0,013}{1,006}×100=98,71\% (0,25)$$

$$n\_{NH3}= n\_{0,NH}\_{3}-2x\_{fin}(0,25)=1,176-2×0,331=0,514mol(0,25)$$

$$X\_{NH3}=\frac{n\_{0,NH3}-n\_{i}}{n\_{0,NH3}}×100(0,25)=\frac{1,176-0,514}{1,176}×100=56,29\%(0,25)$$

**5. The yield of the reaction**:

$$ R\% = \frac{Actual quantity of the product}{Maximum quantity }×100(0,5)$$

$$R\%=\frac{2×x\_{fin}}{2×x\_{max}}×100(0,5)=\frac{2×0,331}{2×0,335}×100=98,81\%(0,25)$$

***Exercise 3 (4points):***

What’s the correct answer? (each correct answer 0,5point)

1. Which group of elements is known as the "alkali metals"? ماهي مجموعة المعادن القلوية

|  |  |  |  |
| --- | --- | --- | --- |
| * IA
 | * IIA
 | * IIA
 | * IVA
 |

1. Which of the following elements is a metalloid? من بين هذه العناصر من هو شبيه المعدن

|  |  |  |  |
| --- | --- | --- | --- |
| * Sodium (Na)
 | * Boron (B)
 | * Oxygen (O)
 | * Fluorine (F)
 |

1. What is the oxidation state of fluorine in most of its compounds? ماهي درجة اكسدة الفلور في أغلب مركباته

|  |  |  |  |
| --- | --- | --- | --- |
| * +1
 | * -1
 | * +2
 | * -2
 |

1. What is the primary use of hypochlorite (NaClO)? ماهي الفائدة الأولى من استعمال الهيبوكلوريت

|  |  |  |  |
| --- | --- | --- | --- |
| * As a coolant كغراء
 | * As a disinfectant
* كمعقم
 | * As a semiconductor كشبيه موصل
 | * As a fertilizer كسماد
 |

1. What is the primary reason alkali metals are stored in oil? ماهو السبب الرئيسي من خزين المعادن القلوية في الزيوت

|  |  |  |  |
| --- | --- | --- | --- |
| * To prevent them from melting

لمنع الذوبان | * To avoid violent reactions with air or water لمنع تفاعلها مع الهواء أو الماء
 | * To enhance their electrical conductivity
* لتحسين ناقليتها
 | * To increase their density

لزيادة كثافتها |

1. What is the trend in electronegativity as you move from top to bottom in a group? كيف تتغير الكهروسلبية كلما انتقلنا من الأعلى الى الأسفل في المجموعة

|  |  |  |
| --- | --- | --- |
| * Electronegativity increases.تزداد
 | * Electronegativity decreases.تنقص
 | * Electronegativity remains constant. ثابتة
 |

1. What is the general trend in atomic radius as you move from left to right across a period in the periodic table? كيف يتغير القطر الذري للعناصر اذا انتقلتا من اليسار الى اليمين في الدور او السطر

|  |  |  |
| --- | --- | --- |
| * Atomic radius decreases.ينقص
 | * Atomic radius increases.يزيد
 | * Atomic radius remains constant.ثابت
 |

1. Which rule describes the periodic table's filling order of electron sublevels (s, p, d, f)?

ماهي قاعدة ملأ الإلكترونات في المدارات (s, p, d, f)

|  |  |  |
| --- | --- | --- |
| * Hund's rule
 | * Pauli exclusion principle
 | * Klechkowski rule
 |

Good luck