



## IDENTIFYING DATA

### Physical chemistry 1

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|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------|------------|
| Subject             | Physical chemistry<br>1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |      |            |
| Code                | V11G200V01303                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |      |            |
| Study programme     | (*)Grao en Química                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |      |            |
| Descriptors         | ECTS Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Choose    | Year | Quadmester |
|                     | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Mandatory | 2nd  | 1st        |
| Teaching language   | Spanish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |      |            |
| Department          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |      |            |
| Coordinator         | Pérez Juste, Ignacio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |      |            |
| Lecturers           | Hervés Beloso, Juan Pablo<br>Pérez Juste, Ignacio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |      |            |
| E-mail              | uviqipipj@uvigo.es                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |      |            |
| Web                 | <a href="http://webs.uvigo.es/qf1_web/">http://webs.uvigo.es/qf1_web/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |      |            |
| General description | <p>Physical Chemical I is one of the first contacts of a student of Chemistry with the Physical Chemistry. This discipline studies the properties and the behaviour of the chemical systems employing the methods of the Physics. This matter presents the rigorous macroscopic treatment of chemical systems in equilibrium, systems already entered in Chemistry I. Taking advantage of the basic knowledge of the principles of the Thermodynamics, they will be applied to systems of chemical interest to obtain a quantitative description of them. For this purpose, it is fundamental to be familiarised with differential calculus in more than a variable and integral calculus in one variable, skill already seen in Mathematics II.</p> <p>The knowledge on the macroscopic description of the chemical systems that will be reached in this subject are complementary with the contents of the subject Physical Chemistry III the following year. The experimental applications of these knowledges will be studied in the subject in the second term Physical Chemistry II.</p> |           |      |            |

## Competencies

|      |                                                                                                                                                                         |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code |                                                                                                                                                                         |
| A6   | (*)Demostrar coñecemento e comprensión de feitos esenciais, conceptos, principios e teorías en: principios de Termodinámica e as súas aplicacións en Química            |
| A18  | (*)Demostrar coñecemento e comprensión de feitos esenciais, conceptos, principios e teorías en: principios de Electroquímica                                            |
| A19  | (*)Aplicar os coñecementos e a comprensión á resolución de problemas cuantitativos e cualitativos de natureza básica                                                    |
| A20  | (*)Avaliar, interpretar e sintetizar datos e información química                                                                                                        |
| A23  | (*)Presentar material e argumentos científicos de xeito oral e escrita a unha audiencia especializada                                                                   |
| B1   | (*)Comunicarse de forma oral e escrita en polo menos unha das linguas oficiais da Universidade                                                                          |
| B3   | (*)Aprender de forma autónoma                                                                                                                                           |
| B4   | (*)Procurar e administrar información procedente de distintas fontes                                                                                                    |
| B5   | (*)Utilizar as tecnoloxías da información e das comunicacións e manexar ferramentas informáticas básicas                                                                |
| B6   | (*)Manexar as matemáticas, incluíndo aspectos tales como análise de erros, estimacións de ordes de magnitude, uso correcto de unidades e modos de presentación de datos |
| B7   | (*)Aplicar os coñecementos teóricos á práctica                                                                                                                          |
| B8   | (*)Traballar en equipo                                                                                                                                                  |
| B9   | (*)Traballar de forma autónoma                                                                                                                                          |
| B12  | (*)Planificar e administrar adecuadamente o tempo                                                                                                                       |
| B13  | (*)Tomar decisións                                                                                                                                                      |
| B14  | (*) Analizar e sintetizar información e obter conclusións                                                                                                               |
| B15  | (*)Avaliar de modo crítico e construtivo o entorno e a si mesmo                                                                                                         |

## Learning aims

|                                    |                               |
|------------------------------------|-------------------------------|
| Expected results from this subject | Training and Learning Results |
|------------------------------------|-------------------------------|

(\*)Emplear el concepto de función de estado para calcular las variaciones de las distintas funciones de estado termodinámicas de una sustancia pura.

A6  
A19  
A20  
A23  
  
B1  
B3  
B4  
B5  
B6  
B7  
B8  
B9  
B12  
B13  
B14  
B15

(\*)Obtener la entropía de una sustancia a partir de medidas calorimétricas

A6  
A19  
A20  
A23  
  
B1  
B3  
B4  
B5  
B6  
B7  
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B9  
B12  
B13  
B14  
B15

(\*)Establecer si un proceso que sufre una sustancia pura es espontáneo o no a partir del cálculo de las variaciones de las propiedades termodinámicas

A6  
A19  
A20  
A23  
  
B1  
B3  
B4  
B5  
B6  
B7  
B8  
B9  
B12  
B13  
B14  
B15

(\*)Manejar tablas termodinámicas para obtener valores de las distintas funciones de estado termodinámicas de reacción y calcular las funciones termodinámicas de reacción a temperaturas distintas

A6  
A19  
A20  
A23  
  
B1  
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B12  
B13  
B14  
B15

(\*)Calcular la función fugacidad para un gas real a partir de su ecuación de estado o bien a partir de medidas experimentales

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A23  
  
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| (*)Calcular la constante termodinámica de reacciones en disolución, a partir de las concentraciones de las especies o a partir de las funciones termodinámicas                                                                                | A6  | B1  |
|                                                                                                                                                                                                                                               | A19 | B3  |
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| (*)Calcular las características termodinámicas de un cambio de fase, y saber el intervalo de aplicabilidad de las ecuaciones empleadas                                                                                                        |     | B14 |
|                                                                                                                                                                                                                                               |     | B15 |
|                                                                                                                                                                                                                                               | A6  | B1  |
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| (*)Calcular las propiedades termodinámicas de una disolución ideal a partir de su composición                                                                                                                                                 |     | B12 |
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|                                                                                                                                                                                                                                               | A6  | B1  |
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| (*)Calcular las propiedades coligativas de una disolución a partir de la concentración del soluto y las propiedades del disolvente. Establecer cuándo estos resultados se pueden aplicar a un caso real                                       |     | B8  |
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| (*)Calcular las actividades y coeficientes de actividad de disoluciones no electrolíticas y emplear el modelo adecuado para el cálculo del coeficiente de actividad iónico medio. Obtener este coeficiente a partir de medidas experimentales |     | B6  |
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| (*)Emplear medidas experimentales procedentes de las células galvánicas para determinar funciones de estado de reacción                                | A6  | B1  |
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| (*)Determinar la actividad y/o el coeficiente de actividad iónico medio de un electrolito mediante medidas experimentales de FEM de células galvánicas | A6  | B1  |
|                                                                                                                                                        | A18 | B3  |
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| (*)Analizar la importancia de la interfase y de los distintos fenómenos asociados a ella en los procesos termodinámicos de los sistemas materiales     | A6  | B1  |
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| (*)Establecer la importancia de la tensión superficial y los distintos procesos asociados en función de la naturaleza del sistema                      | A6  | B1  |
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| (*)Diferenciar entre procesos de adsorción física y química y describir los modelos empleados para su descripción                                      | A6  | B1  |
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## Contents

Topic

|                                                |                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Principles of the thermodynamics in Chemistry. | First principle of the Thermodynamics. Internal energy. Enthalpy. Heat capacity. Thermochemistry.<br>Second principle of the thermodynamics. Entropy. Molecular interpretation of the entropy.<br>Third principle of the Thermodynamics. Calculation of the variations of entropy.               |
| Thermodynamic functions                        | Equations of Gibbs. Relations of Maxwell. Calculation of variations of the functions of state.<br>Open systems. Partial molar magnitudes. Chemical potential. Chemical potential of an ideal gas. Chemical potential in a mix of ideal gases.<br>Chemical potential of the real gases. Fugacity. |
| Chemical equilibrium between gases.            | Conditions of thermodynamic equilibrium. Degree of advance. Constant of thermodynamic balance in reactions in gas phase. Influence of the temperature in the constant of balance. Factors that affect to the position of the equilibrium: principle of Le Châtelier.                             |
| Balance of phases in systems of a component.   | Concepts of component, phase and degree of freedom. Conditions of balance between phases. Rule of the phases. Changes of phase of prime importance. Equations of *Clapeyron and *Clausius-*Clapeyron. Changes of phase of upper order.                                                           |
| Ideal solutions.                               | Partial molar volumes. Equation of *Gibbs-*Duhem. Ideal dissolution: Law of *Raoult. Diagrams *P-*x and *T-*x. Ideal dilute solution: Law of Henry. Colligative Properties.                                                                                                                      |
| Non ideal solutions.                           | Deviations of the law of *Raoult. Activity and coefficient of activity. Coefficients of activity in the scales of molality and molarity. Electrolyte solutions. Theory of *Debye-*Hückel.                                                                                                        |
| Chemical equilibrium in solution.              | Constant of thermodynamic equilibrium in reactions in solution. Acid-base equilibria. Product of solubility. Saline effects.<br>Electrochemical systems. Galvanic and electrolytic cells. Measure of the electromotive strength of a galvanic cell. Equation of *Nernst. Potential of electrode. |
| Thermodynamics of surfaces.                    | Surfaces and interfaces. Superficial tension.<br>Phenomena derived of the superficial tension. Adsorption. Physisorption and Chemisorption Isotherms.                                                                                                                                            |

## Planning

|                                    | Class hours | Hours outside the classroom | Total hours |
|------------------------------------|-------------|-----------------------------|-------------|
| Master Session                     | 26          | 31                          | 57          |
| Seminars                           | 26          | 38                          | 64          |
| Troubleshooting and / or exercises | 0           | 14                          | 14          |
| Self-assessment tests              | 0           | 10                          | 10          |
| Short answer tests                 | 2           | 0                           | 2           |
| Long answer tests and development  | 3           | 0                           | 3           |

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

|                | Description                                                                                                                                                                                                                                    |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Master Session | (*)Consistirán na exposición breve por parte do profesor dos aspectos fundamentais de cada tema, tomando como base o material dispoñible na plataforma TEMA. Tamén se exporán problemas numéricos que axuden a comprender e asentar conceptos. |
| Seminars       | (*)As clases de seminario dedicaranse á resolución de problemas e profundarase sobre os aspectos que presenten maiores dificultades aos alumnos. Estas clases serán principalmente labor *do alumno, baixo a supervisión do profesor.          |

## Personalized attention

| Tests                              | Description |
|------------------------------------|-------------|
| Self-assessment tests              |             |
| Troubleshooting and / or exercises |             |

## Assessment

|                                    | Description                                               | Qualification |
|------------------------------------|-----------------------------------------------------------|---------------|
| Troubleshooting and / or exercises | (*)Problemas propostos para cada tema da materia.         | Hasta un 15   |
| Self-assessment tests              | Tests in the platform TEMA.                               | Hasta un 15   |
| Short answer tests                 | (*)Probas escritas curtas sobre certas partes da materia. | Hasta un 20   |

**Other comments on the Evaluation****Sources of information**Levine, **Fisicoquímica**, McGraw-Hill. 5ª Ed,Atkins, **Química Física**, Panamerica, 8ª Ed,Engel, **Química Física**, Pearson,Chang, **Fisicoquímica**, McGraw-Hill,**Recommendations****Subjects that continue the syllabus**

Physical chemistry 2/V11G200V01403

**Subjects that it is recommended to have taken before**

Mathematics: Mathematics 2/V11G200V01203

Chemistry: Chemistry 1/V11G200V01105

Chemistry: Chemistry 2/V11G200V01204