

## DAY 5: Thursday, 25 July

### STUDENT

- 9:00 a.m. – 12:00 a.m.  
Free time / animation
- 2:00 p.m. – 6:00 p.m.  
City bus tour

### MENTOR

- All day long  
Translation  
of theoretical exam
- 7:00 p.m. – 12:00 p.m.  
Happy hour



Notre-Dame de Paris

### Birthdays

**Erwin Rait** *Austria* Student

**Joao Paulo** *Brazil* Scientific observer

**Jahongir Bobojonov** *Tajikistan* Student

**Sandrina Frunza** *Bulgaria* Student guide

**Teresa** *Italy* Student

Meteo



41°C  
sun

# making science together!

## The chemistry of Eiffel Tower

The Eiffel Tower, the great iron lady, symbol of Paris will celebrate its 130<sup>th</sup> birthday this year! The Eiffel Tower was built by Gustave Eiffel in 1889, in puddled iron, a special iron, containing less carbon than cast iron. Puddling is a method of refining cast iron by oxidation of carbon by stirring it in an oven. Containing 0.025% carbon, the puddled iron provides a mean breaking strength of 32 kg.mm<sup>-1</sup>. It is a material whose longevity is recognized... but only if it is repainted regularly! As Gustave Eiffel himself once wrote: "the painting is the essential element of the conservation of a metal work". Indeed, several factors can jeopardize this metal: rust, pollution due to a large city... The Eiffel Tower has been repainted nineteen times since its construction, a painting campaign requiring 60 tons of paint, costing about 4 million euros and lasting about 18 months. Even today, the Eiffel Tower is hand-painted!

The color of the Eiffel Tower has changed over the time, originally it was red-brown because the paint used as antirust contained minium, a lead-based pigment (Pb<sub>3</sub>O<sub>2</sub>) mixed with linseed oil. It was ochre-yellow in 1899, and has been since 1968 "Eiffel Tower brown", a color specially designed for it and used only on it.

## Universcience

Created in 2010, **Universcience**, is a public organization uniting the "Palais de la découverte" and the "Cit  des sciences et de l'industrie", two high places of scientific culture in Paris! You had or will have the opportunity to visit both, and the farewell banquet will be at the "Cit  des sciences et de l'industrie"!

Its ambition is to promote scientific and technical culture, and to impart and endear today's sciences to the public. They do so through innovation and pedagogy.



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POUR L' COLE  
DE LA CONFIANCE

5



catalyzer

## Things are getting serious with the Practical exam!



Yesterday, all students participated in the Practical exam at the Pierre-Gilles de Gennes Highschool. Five hours of hard work!

I<sup>T</sup>C<sup>T</sup>h<sup>O</sup>  
51st — International  
Chemistry Olympiad  
France — Paris — 2019



# Problem P1: Environmental-friendly oxidation



Chemists are always looking for efficient ways to oxidize molecules: this is a most convenient method to convert functional groups in organic syntheses. These reactions occur quite softly in living organisms, especially in fundamental metabolic reactions such as Calvin and Krebs cycles. However, when a chemist performs oxidation reactions in a laboratory, reagents such as chromium- or manganese-based compounds in harsh conditions are often used in spite of their harmful character for the environment. Some reagents, such as potassium peroxy-monosulfate, circumvent this issue. Indeed,

this compound, often called by one of its commercial names (Oxone®), is a strong oxidizing agent ( $E^\circ = 1.81\text{ V}$ ) that releases only non-toxic sulfate salts as side products. Moreover, it is a versatile reagent that oxidizes numerous compounds ranging from alcohols (preparatory problem P2) and aldehydes (problem P1), to widespread species such as phosphines and thioethers. In everyday life, Oxone® is used in swimming-pools and water-waste treatment: associated to a metal cation such as  $\text{Co}^{2+}$ , it is an efficient sanitizing agent.

# Problems P2 and P3: To learn everything about wine!

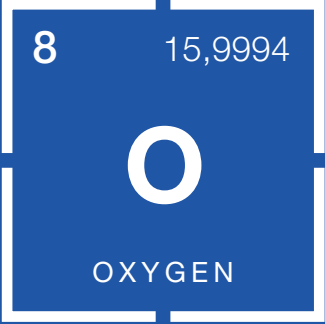


Wine is one of the symbols of France... Contrarily to most countries where beer is the most encountered alcoholic beverage, French people drink an average of 42 liters of wine per year. Red, white, rosé... some parts of France (Bordeaux, Bourgogne) are known worldwide for their production. Wine is also an interesting aqueous solution, that is a wide subject of study for chemists. Its constituents (ethanol in preparatory problem 7 or iron in problem P2) are monitored to ensure a good quality, and some additives are used to protect it (such as sulfur dioxide studied in problem P3). Chemical analysis uses traditional methods (redox titrations) and modern ones (spectroscopy) to quantify accurately all these compounds, and to control the application of the numerous rules that apply to foodstuffs. Did you know, for instance, that mass spectrometry is used to study aroma in wines, but also to determine the place of production of used grapes? Vineyard is also part of the French landscape and its protection is a challenge for chemists (as illustrated for instance in preparatory problem P5).

# Periodic ID card of the day

## 8 . Oxygen

Discovery: 1774  
by J.Priestley (UK) and  
C.W.Scheele (Sweden)  
Family: Chalcogens  
Period: 2<sup>nd</sup>



### A few of its properties

Dioxygen  $\text{O}_2$  is full of contradiction: by-product of the photosynthesis of green plants, it is essential to survive, but also a powerful oxidant that corrodes every living form. 2.4 billion years ago, after the oxidation of telluric iron was done, the molar fraction of oxygen in the air increased by 2% in 200 million years, causing the first of the major ecological disasters. Surviving species protected themselves by producing peroxidases and by hosting a symbiote, the mitochondria. Oxygen represents half the Earth's mass, and 86% of ocean's.

# Game of the day

### The element that counts for the Eiffel tower

Gustave Eiffel chose puddled iron (>99% Fe) to build the tower strong and flexible enough to reach its record 324 meters height. There are more iron atoms in its metallic structure (it weights about 7,300 tons) than its total 300 million visitors since 1889. But exactly how many digits are needed to write this number of iron atoms? (assume Fe has an atomic weight of 56 and don't hesitate to take even bigger approximates to solve it without a pencil).

### Answer – Game of Wednesday, 24 July

The city of Ytterby near Stockholm in Sweden gave its name to the elements Yttrium (Y), Ytterbium (Yb), Erbium (Er) and Terbium (Tb).

# Vocabulary

Traduction	Translation
Visiter	To visit
Toilettes	Restroom (WC)
Se balader	To stroll
Faire la grasse matinée	To lie in
Bateau-mouche	Riverboat
Croisière	Cruise
Appuyer sur le champignon	Literally: To press the mushroom Meaning: To accelerate

# Practical exam and visit of the Palais de la Découverte!



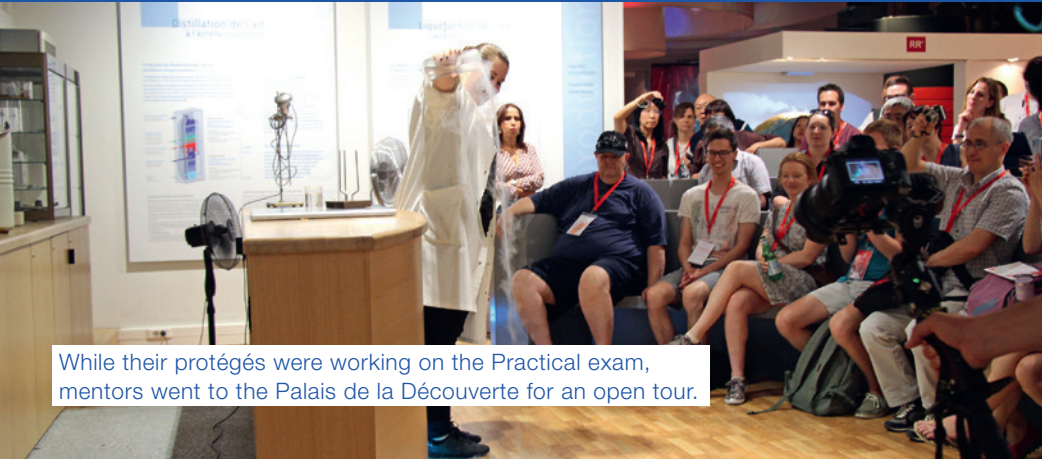
Students are waiting in the amphitheater to be called to their labs.



Jean-Michel Blanquer, French Minister of National Education and Youth, was here to greet all participants and to wish students good luck!



Discovering the subjects of the Practical exam!



While their protégés were working on the Practical exam, mentors went to the Palais de la Découverte for an open tour.