Some observations on students' performance in key topics on the L.C. chemistry paper

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The Atom/P.T.E./Bonding

- Clarity needed between orbits, orbitals, sub-levels and main levels.
- 2^{nd} and 3^{rd} Ionisation energies.
- Intermolecular forces - especially differences between Van Der Waals and dipole-dipole forces.
- Consequences of the above for organic molecules e.g ether and methanol.

Stoichiometry

- Essential to know how to convert between moles, grams, cm^3, litres and no. particles.

- Need to note if a calculation is at S.T.P. or R.T.P.

- In Q10 (c) in 2019 those who attempted it did quite well with the above skills (next slide)

(*c*) When 3.17 g of mercury thiocyanate [$Hg(SCN)_2$] is heated in a well-ventilated fume cupboard it decomposes completely according to the following balanced equation.

$$2Hg(SCN)_2\ (s) \rightarrow 2HgS\ (s) + CS_2\ (l) + C_3N_4\ (s)$$

(*i*) What mass of C_3N_4 is produced in this reaction?

All the products of the reaction above are unstable and, if heating in air is continued, these products burn or decompose according to the following balanced equations.

$$HgS\ (s) + O_2\ (g) \rightarrow Hg\ (l) + SO_2\ (g)$$

$$CS_2\ (l) + 3O_2\ (g) \rightarrow CO_2\ (g) + 2SO_2\ (g)$$

$$2C_3N_4\ (s) \rightarrow 3(CN)_2\ (g) + N_2\ (g)$$

If all the reactions go to completion,

(*ii*) how many litres of oxygen gas, measured at s.t.p., are required for the complete combustion of the CS_2,

(*iii*) what is the number of mercury atoms produced,

(*iv*) what is the total number of moles of gas formed? (25)

Acids, bases and pH

- Arrhenius definitions.
- In a titration, choosing the correct indicator and why.
- In problems relating to weak acids and weak bases the use of the formula **$pH = -\log\sqrt{(k_a \times M)}$** and **$pOH = -\log\sqrt{(k_b \times M)}$** if you can locate the 2008 paper, Q8 was a good one to demonstrate the above (next slide).
- In the above formula, some forgot to get the square root before getting the log.
- At the final step some forgot to use pH + pOH = 14.
- Explaining why pure water with a pH that is not 7 may be neutral.

2008 Q8

8. (*a*) (*i*) Write an expression for the self-ionisation of water. (5)

(*ii*) Define K_w, the ionic product of water.

The value of K_w at 25 °C is 1.0×10^{-14}. Show that the pH of pure water is 7.0 at 25 °C. (12)

(*iii*) Calculate the pH of a 0.5 M solution of a strong monobasic (monoprotic) acid.

Calculate the pH of a 0.5 M solution of a weak monobasic acid with a K_a value of 1.8×10^{-5}. (12)

(*b*) (*i*) Explain clearly how suspended solids are removed in the treatment of water for drinking. (9)

(*ii*) Identify **two** chemicals added at the final stages of the treatment of water for drinking. State the purpose of adding each chemical you have identified. (12)

Volumetric Analysis

- Meanings of, and calculations with % (w/v), % (v/v), % (w/w).

- Knowing that when using the formula: $\frac{V_1 M_1}{n_1} = \frac{V_2 M_2}{n_2}$

  that the M value is always in moles/L in the answer after substitution.

- In the formula $(NH_4)SO_4.FeSO_4.6H_2O$ they may forget to multiply 18 by 6 for the $6H_2O$ and so fail to get 392.

Rates of Reaction

- Reaction profile diagram.
- Oxidation of methanol using a hot Pt catalyst.
- Observations, the two things it demonstrates and products found in the flask.
- Whenever possible to bring in the collision theory in explanations.

Equilibrium

- Common errors with the formula are:
  - Using + instead of x
  - Placing [reactants] on top.
  - Using ( ) instead of [ ]
- Maths problems vary from year to year in difficulty. 2013 Q9 (c) was challenging.
- Students find it hard to understand how we got 0.00089 moles leftover on the left hand side. I'd certainly give this to a class!
- Spotting that one can avoid using the dreaded quadratic equation formula by square rooting both sides (if applicable).

- 2013 Q9 (c)

(*c*) Write the equilibrium constant (K_c) expression for this reaction. (6)

A mixture of 1.0×10^{-3} moles each of iron(III) chloride and potassium thiocyanate was allowed to come to equilibrium in 1 litre of solution at room temperature according to the equation above.
It was found that 1.1×10^{-4} moles $\mathbf{Fe(CNS)^{2+}}$ were present in the solution at equilibrium.

Calculate the value of the equilibrium constant (K_c) for the reaction. (12)

Oxidation-Reduction

- Mandatory student experiment No. 8

Thermochemistry

- Bond energies

- In a given reaction indicating which bonds are breaking and forming.

- Remembering the formula: Heat produced = mcΔt

Organic chemistry

- The benzene molecule

- Oxidation of phenylmethanol to benzoic acid - mandatory exp. 26

Advice to teachers and students

- It is vital to teach the entire course.
- Do teach the option (when it returns!) as it is a really easy question.
- Time management is vital in the exam and compared to some subjects, it's easy in chemistry.
- Reading a question carefully is important. A good example was 2019 Q10b (ii) where the answer needed 4 points despite the words "two differences" in the question wording. (see marking scheme)

- 2019 Q10 b (ii)

(*ii*) Give two differences between an atomic orbit, as described by Bohr, and an atomic orbital.

(6)

Bohr **orbit**	**orbital**
pathway **/** **2-d**imensional	**region (space, volume) /** **3-d**imensional
capacity $2n^2$ electrons **/ capacity 2, 8, etc** electrons	**capacity 2** electrons
electron definitely located there	**high probability of finding electron** there
fixed distance from nucleus / circle (circular)	***no fixed distance from nucleus / not circular / spheres, dumbbells, etc***
definite shape (size)	***no absolute (definite) boundary (size)***
inconsistent with wave properties of electron	***electron can have wave properties***
uncertainty principle not taken into account	***uncertainty principle taken into account***

- Definitions really must be learned off by heart. My pupils found the A3 chart method the best.
- If students can do so, leave Q5 until last or avoid it as it can be a low scoring one for too many.
- If the 28 page booklet is insufficient, number the extra sheets 29, 30 etc and afterwards outside the centre note down how many you used in case they did not get scanned.
- Whether a blue or black pen/biro is used, make sure it is very dark. Do not answer in pencil.
- Never begin a new question near the end of a page.

- In answering a question do not waste time by re-writing the question as part of the answer.
- Where parts of a question are not divided into (a), (b), (c) etc use the instructional VERB from the question to indicate which part you are answering. E.g.
  - What _____
  - When_____
  - Why_____
  - Give_____
  - Write_____
- This mirrors what the marker sees on the scheme.

- In Q4, attempt all questions as the best will count,
  (pre covid best 8 out of 11)

- In calculations highlight the final numerical answers.

- Do not waste time making diagrams works of art. Most importantly is to include all the labels.

- Write legibly.

Transition year Chemistry

- Wide gap between Junior Cycle chemistry and 5th year chemistry.
- A “bridging course” is needed.
- Why not try to organise this is T.Y.?
- Experience shows that many TY students in a chemistry class are already decided on not doing L.C. chemistry.
- One school has a weekly TY chemistry class for those who are committed to taking chemistry in 5th year.
- What would you do in such a class if your principal arranged for you?

- I would get my old pre 1992 Intermediate Cert syllabus A science textbooks and cover its chemistry section.

- Intermediate Cert students were far better prepared for 5th year than their counterparts today.

The End!