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| logo1  DEPARTAMENTO DE  CIENCIAS NATURALES | Year 12 IB Chemistry  3rd Term test  Option D (60 minutes) |
| Name and surnames | |
| Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Marks. A\_\_/16 B\_\_/14 C\_\_ /10 | |

1. Pharmaceutical products can often undergo up to 12 years of development and testing before being sold commercially. Define the following terms in relation to this process.
   1. LD50

Lethal dose to 50 % of animal population

(A1)

* 1. Therapeutic window

Range of doses between ED50 and TD50 that a drug can safely be admitted

(A1)

* 1. Bioavailability

The % of a drug that reaches bloodstream; do not accept amount

(A1)

1. Aspirin is one of the most widely used drugs worldwide.
   1. It is used as both a mild analgesic (painkiller) and also as a prophylactic.
      1. Explain how a mild analgesic works.

Prevents releases of prostaglandins; no stimulation of pain receptors

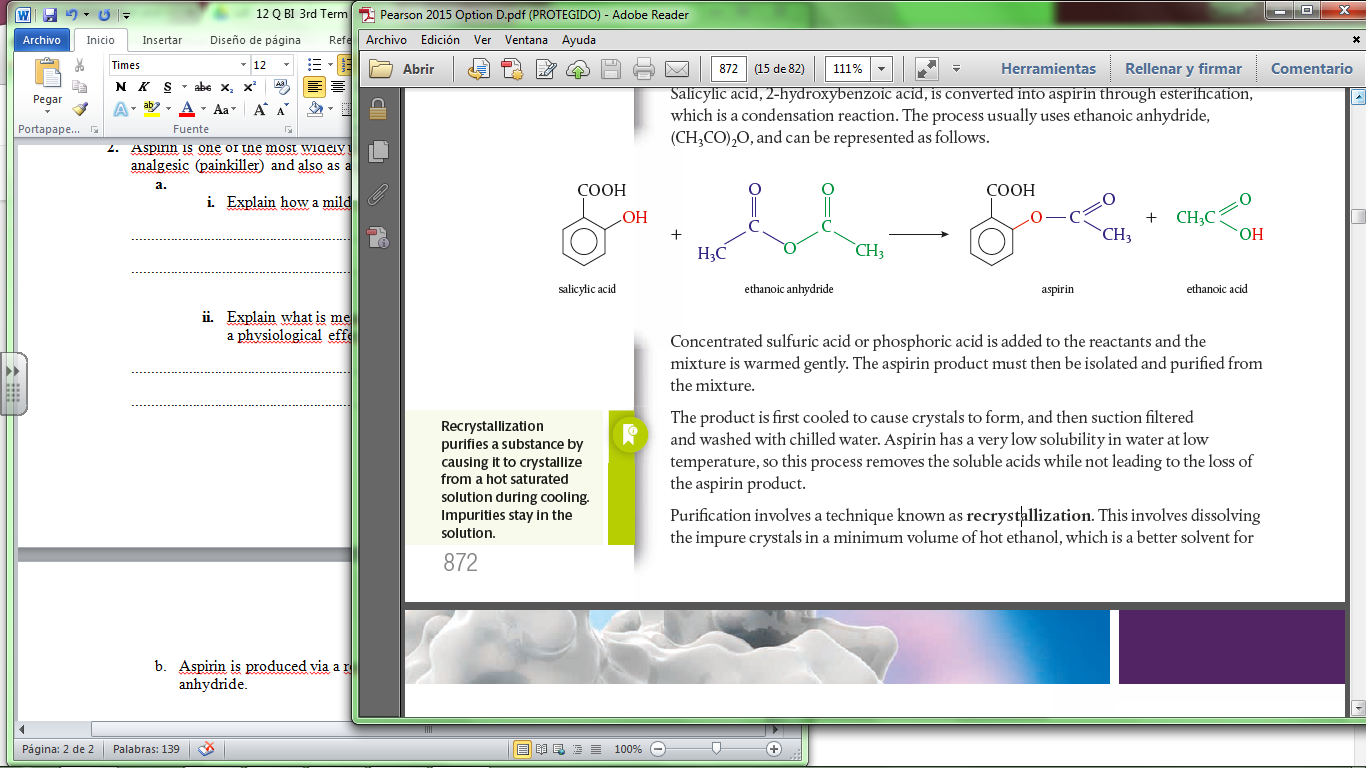
(A2)

* + 1. Explain what is meant by “prophylactic” and give one example of a physiological effect in this context.

A drug taken as a preventative measure; anticoagulant

(B1)

* 1. Aspirin is produced via a reaction between salycilic acid and ethanoic anhydride as shown below.



* + 1. Excluding the benzene ring, state the 2 functional groups found in aspirin.

Carboxylic acid; ester

(A1)

* 1. The final stage of the synthesis is purification to remove impurities from the white product obtained.
     1. State the name of the purification process commonly used.

Recrystallisation

(A1)

* + 1. The literature value for the melting point of aspirin is 159 ºC. If the experimental value was seen to be 151 ºC, calculate the % error between the two values.

5%

(C1)

1. The term “dyspepsia” is used to describe feelings of pain and discomfort in the upper abdomen. These can include heartburn, indigestion and ulceration. There are a variety of drugs which can be used to treat dyspepsia.
   1. One such example is Ranitidine (Zantac).

* + 1. Explain how Zantac reduces acid secretion in the stomach.

Zantac interacts with H2 receptors; prevents histamine interacting with H2 receptors; prevents secretion of acid into stomach (ANY 2)

(A2)

* + 1. Use the data booklet to state 1 functional group shared by both Zantac and histamine.

Amine (secondary or tertiary)

(A1)

* 1. Antacids are a common treatment and often contain metal carbonates such as Na2CO3.
     1. Write a balanced equation between sodium carbonate and hydrochloric acid.

Na2CO3 + 2HCl 🡪 2NaCl + H2O + CO2

(A1)

* + 1. Describe 1 problem associated with the use of carbonates and hydrogencarbonates as antacids.

Production of carbon dioxide gas

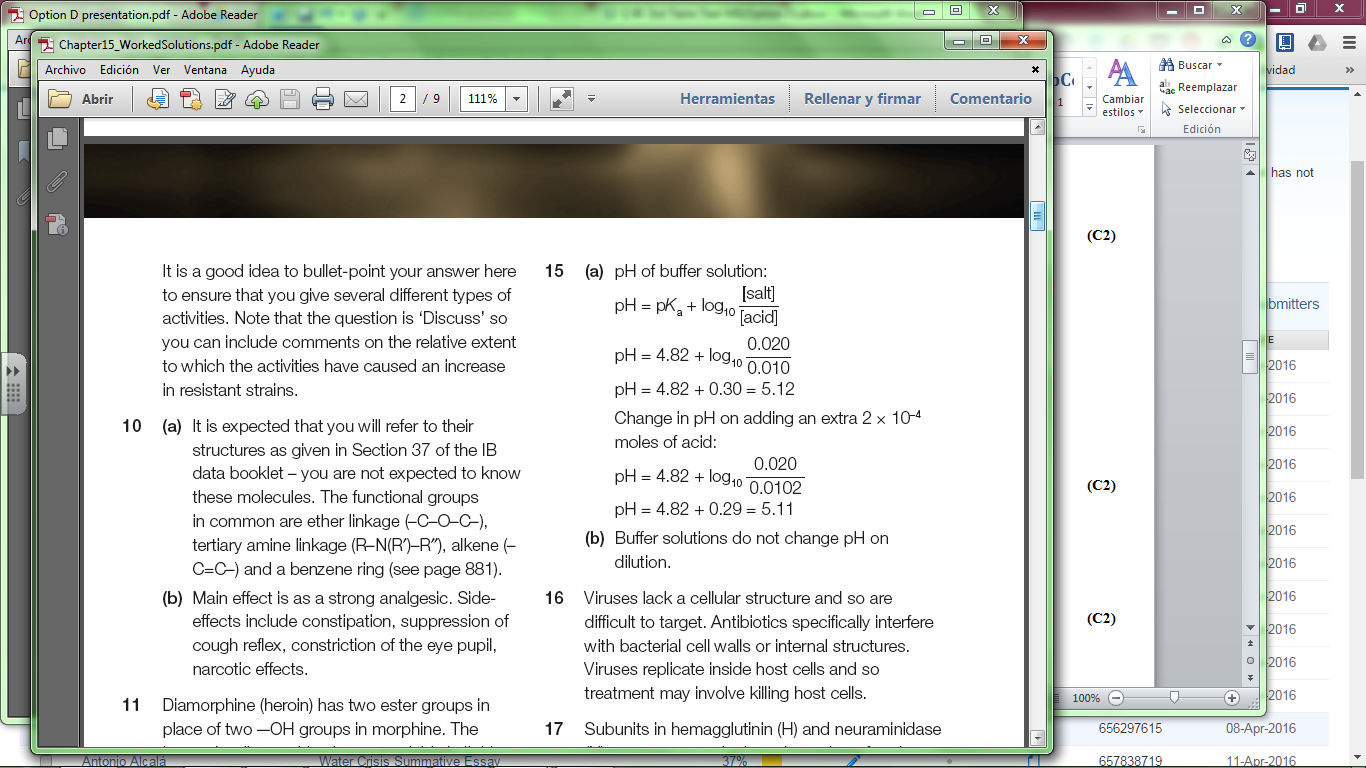
(A1)

* + 1. Magnesium hydroxide and aluminium hydroxide can also be used as antacids. Show which would neutralise the greater amount of hydrochloric acid if 0.3 moles of each are used.

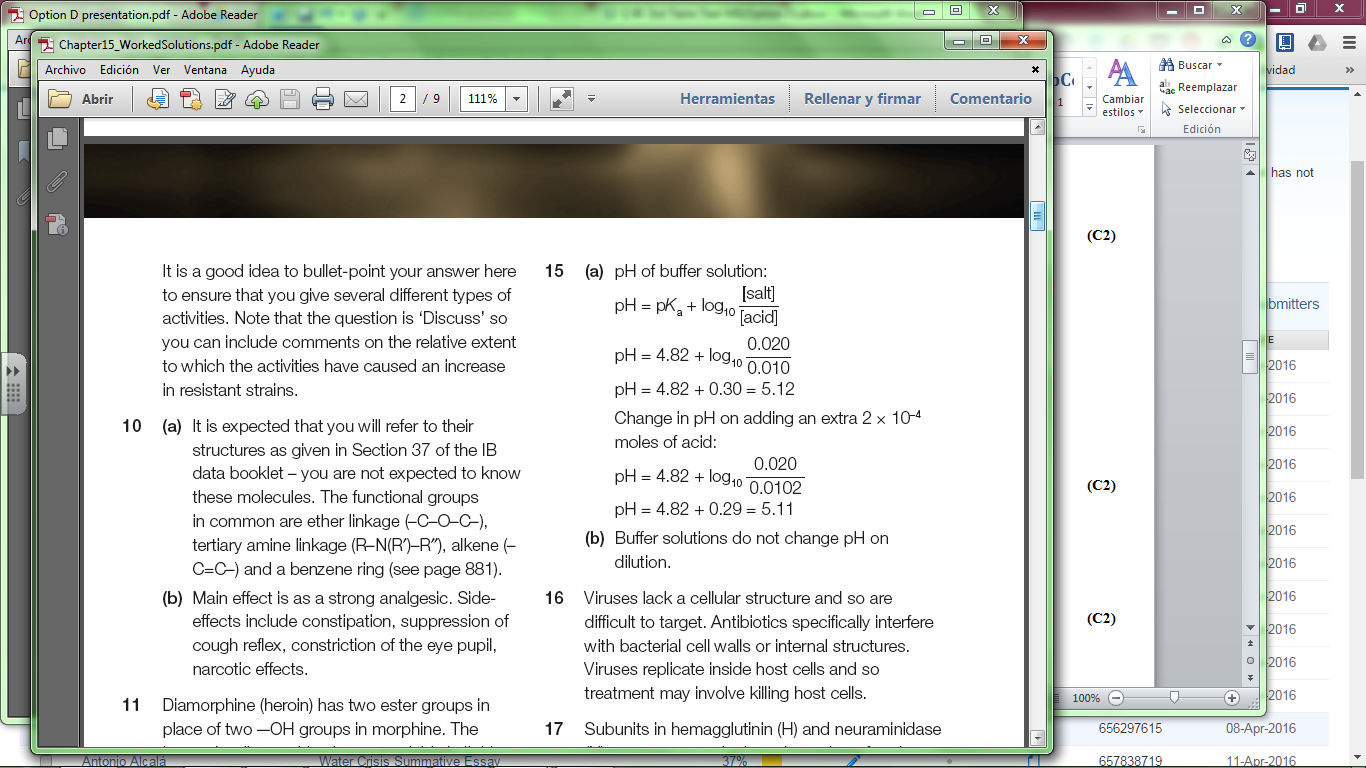
Mg(OH)2 🡪 2OH- so 0.6 produced; Al(OH)3 🡪 3 OH- so0.9 moles OH-

(C2)

* 1. The Henderson-Hasselbach equations found in the data booklet allow use to calculate the pH of buffer solutions.
     1. 100 cm3 of a buffer is prepared which contains 0.100 mol dm-3 butanoic acid and 0.200 mol dm-3 sodium butanoate. (the pKa for butanoic acid can be found in the data section)

pKa 4.82; pH = 5.12 (Mistake in shown calc with extra 0) (C2)

* + 1. What is the change in pH when 2.00 cm3 of 0.100 mol dm-3 HCl is added to this buffer?

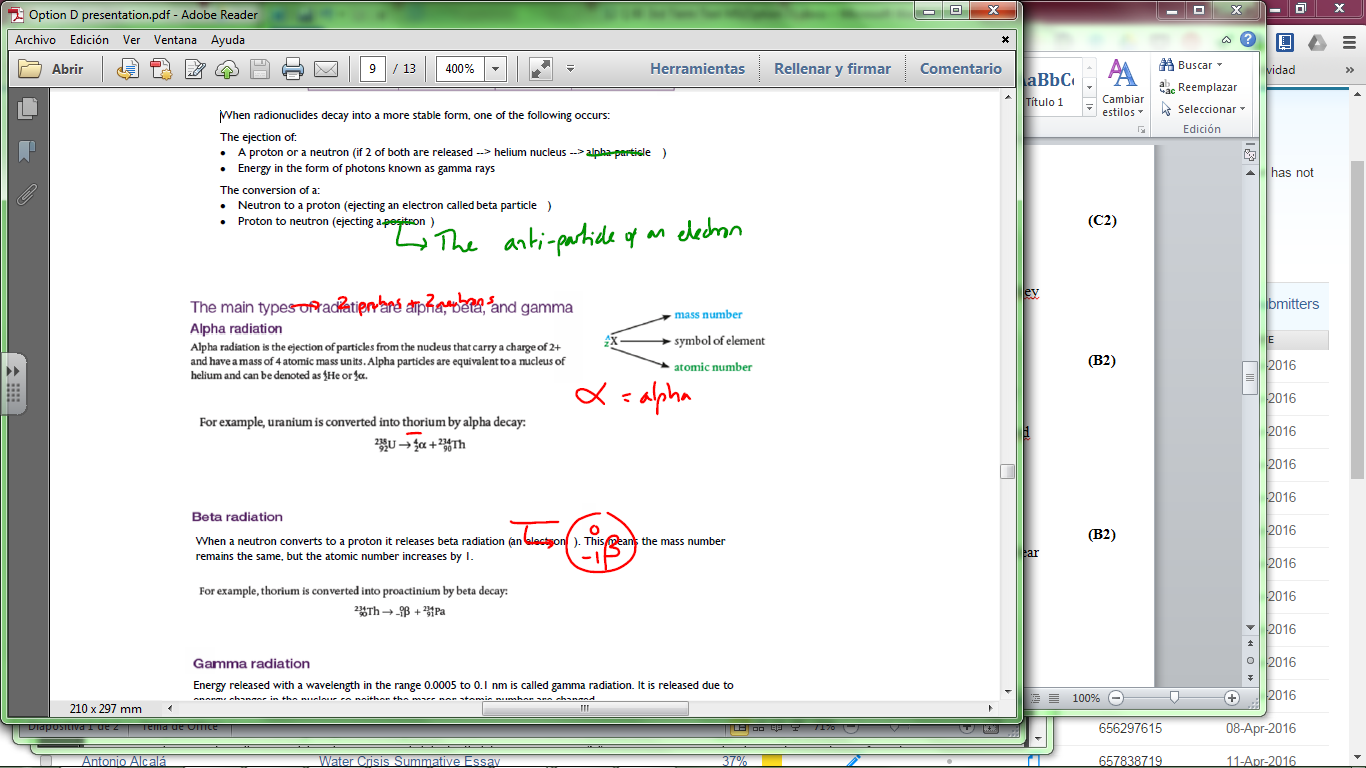
New conc = 0.0102 (C2)

1. The antiretroviral drugs Tamiflu (oseltamivir) and Relenza (zanamivir) are found in Section 37 of the data booklet. State the the 3 funtional groups that they have in common.

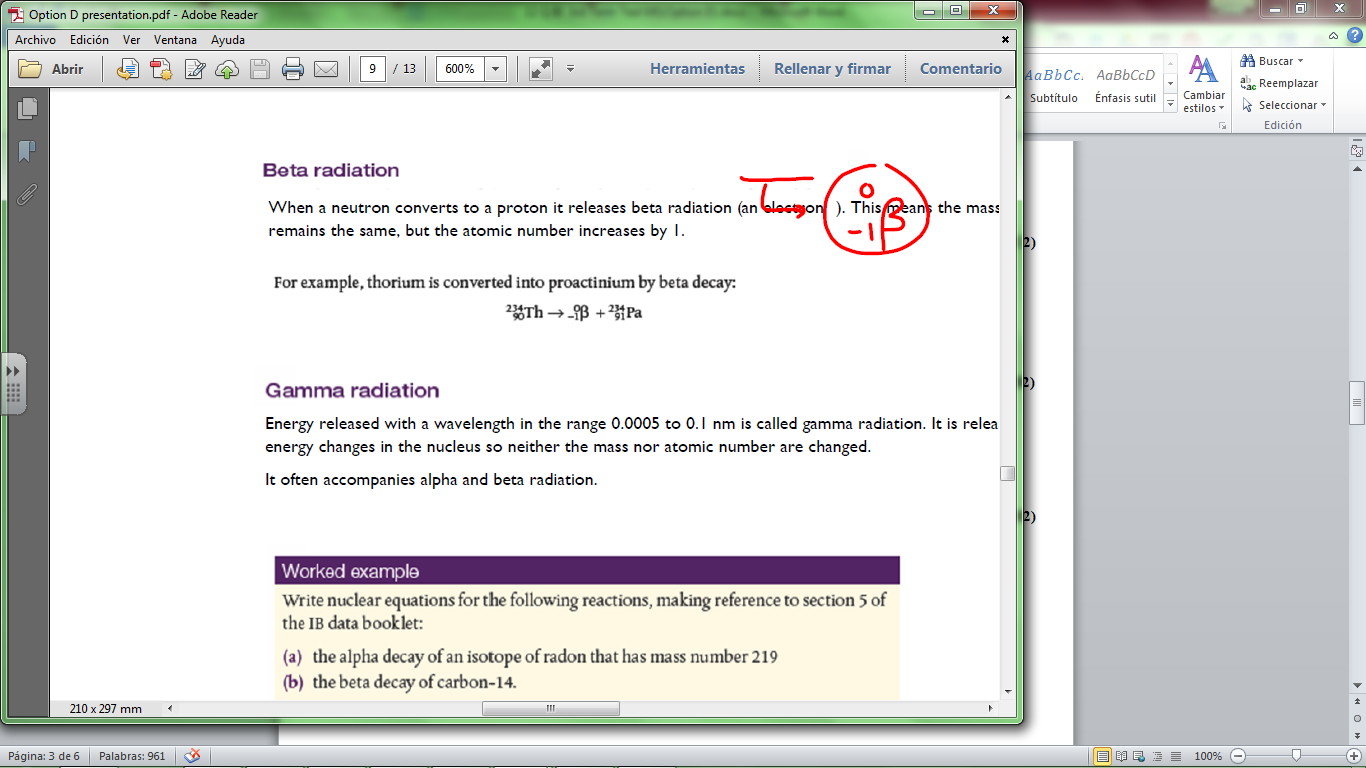
Ester; ether; amide;

(B2)

1. Unstable nuclei undergo radioative decay by emitting one of several types of radiation.
   1. Thorium-234 is formed by the alpha decay of uranium. Use the selected section of Section 6 to write a nuclear equation for this process.

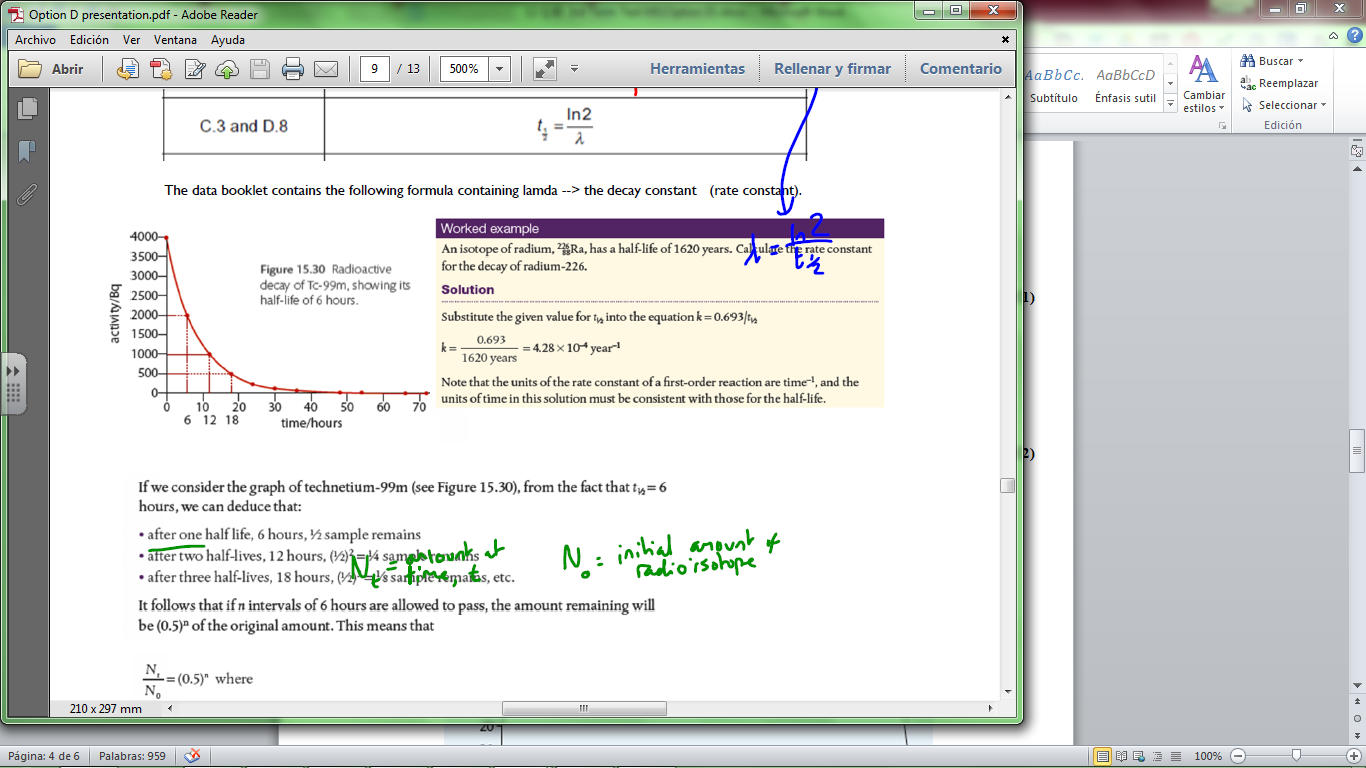
 (B2)

* 1. Thorium-234 can undergo beta radiation. Complete the following nuclear reaction.

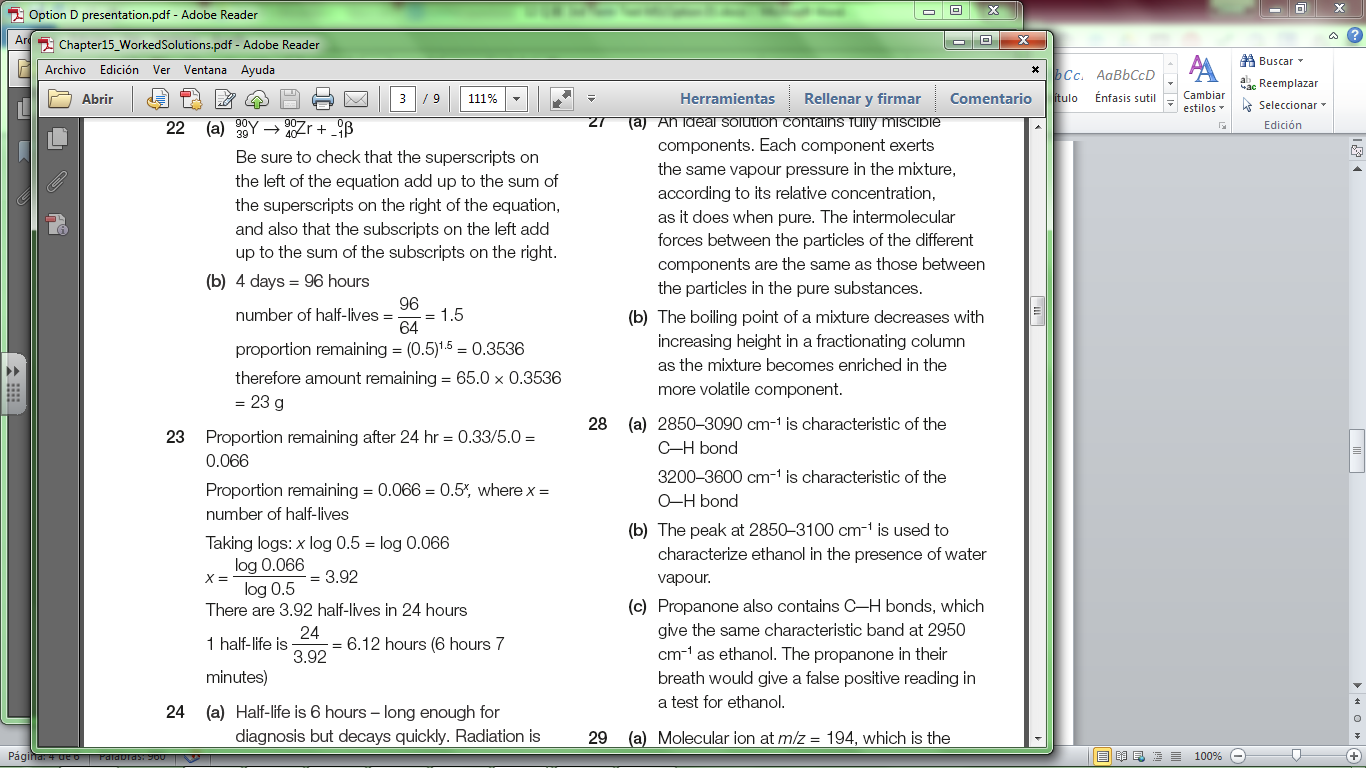


**(B1)**

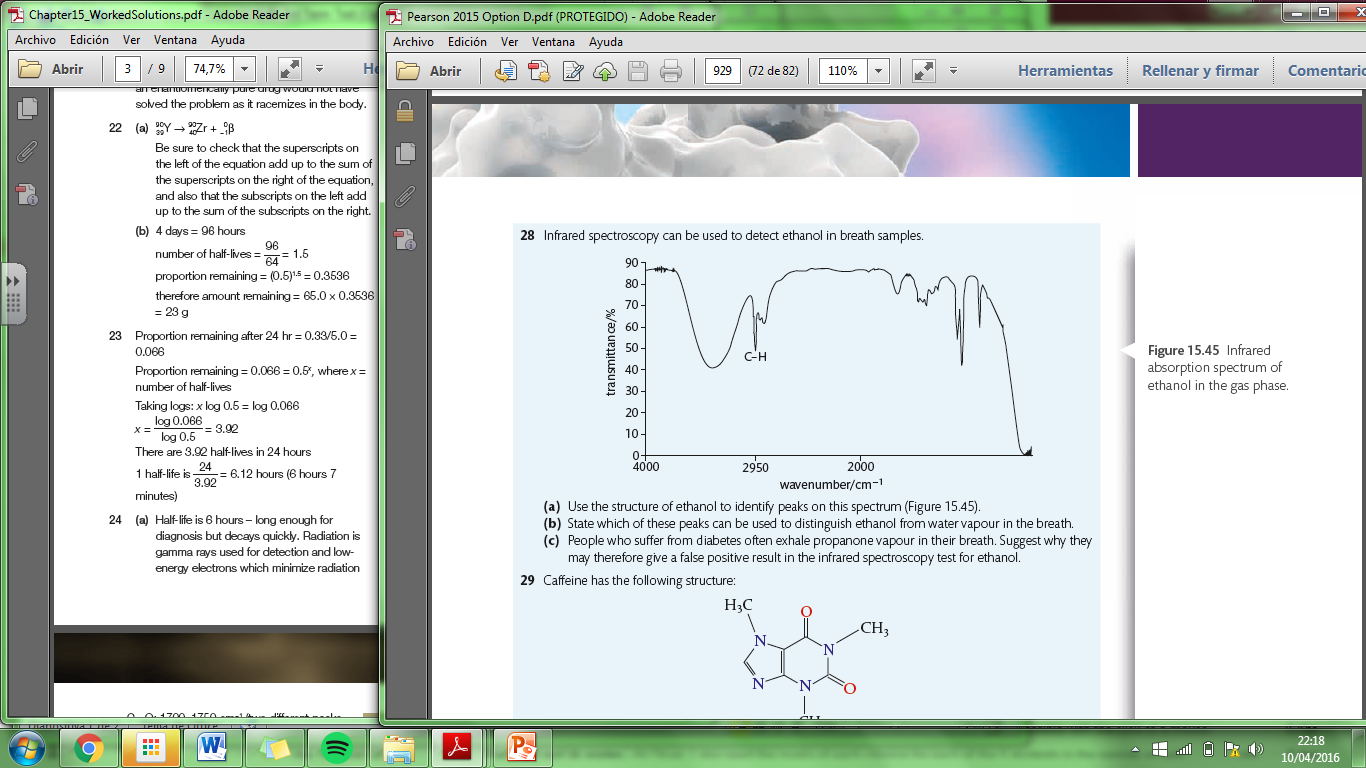
* 1. The isotope radium-226 has a half-life of 1620 years. Calculate the rate constant for the decay of this isotope using the relevant equation from the data booklet.

Value; (C1)

* 1. The 90Y isotope has a half-life of 64 hours. Use the relvant equation in Section 1 to calculate how much of a 65.0 g sample would remain after 4 days.

1.5 half-lives; 23 g (C2)

1. Infrared spectroscopy can be used to detect ethanol in breath samples of “drink drivers”.



* 1. Use Section 26 and your knowledge of the structure of ethanol to identify the 2 important peaks on this spectrum.

OH trough at 3200; CH trough at 2950 (B2)

* 1. Explain why one of these peaks will also be present in the breath of people who have not been drinking alcohol.

OH in H2O

(B1)

* 1. People who suffer from diabetes often exhale propanone vapour in their breath. Explain why this might give a false positive result for the presence of alcohol?

Would also give CH peak

(B1)

* 1. Describe how acified potassium dichromate is used to detect ethanol in a breathalyser.

Ethanol oxidised/dichromate reduced; Colour change from orange to green Cr3+

(A2)

1. The environmental impact of the synthesis, isolation and administration of medications are important to consider. State one problems associated with each of the following:
   1. High-level nuclear waste

Large amount of ionizing radiation for long time

(B1)

* 1. The use of antibiotics in animal feed

Antibiotic resistance

(B1)

1. The anti-cancer drug “Taxol” was originally isolated from the bark of Pacific yew trees which take 200 years to grow and are only found in some parts of the US.
   1. One current method being researched to synthesize this drug if through fermentation reactions by some fungi. Explain how this current research is related to the principles of “green chemistry”.

Green chemistry more environmentally friendly; Less trees harvested; fermentation process less damage; OWTTE

(B2)

* 1. The most common method of production of Taxol is now enantioselective synthesis using a chiral auxillary. Briefly explain what a “chiral auxillary” is and why it is needed in this synthesis. The structure for Taxol is found in the data booklet.

Is itself an enantiomer; needed to make a chiral product; prevents formation of unwanted enantiomer product (ANY 2)

(A2)