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# 2019 HSC CHEMISTRY

## LECTURE GIFT

1000 QUESTIONS  
(FREE RESPONSE & MCQ QUESTIONS)

**PART III**  
(300/1000)

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**Question 201:** Explain the reason why the combustion of alkanes is exothermic despite the reaction require heat to occur.

**Question 202:** Which of the following is true about the reaction quotient when substances A and B are added into a vessel to form C and D at the start of reaction?

- (A) Reaction quotient increases with time.
- (B) Reaction quotient decreases with time.
- (C) Reaction quotient is independent with time.
- (D) Reaction quotient is zero.

**Question 203:** The carbonic acid – hydrogen carbonate buffer is naturally occurring in the blood to maintain a pH of approximately 7.35. Suppose that 4M of sodium hydrogen carbonate is allowed to be mixed with 0.01L of blood containing 3M of carbonic acid. You are given that the acid dissociation constant of carbonic acid in blood at a certain temperature used in the reaction is  $8.0 \times 10^{-7}$ .

Calculate the volume of aqueous sodium hydrogen carbonate is required to establish a blood buffered solution of 7.4.

**Question 204:** A student dissolved 1.00 gram of  $(\text{NH}_4)_2\text{SO}_4$  fertiliser in a 0.250L volumetric flask using warm water. Later, 100mL of this standardised solution is pipetted into a beaker where 3 drops of hydrochloric acid at 1M was added to acidify the solution. This was followed by adding 1M aqueous  $\text{BaCl}_2$  to the mixture to form a precipitate. The solution was filtered using filter paper and the filtrate was dried in an oven.

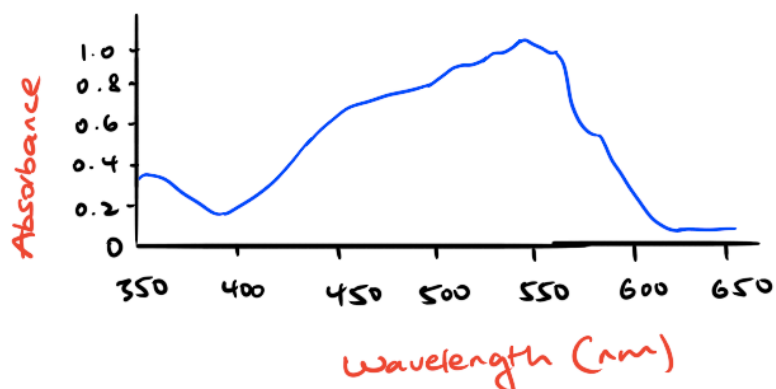
Calculate the mass of the precipitate and the percentage of sulfate content present in the fertiliser.

**Question 205:** Referring to Q204, propose three reasons why the experiment value of the percentage of sulfate content may be less than the actual value. In your answer, provide a recommendation to reduce each of these sources of error.

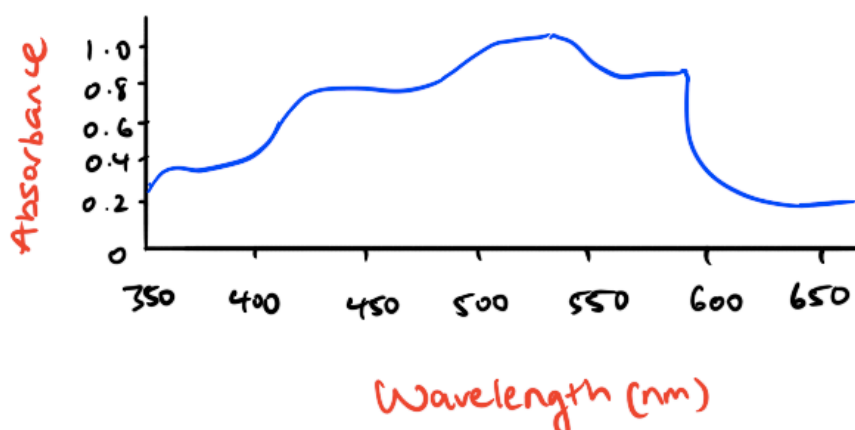
**Question 206:** Describe the role of the flame in atomic absorption spectroscopy.

Question 207:

(a) What is the Lambda max for the spectrum below?



(b) Looking at the spectrum below, is it the same spectrum for the molecule that produced the spectrum in part (a)?



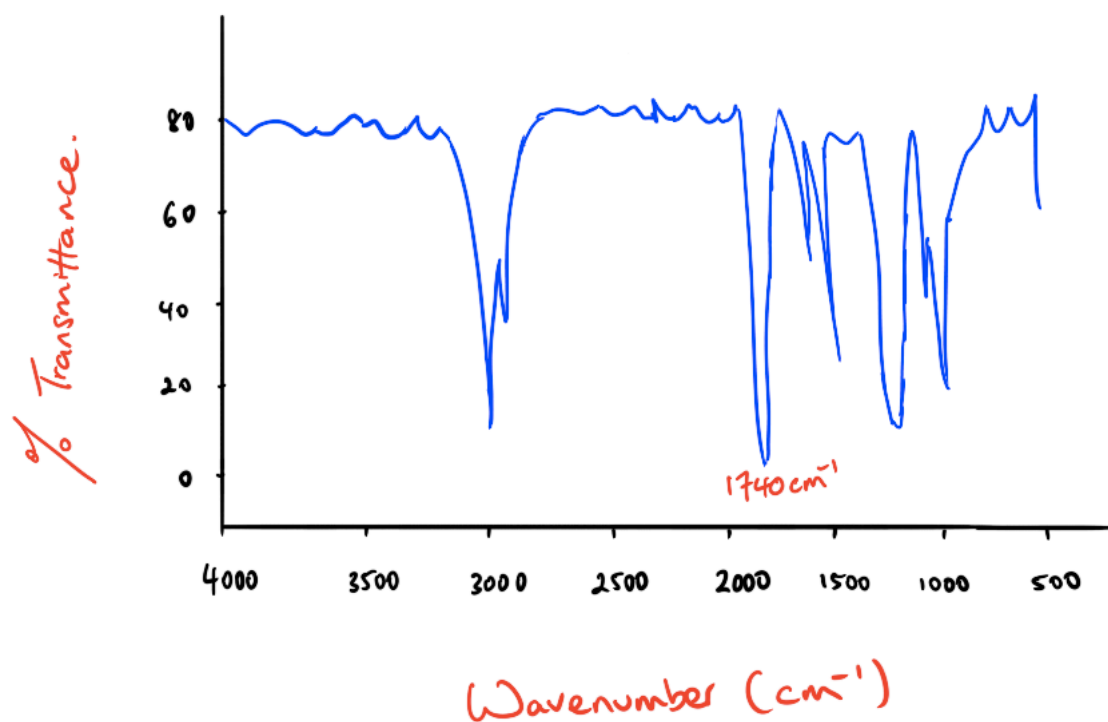
Question 208: Describe the relationship between wavelength, frequency and the energy of an electromagnetic radiation.

Question 209: Which of the following is true as you move from the ultraviolet radiation to the visible light section of the electromagnetic spectrum?

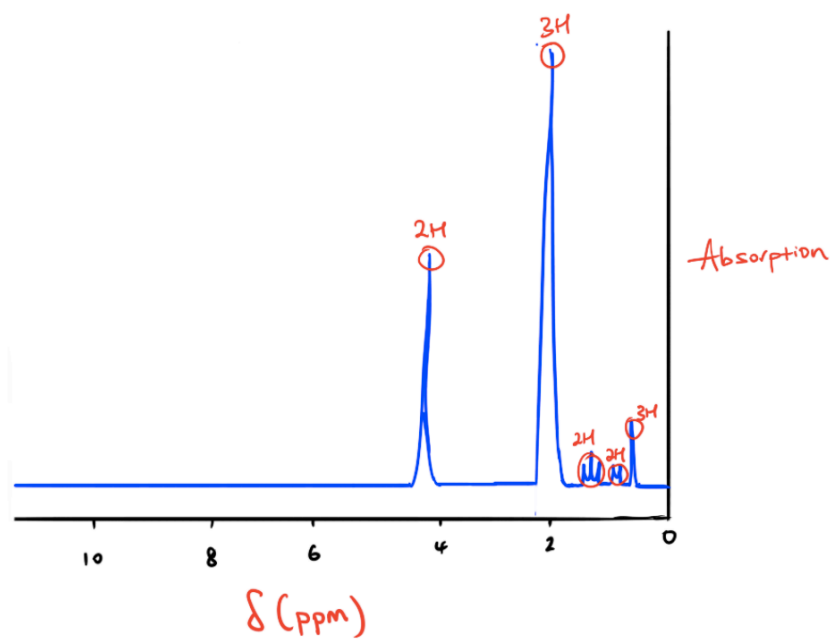
- (A) The wavelength of light decreases.
- (B) The energy of radiation remains unchanged.
- (C) The energy of radiation increases.
- (D) The energy of radiation decreases.

**Question 210:** Using the data below, draw the structure of the molecule with the formula,  $C_6H_{12}O_2$ .

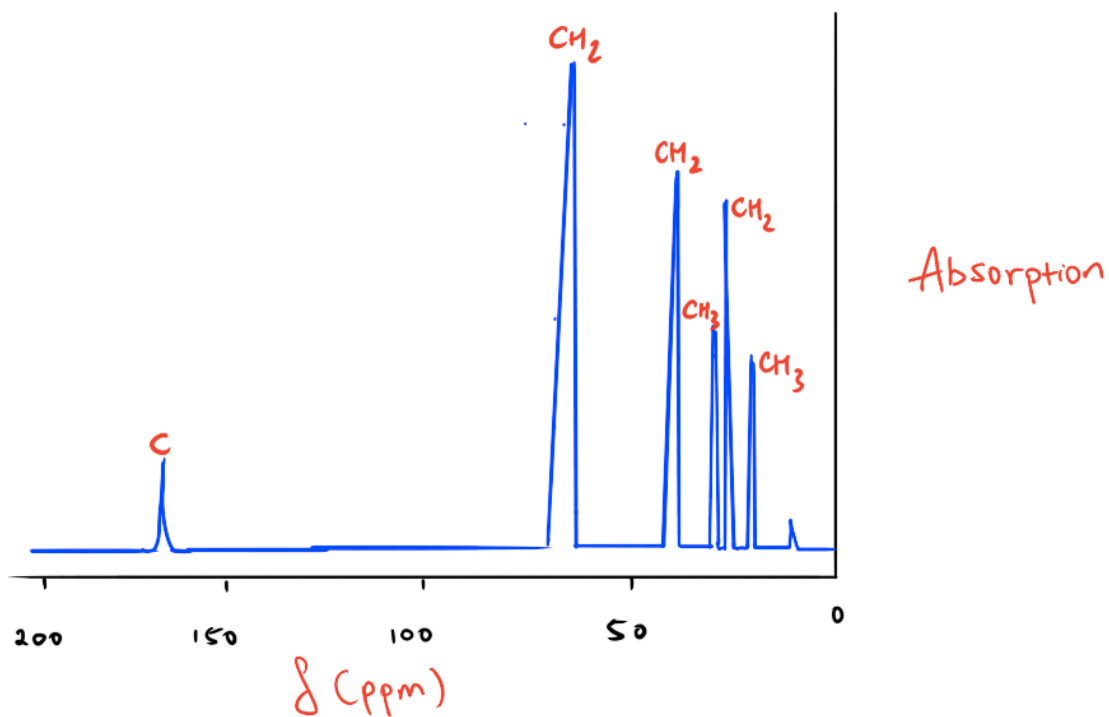
### Infrared Spectroscopy Data



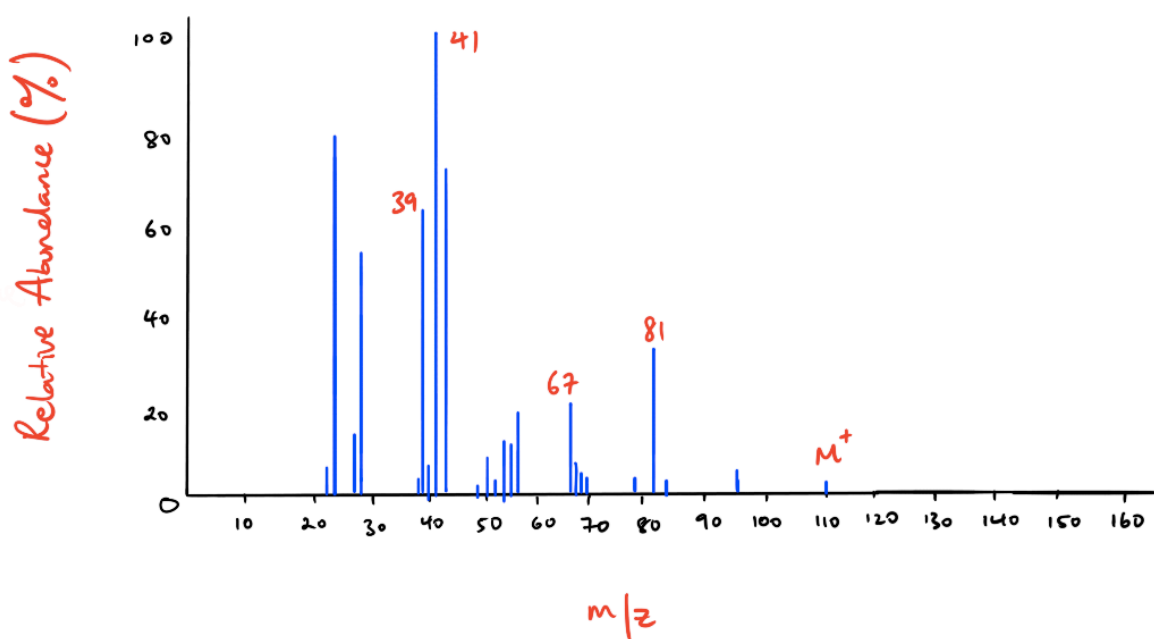
### $^1\text{H-NMR}$ Spectroscopy Data

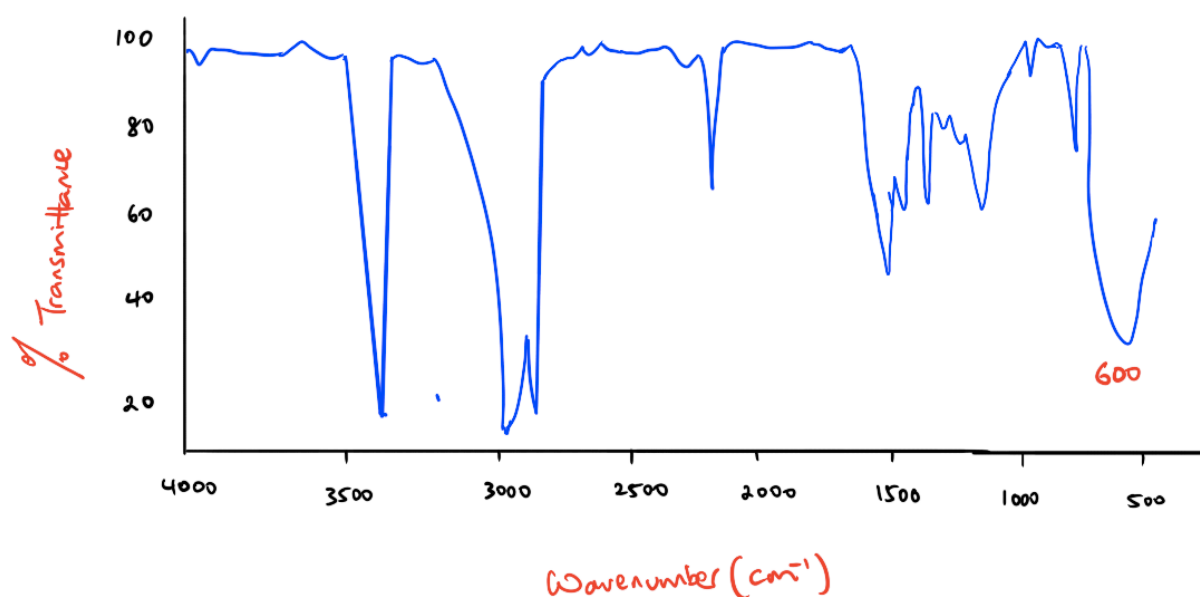


### 13-C NMR Spectroscopy Data



Refer to the following spectroscopy data to answer Q211 – Q213.





**Question 211:** What is the molecular formula given that the relative abundance of the M and M+1 peak are 2 and 0.17 respectively.

**Question 212:** What functional group(s) is present in the molecule from the spectroscopy data.

**Question 213:** Draw two structures that the molecule may have with the spectroscopy data provided.

**Question 215:** Draw the structural formula for prop-2-en-1-ol.

**Question 216:** Name the type of electromagnetic radiation used in  $^1\text{H}$  NMR and  $^{13}\text{C}$  NMR.

**Question 217:** Name the type of electromagnetic radiation used in UV-Vis Spectroscopy.

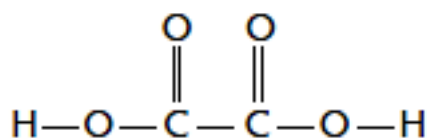
**Question 218:** Name the type of electromagnetic radiation used in mass spectrometry.

**Question 219:** Name the type of electromagnetic radiation used in infrared spectroscopy.

**Question 220:** Describe the reason why a ketone molecular have a higher melting and boiling point than a comparable aldehyde molecule.

**Question 221:** For the following molecule, what is the bond angle for the O-C-O bond?

**HINT:** When determining bond angle and geometry, treat double bonds as single electron pair.



- (A) 90°
- (B) 120°
- (C) 180°
- (D) 360°

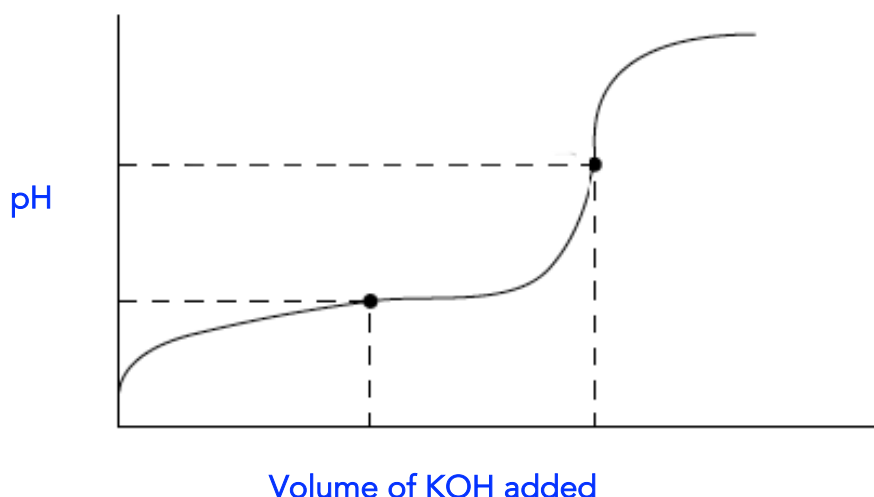
**Question 222:** Suppose that a student wants to calculate the molecular mass of a monoprotic, strong acid ('X'). To prepare the acid solution, 30 grams of X was dissolved and filled with water in a 500mL volumetric flask. Subsequently, the student titrated 30mL aliquots of the acid against standardised sodium hydroxide with the following results shown in the table below.

Titration	Volume of NaOH used	Concentration of NaOH used
1	83.41	0.25 M
2	83.31	0.25 M
3	83.51	0.25 M

- (a) Calculate the moles of X in the 30mL aliquots.
- (b) Calculate the molecular mass of X.
- (c) If the solid acid was not pure, explain how this would affect the molecular mass that you calculated in part (c).
- (d) If the solid acid's actual mass was 31 grams rather than 30g due to error of the electronic balance that the student used, explain how this would affect the molecular mass that you calculated in part (c)
- (e) If the concentration of sodium hydroxide used was higher than 0.25M, how this would affect the molecular mass that you calculated in part (c).

**Question 223:** Justify if an indicator would be considered suitable for use in a titration if the pH of the equivalence point lies within indicator's endpoint.

**Question 224:** For the following titration curve of a weak acid titrated with a strong base, justify if the acid is monoprotic or diprotic.



**Question 225:** Describe the relationship between temperature and entropy.

**Question 226:** Describe the relationship between pressure and entropy.

**Question 227:** Describe the relationship between concentration and entropy for solutions.

**Question 228:** If a system is at equilibrium, which of the following is true?

- (A) Increasing temperature will increase the system's entropy.
- (B) Decreasing temperature will increase the system's entropy.
- (C) At equilibrium, the change in enthalpy of the forward and reverse reactions have the same magnitude but different in their signs.
- (D) At equilibrium, the change in enthalpy of the forward and reverse reactions have direct magnitudes but same in their signs.

**Question 229:** Which of the following reaction conditions will help the production of only carbon dioxide and liquid water from an alcohol?

- (A) Burning alcohol in limited oxygen
- (B) Burning alcohol in limited oxygen and high pressure
- (C) Burning alcohol in excess oxygen and low temperature
- (D) Burning alcohol in excess oxygen and high temperature

**Question 230:** Which of the following is true about the sign of the change in enthalpy for the evaporation of water at constant pressure?

- (A) Positive.
- (B) Negative.



- (C) Depends on the system's volume.
- (D) Depends on system's temperature.

**Question 231:** Assuming complete ionisation, what is the mass of phosphoric acid required to make a 0.1L solution of  $\text{H}_3\text{PO}_4$  at a concentration of 0.09M?

- (A) 0.005 grams
- (B) 0.3 grams
- (C) 0.9 grams
- (D) 2.7 grams

**Question 232:** Draw the apparatus setup for an esterification experiment that you performed as part of the HSC Chemistry course, labelling all components.

**Question 233:** Distinguish the terms 'oxidation' and 'reduction'.

**Question 234:** A student pumped gas A into a closed system. A day later, the student noticed a leakage in the vessel and noticed that the volume of the gas remaining is exactly half of what was initially present. However, the student also noticed that the room's temperature has risen resulting in the temperature of the system to increase by 15% than its initial temperature. What would be the expected pressure change noticed by the student as a result of the change in gas volume and system temperature?

- (A) 33%
- (B) 55%
- (C) 100%
- (D) 130%

**Use the following information to answer Question 235 – 236.**

You reacted 231.5 grams of  $\text{Mg}(\text{OH})_2$  with 413mL of nitric acid at a concentration of 2M.

**Question 235:** Calculate the theoretical yield of  $\text{MgCl}_2$ .

**Question 236:** Calculate the percentage yield of  $\text{MgCl}_2$  given that 12.30 grams was found to be produced in the experiment.

**Question 237:** Which of the following justifies why it is more preferable to use relative absorbance to measure absorption compared to transmittance in spectroscopy techniques.

- (A) Absorbance can be reported more precisely than transmittance.
- (B) The cuvette used to hold the sample solution does not absorb the incident radiation's wavelengths.
- (C) Absorbance is proportional to concentration whereas transmittance is not.
- (D) None of the above.

**Question 238:** What is the IUPAC name for  $N_2O_5$ ?

**Question 239:** What is the IUPAC name for  $PCl_3$ ?

**Question 240:** What is the IUPAC name for  $H_2S$ ?

**Question 241:** What is the IUPAC name for  $H_3PO_4$ ?

**Question 242:** Which of the following is true about  $CO_2$ ?

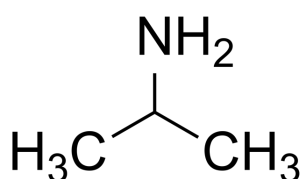
- (A)  $CO_2$  is a metallic oxide.
- (B)  $CO_2$  will react with a base via neutralisation reaction.
- (C)  $CO_2$  will react with an acid via neutralisation reaction.
- (D)  $CO_2$  can dissolve in water to form an acidic solution.

**Question 243:** Which of the following is true about  $CaO$ ?

- (A)  $CaO$  is a non-metallic oxide.
- (B)  $CaO$  will react with a base via neutralisation reaction.
- (C)  $CaO$  will react with an acid via neutralisation reaction.
- (D)  $CaO$  can dissolve in water to form an acidic solution.

**Question 244:** What is the IUPAC name for  $HClO_3$ ?

**Question 245:** What is the IUPAC name for the following molecule?



Use the following information to answer Questions 246 - 250

You performed an experiment where you initially decomposed 250 grams of  $\text{Cu}(\text{NO}_3)_2$  in a closed, empty vessel to form an equilibrium with the solid  $\text{CuO}$  as well as oxygen and nitrogen dioxide that are produced as a result of the reaction. You are given that total pressure of the system at equilibrium is 4.7 atm.

**Question 246:** Write a balanced equation for the equilibrium is established.

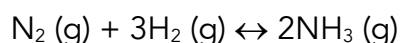
**Question 247:** Determine the moles of oxygen gas at equilibrium.

**Question 248:** Determine the mass of undecomposed  $\text{Cu}(\text{NO}_3)_2$  solid that is present at equilibrium.

**Question 249:** Calculate the equilibrium constant value in terms of pressure.

**Question 250:** At the same temperature, if twice as amount of  $\text{Cu}(\text{NO}_3)_2$  initially present in the empty vessel, how would the total pressure of the system may have changed?

**Question 251:** The Haber process which can be chemically expressed as



Which of the following is true for in order for the equilibrium position to shift to the right?

- (A)  $K_p > 1$
- (B)  $Q < K_p$
- (C)  $Q = K_p$
- (D)  $Q < 2K_p$

**Question 252:** For the reaction between carbon monoxide being mixed with water vapour to form carbon dioxide and hydrogen gas, which of the following is correct about the percentage of carbon dioxide product formed at equilibrium?

You are given that the equilibrium constant value is equal to 4 at a specific reaction temperature that is held constant. The moles of both carbon monoxide and water

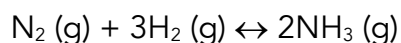
vapour are the same when they are inserted into the vessel, assume that reaction vessel's volume is held constant throughout.

- (A) 67%
- (B) 33%
- (C) 50%
- (D) 78%

**Question 253:** Which of the following reaction will have an equilibrium constant value that is not greater than one?

- (A)  $A(g) + B(g) \leftrightarrow C(s)$
- (B)  $A(s) + B(g) \leftrightarrow C(s) + D(g)$
- (C)  $2A(s) + 2B(s) \leftrightarrow 3C(s) + 3D(s)$
- (D)  $2A(l) + B(g) \leftrightarrow C(l) + 2D(g)$

**Question 254:** For the following reaction,

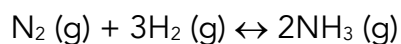


Explain whether or not the equilibrium position will shift upon the addition of an inert gas at:

- (i) Constant pressure
- (ii) Constant volume

If there is a shift, explain the direction in which the shift in equilibrium position will take place and how the concentration of the reactants and product will be affected.

**Question 255:** For the following equilibrium, which statement is true if the reaction takes place at **constant pressure** upon the addition of Neon gas?



- (A) The percentage of ammonia formed from reactants is decreased.
- (B) The percentage of ammonia formed from reactants is increased.
- (C) There is no shift in the equilibrium position.
- (D) The percentage dissociation of ammonia is decreased.

**Question 256:** For the following equilibrium, which statement is true if the reaction takes place at **constant volume** upon the addition of Neon gas?



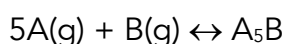
- (A) The percentage dissociation of  $\text{PCl}_5$  is increased.
- (B) The percentage dissociation of  $\text{PCl}_5$  is decreased.
- (C) There is no shift in the equilibrium position.
- (D) None of the above

**Question 257:** For the following equilibrium, which statement is true if the reaction takes place at **constant pressure** upon the addition of Neon gas?



- (A) The percentage dissociation of  $\text{PCl}_5$  is increased.
- (B) The percentage dissociation of  $\text{PCl}_5$  is decreased.
- (C) There is no shift in the equilibrium position.
- (D) None of the above

**Question 258:** For the reaction below:



Which of the following affects the moles of substance C if system is at equilibrium?

- (A) The system's pressure
- (B) The system's temperature
- (C) The system's pressure and temperature
- (D) The availability of a catalyst as well as the system's temperature and pressure.

**Question 259:** Explain what will happen if the percentage dissociation of a weak acid when a strong acid is added to it. Provide a relevant chemical equation to support your answer.

**Question 260 – Outside Syllabus Question:** State the law in which the law of chemical equilibrium is derived from.

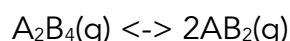
**Question 261:** Suppose that there is a reaction at equilibrium with a  $K_c$  value of 100. If the volume of the reaction vessel's is doubled, the  $K_c$  value would be:

- (A) 50
- (B) 100
- (C) 150
- (D) 200

**Question 262:** The insertion of an inert gas into a system with sulfur trioxide, sulfur dioxide and oxygen at equilibrium will result in:

- (A) Decrease dissociation of  $\text{SO}_3$
- (B) Increase dissociation of  $\text{SO}_3$
- (C) No change in the dissociation of  $\text{SO}_3$
- (D) A change in the dissociation of  $\text{SO}_3$ , however, more information is required.

**Question 263:** Suppose that for the reaction below:



The equilibrium constant expression in terms of pressure can be represented by  $(4x^2P) / (1 - x^2)$ .

Which of the following is true given that 'P' represents the system's pressure and 'x' represents the percentage dissociation of  $\text{A}_2\text{B}_4$ ?

- (A) Equilibrium constant increases with the system's pressure.
- (B) Equilibrium constant increases with percentage dissociation of  $\text{A}_2\text{B}_4$ .
- (C) Equilibrium constant decreases with percentage dissociation of  $\text{A}_2\text{B}_4$
- (D) Equilibrium constant remains unchanged with regardless of the system's pressure and percentage dissociation of  $\text{A}_2\text{B}_4$ .

**Question 264:** Explain why you found that doubling the volume of a buffer that a student created did not change the buffer pH.

**Question 265:** Provide a reason why you found that doubling the volume of a buffer that a student created did change the buffer pH.

**Question 266:** Define the common ion effect.

**Question 267:** Explain how the term neutralisation varies according to the theories proposed by Arrhenius and Bronsted-Lowry.

**Question 268:** Explain whether or not a catalyst can increase the yield of a reaction.

**Question 269:** Which of the following statement is true?

- (A) A catalyst lowers the activation energy of the original reaction pathway.
- (B) A catalyst cannot alter the equilibrium constant value.

(C) A catalyst cannot alter the equilibrium constant value but a catalyst can alter the equilibrium position as there can be more than one equilibrium position that satisfy the equilibrium constant.

(D) A catalyst provides an alternative reaction pathway with a lower activation energy than the original reaction pathway.

**Question 270:** Explain the reason towards why catalyst cannot change the equilibrium position.

**Question 271:** Describe the nature of a chemical reaction where the use of a catalyst is not suitable.

**Question 272:** Explain the social issues related to chemical synthesis and design.

**Question 273:** Explain the economic issues related to chemical synthesis and design.

**Question 274:** Explain the environmental issues related to chemical synthesis and design.

**Question 275:** Explain the function of using infrared spectroscopy, U.V Visible Spectroscopy, Nuclear Magnetic Resonance spectroscopy and Mass Spectroscopy.

**Question 276:** Construct models showing the differences between a concentrated acid and dilute acid.

**Question 277:** Construct models showing the differences between a strong acid and a weak acid.

**Question 278:** Draw all the possible chain isomers for heptane.

**Question 279:** Which of the following is true about the relationship between 2-methylbutane and pentane?

- (A) They are isotopes.
- (B) They are functional group isomers.
- (C) They are chain isomers.
- (D) They are position isomers.

**Question 280:** Which of the following is true about the relationship between butane and methylpropane?

- (A) They have a different molecular formula.
- (B) They are functional group isomers.
- (C) They are chain isomers.
- (D) They are position isomers.

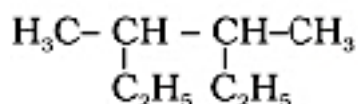
**Question 281:** Which of the following is true about the relationship between two butene molecules with a different position in their C=C bond?

- (A) They are allotropes.
- (B) They are functional group isomers.
- (C) They are chain isomers.
- (D) They are position isomers.

**Question 282:** Which of the following is true about the relationship between propanone and propen-2-ol?

- (A) They have a different molecular formula.
- (B) They are position isomers.
- (C) They are chain isomers.
- (D) They are functional group isomers.

**Question 283:** What is the IUPAC name of the molecule below?



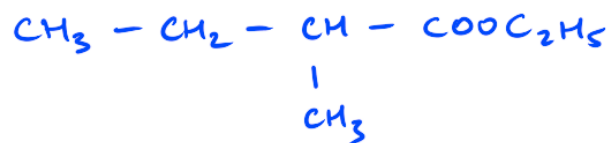
**Question 284:** Explain the melting and boiling point trend for comparable carboxylic acid, alcohol and esters. That is, esters with the same number of carbon atoms in parent chain.

**Question 285:** Explain the melting and boiling point trend for comparable aldehyde, ketone and alcohol molecules.

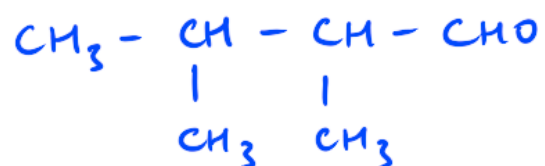
**Question 286:** Explain the melting and boiling trend for comparable amine, amides and alcohol molecules.



Question 287: What is the IUPAC name of the molecule below?



Question 288: Assign the IUPAC name for the molecule below.



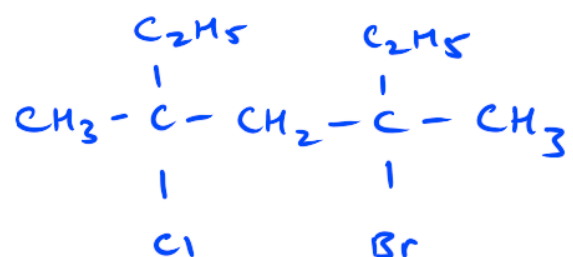
Question 289: What is the IUPAC name of the molecule below?



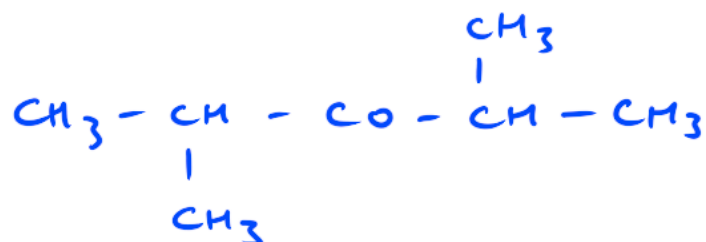
Question 290: Assign the IUPAC name for the molecule below.



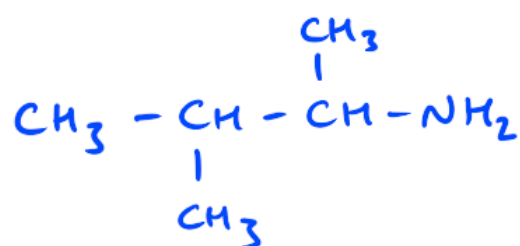
Question 291: What is the IUPAC name of the molecule below?



**Question 292:** Assign the IUPAC name for the molecule below.



**Question 293:** What is the IUPAC name of the molecule below?



**Question 294:** Describe a factor that may account for the difference between the experimental yield to theoretical yield.

Use the following information to answer Question 295 – 296.

Iodine (V) oxide can react to consume carbon monoxide gas in the atmosphere to form iodine gas and carbon dioxide.

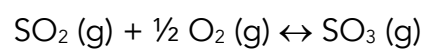
**Question 295:** Suppose that 200 grams of iodine (V) oxide is reacted with 40 grams of carbon monoxide, calculate the theoretical yield of carbon dioxide.

**Question 296:** Calculate the percentage yield when you are given that 0.843 moles of carbon dioxide was formed when a student performed the experiment.

**Question 297:** Write the chemical equation for the hydrobromination of but-2-ene, showing the structural formula for all of the reactants and products.

**Question 298:** Distinguish between monoprotic and diprotic acids.

**Question 299:** Write the  $K_{eq}$  expression for the following equilibrium reaction



**Question 300:** Distinguish the terms 'Lewis acid' and 'Lewis base'.