ConquerHSC

Do. Believe. Conquer.

Student Name: _____

Student ID: _____

2019 Sample HSC Chemistry Paper #2

General Instructions

- **Reading Time - 5 minutes**
- **Working time - 3 hours**
- Please write using black pen.
- Draw diagrams using a pencil.
- NESA approved calculators are permitted.
- A Formula Sheet, Data Sheet and Periodic Table are supplied and attached at the back of this paper (booklet).**
- Please provide full working out in your responses to Section II questions.

****NOTE:** There will **NOT** be a Formula, Data Sheet and Periodic Table attached for this paper until I make one. So, use the one on NESA website when attempting this paper. However, for the official paper on HSC Day, you **WILL** be provided with a formulae sheet, data sheet and periodic table attached at the back of your exam paper (booklet).

Section I - 20 marks

Section II - 80 marks

Total Marks / 100

SECTION I

Question 1: Which of the following reactions have the largest increase in entropy?

(A) $2A_2B_{(l)} \rightarrow 2A_{2(g)} + B_{2(g)}$
(B) $2A_2B_{(l)} \rightarrow 2A_{2(l)} + B_{2(l)}$
(C) $A_2B_{(g)} \rightarrow A_2B_{(l)}$
(D) $A_2B_{(l)} \rightarrow A_2B_{(s)}$

Question 2: The correct relationship for the equilibrium constant is

(A) K_f / K_r
(B) K_fK_r
(C) $K_f - K_r$
(D) K_r / K_f

Question 3: Suppose that the equilibrium constant for the decomposition of gaseous hydrogen iodide into hydrogen gas and iodine gas is 0.0198 at 448 degrees Celsius. You found that at the same conditions, the gases have the following partial pressures at equilibrium. Determine the partial pressure of hydrogen iodide.

Gas	Partial pressure (atm)
Hydrogen Gas	0.710
Iodine Gas	0.888

(A) 0.125
(B) 7.87
(C) 5.64
(D) 0.389

Question 4: How many ^{13}C NMR signals do you expect the following molecule to have?

(A) 3
(B) 4
(C) 5
(D) 6

Question 5: Suppose that you want to determine the exact composition of chromium and iron in a metal alloy. Which of the following technology should you use?

(A) Gravimetric Analysis
(B) Atomic Absorption Spectroscopy
(C) Proton NMR
(D) Infrared Spectroscopy

Question 6: Under standard conditions, it is possible to oxidise primary alcohol to a

(A) Carboxylic Acid
(B) Aldehyde
(C) Ketone
(D) Both A and B

Question 7: It is said that ethanol burns more cleanly than octane. What is this statement referring to in chemical terms?

(A) Ethanol will consume more oxygen than octane.
(B) Ethanol requires less oxygen than octane to under complete combustion.
(C) Ethanol requires more oxygen than octane to undergo complete combustion.
(D) Ethanol can be manufactured to be a biofuel meaning that it is more environmentally friendly than octane.

Question 8: Which of the following justifies the need to remove sodium ions from the flame test instrument prior to testing other metals.

(A) Sodium is commonly found in most environments.
(B) Sodium produces a bright yellow glow which can obscure the colour of the metal ion being tested.
(C) Sodium produces a bright white glow which is harmful your eye.
(D) The platinum wire is dipped into concentrated HCl and heated on a blue flame Bunsen burner to ensure that the experiment is valid.

Question 9: Suppose that your teacher wants you to prepare a buffer with a pH of 10. Which of the weak bases below should you use?

Weak Base	K_b
X	2.1×10^{-2}
Y	6.0×10^{-4}
Z	9.0×10^{-8}
K	3.3×10^{-10}

(A) X
(B) Y
(C) Z
(D) K

Question 10: For the dissolution of sodium hydroxide in water and raising the temperature of water, which of the following is correct?

	Change in system's enthalpy	Change in system's entropy
(A)	Positive	Positive
(B)	Positive	Negative
(C)	Negative	Negative
(D)	Negative	Positive

Question 11: The forward rate of a reaction between substance Y and Z is equal to

Rate of forward reaction = $k_{forward}[Y]^2[Z]$

You are told that $k_{forward}$ is the rate constant for the forward reaction. Suppose that you removed from substance Y from the reaction vessel, precisely so that only 50% of its initial concentration is left over.

In order for the forward rate of reaction to proceed at half of its initial rate, what must the concentration of substance Z be?

(A) Same as its initial concentration
(B) Reduced by 25% compared to its initial concentration
(C) Reduced by 50% compared to its initial concentration
(D) Doubled compared to its initial concentration

Question 12: Calculate the resulting concentration of Pb^{2+} when 0.1L of lead (II) chloride of 0.1M reacted with equal volume of sulfuric acid at 0.05M.

(A) 0.050M
(B) 0.750M
(C) 0.030M
(D) 0.025M

Question 13: Which of the following is AgCl least soluble in?

(A) 0.1M of Iron (III) Chloride
(B) 0.1M of Sodium Chloride
(C) 0.1M of Potassium Chloride
(D) 0.1M of Silver Nitrate

Question 14: Which of the following is true for the molar solubility of the compounds AB_2 and AZ_3.

(A) AB_2 has a higher molar solubility than AZ_3
(B) AZ_3 has a higher molar solubility than AB_2
(C) Both AB_2 and AZ_3 has equal molar solubility
(D) More information is required to arrive to a conclusion

Question 15: Which of the following 0.5M solutions is expected to have the lowest pH?

(A) Na_2CO_3
(B) Na_3PO_4
(C) Na_2S
(D) NaCl

Question 16: Which of the following statements is true for mass spectroscopy (MS)?

(A) The analyte molecule is transformed into gaseous ions
(B) Gaseous ions are detected based on their mass-to-charge ratio
(C) From MS data, both isotopic mass and ratios can be seen
(D) A, B and C correct

Question 17: Which of the following is the explains the primary reason for the use of infrared spectroscopy (IR) in analysing the structure of organic compounds?

(A) Elements absorb a specific wavelength of energy.
(B) All chemical bonds absorb infrared radiation
(C) The intensity of the peaks displayed on the IR spectra helps determine the molecule mass of the organic compound
(D) The majority of organic compounds' functional groups are able to absorb infrared radiation.

Question 18: Which of the following best describes the shape of the central carbon atoms in ethylene?

(A) Bent
(B) Tetrahedral
(C) Trigonal Planar
(D) Linear

Question 19: The K_p for the following equilibrium reaction:

$$2SO_{3\,(g)} <-> 2SO_{2\,(g)} + O_{2\,(g)}$$

At one thousand degrees Celsius is approximately 0.3. However, when the temperature is increased by 300 degrees Celsius, the K_p is 41. Which of the following is true?

	Change in system's enthalpy	Change in system's entropy
(A)	Zero	Zero
(B)	Greater than Zero	Greater than Zero
(C)	Greater than Zero	Less than Zero
(D)	Less than Zero	Less Than Zero

Question 20: A flame test for a solution of potassium nitrate would produce a flame of what colour?

(A) Apple-green
(B) Violet
(C) Brick-Red
(D) Yellow

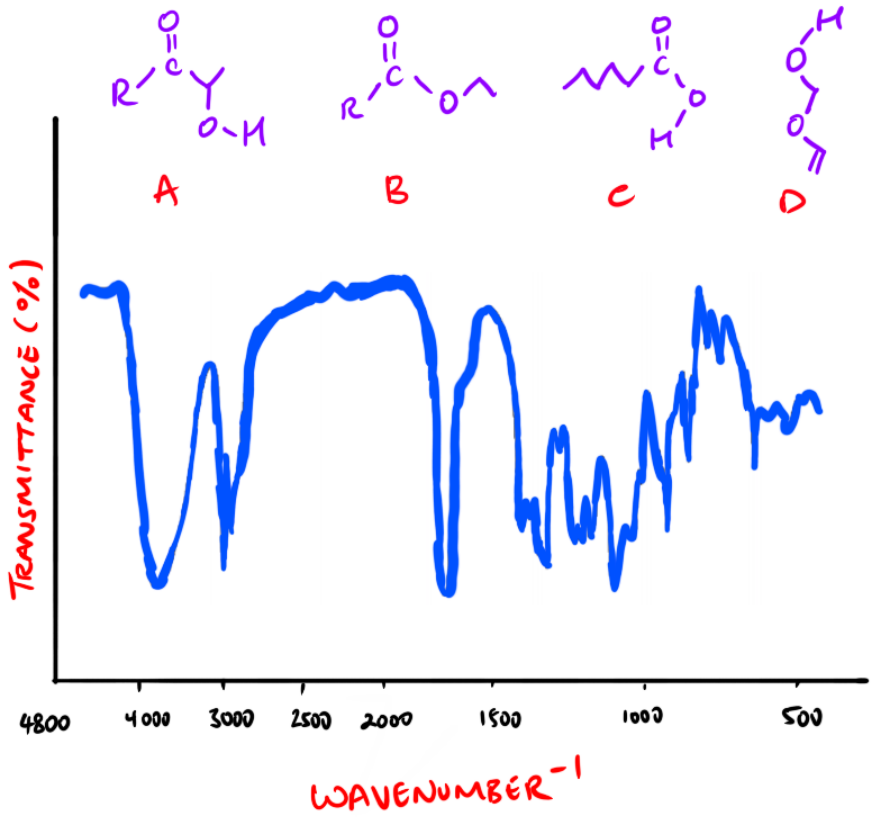
SECTION II

Question 21:

(a) Given that hypochlorous acid (HOCl) is a weak acid, write the chemical equation for the reaction between HOCl and H_2O. [3 marks]

(b) Explain the reason to why NaOCl is basic. Use a relevant chemical equation to support your answer. [3 marks]

Question 22: Explain which molecule (A, B, C or D) does the following infrared radiation (IR) spectrum diagram belong to. [8 marks]



Question 23: Draw a ^{1}H NMR spectrum for ethanol with chemical shift between 0 to 4 ppm. Show signals for CH_2, OH and CH_3 & the number of peaks in each signal. **[6 marks]**

Question 24: Suppose you have 100mL of 0.5 mole of H_2SO_4 and 200mL of 1 mole of KOH. You have both them reacting in a calorimeter.

Suppose that you are told that the enthalpy due to neutralisation for the reaction between sulfuric acid and potassium hydroxide is -57kJ per one mole of water formed.

The heat capacity of the calorimeter is 30 J/K.

The initial temperature of H_2SO_4 is 23.5°C and the temperature at which KOH is added is 25.6°C.

Calculate the temperature of the solution after neutralisation. **[6 marks]**

Question 25: Discuss the how the properties of soaps and detergents account for their uses in our everyday lives. Include a relevant diagram in your answer. **[6 marks]**

Question 26: Compare the uses of nylon and polyesters by relating it to their structure and properties. **[6 marks]**

Question 27: Suppose you have two beakers. You have been informed that one beaker contains potassium acetate and the other contains potassium chloride. Describe a suitable procedure that you could carry out to confirm the chemical identity of the substance stored in each beaker. Use a flowchart to illustrate your procedure. **[5 marks]**

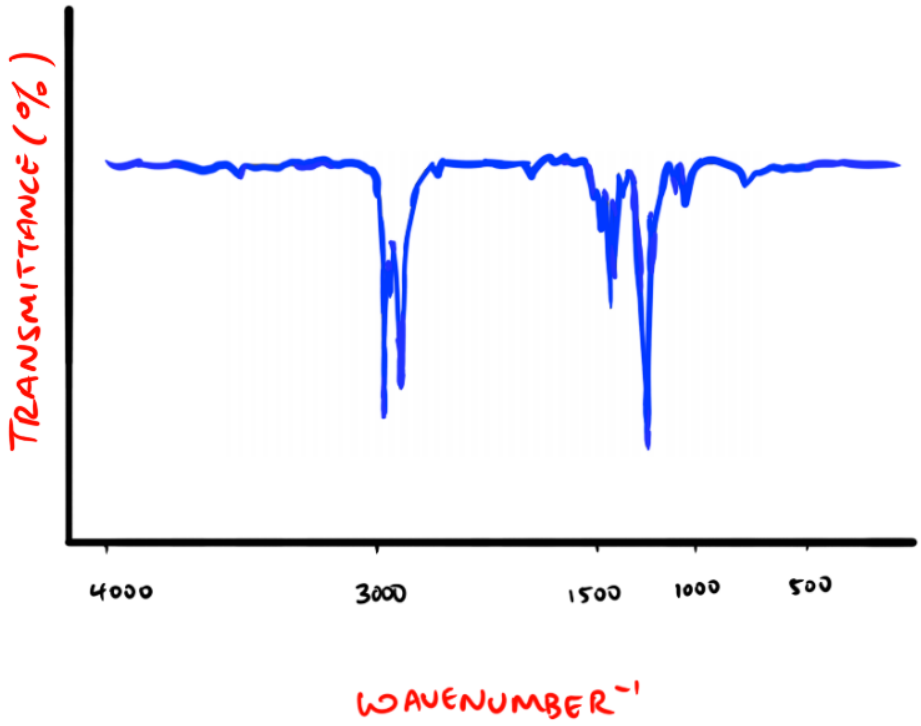
Question 28: Explain three conditions that must be satisfied in order to successfully perform a precipitation titration in which useful results can be obtained. **[6 marks]**

Question 29: Account for the need to monitor water quality. **[5 marks]**

Question 30: Five grams of an unknown organic compound had undergone complete combustion to produce 12 grams of carbon dioxide and 6 grams of water.

(a) Write the empirical formula for the unknown organic compound. **[3 marks]**

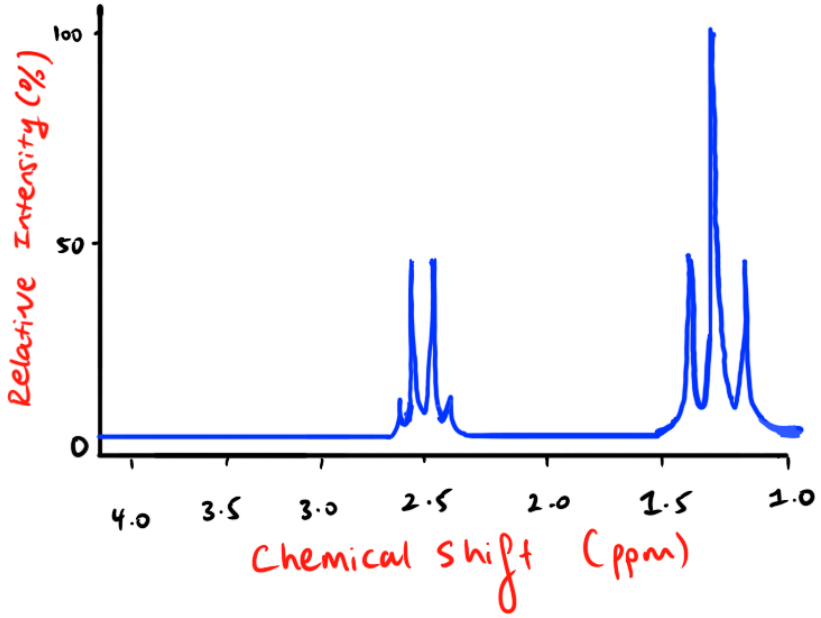
(b) Interpret the following IR spectrum diagram.



Which bond in the compound gives the signal shown at 1140 cm^{-1}? **[1 mark]**

(c) The molecular ion of the organic compound has a mass-to-charge ratio of 74, write the molecular formula for the organic compound. **[2 marks]**

(d) You are given the following NMR spectra for the same organic compound.
Draw the structural formula for the organic compound. [2 marks]



Question 31: Three molecules and their maximum wavenumber of infrared radiation absorption are displayed below. Account for their difference in IR absorption. [4 marks]

Molecule	Absorption due to bond between carbon and hydrogen.
Hex-1-yne	3300
Hex-1-ene	3100
Hexane	2900

Question 32: You are given the data that 0.002 grams of $Ca_3(PO_4)_2$ will dissolve in 100 grams of water at 25 degrees Celsius.

(a) Express the solubility product constant expression for $Ca_3(PO_4)_2$ **[1 mark]**

(b) Calculate the solubility of $Ca_3(PO_4)_2$ in mol/L at the same temperature. **[2 marks]**

(c) Compute the K_{sp} for calcium phosphate at 25 degrees Celsius. **[2 marks]**

(e) Suppose that you added the same amount of calcium phosphate into a 0.200M NaF solution, rather than 100 grams of water.

Explain how the solubility of $Ca_3(PO_4)_2$ would change and include at least one chemical equation in your answer. No calculations required. **[3 marks]**

Question 33: Using the data in the following table, account for the differences in electrical conductivity and pH between hydrochloric acid & propanoic acid. **[4 marks]**

Property	Hydrochloric Acid	Propanoic Acid
Concentration of acid solution	0.100M	0.100M
Relative electrical conductivity of acid solution	High	Low
pH of acid solution	1.00	1.00

Question 34: Name and justify your choice of an indicator that is suitable for use in a titration between NaOH and CH_3COOH. **[3 marks]**

END OF EXAM

Check FULL sample solutions & marking guidelines - www.conquerhsc.com

Warmest,
ConquerHSC Team