Conquer

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2019 HSC CHEMISTRY

LECTURE GIFT

1000 QUESTIONS

(FREE RESPONSE & MCQ QUESTIONS)

PART I

(100/1000)

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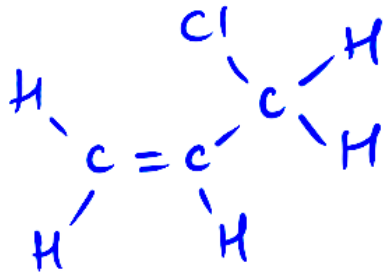
FREE RESPONSE QUESTIONS

Question 1: Write the structural formulae for 2,4-dichlorobut-1-ene.

Question 2: Write the structural formulae for methyl propanoate.

Question 3: Write the IUPAC name for the following organic compound.



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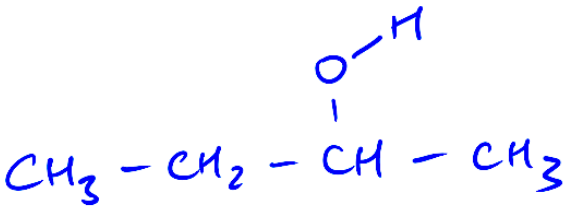

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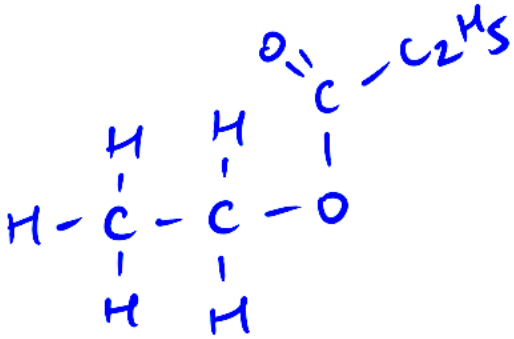

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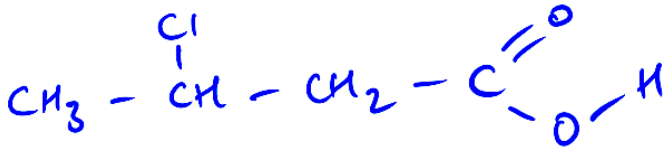
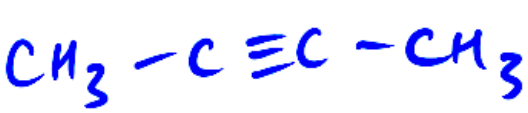


Question 7: Write the IUPAC name for the following organic compound.



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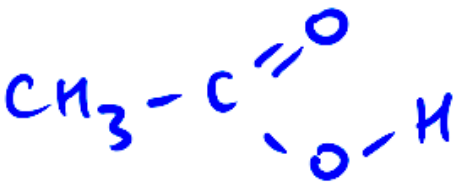
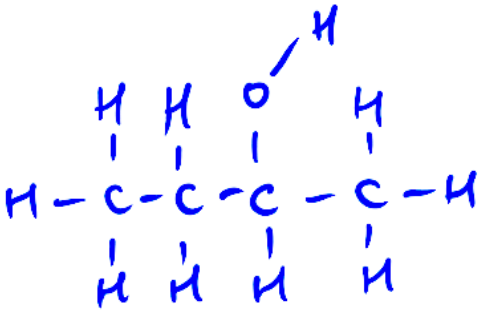
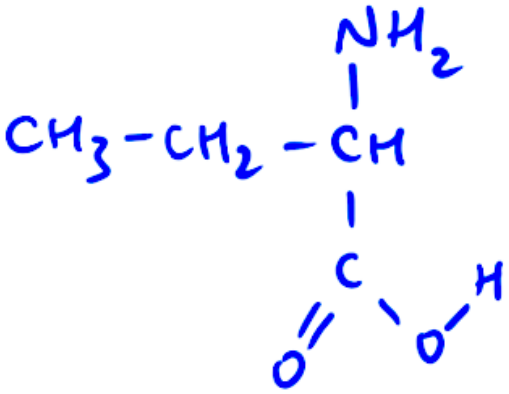


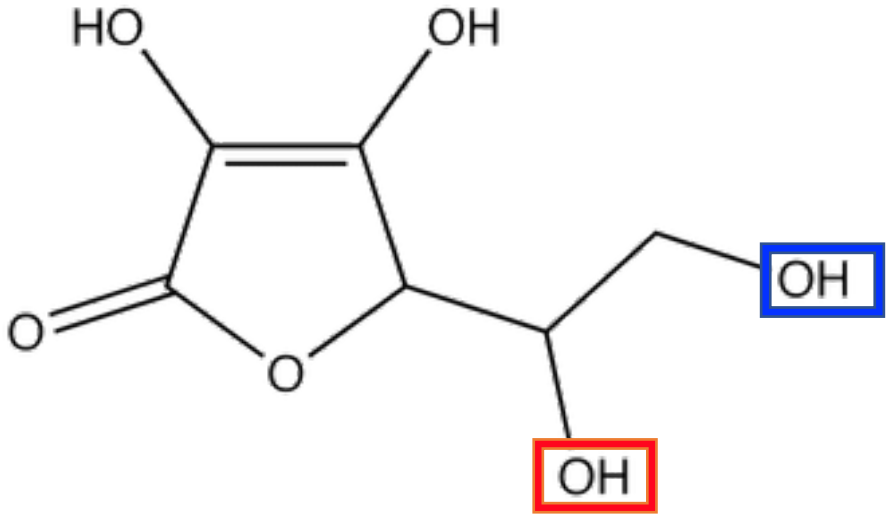
Question 9: Write the IUPAC name for the following organic compound.



Question 10: Write the IUPAC name for the following organic compound.



Question 11: Refer to the diagram below of ascorbic acid's chemical structure to answer part (a) and (b).



(a) Classify the hydroxyl groups, marked with red and blue rectangles, separately based on them being primary, secondary or tertiary alcohol group.
(b) Circle the part of the molecule that would react with bromine water, resulting in the decolourisation of bromine water.

Question 12: Draw the structural formulae for the monomers of polyethylene, poly(vinyl chloride), polystyrene and polytetrafluoroethylene.

Question 13: Write the structural formulae and IUPAC name for three isomers for $C_4H_{10}O$.

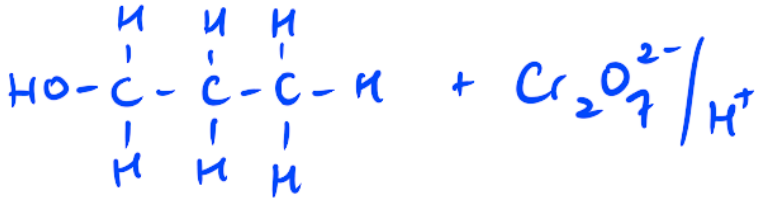
Question 14: Write the balanced chemical equation of converting ethanol from ethylene and vice versa, providing the reaction condition in your equations.

Question 15: Carboxylic acids undergo esterification with alcohols to produce esters.

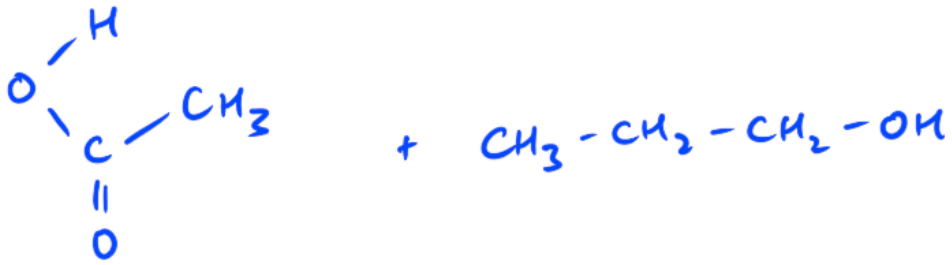
(a) What is the IUPAC name of the ester shown below?
(b) What is the IUPAC name of the alcohol & carboxylic acid used to produce the ester.
(c) In order to differentiate between the alcohol, carboxylic acid and ester in part (a) and (b), justify the physical or chemical properties that you would use.

Question 16: Draw the product of each of the following chemical reactions and name the resulting products' functional group.

(a)



(b)



(c)

(d)

Question 17: Write the structural formulae and IUPAC name for the primary, secondary and tertiary alcohol with the formula of C_4H_9OH.

Question 18: Explain the chemical tests that you would use to differentiate between a cyclohexane, cyclohexene, ethanol and hexanoic acid.

Question 19: Suppose your lab friend accidentally removed your beaker labels. You know that you have stored ethanoic acid, ethanol and ethyl ethanoate separately in three of the beakers which no longer has labels on them. Explain the procedure that you would use to identify the substance stored in each of the three beakers.

Question 20: Ascorbic acid can be found in oranges. The chemical reaction between ascorbic acid (HVit) and water is given as:

$$HVit_{(aq)} + H_2O_{(l)} \leftrightarrow Vit^-_{(aq)} + H_3O^+_{(aq)}$$

(a) Write the acid dissociation constant (K_a) for ascorbic acid which is expressed as HVit.
Determine the concentration of ascorbic acid given that the pH solution, formed after the dissolution of ascorbic acid in water, is 4.2. You are given that the K_a(ascorbic acid) = 8.0×10^{-5}.

(b) Given that the pK_a of ethanoic acid is 4.76. Explain whether or not ascorbic acid is a stronger acid than ethanoic acid.

(c) A fellow student performed a titration involving 0.02L of Vitamin C aliquot titrated with sodium hydroxide of 0.1M. Explain which of the following would be the titration curve for this titration.

(d) You went to Woolworths supermarket to buy orange juice to meet your daily Vitamin C intake. You measured the pH of the orange juice to be 2.8. Determine the $[Vit^-] / [HVit]$.

Question 21: Calculate the pH of a solution of 0.050M of hydrofluoric acid given that the acid dissociation constant for the acid is 3.5×10^{-4}.

Question 22: Calculate the pH of a solution of 0.010M of HCN given that the acid dissociation constant for the acid is 6.17×10^{-10}.

Question 23: Cobalt (II) chloride hexahydrate crystals can establish equilibrium as shown below, resulting in them having pink or blue colour.

$$[Co(H_2O)_6]Cl_{2\,(s)} \leftrightarrow [Co(H_2O)_4]Cl_{2\,(s)} + 2H_2O_{\,(g)} \quad \Delta H = 109 \text{ kJ/mol}$$

Pink Blue

HSC Pointer: You can assume that the change in enthalpy value is for the forward reaction if not specified in question.

(a) Justify the colour that you expect to see when a system containing pink and blue cobalt (II) chloride crystals is put under a burning bunsen burner.
(b) Account for the use of cobalt (II) chloride blue paper is suitable to detect the water with reference to the chemical equation in the question.

Question 24: By dissolving ammonium chloride in aqueous ammonia, a buffer solution can be formed. Given that the pK_a of ammonium ion is 9.24.

(a) Calculate the grams of NH_4Cl that you would need to dissolve in 0.05M of aqueous ammonia solution to create a buffer solution with a pH of 8.8.
(b) Discuss how the $[NH_3] / [NH_4^+]$ ratio and pH has an effect on the buffer capacity.

Question 25: Classify the following salts as either acidic, neutral or basic.

$$NaCl,\ NaOCl,\ NH_4Cl$$

Given that HOCl is a weaker acid, justify your answer and include all relevant chemical equations.

Question 26: From studies, it is generally found that lipids in food that are unsaturated are more favourable to the human body than saturated ones.

(a) Outline what does the term 'saturated' mean in terms of chemical structure of organic compounds.
(b) Explain the chemical test you would perform to determine whether a lipid is saturated or not.

Question 27: Describe the chemist test that would be suitable to differentiate between butan-1-ol and but-2-ene, the expected observations as a result of performing the test and explain why the test(s) chosen is suitable.

Question 28: Describe the chemist test that would be suitable to differentiate between butanoic acid and methylbutanoate, the expected observations as a result of performing the test and explain why the test(s) chosen is suitable.

Question 29: Define the term 'hydrocarbon'.

Question 30: Draw two structural isomers for an alkane molecule with 6 carbon atoms which is commonly found as refined petroleum in crude oil.

Question 31: Explain the term 'functional group' in the context of organic chemistry.

Question 32: State Le Chatelier's Principle.

Question 33: Define the term 'amphiprotic'.

Question 34: "Acetic acid is classified as a weak acid whereas nitric acid is a strong acid." Explain this statement.

Question 35: Define a 'base' and an 'acid' according to the Bronsted-Lowry definition.

Question 36: Calculate the pH of aqueous hydrochloric acid at a concentration of 0.14M.
Question 37: Write the chemical equations for the dissociation of hydrochloric acid in water and the dissociation of ethanoic acid in water.

Question 38: For the equilibrium $2NO_2$ (g) ↔ N_2O_4 (g) occurring in a closed system, explain what would happen to the concentration of both the reactant and product if the pressure of the system is increased.

Question 39: Explain the effect a catalyst has on system that is approaching and at equilibrium.

Question 40: For the following reaction at equilibrium in a closed system:

$$CO(g) + 2H_2(g) \leftrightarrow CH_3OH(g)$$

Outline two modifications to the system's environment that could be performed to increase the yield of methanol. Use Le Chatelier's Principle to justify your answer.

Question 41: Refer to Equation A and Equation B to answer part (a) and (b)

Equation A: H_2CO_3 (aq) + H_2O(l) ↔ HCO_3^- (aq) + H_3O^+ (aq)

Equation B: HCO_3^- (aq) + H_2O (l) ↔ CO_3^{2-} (aq) + H_3O^+ (aq)

(a) List 3 conjugate acid-base pairs shown in Equation A and B.
(b) The hydrogen carbonate ion is amphiprotic. Explain which one of the equation illustrates the ion acting as a Bronsted-Lowry base.

Question 42: Define the term 'buffer'.

Question 43: Define the term 'buffer capacity'.

Question 44: You created a buffer solution by dissolving ammonium chloride and aqueous ammonia.

(a) Write the relevant chemical equation illustrating this buffer

(b) Write the relevant chemical equation illustrating the reaction between hydrochloric acid with relevant component of the buffer as the acid is added into the buffer solution.
(c) Write the acid dissociation constant for ammonium ion in the buffer solution.
(d) Explain the reason towards why the change in pH is small when small quantities hydrochloric acid and sodium hydroxide are added into the buffer solution. Use relevant chemical equations to support your answer.
(e) Calculate the pH of the buffer solution given that the moles of NH_4Cl that is used to make the buffer is 0.100 moles which is dissolved in a one litre beaker of aqueous ammonia with a concentration equal to the moles of NH_4Cl used to make the buffer. You are given that the acid dissociation constant of NH_4^+ is equal to 5.8×10^{-10}

Question 45: You mixed 0.05L of aqueous potassium chloride at 0.1M with equal volume of silver nitrate at a concentration of 0.0200M. Determine whether or not a precipitate will form. Show all your working.

Question 46: Given the following equilibrium that is established in a lab at 2372 degrees Celsius, K_{eq} is equal to 4×10^{-4}.

$$N_2\,(g) + O_2\,(g) \leftrightarrow 2NO(g)$$

(a) Write the equilibrium constant expression in terms of concentration (K_c) for the above reaction.
(b) Suppose that the $[N_2]_{equilibrium} = 1.0 \times 10^{-1}$ and $[NO]_{equilibrium} = 1.0 \times 10^{-4}$, calculate $[O_2]_{equilibrium}$ at 2372 degrees Celsius.
(c) Now suppose that you pumped oxygen gas into the system that is at equilibrium. Explain what would will be the effect on the equilibrium constant value and effect on the concentration of nitrogen monoxide as a result of adding oxygen into the system.

Question 47: Explain the term 'conjugate acid-base pair' in terms of CH_3COOH and CH_3COO^-.

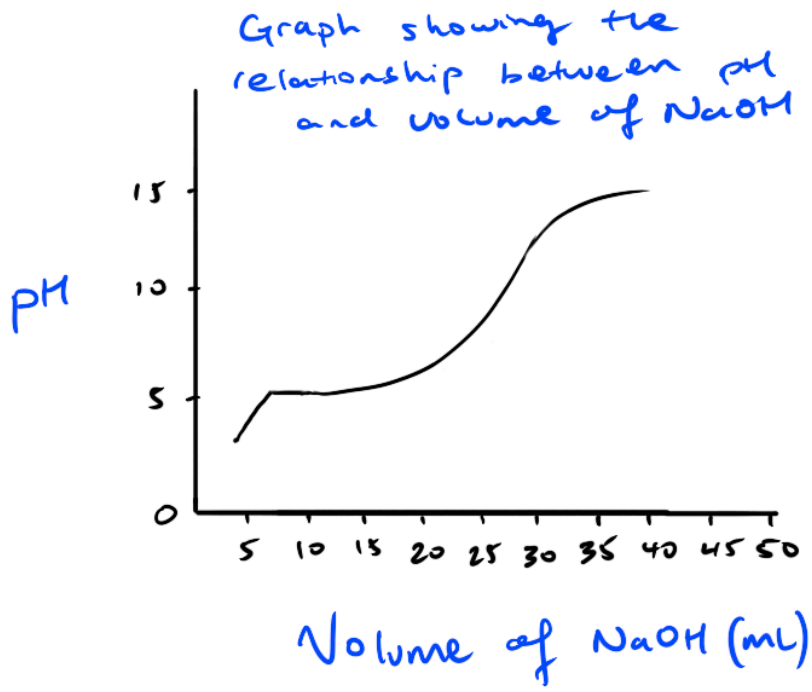
Question 48: A sample of paint was analysed for its lead content. Nitric acid was used to dissolve the Pb^{2+} ions. The filtrate was reacted with KI where the precipitate, lead (II) iodide, was analysed to determine the concentration of Pb^{2+} ions present in the paint sample.

(a) Write the expression for the solubility product of lead (II) iodide.
(b) You are given that at 25 degrees Celsius, the solubility of PbI_2 in one litre of water is 0.581 grams. Calculate the $[Pb^{2+}]$ and $[I^-]$ in a saturated solution of PbI_2 at 25 degrees Celsius.
(c) Given that the concentration of the KI solution is 0.1M, calculate the molar solubility of PbI_2 at 25 degrees Celsius.

Question 49: Given that the pK_a of HOCl is 7.54. Swimming pool has calcium hypochlorite added to them to establish a buffer.

(a) Determine the pH where the concentration of OCl^- is identical to that of HOCl.
(b) Explain how does the concentration of HOCl will shift compared to the concentration of OCl^- if the pH of the system is decreased.

Question 50: For the titration of acetic acid with sodium hydroxide, the pH graph is depicted below.



You are given the following data that is extracted from a scientist's handbook who performed the experiment.

$V_{CH3COOH}$ = 0.0100L
[NaOH] = 0.04M

Temperature = 25 degrees Celsius.

(a) Write a balanced chemical equation for the reaction.
(b) Identify the indicator that would be suitable to use in this titration and justify your choice.
(c) Determine the volume of sodium hydroxide that is used to attain equivalence point.
(d) Using the pH graph as a reference, approximate the pK_a of acetic acid.
(e) Calculate the concentration of acetic acid.
(f) Name 5 chemical species that you would expect to find in the salt solution at endpoint.

Question 51: You dissolved 0.5 grams of Lead (II) bromide in 0.05L of water.

(a) Write the chemical equation for the equilibrium established in a saturated solution of lead (II) bromide.
(b) Write the expression for the solubility product of lead (II) bromide.
(c) Calculate the solubility product value for lead (II) bromide.

Question 52: You wish to investigate the salinity of the water in your local lake. To do this, you titrated the chloride ions present in the water sample that you collected from the lake with $AgNO_3$. You used K_2CrO_4 as an indicator. You added deionised water to a 0.025L sample of lake water you collected to fill up a 0.250L volumetric flask. After titration, you found that 0.00915L of $AgNO_3$ at a concentration of 0.05M was required to be used in order to attain equivalence point with 0.01L of diluted seawater.

(a) Write the relevant chemical equation between chloride and silver ions.
(b) State the name of a potential common ion in your water sample that could react with $AgNO_3$.
(c) Calculate the concentration of chloride ions in the water sample that you collected from the lake under the assumption that chloride ions are the only ion that precipitated silver ions.
(d) Write the expression for the solubility product of silver chromate.
(e) You are given that the solubility product value of silver chromate is 1.3×10^{-12} at 25 degrees Celsius. Determine where a precipitate is formed at equivalence point if the $[Ag^+]$ is 2.0×10^{-4} and the $[CrO_4^{2-}]$ is 2.0×10^{-2}.

Question 53: As you have investigated in Module 5 of your HSC Chemistry Course, by adding thiocyanate ions to Fe^{3+} ions, an equilibrium can be established as shown by the equation below.

$$Fe^{3+}\ (aq) + SCN^{-}\ (aq) \leftrightarrow FeSCN^{2+}\ (aq)$$

Orange Colourless Dark Red

(i) Write the equilibrium constant expression for the equilibrium reaction above.

(ii) Suppose you pour enough NaF into the iron (III) thiocyanate equilibrium to cause a reaction, explain colour change would you expect to observe? Include a chemical equation to your answer.

Question 54: Refer to the following gaseous equilibrium below.

$$A(g) + 2B(g) \leftrightarrow C(g)$$

Explain, using collision theory, the direction in which the system's position will shift in order re-establish equilibrium in the event that the system's volume is DECREASED.

Question 55: Refer to the following gaseous equilibrium below.

$$A(g) + 2B(g) \leftrightarrow C(g)$$

Explain, using collision theory, the direction in which the system's position will shift in order re-establish equilibrium in the event that the system's volume is INCREASED.

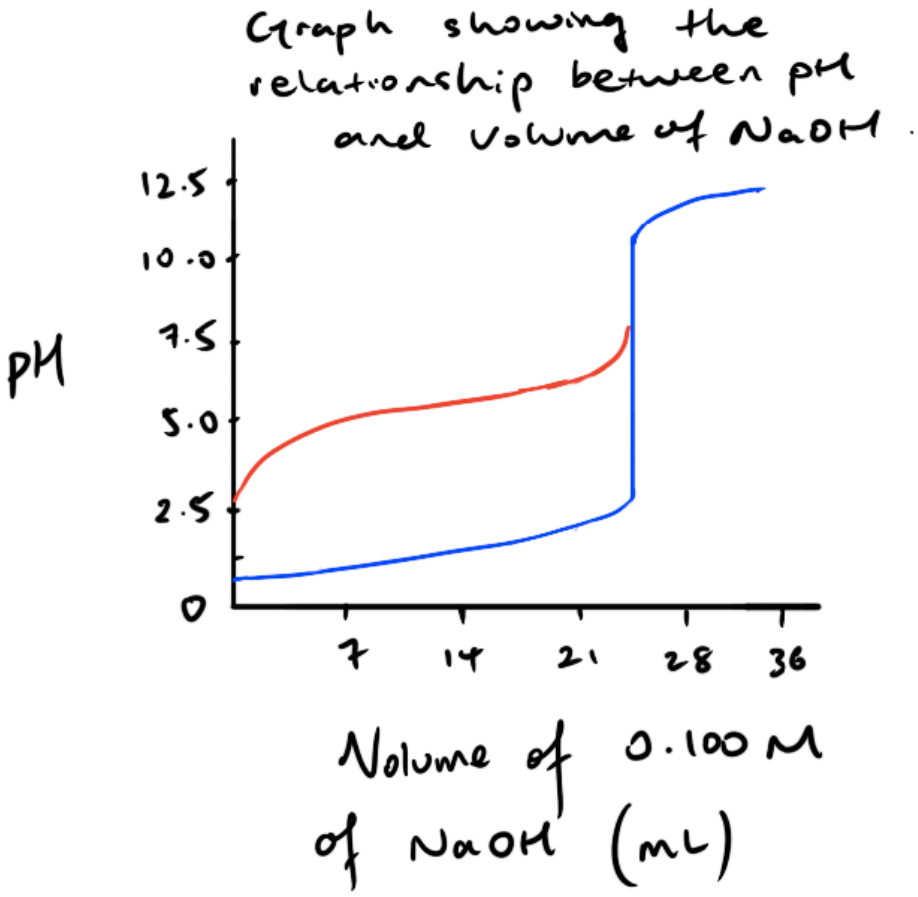
Question 56: The Haber Process equilibrium is depicted below to manufacture ammonia in industry. You are given that the forward reaction is exothermic.

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$$

(a) Write the equilibrium constant expression in terms of concentration for the above equilibrium.

(b) Explain the effect of increasing the system's pressure on the product's yield.
(c) Besides altering the system's volume or pressure, propose two changes you can induce into the equilibrium system in order to increase the yield of ammonia produced.

Question 57: The following chart depicts titration curves. The red line shows the titration of 0.025L of propanoic acid at 0.1M with NaOH. The blue line shows the titration of 0.025L of hydrochloric acid at 0.1M with sodium hydroxide. You are given that the acid dissociation constant for CH_3CH_2COOH is 1.4×10^{-5} M.



(a) Justify the reason towards why both acid-base titrations shown in the graph is found to use the same average volume of sodium hydroxide to reach the equivalence point.
(b) Justify the reason towards why the pH of the solution <u>at equivalence point</u> is HIGHER in the propanoic acid – sodium hydroxide titration compared to the hydrochloric acid – sodium hydroxide titration.

(c) Justify the reason towards why the pH of the solution **prior to equivalence point** is **HIGHER** in the propanoic acid – sodium hydroxide titration compared to the hydrochloric acid – sodium hydroxide titration.
(d) Justify the reason towards why the pH of the solution **after the equivalence point** is **EQUAL** in the propanoic acid – sodium hydroxide titration compared to the hydrochloric acid – sodium hydroxide titration.
(e) Given the following indicators and their pK_a, justify which indicator is the most appropriate for the titration between CH_3CH_2COOH and NaOH.

Indicator	pK_a
Methyl Orange	3.7
Methyl Red	5.1
Phenolphthalein	9.6

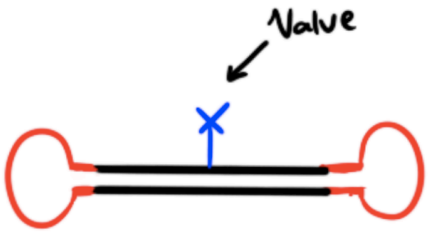
Question 58: For the equilibrium, $2NO_2\ (g) \leftrightarrow N_2O_4\ (g)$, the equilibrium constant value in terms of concentration (K_c) is equal to 6.3×10^{-3} at degrees Celsius. The change in enthalpy for the forward reaction is exothermic.

(a) Explain which of the two oxides would have the greater equilibrium concentration at 230 degrees Celsius.
(b) Given that nitrogen dioxide exhibit a brown colour and dinitrogen tetroxide is colourless, explain what macroscopic observations you would expect to see if:
    (i) The temperature of the system at equilibrium is doubled
    (ii) Additional nitrogen dioxide is pumped into the system at equilibrium

Question 59: Suppose that the pOH of acid X is 11 and the pOH of acid Y is 13. You are told that both of the acids have same the concentration of 0.10M.

(a) Explain which of the two acids (X or Y) is stronger, supporting your answer by referencing the pH of the two acids.
(b) Describe two other chemical tests that you could determine which of the two acids (X or Y) is the stronger acid besides measuring pOH or pH.

Question 60: The tubes of two round-bottomed flasks, each had a volume of one litre, were connected and separated by a valve, as shown in the diagram below.



Suppose that you pump iodine gas into one flask and hydrogen gas into the other with the valve closed to prevent the mixing of the gases. You are given that iodine gas has a purple colour, hydrogen gas is colourless, hydrogen iodide is colourless.

(a) When the valve is opened, the gases are allowed to mix and reach equilibrium. Write the relevant chemical equation to illustrate the reaction between hydrogen and iodine gas.
(b) Describe the macroscopic changes that you would observe as the system establishes equilibrium.
(c) You measured that the equilibrium concentration of hydrogen and iodine gas are both equal to 1.12×10^{-3}. The concentration of hydrogen iodide at equilibrium is equal to 7.76×10^{-3} at equilibrium. Determine the equilibrium constant value in terms of concentration.
(d) Predict what would happen to the $[H_2]_{equilibrium}$ if iodine gas is added into the system with the valve opened.
(e) Knowing that the forward reaction is endothermic, predict how the concentration of hydrogen gas at equilibrium will change if the temperature of the system is increased.

Question 61: It is found that when 0.020L of HCl at the concentration of 0.5M is reacted with the same volume of sodium thiosulfate at 45 degrees celsius, a sulfur precipitate will be formed. The observation of precipitation is when the solution becomes cloudy after 2 minutes. Explain if the time taken for the same precipitate to form would be more or less than 2 minutes if the reaction occurred at 80 degrees Celsius instead. Support your answer by using collision theory.

Question 62: Write the equilibrium constant expression in terms of concentration for $SO_2(g) + ½\ O_2(g) \leftrightarrow SO_3(g)$

Question 63: During the making of soft drinks, carbon dioxide is dissolved in aqueous $NaHCO_3$. As a result, an equilibrium between water and carbon dioxide in water forms carbonic acid can be established when soda is sealed in a can. Explain why an open soft drink would be more basic than a closed soft drink.

Question 64: Given that the pK_a of phosphate ion is 12.2 and the pK_a of ammonium ion is 9.2, determine whether ammonia or phosphate ion is the stronger base.

Question 65: It is found that the $H_2PO_4^-$ / HPO_4^{2-} buffer is naturally occurring in human urine.

(a) Write the acid dissociation constant expression for the buffer.
(b) Given that the pK_a for the dihydrogen phosphate ion – hydrogen phosphate buffer is 7.0, determine which species in the acid-base conjugate pair that make up the buffer exist in higher concentration if urine has a pH of 5.9.

Question 66: Describe the observation when a carboxylic acid reacts with Na_2CO_3.

Question 67: Justify in terms of the physical AND chemical properties of the following generic classes of compounds in order to differentiate them from each other through chemical tests.

Class A: Alcohol
Class B: Aldehyde
Class C: Carboxylic Acid

Question 68: Draw the structural isomers of pentane.

Question 69: Explain the difference between a reversible and an irreversible reaction.

Question 70: Explain the difference between reaction rate and extent of reaction.

Question 71: Explain the purpose of providing temperature when reporting equilibrium constant value.

Question 72: Explain the difference that you would expect to see in the infrared spectra of butanoic acid and butan-1-ol.

Question 73: Calculate the percentage yield of ethanoic acid that is produced by the oxidation of 36.1 grams of ethanol. You are given that 20.3 grams of ethanoic acid was successfully obtained.

Question 74: You mixed propene with hydrochloric acid to produce two isomers.

(a) Draw the two isomers that you expect to be produced as products
(b) A fellow student claimed that you can use proton NMR to differentiate the two isomers that you have drawn in part (a). Explain which or not the student's statement is correct.

Question 75: Draw the structural isomers of C_3H_8O.

Question 76: Define the term 'structural isomer', providing examples to illustrate your answer.

Question 77: Name the reagent that can be used in order to convert butan-1-ol to 1-chlorobutane

Question 78: Lead (II) chromate is not very soluble in water and has a yellow appearance.

(a) Write a balanced chemical equation showing the dissolution of lead (II) chromate in water.
(b) Write the solubility product expression for $PbCrO_4$.
(c) Given that the solubility of lead (II) chromate is 1.9×10^{-14}, calculate the concentration of chromate ions in a saturated solution of lead (II) chromate.
(d) Suppose you pour 0.030L of $Pb(NO_3)_2$ at a concentration of 0.1M and 0.020L of K_2CrO_4 at the same concentration as lead (II) nitrate. Calculate the concentration of lead ions present in solution after precipitation and the concentration of chromate ions after the precipitation of $PbCrO_4$.

Question 79: State a main feature of a monomer that allows it to be used to manufacture a condensation polymer.

Question 80: Describe the method that you would use to convert ethane to ethanoic acid.

Question 81: List the factors that distinguishes infrared spectroscopy from NMR spectroscopy.

Question 82: Explain the trend in boiling point between primary, secondary and tertiary alcohols.

Question 83: Explain the trend in the solubility in water between primary, secondary and tertiary alcohols.

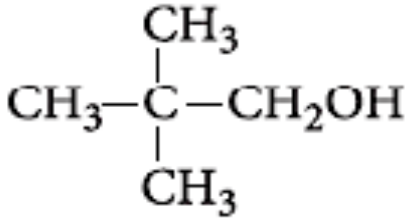
Question 84: The fermentation of sucrose present in sugar cane and fruits such as grapes is important in producing ethanol that is used as fuel and a solvent in paints. The process of converting sucrose to ethanol is shown in the chemical reactions below.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} 2\underset{\text{Ethanol}}{C_2H_5OH} + 2CO_2$$

Evaluate the importance of manufacturing ethanol via fermentation.

Question 85: State if the following alcohols are primary, secondary or tertiary.

Alcohol	**Class** (Primary, Secondary or Tertiary)
	

$H_2C=CH-CH_2OH$	
$CH_3CH_2CH_2OH$	

Question 86: Draw the molecular structure of 4-chloropentan-2-one.

Question 87: Draw the molecular structure of 3-methylbutanal.

Question 88: Draw the molecular structure of 3-oxopentanal.

Question 89: State the IUPAC name of CH_3CH_2CHO.

Question 90: Explain the method that you use to convert propan-2-ol to Propanone.

Question 91: Explain the reason towards why aldehydes and ketones have a lower melting and boiling point than comparable alcohol (i.e. alcohol with same number of carbon atoms).

Question 92: Justify the statement that "A chemical property of amine is that they are basic."

> **Fun Fact:** Did you know a physical property of amines is that they're unstable and they can *explode* if they're in a dry, solid state? :O

Question 93: State the IUPAC name for $H_2NCH_2CH_2CH=CH_2$

Question 94: Write the structural formula for N,N-ethylmethylamine.

Question 95: Arrange the following molecules in increasing order of their boiling point and explain why.

Ethanol, $C_2H_5NH_2$ and $(CH_3)_3N$

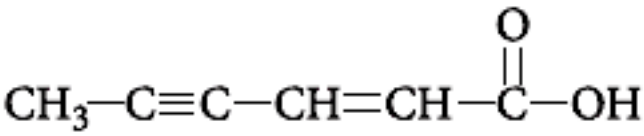
Question 96: Explain the purpose of refluxing in esterification.

Question 97: Explain one effect of adding unreactive gases on a system that has established a homogenous gaseous equilibrium.

Question 98: Explain if polyethylene is classified as an addition polymer or a condensation polymer.

Question 99: Draw the chemical structure of the monomer of Nylon.

Question 100: State the IUPAC name for the molecule below.



Question 101: State the reason to why a water bath is used during esterification rather than directly heating the reaction mixture in a round-bottom flask.

Q102 – Q200

There will be a scheduled email sent to you for the download link for Q102 – 200 alongside answers to Q1 – Q100 next Sunday.

MULTIPLE CHOICE QUESTIONS

Question 1: Which of the following is correctly shows the incomplete combustion of ethanol?

(A) C_2H_5OH (l) + O_2 (g) ↔ CO_2 (g) + H_2O (l)
(B) C_2H_5OH (l) + 5/2 O_2 (g) ↔ $2CO_2$ (g) + H_2O (l)
(C) $2C_2H_5OH$ (l) + $5O_2$ (g) ↔ $4CO_2$ (g) + $2H_2O$ (l) + $C_{(s)}$
(D) C_2H_5OH (l) + O_2 (g) ↔ CO (g) + H_2O (l)

Question 2: Aldehyde and ketones have higher melting and boiling points than alkanes of comparable molecular mass (same number of carbon) due to
(A) Alkanes have weaker dispersion forces than aldehyde and ketone.
(B) Aldehyde, ketone and alkane all exhibit dispersion forces.
(C) Aldehyde and ketone exhibit dispersion forces.
(D) Aldehyde and ketone exhibit dipole-dipole forces.

Question 3: Instead of reacting saturated alkanes and bromine water under high temperature, ultraviolet from sunlight can used to allow the substitution reaction of saturated alkane and bromine water to occur. Here, ultraviolet light is acting as a:

(A) Intermediate
(B) Reactant
(C) Catalyst
(D) By-product

Question 4: Which of the following is false about Le Chatelier's Principle?

(A) Le Chatelier's Principle states that if a system at equilibrium is disturbed, the system will respond to counteract and minimise the change in order to re-establish equilibrium.
(B) Le Chatelier's Principle predicts the extent of change in order to re-establish when a closed system at equilibrium is disturbed.
(C) Le Chatelier's Principle can be used to assist in devising changes to be made into a system to increase the yield of the product(s).
(D) Le Chatelier's Principle can be used to predict how a system at equilibrium will respond to an applied disturbance.

Question 5: If K_c is greater than 1000 then it is generally considered that

(A) The product's equilibrium concentration is large.
(B) At equilibrium, most of the reactants are consumed relative to products formed.
(C) The forward reaction is thermodynamically more favourable compared to the reverse reaction.
(D) The forward reaction is mostly likely exothermic.

NOTE: If K_c is approximately equal to 1, then we are able to obtain appreciable amounts of products provided that the reaction conditions are chosen appropriately and carefully monitored.

Question 6: If K_c is less than 0.001 then it is generally considered that

(A) The product's equilibrium concentration is small.
(B) At equilibrium, most of the reactant are unreacted compared to the products formed.
(C) The forward reaction is thermodynamically less favourable compared to the reverse reaction.
(D) The forward reaction is mostly likely endothermic.

NOTE: If K_c is approximately equal to 1, then we are able to obtain appreciable amounts of products provided that the reaction conditions are chosen appropriately and carefully monitored.

Question 7: Suppose that you have appreciable amounts of chloroethane in your test sample. Which of the following would you observe in your proton NMR spectra?

(A) A quartet and doublet
(B) A triplet and quartet
(C) A doublet and singlet
(D) A triplet and doublet

Question 8: In a carbon-13 NMR spectrum, which of the following is correct about the amount of signals that 2-methylpropanoic acid would exhibit?

(A) Two
(B) Three
(C) Four
(D) Five

Question 9 [OUT OF SYLLABUS]: For the reaction, 4E(g) + 4D(g) ↔ 5F(g) where the forward reaction is exothermic, which of the following is true about the units of the equilibrium constant value.

(A) M
(B) $M^{1/2}$
(C) M^{-1}
(D) $M^{1/2}$

NOTE: This question is just for fun. Good practice in working out your units.

Question 10: What is the correct K_c expression for the following esterficiation reaction to manufacture the ester, ethyl ethanoate.

$$CH_3COOH(l) + CH_3CH_2OH(l) \; CH_3COOCH_2CH_3(l) + H_2O(l)$$

(A) $K_c = \frac{[CH_3COOCH_2CH_3]eq\,[H_2O]eq}{[CH_3COOH]eq\,[CH_3CH_2OH]eq}$

(B) $K_c = \frac{1}{[CH_3COOH]eq\,[CH_3CH_2OH]eq}$

(C) $K_c = \frac{[H_2O]eq}{1}$

(D) $K_c = \frac{[CH_3COOCH_2CH_3]eq}{1}$