Conquer

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2019 HSC CHEMISTRY

LECTURE GIFT

1000 QUESTIONS

(FREE RESPONSE & MCQ QUESTIONS)

PART II

(200/1000)

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Be sure to include your unique Lecture Ticket Number alongside your enquiry.

Question 101: For the reaction:

$$CO_{2(g)} + C_{(s)} \leftrightarrow 2\ CO_{(g)}$$

Compute the equilibrium constant value in terms of concentration at 800 degrees Celsius when the initial partial pressure of CO_2 is 0.40 atmospheres and the total equilibrium pressure is 0.70 atmospheres.

Question 102: Using Le Chatelier's Principle, you can infer:

(A) The direction in which the equilibrium position will shift due to a change in the system's pressure, temperature or concentration of reacting species.
(B) The K_a value of a weak acid.
(C) The equilibrium constant value of the reaction.
(D) The change in enthalpy value of the reaction.

Question 103: Suppose you have the following reaction in a closed system:

$$A_{(s)} \leftrightarrow 2B_{(g)} + C_{(g)}$$

Initially, at equilibrium, the system has a total pressure of 'P' due to gases B and C. However, you added more gas B into the system such that the new partial pressure of gas B is equal to the original total pressure of the system, P.

Express the relationship between the original and new total pressure of the system as a percentage.

Question 105: What is the name of compound A that is formed from the reaction between ethanol and acidified $Na_2Cr_2O_7$ and the name of Compound B that is formed due to further reaction.

(A) Compound A = CH_3CHO and Compound B = CH_3COOH
(B) Compound A = CH_3COCH_3 and Compound B = CH_3COOH
(C) Compound A = CH_3COOH and Compound A = CH_3CHO
(D) Compound A = CH_3OCH_3, Compound B = CH_3CH_3

Question 106: Calculate the percentage of sulfur dioxide that is consumed to produce sulfur triodixde and nitric oxide for the following reaction with nitrogen dioxide:

$$SO_2(g) + NO_2(g) \leftrightarrow SO_3(g) + NO(g)$$

You are given that the K_c = 3.0 for the reaction and that the concentration of sulfur dioxide and nitrogen dioxide are at 1.5M when they were added into a closed vessel.

Question 107: Given that the K_c value for the following reaction is equal to 10.

$$H_{2\,(g)} + I_{2\,(g)} \leftrightarrow 2HI_{\,(g)}$$

Determine the percentage dissociation of hydrogen iodide with an initial concentration of 3M.

Question 108: Which of the following is false in order for a dynamic equilibrium to be established.

(A) At equilibrium, the closed system must have constant macroscopic properties such as colour, pH, pressure and temperature.
(B) The system must be closed.
(C) The equilibrium position will always shift when there is a change in volume or pressure.
(D) The equilibrium position would shift when a disturbance is applied to the system such as altering the concentration of reacting species and temperature.

Fun True/False Question 109 (Outside scope of HSC Syllabus): If macro-property of temperature is constant at equilibrium for a closed system, the system must be a thermal equilibrium with its environment such that the transfer of kinetic energy to and from the system must be occurring at the same rate.

Question 110: Define the term 'equilibrium position'.

Question 111: Which disturbance, if applied to a system at equilibrium, would you not expect to see a sudden change in the concentration of reacting species?

(A) A change in temperature
(B) A change in volume or pressure
(C) The addition of a catalyst.
(D) A change in concentration of reacting species

Question 112: Explain the shift in equilibrium position due to changes in temperature with reference to the change in forward and reverse rate of reaction and activation energy.

Question 113: Describe the effect of entropy and enthalpy as thermodynamic factors on a system attaining equilibrium.

Question 114: For the reaction that is at equilibrium:

$$2NO(g) + O2(g) \leftrightarrow 2NO2(g)$$

Given that initially the moles of nitric oxide, oxygen and nitrogen dioxide at equilibrium are 0.24, 0.1 and 1.2 respectively. Calculate the moles of oxygen required to be pumped into the system to increase the moles of nitrogen dioxide by 0.1 moles in the new equilibrium position.

Question 115: Suppose you have a solution containing Pb^{2+}, Cu^{2+} and Ag^{+} ions. Construct a flowchart that illustrates the method that can be used to confirm the presence of each of the ions.

Question 116: Suppose you have a solution containing CO_3^{2-} and PO_4^{3-} ions. Construct a flowchart that illustrates the method that can be used to confirm the presence.

Question 117: Explain with the name of two reactants that you can use to INCREASE the solubility of magnesium hydroxide with reference to Le Chatelier's Principle.

Question 118: Explain with the name of two reactants that you can use to DECREASE the solubility of magnesium hydroxide with reference to Le Chatelier's Principle.

Question 119: You are ordered by the teacher to perform some calculations involving the solubility product of barium sulfate with relation to sodium sulfate.

(a) Calculate the maximum grams of barium sulfate that can be dissolved in 0.2L of water, suppose no change in volume.

(b) Calculate the maximum grams of barium sulfate dissolved in 0.2L of aqueous sodium sulfate without the formation of a precipitate.

Question 120: Compare the Arrhenius and Bronsted-Lowry theories used to define acids and bases, providing examples in your response.

Question 121: Which of the following is false between the relationship endpoint and equivalence point

(A) The pH of the endpoint of an indicator is dependent the equivalence point.
(B) The pH of the endpoint is dependent of the indicator.
(C) The pH of the endpoint of an indicator is independent of the titration's equivalence point.
(D) The pH of the endpoint should be close to the equivalence point of titration.

Question 122: You are given that the K_a of 0.1M $H_2PO_4^-$ is equal to 6.2×10^{-8}. Determine if a solution of aqueous sodium dihydrogen phosphate will be acidic or basic.

Question 123: The decomposition of calcium carbonate into calcium oxide and carbon dioxide is allowed to reach equilibrium with a K_p value of 2.4.

Calculate the mass of calcium carbonate at equilibrium if 190 grams of calcium carbonate was initially added into a twenty-litre closed system at a temperature of 230 degrees Celsius.

Question 124: For the following equation, calculate the equilibrium constant value in terms of pressure.

$$2KClO_3\ (s) \leftrightarrow 2KCl\ (s) + 3O_2\ (g)$$

You are given that, at equilibrium, the system's pressure is 0.40 atm with some $KClO_3$ and KCl present.

Question 125: Suppose that you initially placed 0.2 kg of NH_4HS solid into a closed system which is allowed to decompose to form ammonia and hydrogen sulfide with a K_p of 1.5 for the equilibrium formed at 700 kelvins.

Calculate the mass of NH_4HS that is left **NOT** decomposed at equilibrium.

Question 126: For the decomposition of nitric oxide into nitrogen and oxygen gas, calculate the equilibrium constant value in terms of concentration. You are given that the initial NO concentration is 0.2M with a 10% dissociation.

Question 127: Provide one reason why the following system represents an example of a heterogenous equilibrium.

$$H_2O\ (s) \leftrightarrow H_2O\ (l)$$

Question 128: Construct the chemical equation for the equilibrium, $K_c = \frac{[CH4][H2O]}{[CO][H2]^3}$.

Question 129: For the following chemical equilibrium

$$As_4O_6\ (s) + 6C\ (s) \leftrightarrow As_4\ (g) + 6CO\ (g)$$

Explain whether or not the equilibrium position will shift if As_2O_6 is added into the system. If so, state in which direction.

Question 130: Calculate the percentage yield for the equilibrium reaction formed when 13.19 grams of nitrogen gas is mixed with 7.2 grams of hydrogen to form 4.12 grams of ammonia.

Question 131: What is the difference between yield and purity, provide a generic equation for both.

Question 132: List three factors that you can change to increase the rate of reaction.

Question 133: For the equilibrium formed from the dissociation of hydrogen iodide into hydrogen and iodine gas at 80 degrees Celsius, the equilibrium constant value is approximately equal to 0.91. Given that the initial concentration of hydrogen gas and iodine gas is 1.50 moles per litre at equilibrium, calculate the equilibrium concentration of hydrogen iodide.

Question 134: The nature of chlorine ions in the reaction below is

$$3Cl^-\ (aq) + 4CrO_4^{2-}\ (aq) + 23H^+\ (aq) \leftrightarrow 3HClO_2\ (aq) + 4Cr^{3+}\ (aq) + 10H_2O(l)$$

(A) Reductant
(B) Oxidant
(C) Catalyst
(D) Base

Question 135: The rate constant (k) for the forward reaction shown below is 2.0×10^{-5} M/s.

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

You also know that the equilibrium constant for the same reaction is 1.0×10^{3}. Calculate the rate constant (k) for the reverse reaction.

(A) 2.0×10^{-8}
(B) 2.0×10^{-9}
(C) 5.0×10^{7}
(D) 10.0×10^{7}

Question 136: Suppose you have a buffer with equal concentrations of a weak base and its conjugate acid. If you pour water such that the initial volume of the buffer is multiplied by two, what is the resulting pH of the buffer solution after dilution compared prior dilution?

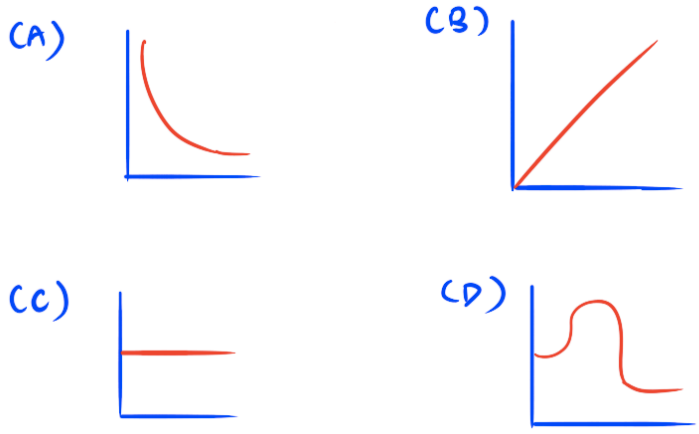
(A) pH will increase by one unit compared to initial pH
(B) pH will decrease by one unit compared to initial pH
(C) pH will increase almost by one unit compared initial pH
(D) There will be little effect on the buffer's pH after dilution.

Question 137: The Arrhenius equation helps govern the rate constant which are used to derive the equilibrium constant expression. Which of the following variables will lower the rate constant of the forward reaction which is calculated by the Arrhenius equation, as shown below.

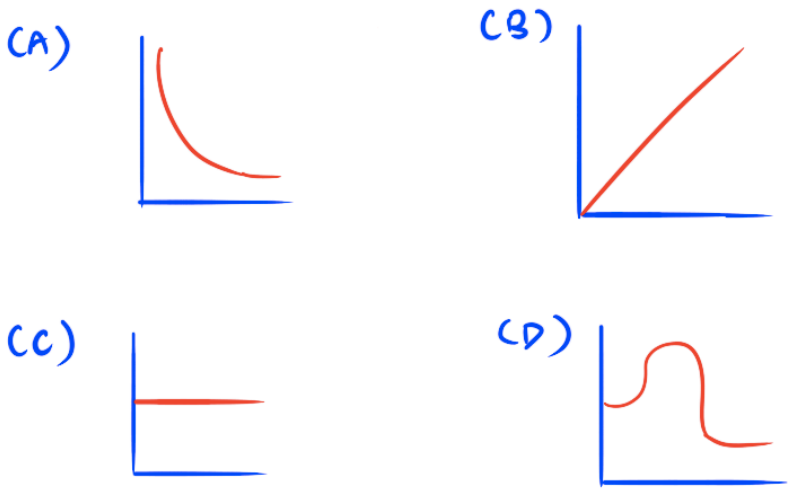
$$k_{forward} = Ae^{\frac{-Ea\ (forward)}{RT}}$$

(A) Decreasing system's temperature
(B) Increase reactant's concentration
(C) Increasing system's volume
(D) Reducing the forward reaction's activation energy.

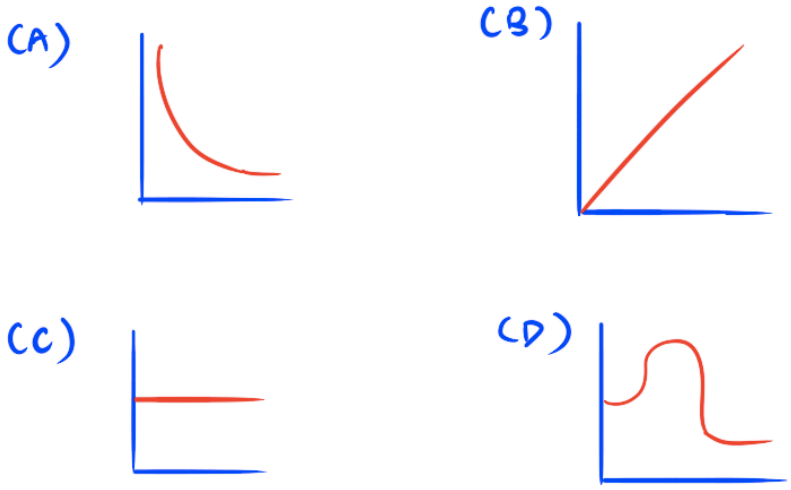
Question 138: Which of the following diagram best illustrates the relationship between activation energy and rate of reaction?



Question 139: Which of the following diagram best illustrates the relationship between temperature and rate of reaction?



Question 140: Which of the following diagram best illustrates the relationship between activation energy and temperature?



Question 141: Write the equilibrium constant expression for the following reaction

$$NOCl(g) \leftrightarrow NO(g) + \frac{1}{2} Cl_2$$

Question 142: Is the following equilibrium reaction one of homogenous or heterogenous? Explain your answer.

$$H_2O(l) \leftrightarrow H_2O(g)$$

Question 143: In a saturated solution of aqueous potassium chloride that has established equilibrium, the intermolecular forces between water molecules, lattice energy and ion-dipole forces are also at equilibrium.

Predict the effect of the solubility of ionic compounds if the strength of the solvent intermolecular forces and lattice energy are decreased.

Question 144: Calculate the concentration of hydronium ions in solution with a hydroxide ion concentration of 4.8×10^{-3}.

Question 145: Which of the following involves a cautious and controlled neutralisation reaction

(A) Precipitation
(B) Oxidation
(C) Titration
(D) Dissociation

Question 146: Construct a graph for the system containing substances A and B. You are given that, initially, 0.5M of substance A was inserted into the system to establish an equilibrium with B. Illustrate and label all relevant parts of your graph.

Use the following data to answer Question 147 – 150.

The following equilibrium is allowed to be established in a closed 5 litre container.

$$4H_2\,(g) + CS_2\,(g) \leftrightarrow CH_4\,(g) + 2H_2S\,(g)$$

You are also given the following information

Reacting Species	Initial moles	Equilibrium concentration
Hydrogen Gas	2.5	Unknown
Carbon sulfide	1.5	Unknown
Methane	1.5	0.25M
Hydrogen sulfide	2.0	Unknown

Question 147: Which of the following ratio represents the change in concentration relationship between the two reacting species shown below.

$$\frac{\Delta[H2S]}{\Delta[CS2]}$$

(A) +2 / +1
(B) -2 / -1
(C) +1 / -1
(D) -2 / +1

Question 148: What is the change in the moles of hydrogen sulfide that was initially added to when equilibrium is established.

Question 149: What is the number of moles of carbon sulfide at equilibrium.

Question 150: What is the concentration of hydrogen at equilibrium.

Question 151: For the reaction $2A(g) \leftrightarrow B(g) + C(g)$ with an equilibrium constant of 0.020 at 300 degrees Celsius, the initial concentrations of all three gases are equal to 1.5×10^{-3}. Which of the following is true?

(A) The concentrations of B and C gases will increase as the system reaches equilibrium.
(B) The system is at equilibrium.
(C) The concentrations of A and B gases will increase as the system reaches equilibrium.
(D) The concentration of A gas will increase as the system reaches equilibrium.

Question 152: For the equilibrium involving the reaction between sulfur dioxide and oxygen to form sulfur trioxide as shown below

$$2SO_2\,(g) + O_2\,(g) \leftrightarrow 2SO_3\,(g)$$

Which of the following is true if the initial moles of sulfur dioxide and oxygen are equal in a one litre reaction vessel?

(A) $[SO_2] > [O_2]$
(B) $[SO_2] = [SO_3]$
(C) $[SO_2] < [O_2]$
(D) $[SO_2] = [O_2]$

Question 153: The appropriate equilibrium expression in terms of concentration for the following reaction is:

$$CoO\,(s) + H_2\,(g) \leftrightarrow Co\,(s) + H_2O\,(g)$$

(A) $[Co]\,[H_2O] / [CoO]\,[H_2]$
(B) $[H_2] / [H_2O]$
(C) $[CO]\,[H_2O] / [H_2O]$
(D) $[H_2O] / [H_2]$

Question 154: Write the base dissociation constant expression for the reaction between ammonia and water.

Question 155: For the following equilibrium reaction, calculate the equilibrium concentrations of hydrogen iodide, hydrogen and iodine gas.

$$2HI(g) \leftrightarrow H_2(g) + I_2(g)$$

You are given that the initial concentration of hydrogen and iodine gases to be 0.010 M and the initial concentration of hydrogen iodide to be 0.096M.

Question 156: Draw a Beer's Law calibration plot for the data below obtained from the equilibrium formed between Iron (III) ions, thiocyanate ions and Iron (III) thiocyanate ions.

Concentration (M)	Absorbance
1.1×10^{-4}	0.30
3.0×10^{-4}	0.065
8.0×10^{-4}	0.160
12×10^{-4}	0.239
18×10^{-4}	0.340

Question 157: The equilibrium constant value, K_{eq}, is governed by which of the following?

I. The system's temperature
II. The nature of the species (reactants and products) involved in the reaction
III. The concentration of reactants
IV. The concentration of products

(A) I and II
(B) I and III
(C) I, III and IV
(D) I, II, III and IV

Question 158 - Quick True or False Question: Changes in the system's volume & pressure do not affect the value of equilibrium constant. This also the same for changes in the reacting species (reactant(s) and product(s) involved in the equilibrium reaction). Volume, pressure and changes in concentration only affects the equilibrium concentration of the reactants and products but not the equilibrium reaction's K_{eq}.

(A) True
(B) False

Question 159: Use the following figures, representing the reaction X ↔ Y, to answer parts (a) – (d).

Figure I.

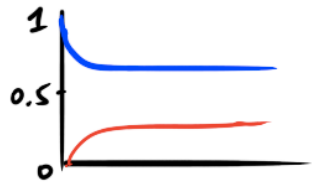


Figure II.

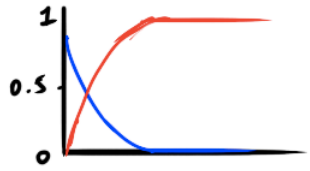


Figure III.

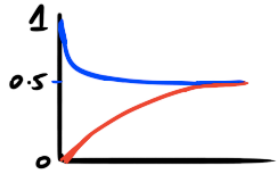
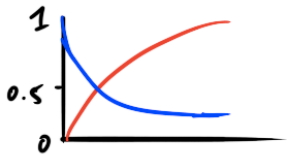


Figure IV.



(a) Which figure shows show a complete reaction?
(b) Which figure shows a reaction with an equilibrium constant value of almost 1?
(c) Which figure, out of the four figures, has the smallest equilibrium value?
(d) Which figure shows approximately equal concentrations of X and Y substances at equilibrium?

Question 160: The rate law is used to derive the equilibrium constant expression. For the reaction below, the rate of the forward reaction be determined using the equation, Rate = $k[BF_3][NH_3]$ given that the rate constant for the forward reaction is 3.41 M/sec. Calculate the $rate_{forward}$ for the concentrations of both BF_3 and NH_3 being 0.5 moles per litre.

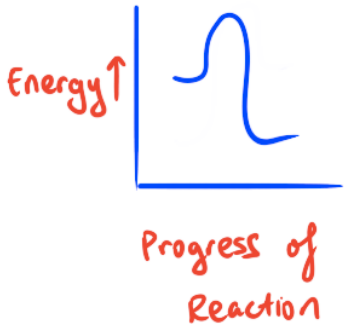
(A) 0.8 M/sec
(B) 0.4 M/sec

(C) 0.25 M/sec
(D) 0.5 M/sec

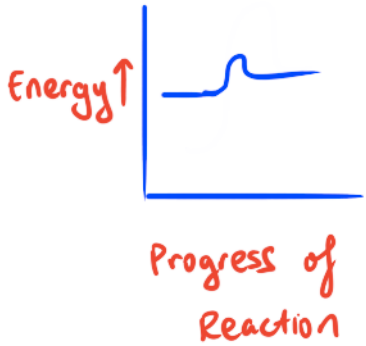
Question 161: Which of the following reaction energy diagram corresponds to a reaction that is both fast and exothermic.

(A)

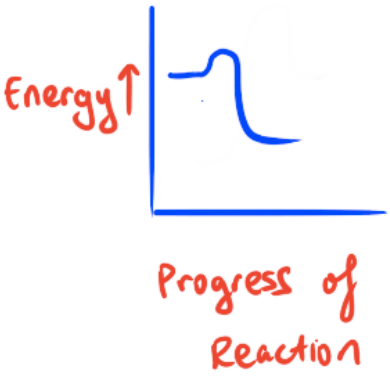
(B)



(C)



(D)



Question 162: Suppose you mix 0.005M of lactic acid and 0.06M of propionic acid with the acid dissociation constant of 1.4×10^{-4} and 1.4×10^{-5} respectively. What is the resulting pH of the solution due to the two acids, assume no reaction due to their low concentration.

Question 163: Suppose the following system involving the interaction between hydrogen, hydrogen iodide and iodine gases which is allowed to reach equilibrium:

$$H_2(g) + I_2(g) \leftrightarrow 2\ HI(g)\ ;\ K_c \text{ and } K_p = 51.0$$

Side Note: K_c and K_p does not necessarily have to be equal. The reason for this has to do with the equation $K_p = K_c(RT)^{\Delta n}$ which is **OUTSIDE** the scope of HSC Chemistry.

You are given that the initial pressure of hydrogen iodide is 0.975 kPa, hydrogen and iodine gases are both at 0.105 kPa initially. Calculate the equilibrium partial pressure of all three gases.

Question 164: A closed system at equilibrium has the reaction shown below.

$$3\ Fe(s) + 4\ H_2O(g) \leftrightarrow Fe_3O_4(s) + 4\ H_2(g)\ ;\ \Delta H_{forward} = -200\ kJ$$

Which of the following disturbances, if be applied to the system, will reduce the yield of hydrogen gas.

(A) Increasing the temperature of the system
(B) Reducing the volume of the system
(C) Increasing the volume of the system
(D) Adding a catalyst into the system

Question 165: Explain the reason towards why the addition of an inert gas or a gas that is not involved in the equilibrium reaction has no effect on the equilibrium position.

Question 166: Explain why obtaining useful results from a conductometric titration involving titration a weak acid with sodium hydroxide concentration will depend on the concentration of the weak acid.

Question 167: In the output spectrum of mass spectroscopy, the peak with the largest mass to charge ratio is

(A) The reference peak
(B) The molecular ion peak
(C) The daughter peak
(D) The base peak

Question 168: To establish the following equilibrium reaction,

$$H_2(g) + F_2(g) \leftrightarrow 2HF(g)$$

3.0 moles of hydrogen gas was pumped into the same 3.0 litre container as 6.0 moles of fluorine gas. The equilibrium constant value in terms of concentration is 1.15×10^2. Calculate the equilibrium concentration of all the reactants and products.

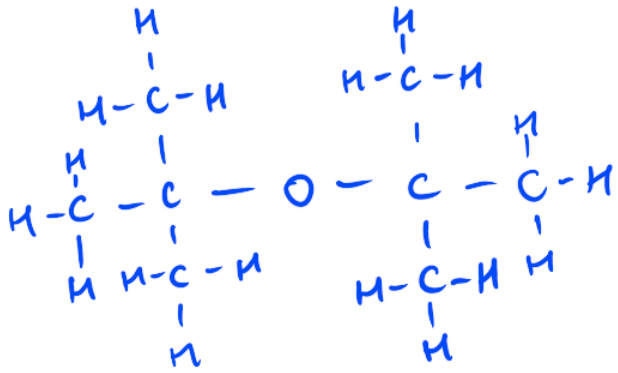
Question 169: Write the equilibrium constant expression for the following reaction.

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

Question 170: Write the equilibrium constant expression for the following reaction

$$Ca_3(PO_4)_2(s) \leftrightarrow 3\ Ca^{2+}(aq) + 2PO_4^{3-}(aq)$$

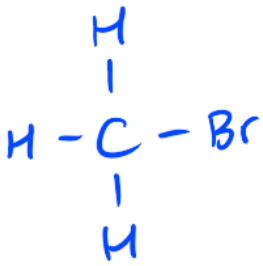
Use the following diagram to answer Questions 170 – 171.



Question 170: How many ^{1}HMR signal(s) do you expect to see?

Question 171: How many peaks do you expect to see for each of the signal(s) produced.

Use the following diagram to answer Questions 172 – 173.



Question 172: How many ^{1}HMR signal(s) do you expect to see?

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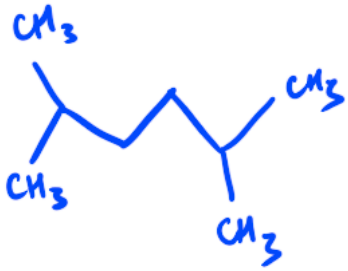
Use the following diagram to answer Questions 174 – 175.



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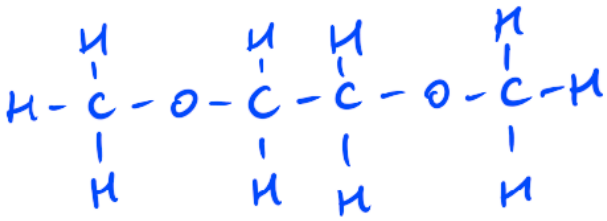
Question 175: How many peaks do you expect to see for each of the signal(s) produced.

Use the following diagram to answer Questions 176 – 177.



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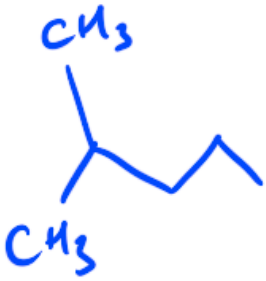
Question 181: How many peaks do you expect to see for each of the signal(s) produced.

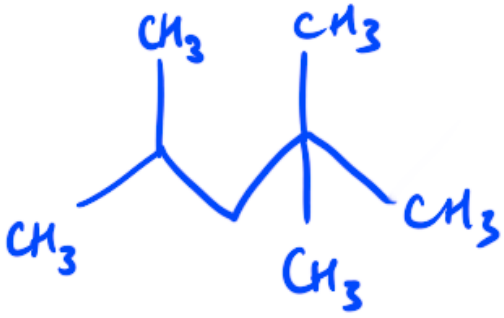
Use the following diagram to answer Questions 182 – 183.



Question 182: How many ^{1}HMR signal(s) do you expect to see?

Question 183: How many peaks do you expect to see for each of the signal(s) produced.

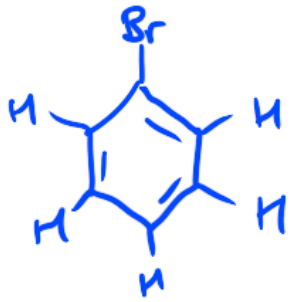
Use the following diagram to answer Questions 184 – 185.



Question 184: How many ^{1}HMR signal(s) do you expect to see?

Question 185: How many peaks do you expect to see for each of the signal(s) produced.

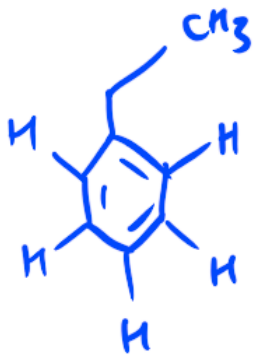
Use the following diagram to answer Questions 186 – 187.



Question 186: How many ^{1}HMR signal(s) do you expect to see?

Question 187: How many peaks do you expect to see for each of the signal(s) produced.

Use the following diagram to answer Questions 187 – 189.



Question 188: How many ^{1}HMR signal(s) do you expect to see?

Question 189: How many peaks do you expect to see for each of the signal(s) produced.

Question 190: For the following equilibrium reaction

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

You inserted 10 grams of solid A into a closed one litre container. Suppose that 50% of solid A decomposed into gases B and C. What is the density of the equilibrium mixture after decomposition?

Use the following information to answer Questions 191 - 192

The reaction between hydrogen gas and iodine gas to form hydrogen iodide has an equilibrium constant value of 52 as shown below.

$$H_2\ (g) + I_2\ (g) \leftrightarrow 2HI\ (g)$$

Suppose that some unknown moles of HI was inserted into the closed three litre container. It was found that, at equilibrium, 0.3 moles of hydrogen gas was present in the mixture.

Question 191: Calculate the moles of hydrogen iodide that was inserted into the 3L vessel initially.

Question 192: Calculate the concentrations of iodine gas and hydrogen iodide at equilibrium.

Use the following information to answer Questions 193 - 194

For the following at reaction at equilibrium in a two-litre closed vessel.

$$CO(g) + Cl_2(g) \leftrightarrow COCl_2\ (g)$$

The moles of carbon monoxide, chlorine gas and $COCl_2$ at equilibrium are given to be 0.58, 0.3 and 1.6 respectively.

Question 193: Calculate the equilibrium constant value.

Question 194: Calculate the moles of chlorine gas that is added into the vessel to decrease the [CO] to 0.3 moles per litre.

Question 195: Draw a conductometric titration graph, showing the ionic conductance due to ions involved in a titration of HCl with NaOH.

Question 196: Explain the reason why the ion conductance due to some 'Ion A' may be is greater than the ion conductance of some 'Ion B', given that they are in equal concentration in solution.

Question 197: Compare the slope of titration curve near the equivalence point for a strong acid-strong base titration versus a weak acid-strong base titration.

Question 198: Suppose water is mixed with 2.5×10^{-4} moles of sodium hydroxide and 5×10^{-6} moles of hydrobromic acid with the resulting volume of the three substances to be 1 litre. Determine the pH of the resulting solution.

Question 199 - (Outside Scope of Syllabus): Suppose you have an aqueous solution of hydrobromic acid at a concentration of 1.5×10^{-10}. Explain why is the pH less than 9.8.

Question 200: What is the K_c for $H_2(g) + SO_2(g) \leftrightarrow H_2S(g) + O_2(g)$, when given the following:

$$\text{Equation 1: } H_2(g) + S(s) \leftrightarrow H_2S(g)\ ;\ K_c = 2.0 \times 10^{-3}$$

$$\text{Equation 2: } S(s) + O_2(g) \leftrightarrow SO_2(g)\ ;\ K_c = 10.0 \times 10^{3}$$