Blakehurst High School
CHEMISTRY

Year 12 Half Yearly Exam 2000

Time Allowed - 1 ½ hours

PART A – Attempt **ALL** questions
Each question is work **1 mark**
Select the alternative A,B,C, or D that best answers the question
Mark your answers in pencil on the Answer Sheet provided

1. Arrhenius defined an acid as a substance that:

(A) reacts with active metals to produce hydrogen gas
(B) neutralizes bases
(C) forms hydrogen ions when dissolved in water
(D) donates protons

2. Which of these mixtures would function as a buffer in water solution?

(A) propanoic acid/sodium propanoate
(B) hydrochloric acid/sodium chloride
(C) nitric acid/sodium hydroxide
(D) ammonia/sodium sulphate

3. What is the $OH^-(aq)$ concentration (mol L^{-1}) in a 0.0800 mol L^{-1} nitric acid solution?

(A) 0
(B) 1.25×10^{-13}
(C) 8.00×10^{-12}
(D) 1.00×10^{-7}

4. Which of these gases will dissolve in water to produce an acidic solution?

(A) methane
(B) amonia
(C) hydrogen
(D) sulphur dioxide

5. The following equations show some reactions of the hydrogen carbonate ion:

1. $H^+ + HCO_3^- \rightarrow H_2CO_3$

2. $HCO_3^- + H_2O \rightarrow H_2CO_3 + OH^-$

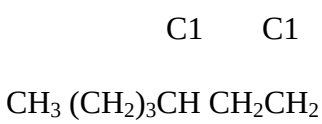
3. $OH^- + HCO_3^- \rightarrow CO_3^{2-} + H_2O$

The hydrogen carbonate ion is acting as a Lowry-Bronsted base in:

(A) 2 and 3
(B) 1 only
(C) 1 and 3
(D) 1 and 2

6. A student named a compound that she had drawn as – *1 methyl-5,7 – chlorohexane*

Its structural formula is shown below:



The correct systematic name for this substance would be:

(A) 5,7-chloroheptane
(B) 1,3-dichloroheptane
(C) 1,3-dichloro-6-methylheptane
(D) 1,3-chloroheptane

7. Methane and steam can react to form carbon monoxide and hydrogen according to the equation:

$$CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)} \quad \Delta H = +131 \text{ kJ}$$

4 moles of methane and 5 moles of steam are placed into a sealed 1 litre container which is heated to 450^0C. Equilibrium is reached and measurements show that there is 1.5 moles of methane in the container. The number of moles of the other gases at equilibrium must be

	$H_2O_{(g)}$	$CO_{(g)}$	$H_{2(g)}$
(A)	5	0	0
(B)	1.5	1.5	4.5
(C)	2	2	6
(D)	2.5	2.5	7.5

8. The Ostwald process is used to manufacture nitric acid. One of the reactions occurring in the process is

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \quad \Delta H = + \ 114 \text{ kJ}$$

The forward reaction would be favoured most by using

(A) high pressure, high temperature
(B) high pressure, low temperature
(C) high pressure, low temperature, catalyst
(D) low pressure, high temperature, catalyst

9. In volumetric analysis, a burette, a pipette, and a titration flask are used. *Just before being used,* they must be rinsed with an appropriate liquid. Which must be rinsed with distilled water *just before being used?*

(A) titration flask only
(B) burette only
(C) pipette only

(D) burette and titration flask only

10. At a certain temperature, a chemist set up the equilibrium

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

in a sealed 5.00 L flask

The amounts of the gases present at equilibrium were-

$SO_{2(g)}$	2.50 mol
$O_{2(g)}$	1.00 mol
$SO_{3(g)}$	4.00 mol

At the temperature, the value of the equilibrium constant for the reaction as written is

(A) 0.078
(B) 1.60
(C) 2.56
(D) 12.8

11. For a given reversible reaction, a catalyst will affect

(A) ΔH for the forward reaction
(B) the size of the equilibrium constant
(C) the time to reach equilibrium
(D) the yield of the products

12. Two hydrocarbons ***P*** and ***Q*** have the molecular formula C_4H_8. ***P*** reacts with hydrogen gas in the presence of a nickel catalyst; ***Q*** does not react with hydrogen gas at all.

Which of the following pairs gives correct possibilities for ***P*** and ***Q?***

	P	***Q***
(A)	methylpropene	cyclobutane
(B)	but –1- ene	butane
(C)	methylpropene	butane
(D)	butane	cyclobutane

13. In volumetric analysis, a standard solution

(A) is placed in the flask during a titration
(B) has a known accurate concentration
(C) contains the indicator
(D) has a concentration of 1.00 mol L^{-1}

14. 900 mL of water are added to 100 mL of a 0.270 mol L^{-1} potassium chloride solution. The concentration of the potassium ions is now

(A) 2.70 mol L^{-1}
(B) 2.43 mol L^{-1}
(C) 0.030 mol L^{-1}
(D) 0.027 mol L^{-1}

15. As you go across Period 2, the trend in bond type in the elements lithium → flourine is

(A) ionic → covalent
(B) metallic → ionic
(C) metallic → covalent
(D) metallic → non-metallic

16. When diamond is melted, the forces that are overcome are

(A) dispersion forces between molecules
(B) dipole/dipole forces between molecules
(C) ionic bonds between ions
(D) covalent bonds between atoms

17. The sodium atom and the sodium ion have the same

(A) radius
(B) atomic number
(C) first ionization energy
(D) electron configuration

18. A solution of sodium hydroxide is added to a solution of propanoic acid. Which of these graphs best shows the change in pH as the base is added to the acid?

(Not available)

PART B

Attempt all questions
Each question is worth 3 marks
Answer all questions in the Answer book

19. The table below gives the formulas of several acids, and their conjugate bases. The table also gives the acid ionization constant, $\boldsymbol{K_a}$, of each acid.

ACID	K_a	CONJUGATE BASE
hydrogen cyanide, HCN	6.17×10^{-10}	CN^-
ethanoic acid, CH_3COOH	1.74×10^{-5}	CH_3COO^-
nitric acid, HNO_3	2.0×10^{1}	NO_3^-
phenol, C_6H_5OH	1.05×10^{-10}	$C_6H_5O^-$
Nitrous acid, HNO_2	7.08×10^{-4}	NO_2^-

(a) Write the ***formula*** of the weakest acid in the table.

(b) Write the ***formula*** of the weakest base in the table.

(c) A solution of nitric acid is added to a solution of sodium ethanoate. An acid/base reaction involving ethanoate ions occurs. Write a balanced ***ionic*** equation for this acid/base reaction.

20. The diagram below shows the electron-dot formula of ethane:

(Not available)

(a) Draw the electron-dot formula of monochloroethane, C_2H_5Cl

(b) Ethane has a boiling point of -89^oC, while monochloroethane has a boiling point of $+12^oC$. Give ***two*** reasons for the higher boiling point of monochloroethane

21. The table summarises properties of four different substances

Substance	Melting point (^{0}C)	Boiling point (^{0}C)	Electrical conductivity when a solid	Electrical conductivity when molten
P	-25	87	none	none
Q	1200	3478	high	high
R	152	1457	none	high
S	600	2400	none	none

With a brief explanation of your choice, identify the substance which:

(a) contains metallic bonds;

(b) is a convalent array; (network)

(c) would be most likely to yield a conducting solution in water

22. Methane and hydrogen sulfide are two components of natural gas. They react incompletely to form carbon disulfide and hydrogen. The reaction for the equation can be written

$$CH_{4(g)} + 2H_2S_{(g)} \rightleftharpoons CS_{2(g)} + 4H_{2(g)}$$

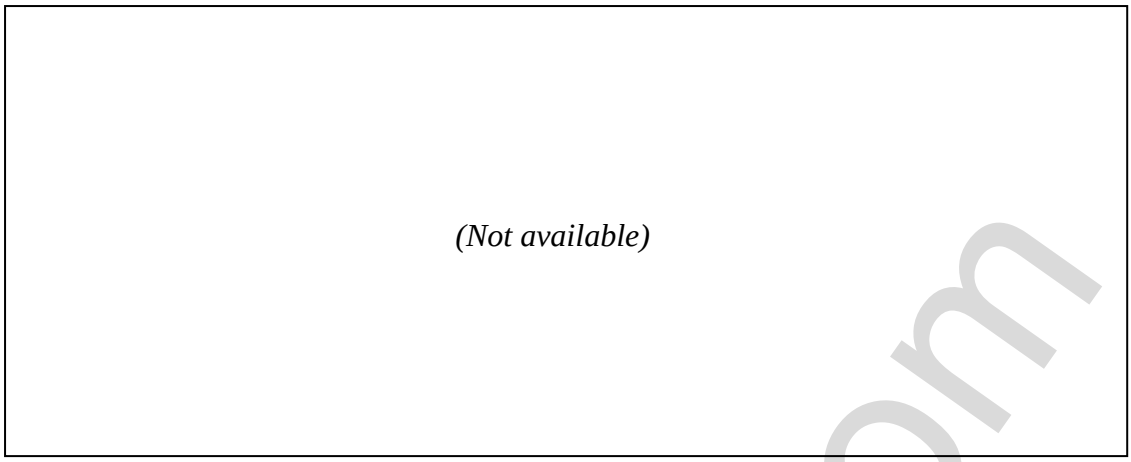
(a) Write an expression for the equilibrium constant for the reation

(b) In an experiment it is found that at equilibrium the concentrations of each substance are

CH_4	5.0 mol L^{-1}
H_2S	10.0 mol L^{-1}
CS_2	2.2 mol L^{-1}
H_2	1.5 mol L^{-1}

Calculate the equilibrium constant for this reaction

(c) The graph below shows how the concentration of carbon disulfide changes during the reaction



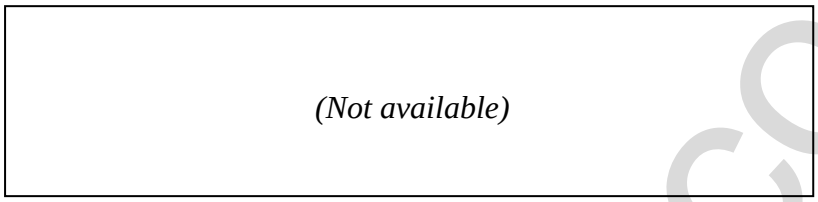
At time *T* the pressure in the reaction vessel is doubled. On the graph in the answer book, continue the sketch to show how the concentration of CS_2 will change after time *T*.

PART C

Attempt ALL questions
Each question is worth 5 marks
Answer all questions in the Part C Answer Book provided

In questions involving calculations, you are advised to show working, as marks may be awarded for relevant working.

23. Compound A is drawn below



(a) Give the systematic name for this compound

(b) Cyclohexane is an isomer of compound A

(i) Define the term *isomer*

(ii) Draw the structural formula of cyclohexane

(c) Describe a chemical test you could perform in the school laboratory to distinguish between compound A and cyclohexane. Explain the results observed

24. The pH values of solutions of four different acids, each having a concentration of 0.010 mol L^{-1}, are:

Acid	HCOOH	H_2S	HI	NH_4C1
pH	2.9	4.5	2.0	5.6

(a) Which acid is the strongest electrolyte? Why?

(b) Which acid has the strongest conjugate base? Why?

(c) Give the names of the conjugate bases of the first two acids in the table

(d) The 0.01 mol L^{-1} HCOOH solution is diluted to a concentration of 0.001 mol $L^{-1.}$ Calculate the new pH value. Show all workings.

25. During a titration a student titrates 25.0 mL of 0.10 mol L^{-1} sodium hydroxide with the weak acid, hydrobromous acid, HOBr. 15.0 mL of hydrobromous acid is needed to neutralise the base.

(a) Write an equation for the reaction

(b) Determine the initial pH of the sodium hydroxide

(c) In the space provided in your answer booklet draw a titration curve for this reaction. On your curve clearly label

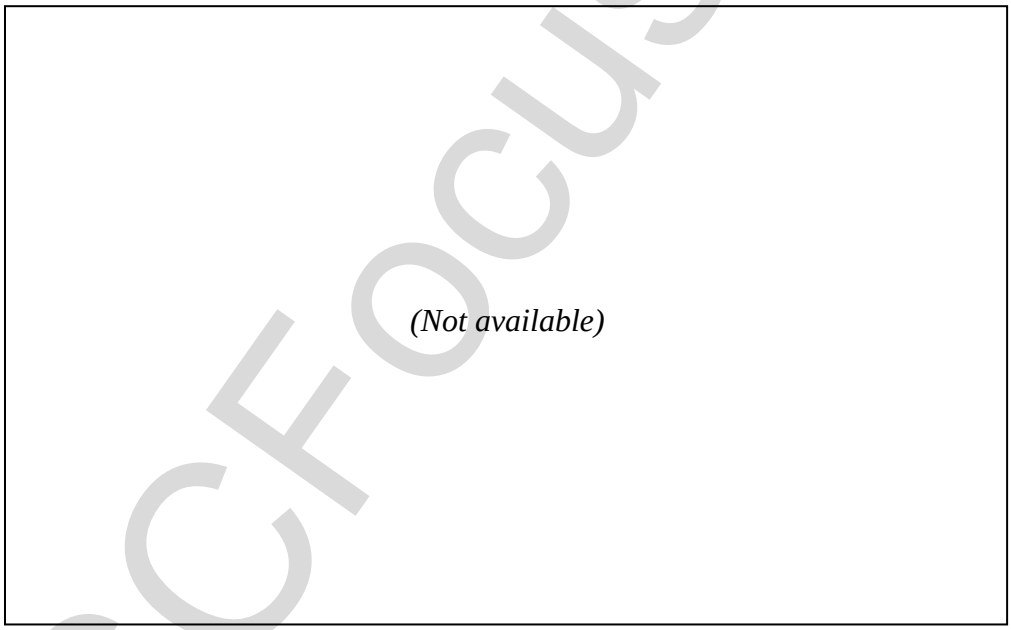
(i) initial pH of the titration

(ii) point on the curve where pH is 7

(iii) position of the equivalence point

(iv) volume of acid needed to neutralise the base

26. The graph below shows the rate curves for ammonia and hydrogen cyanide as a mixture of these two gases attains equilibrium –



(a) At what time was the equilibrium achieved?

(b) State the equilibrium concentration for ammonia.

(c) What is the equilibrium concentration for carbon monoxide if its initial concentration was 1.6 mol L^{-1}?

(d) Write the equilibrium expression for this reaction.

(e) Determine the value for the equilibrium constant.