1994

CHEMISTRY UNIT 2 TRIAL EXAM

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CHEMISTRY UNIT 2 (YEAR 11)
CHEMISTRY IN EVERYDAY LIFE

SECTION A. MULTIPLE CHOICE ANSWER SHEET

ABSENT

SURNAME
GIVEN NAME(S)

How to complete this form

Please use an **HB PENCIL** only.
If you make a mistake, **ERASE** the incorrect answer.
DO NOT just cross it out.

EXAMPLE ONLY

9	**1**	**9**	**1**	**0**	**9**	**1**	**0**	**E**
0	0	0	0	0	0	0	0	A
1	1	1	1	1	1	1	1	E
9	9	9	9	9	9	9	9	X

Enter your Student Number (if one is provided) in the box below as shown in the example above

All answers must be completed like this.

A	B	C	D

ONLY mark ONE box per line.

STUDENT NUMBER

0	0	0	0	0	0	0	0	A
1	1	1	1	1	1	1	1	E
2	2	2	2	2	2	2	2	F
3	3	3	3	3	3	3	3	G
4	4	4	4	4	4	4	4	J
5	5	5	5	5	5	5	5	L
6	6	6	6	6	6	6	6	R
7	7	7	7	7	7	7	7	T
8	8	8	8	8	8	8	8	W
9	9	9	9	9	9	9	9	X

PLEASE TURN OVER

SECTION A.

MULTIPLE CHOICE ANSWER SHEET

Instructions

Complete **ALL** the questions.

Marks will **NOT** be deducted for incorrect answers.

NO mark will be given if more than **ONE** answer is completed for any question.

USE HB PENCIL ONLY.

One answer per line ***One answer per line***

1	A	B	C	D	**17**	A	B	C	D
2	A	B	C	D	**18**	A	B	C	D
3	A	B	C	D	**19**	A	B	C	D
4	A	B	C	D	**20**	A	B	C	D
5	A	B	C	D	**21**	A	B	C	D
6	A	B	C	D	**22**	A	B	C	D
7	A	B	C	D	**23**	A	B	C	D
8	A	B	C	D	**24**	A	B	C	D
9	A	B	C	D	**25**	A	B	C	D
10	A	B	C	D	**26**	A	B	C	D
11	A	B	C	D	**27**	A	B	C	D
12	A	B	C	D	**28**	A	B	C	D
13	A	B	C	D	**29**	A	B	C	D
14	A	B	C	D	**30**	A	B	C	D
15	A	B	C	D	**31**	A	B	C	D
16	A	B	C	D	**32**	A	B	C	D

Please DO NOT fold, bend or staple this form

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

CHEMISTRY UNIT 2 (YEAR 11)
CHEMISTRY IN EVERYDAY LIFE
1994 TRIAL EXAMINATION

(not to be used before Tuesday October 4, 1994)

Reading time: 15 minutes

Total writing time: 1 hour 30 minutes

STUDENT NAME _____

Structure of examination paper: Number of booklets = 1
Number of Sections = 2

Directions to students

Materials

Question and answer booklet of 21 pages, including data tables on page 2.
Multiple choice answer sheet.
An approved calculator may be used.

The task

Answer all items from Section A.
Section A items should be answered on the multiple-choice answer sheet provided.
Answer all questions from Section B.
Section B questions should be answered in this booklet in the spaces provided following each question.
All written responses should be in English.

At the end of the task

Please ensure that you write your **name** in the space provided on this booklet and your **name and student number (if one is provided)** in the space provided on the multiple-choice answer sheet.
Place the multiple-choice answer sheet inside the back cover of this booklet and hand them in.

SPECIFIC INSTRUCTIONS FOR SECTION A

(1) Section A, Question 1, consists of 32 multiple choice items and is worth 32 marks and therefore about 32% of the total marks available for this examination. You should therefore spend about 30 minutes on Section A.

(2) Choose the response you consider is correct or best, and mark your choice on the Multiple Choice Answer Sheet according to the instructions on that sheet.

(3) A correctly answered item scores 1, an incorrect item scores 0. No credit will be given for an item if two or more letters are marked for that item. Marks will NOT be deducted for incorrect answers and you are urged to attempt every item.

DATA

TABLE 1: RELATIVE ATOMIC MASS ($^{12}C = 12.00$)

Element	*Symbol*	*Relative Atomic Mass*
Calcium	Ca	40.1
Carbon	C	12.0
Chlorine	Cl	35.5
Hydrogen	H	1.0
Oxygen	O	16.0
Phosphorus	P	31.0
Sodium	Na	23.0

TABLE 2: PHYSICAL CONSTANTS

Avogadro constant (N_A)	6.023×10^{23} mol^{-1}
Ideal gas molar volume at STP	(0^oC and 1 atmosphere pressure)
	(273K and 101325 Nm^{-2} (Pa)) = 22.4 L
Universal gas constant (R)	8.31 J K^{-1} mol^{-1}

SECTION A QUESTION 1

For each of the following , put a line through the correct response on the answer sheet provided.

Item 1

Which one of the following is **not** a physical property of pure water? Pure water

A. boils at $100^{o}C$ at sea level.

B. is an excellent conductor of electricity.

C. has a high surface tension.

D. is an excellent solvent.

Item 2

The hydrogen bonding in water is an example of

A. intermolecular bonding.

B. intramolecular bonding.

C. covalent bonding.

D. ionic bonding.

Item 3

Electrolytes containing Na^{+} and K^{+} play a vital role in the chemical processes occurring in living cells. These ions are held in solution in cells by

A. hydrogen bonding.

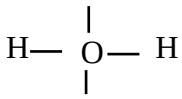
B. covalent bonding.

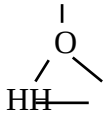
C. ion-dipole bonding.

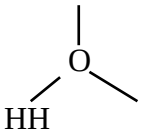
D. ionic bonding.

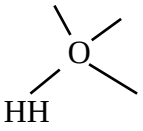
SECTION A QUESTION 1

Item 4
Which one of the following is the best representation of a water molecule?

A. 

B. 

C. 

D. 

Item 5
Gases show varying solubility in water. At room temperature and pressure, which one of the gases listed below is **least** soluble?

A. N_2

B. HCl

C. SO_2

D. NO_2

Item 6
A sample of water is known to be contaminated with the metal lead. This metal is present in solution as the ion, $Pb^{2+}(aq)$. Of the following, the best method for removing some of these metal ions is

A. filtration using a fine grade paper.

B. addition of hydrochloric acid.

C. addition of sodium hydroxide solution.

D. addition of hydrogen sulfide gas.

SECTION A QUESTION 1

Item 7
A student wishes to produce a dilute solution of sulfuric acid from 10 mL of concentrated sulfuric acid. The procedure she should follow is

A. add the 10 mL of acid quickly to the measured amount of cold water while stirring constantly.

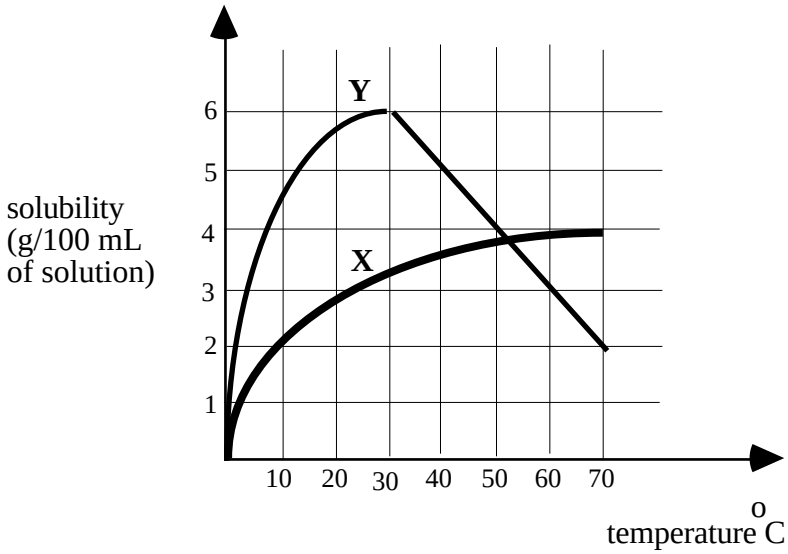
B. add the 10 mL of acid slowly to the measured amount of cold water while stirring constantly.

C. add the measured amount of cold water quickly to the 10 mL of acid while stirring constantly.

D. add the measured amount of cold water slowly to the 10 mL of acid while stirring constantly.

ITEMS 8 AND 9 REFER TO THE FOLLOWING INFORMATION

The solubility in water of two solutes, **X** and **Y**, varies with temperature according to the graphs shown below.



Item 8
The number of grams of solute **Y** that will dissolve in 1.0 L of solution at $50^{o}C$ is

A. 0.4 g

B. 4 g

C. 40 g

D. 80 g

SECTION A QUESTION 1

Item 9

A solution of solute **X** in water contains 50 g per litre at 70^{o}C.
This solution is best described as

A. unsaturated.

B. saturated.

C. supersaturated.

D. very dilute.

Item 10

In two mole of acetic acid (CH_3COOH), there are

A. 2 mole of oxygen atoms.

B. 2 mole of carbon atoms.

C. 8 mole of atoms.

D. 8 mole of hydrogen atoms.

Item 11

In exactly 12 g of $^{12}C_6$, there are

A. approximately 6.023×10^{23} carbon atoms.

B. exactly 6.023×10^{23} carbon atoms.

C. exactly 3.6138×10^{24} protons.

D. exactly 12 mole of neutrons.

Item 12

The relative formula mass of calcium orthophosphate, $Ca_3(PO_4)_2$, is closest to

A. 135.1

B. 279.3

C. 310.3

D. 496.3

SECTION A QUESTION 1

Item 13
Which one of the following is an empirical formula?

A. $C_6H_{12}O_6$

B. $C_{12}H_{22}O_{11}$

C. CH_3COOH

D. $(COOH)_2$

Item 14
A compound has the empirical formula C_2H_3Cl. The relative molecular mass of the compound is 312.5. The molecular formula of the compound is

A. $C_{10}H_{15}Cl_5$

B. $C_{10}H_{15}Cl_2$

C. $(C_2H_3Cl)_{52}$

D. $C_{15}H_{10}Cl$

Item 15
The percentage by mass of sodium in sodium carbonate is

A. 21.7 %

B. 27.7 %

C. 43.4 %

D. 50.0 %

Item 16
36.5 g of the gas hydrogen chloride is dissolved in water to produce 1500 mL of hydrochloric acid. The concentration of the hydrochloric acid is

A. 0.0007 M

B. 0.02 M

C. 0.67 M

D. 24.3 M

SECTION A QUESTION 1

Item 17
In the process of photosynthesis, the number of mole of glucose produced from the complete reaction of 3 mole of carbon dioxide with water is

A. 0.25 mol.

B. 0.50 mol.

C. 0.75 mol.

D. 1.00 mol.

Item 18
At STP, the volume of oxygen gas consumed when 0.25 mole of glucose reacts completely to produce carbon dioxide and water, is closest to

A. 22.4 L

B. 33.6 L

C. 44.8 L

D. 56.0 L

Item 19
The gas ozone, O_3, is a gas in the atmosphere that is best described as

A. a pollutant only.

B. a protective shield only.

C. both a pollutant and a protective shield.

D. neither a pollutant nor a protective shield.

Item 20
Which one of the following is least likely to be a gas that contributes to global warming?

A. H_2

B. CO_2

C. CH_4

D. NO_2

SECTION A QUESTION 1

Item 21
Which one of the following would **not** react in the atmosphere to produce an acidic rainfall?

A. CO_2

B. NO_2

C. SO_2

D. CO

Item 22
The technique of **electrostatic precipitation** is used to prevent the emission into the atmosphere of particles of matter from industrial manufacturing processes. This technique uses the

A. movement of charged particles in a magnetic field.

B. attraction of particles by gravity.

C. attraction of oppositely charged particles.

D. the attraction of similarly charged ions in a solution.

The table below shows four different sets of atmospheric conditions that exist in a large city during different seasons of the year.

	car traffic	**sunshine**	**wind**
(1)	heavy	yes	yes
(2)	heavy	yes	no
(3)	light	no	yes
(4)	light	no	no

Item 23
Which one of the above would result in the greatest concentration of photochemical smog over the city?

A. (1)

B. (2)

C. (3)

D. (4)

Item 24
The use of catalytic converters in cars has the effect of increasing in the exhaust gases, the amount of

A. NO

B. N_2

C. C_7H_{16}

D. CO

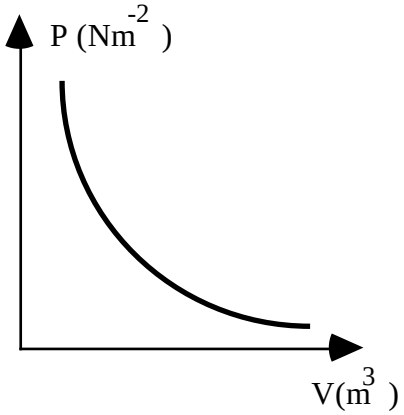
Item 25
According to the Kinetic Molecular Theory, the motion of the particles in the solid, liquid and gaseous states of matter, are best described by
(PS = particles stationary ; PM = particles moving)

	SOLID	**LIQUID**	**GAS**
A	PS	PS	PM
B	PS	PM	PM
C	PM	PS	PM
D	PM	PM	PM

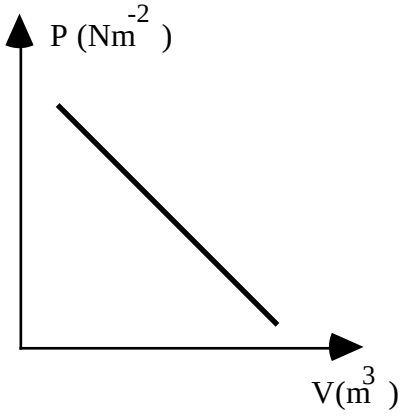
Item 26

The relationship between the pressure (P) of an ideal gas measured in Nm^{-2} (Pa) and the volume (V) of an ideal gas measured in m^3, at a fixed temperature T K, is best shown by

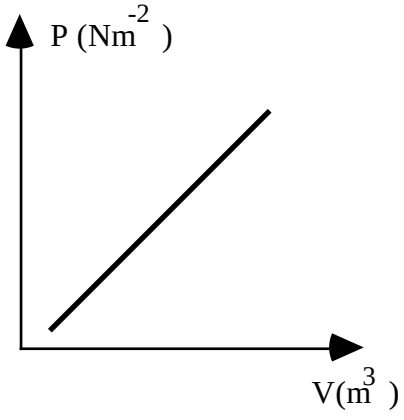
A.



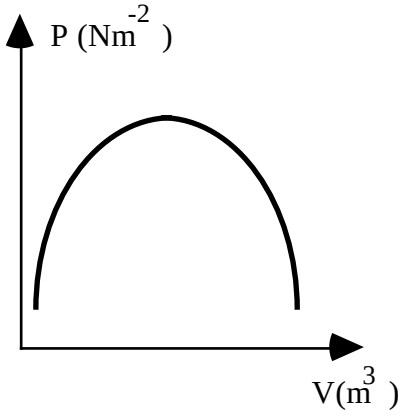
B.



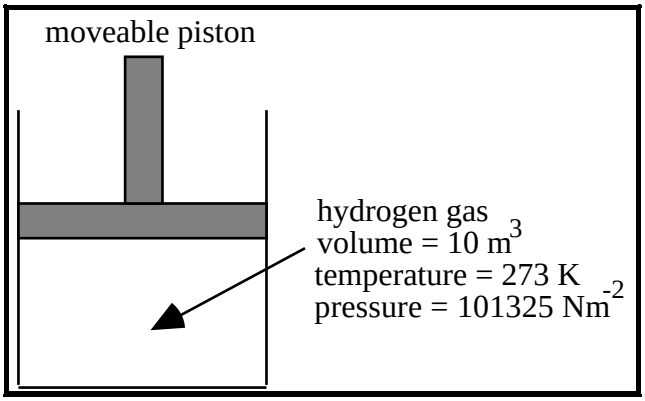
C.



D.



ITEMS 27 AND 28 REFER TO THE DIAGRAM BELOW



Item 27

A fixed amount of hydrogen gas occupies a volume of 10 m^3 at a pressure of 101,325 Nm^{-2} and a temperature of 273 K as shown in the diagram above. The moveable piston keeps the pressure of the gas constant while the temperature is raised to 546 K. The new volume of the gas is

A. 5 m^3

B. 10 m^3

C. 15 m^3

D. 20 m^3

Item 28

The number of mole of hydrogen gas is closest to

A. 0.002 mol.

B. 45 mol.

C. 310 mol.

D. 450 mol.

Item 29

At a temperature of 200^{o}C, 2 dm^{3} of hydrogen gas reacts with 2 dm^{3} of oxygen gas to form water vapour according to the equation: $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$.

The volume of gas at 200^{o}C remaining when the reaction is complete, is

A. 1 dm^{3}

B. 2 dm^{3}

C. 3 dm^{3}

D. 4 dm^{3}

Item 30

Which one of the following chemical equations best shows the oxidation of aluminium metal in the atmosphere?

A. $Al(s) + O_2(g) \rightarrow AlO_2(s)$

B. $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

C. $2Al(s) + 3O_2(g) \rightarrow 2AlO_3(s)$

D. $3Al(s) + O_2(g) \rightarrow Al_3O_2(s)$

THE FOLLOWING CHEMICAL EQUATIONS ARE TO BE USED TO ANSWER ITEMS 31 AND 32

(1) $Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$

(2) $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

(3) $2Zn(s) + O_2(g) = 2ZnO(s)$

(4) $2CO(g) + O_2(g) = 2CO_2(g)$

Item 31
Which one of these chemical equations does **not** represent an oxidation-reduction reaction?

A. (1)

B. (2)

C. (3)

D. (4)

Item 32
Which one of these chemical equations represents the overall reaction occurring in the most simply constructed laboratory galvanic cell?

A. (1)

B. (2)

C. (3)

D. (4)

END OF SECTION A

SECTION B

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 8 questions (numbered 2 to 9) and is worth 68 marks and therefore 68% of the total marks available for the examination.

You should therefore spend about 60 minutes on Section B.
The marks allotted to each question are indicated.

(2) Answers must be written in the spaces following each question in this booklet.

(3) When chemical symbols are used in equations they must be accompanied by correct symbols of state. For example, $H_2(g)$ for hydrogen gas.

QUESTION 2 (7 minutes, 4+4 = 8 marks)

(a) Water boils at a much higher temperature than would be expected for a molecule of its size. Explain why this is so and draw a diagram to illustrate your answer.

_____

_____

_____

_____

_____

QUESTION 2 (continued)

(b) When sodium chloride dissolves in water, the water molecules break up the crystal lattice. Draw a diagram showing the chloride ion surrounded by four water molecules.

QUESTION 3 (7 minutes, 4+4 = 8 marks)

(a) The relative atomic mass of the element carbon is 12.01 while the relative mass of $^{12}C_6$ is exactly 12. Explain why this is so.

(b) Suppose there was element X with a relative atomic mass of 50, consisting of two naturally occurring isotopes as shown in the table below.

	Relative Mass	Percentage Abundance
Isotope 1	51.0	25.0
Isotope 2	?	75.0

Calculate the relative mass of isotope 2.

SECTION B

QUESTION 4 (7 minutes, 1+1+1+1+2+2 = 8 marks)

(a) Balance each of the following chemical equations. Rewrite each equation in its balanced form.

(i) $Zn(s) + HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2(g)$

_____

(ii) $H_2SO_4(aq) + NaOH(aq) \rightarrow Na_2SO_4(aq) + H_2O(l)$

_____

(iii) $Al^{3+}(aq) + NaOH(aq) \rightarrow Al(OH)_3(s) + Na^{+}(aq)$

_____

(iv) $Cu(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + NO_2(g) + H_2O(l)$

_____

(b) Write a balanced equation for each of the following chemical reactions.

(i) Acetic acid (ethanoic acid) is neutralised by an aqueous solution of sodium carbonate.

_____

(ii) ammonia gas reacts with hydrogen chloride gas.

_____

SECTION B

QUESTION 5 (7 minutes, 1+1+1+1+4 = 8 marks)

(a) In each of the following equations, identify the **Lowry/Bronsted acid** on the left hand side of each equation. Write the formula of the acid in the space provided.

(i) $HCl(aq) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$ _____

(ii) $OH^-(aq) + H_3O^+(aq) \rightarrow 2H_2O(l)$ _____

(iii) $H^-(aq) + H_2O(l) \rightarrow H_2(g) + OH^-(aq)$ _____

(iv) $HCO_3^-(aq) + H_2O(l) \rightarrow H_3O^+(aq) + CO_3^{2-}(aq)$ _____

(b) A 0.1M solution of HCl has a volume of 100 mL. 900 mL of water is added. Calculate the pH of the resulting solution.

_____

_____

_____

_____

_____

QUESTION 6 (7 minutes, 5+3 = 8 marks)

When concentrated sulfuric acid is added to sucrose ($C_{12}H_{22}O_{11}$), a violent reaction occurs and water is removed as steam according to the equation:

$C_{12}H_{22}O_{11}(s)$ **concentrated sulfuric acid** $12C(s) + 11H_2O(g)$

$\rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow$

(a) Calculate the maximum mass of carbon that could be produced from the reaction of 100 g of sucrose with excess concentrated sulfuric acid.

_____

_____

_____

_____

_____

QUESTION 6 (continued)

(b) Experiment shows that the mass of carbon produced from the reaction in (a) is less than the maximum value. Suggest one reason for this.

_____

_____

_____

_____

_____

QUESTION 7 (7 minutes, 3+5 = 8 marks)
When ammonia gas (NH_3) is reacted with oxygen under certain conditions, the following reaction occurs:

$$4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(g)$$

(a) Assuming that air is 20% oxygen gas and 80% nitrogen gas by volume, calculate the volume of air that would be needed to provide 300 L of oxygen gas for the reaction above.

_____

_____

_____

_____

_____

(b) Calculate the value of the ratio $\frac{\text{VOLUME OF PRODUCT GASES}}{\text{VOLUME OF REACTANT GASES}}$ when 300 L of O_2 reacts exactly with 400 L of NH_3.

_____

_____

_____

_____

_____

SECTION B

QUESTION 8 (7 minutes, 4+4 = 8 marks)
Argon gas (Ar) makes up a small percentage of the gases in the atmosphere.

(a) Briefly describe how a pure sample of Ar could be obtained from the atmosphere.

_____
_____
_____
_____
_____

(b) 100 mL of pure Ar is obtained from the atmosphere at a temperature of $0^{o}C$ and a pressure of 100,000 Nm^{-2} (Pa). Calculate the number of mole of Ar in the sample.

_____
_____
_____
_____
_____

QUESTION 9 (11 minutes, 1+1+1+1+2+3+3 = 12 marks)
Choose one chemical that you have studied in detail during the year.

(a) Name the chemical and give its chemical formula.

NAME_____FORMULA_____

(b) Give the name and chemical formula of one chemical used in the **production** of your chosen chemical in (a).

NAME_____FORMULA_____

(c) Write a balanced chemical equation for one of the stages in the production of your chosen chemical in (a).

_____

QUESTION 9 (continued)

(d) Describe one **technical problem** associated with either the production of the use of your chosen chemical in (a).

(e) Describe one **health and safety problem** associated with either the production of the use of your chosen chemical in (a).

END OF 1994 VCE CHEMISTRY TRIAL UNIT 2 EXAMINATION

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SUGGESTED SOLUTIONS

QUESTION 1

ITEM 1 ANS B

Pure water is only slightly ionised into $H^+(aq)$ and $OH^-(aq)$. Since very few ions are present, pure water is a poor conductor of electricity at low voltages.

ITEM 2 ANS A

Hydrogen bonding is the attraction between the non-bonding electron pair on one water molecule and the hydrogen atom on a neighbouring water molecule. It is dipole-dipole bonding between (inter) molecules.

ITEM 3 ANS C

The negative (oxygen end) of the water molecule points towards the positive ion. The positive ions are surrounded by water molecules in this way. The bonding is ion-dipole bonding.

ITEM 4 ANS D

The four electron pairs around the oxygen atom point (approximately) to the corners of a tetrahedron.

ITEM 5 ANS A

HCl, SO_2 and NO_2 dissolve readily in water to form acidic solutions. N_2 is only slightly soluble in water.

ITEM 6 ANS D

Lead sulfide is precipitated according to the equation:

$Pb^{2+}(aq) + H_2S(g) \rightarrow PbS(s) + 2H^+(aq)$

ITEM 7 ANS B

To produce a dilute solution of sulfuric acid, you must add the concentrated acid **to** the water slowly while stirring constantly. This method allows the heat generated by the dilution process to be removed easily.

ITEM 8 ANS C

According to the graph, 4 g of solute **Y** will dissolve in 100 mL of solution at 50^oC. Hence, in 1000 mL of solution, 40 g of **Y** will dissolve.

ITEM 9 ANS C

At 70^oC, 4 g of solute **X** will dissolve in 100 mL of solution. Hence, at 70^oC, a saturated solution of **X** will contain 40 g per litre. Hence, this solution (50 g per litre) is supersaturated.

ITEM 10 ANS D

In 2 mole of CH_3COOH ($C_2H_4O_2$) there are 4 mole of C, 8 mole of H and 4 mole of O.

SUGGESTED SOLUTIONS

ITEM 11 ANS A

12 g (1 mole) of $^{12}C_6$ contains exactly the Avogadro number of atoms. Experimentally, this has been determined to be **approximately** 6.023×10^{23}.

ITEM 12 ANS C

The relative formula mass of $Ca_3(PO_4)_2 = (3 \times 40.1) + (2 \times 31.0) + (8 \times 16) = 310.3$

ITEM 13 ANS B

An empirical formula is the simplest whole number ratio between elements in a compound. $C_{12}H_{22}O_{11}$ is an empirical formula.

ITEM 14 ANS A

Let the molecular formula = $(C_2H_3Cl)_n$. Hence, $(24 + 3 + 35.5) \times n = 312.5$.
Hence, $62.5n = 312.5$ and therefore, $n = 5$. The molecular formula is $C_{10}H_{15}Cl_5$.

ITEM 15 ANS C

The percentage of sodium by mass in $Na_2CO_3 = \dfrac{2 \times 23}{(2 \times 23) + 12 + 48} \times 100 = 43.4\ \%$

ITEM 16 ANS C

$n(HCl) = \dfrac{36.5}{36.5} = 1.0$ mol. Hence, $c(HCl) = \dfrac{n}{V} = \dfrac{1.0}{1.5} = 0.67$ M

ITEM 17 ANS B

The overall equation for photosynthesis is $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$.
6 mole of carbon dioxide produces 1 mole of glucose. Hence, 3 mole of carbon dioxide produces 0.5 mole of glucose.

ITEM 18 ANS B

The overall equation for respiration is $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$.
1 mole of glucose reacts exactly with 6 mole of oxygen gas. Hence, 0.25 mole of glucose reacts exactly with $\dfrac{6}{4}$ mole of oxygen gas. Therefore, $V(O_2) = \dfrac{6}{4} \times 22.4 = 33.6$ L

ITEM 19 ANS C

O_3 is an irritant to the respiratory system (a pollutant), but also acts as a shield in the upper atmosphere against ultra violet radiation .

ITEM 20 ANS A

H_2 is present in the atmosphere only in small amounts since it reacts easily with oxygen to produce water. Hence, it is not likely to make much of a contribution to global warming.

SUGGESTED SOLUTIONS

ITEM 21 ANS D
CO_2, NO_2 and SO_2 all react with water to produce the acidic solutions H_2CO_3, HNO_3 and H_2SO_3 respectively. CO is a neutral oxide.

ITEM 22 ANS C
An electric field induces a charge on the small particles and causes them to be attracted to a collector which has the opposite charge.

ITEM 23 ANS B
Photochemical smog requires nitrogen oxides, hydrocarbons and sunlight to form. These conditions would be produced by heavy traffic, sunshine and no wind.

ITEM 24 ANS B
Catalytic converters in cars convert carbon monoxide and nitrogen oxides into carbon dioxide and nitrogen according to equations such as: $2CO(g) + 2NO(g) = 2CO_2(g) + N_2(g)$

ITEM 25 ANS D
According to the Kinetic Molecular Theory, particles are in motion in all three states of matter.

ITEM 26 ANS A
At a fixed temperature, the pressure of a gas is inversely proportional to the volume of the gas. Mathematically , this is $P = \frac{k}{V}$.

ITEM 27 ANS D
At constant pressure, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$. Hence, $\frac{10}{273} = \frac{V_2}{546}$. Therefore, $V_2 = 20\ m^3$

ITEM 28 ANS D
$n(H_2) = \frac{PV}{RT} = \frac{101325 \times 10}{8.31 \times 273} = 447$ mole

ITEM 29 ANS C
2 dm^3 of hydrogen gas reacts exactly with 1 dm^3 of oxygen gas to produce 2 dm^3 of water vapour. 1 dm^3 of oxygen gas remains unreacted. Hence, 3 dm^3 of gas remain.

ITEM 30 ANS B
Aluminium reacts with oxygen gas to produce a thin film of aluminium oxide, $Al_2O_3(s)$.

ITEM 31 ANS A
In (1), the oxidation numbers of Fe, O and H remain constant at +3, -2 and +1 respectively. Hence, this is not an oxidation/reduction reaction.

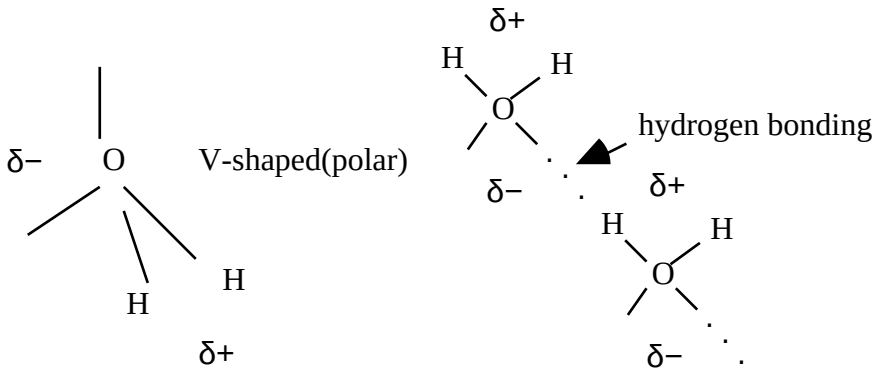
ITEM 32 ANS B
The simple galvanic cell $Cu^{2+}(aq)/Cu(s)//Zn^{2+}(aq)/Zn(s)$ is represented by this overall equation.

SUGGESTED SOLUTIONS

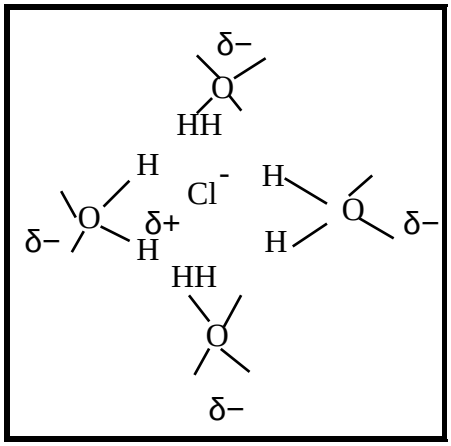
SECTION B

QUESTION 2

(a) Hydrogen bonding exists between neighbouring water molecules. It requires more energy to separate the water molecules than to separate molecules of a similar size where no hydrogen bonding exists.



(b)



QUESTION 3

(a) One mole of $^{12}C_6$ is defined as exactly 12 g. It is the reference point. Naturally occurring carbon is a mixture of isotopes with different relative isotopic masses and different abundances. The relative atomic mass of carbon is a weighted average of these relative isotopic masses. Hence, it is not exactly 12.

(b) Let **M** = the relative isotopic mass. Hence, $(\frac{25}{100} \times 51.0) + (\frac{75}{100} \times \mathbf{M}) = 50$.

Therefore, $12.75 + \frac{3\mathbf{M}}{4} = 50$ and hence, $\frac{3\mathbf{M}}{4} = 37.25$ and $\mathbf{M} = 49.7$ **ANS**

SUGGESTED SOLUTIONS

QUESTION 4

(a)

(i) $Zn(s) + 2HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2(g)$

(ii) $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + H_2O(l)$

(iii) $Al^{3+}(aq) + 3NaOH(aq) \rightarrow Al(OH)_3(s) + 3Na^+(aq)$

(iv) $Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$

(b) (i) $2CH_3COOH(aq) + Na_2CO_3(aq) \rightarrow 2CH_3COONa(aq) + H_2O(l) + CO_2(g)$

(ii) $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

QUESTION 5

(a) The proton donor is the acid. (i) HCl(aq) ; (ii) $H_3O^+(aq)$; (iii) $H_2O(l)$; (iv) $HCO_3^-(aq)$

(b) $c(H^+) = c(HCl) = 0.1 \times \frac{100}{1000} = 0.01\ M = 10^{-2}\ M.$

Hence, $pH = -\log_{10} c(H^+) = -\log_{10}10^{-2} = 2$ **ANS**

QUESTION 6

(a) $n(C) = 12 \times n(sucrose) = 12 \times \frac{100}{342}$. Hence, $m(C) = 12 \times \frac{100}{342} \times 12 = 42.1\ g$ **ANS**

(b) There may be other reactions taking place besides this one and/or some of the carbon may react with the air to produce carbon monoxide/dioxide.

QUESTION 7

(a) Since 20% = 300 L , 100% = 300 x 5 = 1500 L of air **ANS**

(b) $\text{Ratio} = \frac{200\ L\ (N_2) + 600\ L\ (H_2O)}{300\ L\ (O_2) + 400\ L\ NH_3} = \frac{800}{700} = \frac{8}{7}$ **ANS**

SUGGESTED SOLUTIONS

QUESTION 8

(a) Liquefy a sample of air. Take the temperature below the boiling temperature of argon. Use fractional distillation to remove the gas that boils at the known boiling temperature of argon.

(b) $V(\text{Ar}) = 100 \text{ mL} = 100 \times 10^{-6} \text{ m}^3$; $P(\text{Ar}) = 100{,}000 \text{ Pa } (\text{Nm}^{-2})$; $T(\text{Ar}) = 0^{\text{o}}\text{C} = 273 \text{ K}$

$$n(\text{Ar}) = \frac{PV}{RT} = \frac{100000 \times 100 \times 10^{-6}}{8.31 \times 273} = 4.4 \times 10^{-3} \text{ mol}$$ **ANS**

QUESTION 9

There are many possible answers for this question. The sample answer given here is for ethanol in the production of beer.

(a) ethanol, C_2H_5OH

(b) glucose, $C_6H_{12}O_6$

(c) $C_6H_{12}O_6(aq) = 2C_2H_5OH(aq) + 2CO_2(g)$
(Yeast provides the enzyme zymase to catalyse this reaction)

(d) In the production of beer, the conditions must be adjusted so that beer of the correct ethanol content is produced so that either a light (low alcohol) beer or a full strength beer is produced.

(e) Ethanol consumption **in excess** leads to health problems.

END OF 1994 VCE CHEMISTRY TRIAL UNIT 2 EXAMINATION SOLUTIONS

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