chemistry 1

first exams

عندما تطمح في شيء وتسعى جادا في الحصول
عليه ..فإن العالم بأسره يكون في صفك
باولو كويلو

Date 19/11/2005

Chapter 1: Chemical Foundations

1. Perform the following calculations and give the answer rounded to the correct number of significant figures:

Look

$$\frac{15.415 - 14.515}{3.5} + 0.0402957$$

a) 0.30 b) 0.300 c) 0.3000 d) 0.3 e) 0.2999

2. The average velocity of oxygen molecules, O_2, at 1000 °C is 8.00×10^2 m/s. Calculate the velocity in km/h (k=1000, 1 h=60 min, 1 min=60 s).

a) 2.16×10^3 b) 2.52×10^3 c) 2.88×10^3 d) 1.80×10^3 e) 1.44×10^3

3. The number of significant figures in the measurement 0.002090 is:

a) 3 b) 4 c) 5 d) 6 e) 7

Chapter 2: Naming Simple Compounds

4. The correct name for the compound compound N_2O_5 is:

a) Dinitrogen pentoxide
b) Dinitrogen trioxide
c) Nitrogen oxide
d) Dinitrogen monoxide
e) Dinitrogen tetroxide

5. The correct formula for the compound *Titanium(IV) nitrate* is:

a) $TiNO_3$ b) $TiNO_2$ c) Ti_4NO_3
d) $Ti(NO_3)_4$ e) $Ti(NO_2)_4$

Chapter 3: Stoichiometry

6. How many moles of C atoms are present in 52.0 g of C_6H_6?

a) 1.00 b) 2.00 c) 3.00 d) 4.00 e) 5.00

7. If 0.40 g sample containing C, O and H is burned in air to produce 0.53 g CO_2. What is the mass percent of C in the sample? $C + O_2 \rightarrow CO_2$

a) 21 b) 25 c) 30. d) 45 e) 36

8. How many molecules of water are produced when 0.600 mole of CH_4 react with excess O_2? Avogadro's number = 6.02×10^{23}.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

a) 3.61×10^{23} b) 4.82×10^{23} c) 7.22×10^{23}
d) 6.02×10^{23} e) 8.43×10^{23}

9. A 1.520 g sample of a compound containing only N and O is found to contain 1.06 g of oxygen. What is the empirical formula of the compound?

a) NO b) N_2O c) N_2O_3 d) NO_2 e) N_2O_5

10. What is the mass of sulphur that is formed when 8.50 g of H_2S is reacted with 12.75 g of SO_2 according to the **unbalanced** equation?

$$H_2S + SO_2 \rightarrow S + H_2O$$

(Molar Masses (g/mol) of H_2S=34.09, SO_2=64.07. Atomic Mass of S=32.07).

a) 7.76 b) 12.0 c) 10.6 d) 9.18 e) 13.4

Chapter 4: Chemical Reactions and Solution Stoichiometry

11. A 0.50 g sample of HF (Molar Mass= 20. g/mol) is dissolved in water to give 1.0×10^2 mL of solution. The molarity of this solution is:

a) 0.20 b) 0.25 c) 0.50 d) 1.0 e) 2.0

12. What volume (*in mL*) of 18.0 M sulphuric acid must be used to prepare 10.0 L of 0.200 M aqueous H_2SO_4 solution?

a) 278 b) 222 c) 167 d) 111 e) 55.6

13. A 0.6000 g sample of a metal chloride (MCl_2) was dissolved in water and treated with excess aqueous silver nitrate. The silver chloride that formed weighed 1.286 g. Calculate the atomic mass of M.
(Atomic masses of Cl=35.50, Ag=108.0)

$$MCl_2 + 2AgNO_3 \rightarrow M(NO_3)_2 + 2AgCl$$

a) 152.2 b) 96.38 c) 62.90 d) 40.59 e) 76.00

14. A student weighs out 0.528 g of KHP (Molar Mass=204 g/mol) and titrates to the equivalence point with 36.78 mL of NaOH solution. What is the molarity of the NaOH solution? KHP has one acidic hydrogen.

a) 0.0911 b) 0.0784 c) 0.0757 d) 0.0730 e) 0.0704

KHP + NaOH → NaKP + H2O

15. Balance the following oxidation reduction reaction in acidic medium.

$$NO_3^- + I^- \longrightarrow IO_3^- + NO_2$$

From the **balanced** equation, determine the ratio: $\frac{coefficient\ of\ H_2O}{coefficient\ of\ NO_3^-}$

a) $\frac{1}{2}$ b) $\frac{1}{3}$ c) $\frac{2}{1}$ d) $\frac{3}{1}$ e) $\frac{6}{1}$

Chapter 1: Chemical Foundations:

Question 1 :

$$\frac{15.415 - 14.515}{3.5} + 0.0402957$$

Strategy : 1 We subtract (15.415 - 14.515) ⇒ The final answer should have 3 decimal places

2 The answer obtained in 1 should be divided on 3.5, the answer of this step should be rounded to 2 significant figure.

3 The answer obtained in part 2 should be added to 0.0402457 Should contain two decimal places.

Solution:

$$= \frac{0.900}{3.5} + 0.0402457 = 0.26 + 0.0402457$$

$$= 0.247438557$$

$$\simeq 0.30$$ choice a

Question 2 : using factor label method

$$8.00 \times 10^2 \frac{m}{s} \longrightarrow ?? \frac{Km}{h}$$

using given equations and data.

$$8.00 \times 10^2 \frac{m}{s} \times \frac{1\ Km}{1000\ m} \times \frac{60\ s}{1\ min} \times \frac{60\ min}{1\ h} = 2.88 \times 10^3 \frac{Km}{h}$$ choice c

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Question 3 : According to significant figures rules

0.002090 = 4 significant figures choice b

Not sign. ↗ ↑↑↑↑ Sign.

example: How many significant figures are in the following:

(a) 30.00 (b) 0.00004 (c) 30.05 (d) 0.105050

Answer :

(a) 4 significant figures (b) 1 significant figure (c) 4 significant figures (d) 6 significant figures.

Chapter 2: Naming Simple Compounds:

Question 4: N_2O_5 is named according to the following analysis:

a) Is N a non metal or metal?, is O metal or non metal? Both N,O are non metals.

b) Count no. of atoms of N adding prefix indicating the no. of atoms present, the same thing is done for O.

c) 2: meens di- and 5: means penta.

d) We start naming from Left ⟶ Right writting the suitable prefix before atom name.

Dinitrogen Pentaoxide ⟹ Dinitrogen Pentoxide. choice [a]

(two vowels, should omit a.)

Question 5: Titanium (IV) nitrate.

Titanium: Ti but we have Ti^{4+} : 4+ comes from (IV)

Nitrate: NO_3^-

⟹ so, we combine the two ions, knowning that the total charge of compound = zero

$$Ti^{4+}\ NO_3^- \Rightarrow Ti^{(a+1)}\ NO_3^{-11} \Rightarrow Ti^{4+}(NO_3)^{1-}_4 \Rightarrow Ti(NO_3)_4$$

choice [d]

Chapter 3: Stoichiometry:

Question 6: Assume we decompose benzene (C_6H_6) into its constituents according to the following equation $C_6H_6 \longrightarrow 6C + 6H$.

52.0g ?? mol.

Molar mass C_6H_6 = (12)x6 + 6(1) = 78.0 g mol^{-1}

mass C_6H_6 ⟶ mole C_6H_6 ⟶ mol C

$$52.0\text{g } C_6H_6 \times \frac{1\text{mol } C_6H_6}{78.0\text{g } C_6H_6} \times \frac{6\text{ mol C}}{1\text{mol } C_6H_6}$$

= 4.00 mols C present. Choice [d]

Question 7: Sample weight = 0.40g, when it is burned, it produced 0.53g CO_2.

$CO_2 \longrightarrow C + 2O$

0.53g xg

mass CO_2 ⟶ mol CO_2 ⟶ mol C ⟶ mass C

Continuation of question [7]:

$$0.53\,g\ CO_2 \times \frac{1\,mol\ CO_2}{44.0\,g\ CO_2} \times \frac{1\,mol\ C}{1\,mol\ CO_2} \times \frac{12.0\,g\ C}{1\,mol\ C} = 0.144\,g\ C.$$

$$\text{Mass Percent of X atom} = \frac{\text{mass of X produced}}{\text{mass of compound/sample that contain X element}} \times 100\%$$

$$= \frac{0.14\,g}{0.40} \times 100\% = 36\% \quad \text{Choice [e]}$$

Question [8]: According to the balanced equation

$$\underset{0.600\ mol}{CH_4} + 2O_2 \longrightarrow CO_2 + \underset{??\ molecule.}{2H_2O}$$

Strategy: mole CH_4 ⟶ mole H_2O ⟶ molecules H_2O

$$0.600\ mol\ CH_4 \times \frac{2\ mol\ H_2O}{1\ mol\ CH_4} \times \frac{6.02\times10^{23}\ molecule\ H_2O}{1\ mol\ H_2O} = 7.22\times10^{23}\ molecule\ H_2O$$

Choice [c]

Question [9]: Sample mass = 1.520 g.

N | O (1.06 g)

$\Rightarrow$ mass of N = Sample − mass of oxygen

$= 1.520 - 1.06 = 0.46\,g\ N$

Now, I order to write the empirical formula, we should calculate no. of moles of N and O.

moles N: $0.46\,g\ N \times \frac{1\,mol\ N}{14.0\,g\ N} = 0.033\,mol\ N.$

moles O: $1.06\,g\ O \times \frac{1\,mol\ O}{16.0\,g\ O} = 0.066\,mol\ O.$

$N_{0.033}\ O_{0.066}$ $\Longrightarrow$ Divide on 0.033

$\Rightarrow NO_2$ Choice [d]

Question [10]: We have to balance the equation to start the calculation process

$$2H_2S + SO_2 \longrightarrow 3S + 2H_2O$$
$$8.50g \quad 12.75g \quad ??g$$

Strategy: We have to specify the limiting reactant, then

mass ⟶ moles ⟶ moles of S ⟶ mass of S.

Continuation of question 10 :

$$8.50\,g\ H_2S \times \frac{1\,mol\ H_2S}{34.09\,g\ H_2S} = 0.249\ mol\ H_2S.$$

$$12.75\,g\ SO_2 \times \frac{1\,mol\ SO_2}{64.07\,g\ SO_2} = 0.199\ mol\ SO_2.$$

The balanced Chemical Equation says that each $2\,mol\ H_2S \xrightarrow[with]{react} 1\,mol\ SO_2$

But we have actually in our reaction $0.249\ mol\ H_2S \longrightarrow X$

$\Rightarrow 2x = 0.249 \Longrightarrow x = 0.125\ mol\ SO_2$

But we have $0.199\ SO_2$, this means that $0.199\ mol - 0.125\ mol = 0.075\ mol$ will be in excess, So, the limiting reactant is H_2S.

Now;

mass H_2S ⟶ moles H_2S ⟶ moles S ⟶ mass S.

$$0.249\ mol\ H_2S \times \frac{3\ mol\ S}{2\ mol\ H_2S} \times \frac{32.07\,g\ S}{1\ mol\ S} = 12.0\,g\ S$$

Choice [b]

Chapter 4 : Chemical Reactions and Solution Stoichiometry :

Question 11 :

$$Molarity = \frac{moles\ of\ solute}{Liters\ of\ solution} = \frac{(mass/molar\ mass)}{liters\ of\ solution} = \frac{(0.50\,g/20.\,g\,mol^{-1})}{1.0\times10^{2}\times10^{-3}\,L}$$

$= 0.25\ mol/L = 0.25\ M\ HF$ choice [b]

Note: 1000 mL = 1L

Question 12 : According to the law of conservation of matter, so no. of moles of solute in certain solution keeps constant eventhough the volume of solution is changed.

So,

No. of moles before dilution = No. of moles after dilution

$MOLARITY_1 \times VOLUME_1 = MOLARITY_2 \times VOLUME_2$

$M_1 = 18.0\,M \quad V_1 = ??$

$M_2 = 0.200\,M \quad V_2 = 10.0\,L$

According to the law:

$$M_1V_1 = M_2V_2 \Longrightarrow 18.0 \times V_1 = 0.200 \times 10.0\,L$$

$$\Rightarrow V_1 = \frac{0.200\times10.0\,L}{18.0} = 0.111\,L \Rightarrow 111\,mL$$ Choice [d]

Question 13 : The balanced equation is

$$MCl_2 + 2AgNO_3 \longrightarrow M(NO_3)_2 + 2AgCl$$

0.6000 g — excess — 1.286 g

Strategy: mass AgCl ⟶ mole AgCl ⟶ mole MCl_2.

then moles MCl_2 = $\frac{\text{mass } MCl_2}{\text{molar mass } MCl_2}$

molar mass of MCl_2 = $1 \times M + 2(Cl) = M + 71$

Now:

$$1.286\text{ g AgCl} \times \frac{1\text{ mol AgCl}}{143.5\text{ g AgCl}} \times \frac{1\text{ mol } MCl_2}{2\text{ mol AgCl}} = 4.481 \times 10^{-3}\text{ mol } MCl_2$$

molar mass of MCl_2 = $\frac{1}{\text{mole } MCl_2} \times \text{mass } MCl_2$

$\Rightarrow$ $M + 71 = 1/4.481 \times 10^{-3} \times 0.6000 \Rightarrow M + 71 = 133.9$

$\Rightarrow M = 133.9 - 71.0 = 62.9\ g\,mol^{-1}$ Choice C

Question 14 : For Simplicity:

$$KHP + NaOH \longrightarrow H_2O + NaKP$$

This means 1 mol of KHP (acid) reacts with 1 mol NaOH.

No. of moles of KHP = (mass / molar mass)

$\Rightarrow$ moles KHP = $0.528\text{ g} / 204\ g\,mol^{-1} = 2.59 \times 10^{-3}$ mol KHP

moles KHP ⟶ mol NaOH, then we calculate the molarity.

$$2.59 \times 10^{-3}\text{ mol KHP} \times \frac{1\text{ mol NaOH}}{1\text{ mol KHP}} = 2.59 \times 10^{-3}\text{ mol NaOH.}$$

Now;

$$\text{Molarity} = \frac{\text{moles of NaOH}}{\text{volume of Solution (L)}} = \frac{2.59 \times 10^{-3}\text{ mol}}{36.78 \times 10^{-3}\text{ L}} = 0.0704\text{ M}$$

Choice E

Question 15 : Balance the following reaction in acidic medium :

$$NO_3^- + I^- \longrightarrow IO_3^- + NO_2$$

$NO_3^- \longrightarrow NO_2$

1) balance each atom except for O, H

$NO_3^- \longrightarrow NO_2$

2) balance the oxygen by adding H_2O molecule instead of each O to the side which has lower no. of oxygen atoms.

$NO_3^- \longrightarrow NO_2 + H_2O$

3) balance the hydrogen by adding H^+ ion instead of each H to side which has lower no. of H atoms.

$NO_3^- + 2H^+ \longrightarrow NO_2 + H_2O$

4) Add No. of electrons the side which is more positive to equalize the less positive side

$NO_3^- + 2H^+ + e^- \longrightarrow NO_2 + H_2O$

5) Cancel the electrons in each half reaction, even though we need to multiply 1 or 2 halves by a factor.

$6NO_3^- + 12H^+ + 6e^- \longrightarrow 6NO_2 + 6H_2O$

$I^- \longrightarrow IO_3^-$

1) $I^- \longrightarrow IO_3^-$

2) $I^- + 3H_2O \longrightarrow IO_3^-$

3) $I^- + 3H_2O \longrightarrow IO_3^- + 6H^+$

4) $I^- + 3H_2O \longrightarrow IO_3^- + 6H^+ + 6e^-$

5) $I^- + 3H_2O \longrightarrow IO_3^- + 6H^+ + 6e^-$

Adding the two halves.

$$6NO_3^- + 12H^+ + I^- + 3H_2O \longrightarrow 6NO_2 + 6H_2O + IO_3^- + 6H^+$$

$$6NO_3^- + I^- + 6H^+ \longrightarrow 6NO_2 + 3H_2O + IO_3^-$$

$\frac{\text{coefficient of } H_2O}{\text{coefficient of } NO_3^-} = \frac{3}{6} = \frac{1}{2}$ Choice [a]

The End of Exam

Good Luck

مع تمنيات الاستاذ
ابراهيم زياد

طريق التميز في الكيمياء (1)

12

General Chem. 101
First Exam

Date: 3/4/2005
Time: 60 min.

Name: .....[redacted]..... Reg. No.:[redacted]
Instructor Name: .....عبوان الحلبي..... Seat No.: ...67.....

$N = 6.022 \times 10^{23}$, H = 1.00 , N = 14.0 , O = 16.0 , C = 12.0 , Fe = 55.85
Mn = 54.94 , Cl = 35.45 , Ag = 107.9 , Ca = 40.08

الاجابة الصحيحة

ANSWER SHEET

e	1.	a	b	c	d	(e)	e	9.	a	b	c	(d)	e
c	2.	a	b	(c)	d	e	b	10.	a	(b)	c	d	e
a	3.	(a)	b	c	d	e	a	11.	(a)	b	c	d	e
b	4.	a	(b)	c	d	e	d	12.	a	b	(c)	d	e
d	5.	a	b	c	(d)	e	a	13.	(a)	b	c	d	e
a	6.	(a)	b	c	d	e	b	14.	a	(b)	c	d	e
b	7.	a	(b)	c	d	e	c	15.	a	b	(c)	d	e
c	8.	(a)	b	c	d	e	d	16.	(a)	b	c	d	e

GOOD LUCK

15

General Chem. 101

First Exam

Time: 60 min. Date: 14/11/2009

Student's Name: .... Reg. No. ....

دكتورة ملك القادر

Section No. ...3-4... Seat No. ...51...

###@@@@@@@@@@@@@@@@@@@@@

Use the following information: Atomic mass (amu): H = 1.00; C = 12.0; O = 16.0; S = 32.0; Al = 27.0; N = 14.0; Na = 23.0; Avogadro's no. = 6.022×10^{23}; $^{o}C = (^{o}F - 32) \times (5/9)$.

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ANSWER SHEET

1.	a	b	c	d	e	9.	a	b	c	d	e
2.	a	b	c	d	e	10.	a	b	c	d	e
3.	a	b	c	d	e	11.	a	b	c	d	e
4.	a	b	c	d	e	12.	a	b	c	d	e
5.	a	b	c	d	e	13.	a	b	c	d	e
6.	a	b	c	d	e	14.	a	b	c	d	e
7.	a	b	c	d	e	15.	a	b	c	d	e
8.	a	b	c	d	e	16.	a	b	c	d	e

^{35}Cl ^{37}Cl

$100-y$ y

$34,968$ 36.956

$$35.46 = \frac{y}{100} \times 36.956 + \frac{(100-y)}{100} \times 34,968$$

$$35.46 = .36956y + 34,968 - .34968y$$

$$,492 =$$

$$3CCl_4 + 2SbF_3 \longrightarrow 3CCl_2F_2 + 2SbCl_3$$

2Sb
2Sb
6F
6F

6+6

1-Perform the following calculation and give the answer rounded to the correct number of significant figures.

$$(3.28 + 2.8395)\,(1.00 + 4.50) / 23.95$$

a- 1.4054 b - 2 c- 1.4 d- 1.420 e- 1.41

2- Convert (-10) °C to Fahrenheit scale of temperature.

a- 50 b- 23.3 c- 12.2 d- 14 e- 32.3

3- The atomic mass of ^{35}Cl and ^{37}Cl are 34.968 amu and 36.956 amu, respectively. Calculate the natural abundance of ^{37}Cl. Given that the average atomic mass of Cl is 35.46 amu.

a- 98.61% b- 24.75 % c- 1.39% d- 75.25% e- 51.65%

4- After balancing the following reaction,

$$x\,CCl_4 + SbF_3 \rightarrow y\,CCl_2F_2 + SbCl_3$$

The ratio (x / y) is equal to

a- 3 / 2 b- 4 / 2 c- 2 / 2 d- 6 / 2 e- 3 / 3

5- The correct name for $Ni(BrO_3)_2$ is: (Ni is a transition metal element)

a- Nickel (II) bromate b- Nickel (II) hypobromite c- Nickel (II) perbromate

d- Nickel (IV) bromite e- Nickel (II) hypobromite

6- The correct name for SO_3 is

a- Sulfur monoxide b- Sulfur trioxide c- Sulfur (IV) oxide

d- Sulfur dioxide e- Sulfur oxide

S → atoms ?!?

9.96 mg Na_2SO_3

,00996 | 126.05

$$,00996\,g \times \frac{1\,mole}{126.05\,g} \times \frac{1\,mole}{1\,mole} \times \frac{6.022\times10^{23}}{1\,mole}$$

9.96×10^{-3}

$,475 \times 10^{20}$

$$3NO_2 + H_2O \longrightarrow \cancel{3N_2 + H_2O}$$

$$NO + 2HNO_3$$

g ?!

46

4.50g.

14 x

$$4.50g \times \frac{1\,mole}{30g} \times \frac{3}{1\,mole\,NO} \times \frac{46}{1\,mole}$$

$$50.0g\,N_2O_4 \times \frac{1\,mole\,N_2O_4}{92.02} \times \frac{3\,N_2}{1\,mole\,N_2O_4} = 1,63\,mole\,N_2$$

N_2O_4

$$45.0 \times \frac{mole}{32.05g} \times \frac{3}{2} = 2,1$$

~~N_2O_4~~

~~1 mol~~ N_2 x

$$1,63\,mole\,N_2 \times \frac{28}{1\,mole}$$

Avogadro.

7- How many **sulfur atoms** are contained in 9.96 mg (milligram) of Na_2SO_3? The molar mass of Na_2SO_3 is 126.05 g/mol.

$9.96\,mg \times \frac{1\times10^{-3}\,g}{1\,mg} \times \frac{1\,mole\,Na_2SO_3}{126.05\,g\,Na_2SO_3} \times \frac{1\,mole\,S}{1\,mole\,Na_2SO_3} \times \frac{6.022\times10^{23}}{1\,mole}$

a- 4.76×10^{19} b- 4.76×10^{20} c- 9.51×10^{23} $,476 \times 10^{20}$

d- 1.05×10^{21} e- 9.52×10^{20}

1a2

$Al_2 \times 2 + (S + O_4)$

8- The mass percent of **oxygen** in $Al_2(SO_4)_3$ is equal to

$\frac{12 \times 16}{288}$

S= 32
O: 16

a- 28.1% b- 9.37% c- 42.7% d- 21.4% e- 56.1%

$27*2 + 3*32 + 12*16$

$\frac{12 \times 16}{}$

2,08 (12) (1) 8,33 16 4,17

9- The empirical formula for a compound that contains 25.00% C, 8.33% H and 66.67% O is

a- C_2H_6O b- CHO c- $C_4H_{13}O_2$ d- CH_4O_2 e- CH_3O

C: H: O
2,8 8,33 4,17
(1) 4 : 2
CH_4O_2

C $25.00 \times \frac{1}{12} = 2.08$

H $8.33 \times \frac{1}{1} = 8.33$

O $66.67 \times \frac{1}{16.0} = 4,17$

C: H: O.
1 : 4 : 2
CH_4O_2

O: 16
N: 14

10- Consider the following balanced reaction. How many grams of NO_2 are required to form 4.50 g of $NO_{(g)}$? Assume that there is excess water present.

$4.50\,g\,NO \times \frac{1\,mole}{30\,g} \times \frac{3\,mole\,NO_2}{1\,mole\,NO} \times \frac{46}{1\,mole}$

$3\,NO_{2(g)} + H_2O_{(l)} \rightarrow 2\,HNO_{3(aq)} + NO_{(g)}$

a- 38.0 g b- 69.0 g c- 20.7 g d- 10.9 g e- 26.5 g

11- Determine the limiting reactant (LR) and the **mass (in g) of nitrogen** that can be produced from the reaction of 50.0 N_2O_4 with 45.0g N_2H_4 assuming 100% yield. The molar masses are as follows: N_2O_4 = 92.02g/mol, N_2H_4 = 32.05 g/mol.

$N_2O_{4\,(l)} + 2\,N_2H_{4\,(l)} \rightarrow 3\,N_{2\,(g)} + 4\,H_2O_{(g)}$

a- LR is N_2O_4, 105 g N_2 formed b- LR is N_2O_4 , 45.7 g N_2 formed

c- LR is N_2H_4 , 59.0 g N_2 formed d- LR is N_2H_4 , 13.3 g N_2 formed

e- Both reactants are in appropriate stoichiometric ratios and 45.0 g N_2 formed

$50\,N_2O_4 \times \frac{1\,mole}{92.02\,g} \times \frac{3\,mole\,N_2}{1\,mole} = 1,6.$

$45\,N_2H_4 \times \frac{1\,mole}{32.05} \times \frac{3}{2} = 2,1$

12- All of the following compounds are soluble in water **except**

a- NH_4Cl b- $Fe(NO_3)_3$ c- Hg_2I_2 d- $CuCl_2$ e- $Ba(OH)_2$

13- Which of the following conversions involves **oxidation**

a- $H_2O_2 \rightarrow 2H_2O$ b- $Ti^{3+} \rightarrow TiO^{2+}$

c- $BF_3 \rightarrow BF_4^-$ d- $H_{2(g)} \rightarrow H_{2(l)}$

e- $SO_2 \rightarrow CaSO_3$

14- The net ionic equation for the reaction of **nitrous acid** with **lithium hydroxide** is

a- $HNO_{2\,(aq)} + LiOH_{(aq)} \rightarrow LiNO_{2\,(aq)} + H_2O_{(l)}$

b- $HNO_{2(aq)} + LiOH_{(aq)} \rightarrow Li^+_{(aq)} + NO_2^-{}_{(aq)} + H_2O_{(l)}$

c- $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

d- $H^+_{(aq)} + NO^{2-}_{(aq)} + Li^+_{(aq)} + OH^-_{(aq)} \rightarrow Li^+_{(aq)} + NO_2^-{}_{(aq)} + H_2O_{(l)}$

e- $HNO_{2(aq)} + OH^-_{(aq)} \rightarrow NO_2^-{}_{(aq)} + H_2O_{(l)}$

15- After balancing the following chemical reaction is in **Basic solution**, the correct ratio of (I^- / H_2O) is

$MnO_4^- + I^- \rightarrow MnO_2 + I_2$

a- 6/8 b- 8/10 c- 4/3 d- 4/2 e- 3/2

$3e^- + 4H^+ + MnO_4^- \rightarrow MnO_2 + 2H_2O$) $\times 2$

$2I^- \rightarrow I_2 + 2e^-$) $\times 3$

$8H^+ + 2MnO_4^- + 6I^- \rightarrow 2MnO_2 + 4H_2O + 3I_2$

16- The volume in milliliters (ml) of 0.675 M NaOH required to neutralize 35.0 ml of 0.145 M H_3PO_4 is equal to?

a- 5.37 b- 16.1 c- 22.6 d- 10.7 e- 16.9

$NaOH + H_3PO_4 \rightarrow$

$3e^- + 4H^+ + MnO_4^- \rightarrow MnO_2 + 2H_2O$

$2I^- \rightarrow I_2 + 2e^-$

$8H^+ + 2MnO_4^- + 6I^- \rightarrow 2MnO_2 + 4H_2O + 3I_2 + 8OH^-$

General Chem. 101 *1st Semester 07/08* *First Exam.*

10/20

Date: 3/11/2007 **Time: 70 min.**

Student Name: ..... Reg. No.: 00729011

Instructor's Name: ..... Section: ..... Seat No.: .....

Answer Sheet

1-	a	b	c	d	e	11-	a	b	c	d	e
2-	a	b	c	d	e	12-	a	b	c	d	e
3-	a	b	c	d	e	13-	a	b	c	d	e
4-	a	b	c	d	e	14-	a	b	c	d	e
5-	a	b	c	d	e	15-	a	b	c	d	e
6-	a	b	c	d	e	16-	a	b	c	d	e
7-	a	b	c	d	e	17-	a	b	c	d	e
8-	a	b	c	d	e	18-	a	b	c	d	e
9-	a	b	c	d	e	19-	a	b	c	d	e
10-	a	b	c	d	e	20-	a	b	c	d	e

Answer each of the following questions and put "X" on the correct choice on front page.

1. Perform the following calculation and give the answer rounded to the correct number of significant figures.

$$(24.562 - 24.062) \times 12.40$$

a) 6.2000 b) 6.20 c) 6.2 d) 6 e) 6.200

2. A spherical tank has a radius of 341 cm. Calculate its volume in gallons.
Given: $V_{sphere} = \frac{4}{3}\pi r^3$, one gallon = 277 in^3, one in = 2.54 cm , $\pi = 3.142$.

a) 2.05×10^4 b) 5.10×10^4 c) 3.66×10^4 d) 6.49×10^4 e) 1.29×10^4

3. Which of the following changes is a physical change ?

a) Sucrose is converted into ethanol.
b) Steel wool (Fe) was burned in air to produce iron oxide.
c) Calcium carbonate gives a gas when added to HCl.
d) Hydrogen sulfide is produced from zinc sulfide and HCl.
e) $H_2O_{(l)}$ is converted into vapor.

4. The temperature of an object is $-22.0\ ^\circ F$. Convert this to K.

a) 232 b) 238 c) 227 d) 243 e) 382

5. Given the following data for a sample of magnesium:

Isotope	Mass (amu)	Fractional abundance
^{24}Mg	23.9850	0.5841
^{25}Mg	24.9858	0.1000
^{26}Mg	25.9826	0.3159

Calculate the average atomic mass (atomic weight) of magnesium(in amu).

a) 24.72 b) 24.30 c) 24.80 d) 24.64 e) 24.44

6. Choose the correct name of the acid corresponding to the BrO_2^- oxoanion.

a) hypobromous acid b) bromous acid c) hypobromic acid
d) bromic acid e) perbromic acid

7. Choose the correct name for $CoBr_2$.

a) cobalt dibromide b) dibromo cobalt c) cobalt bromide
d) cobalt(I) bromide e) cobalt(II) bromide

8. Write the formula of tetraphosphorous trisulfide

a) $P_2(SO_3)_4$ b) P_4S_4 c) PS_4 d) P_4S_3 e) S_3P_4

9. Calculate the number of moles of CO_2 in 0.400 g CO_2.
Atomic weights: C = 12.0 ; O = 16.0.

a) 6.82×10^{-3} b) 9.09×10^{-3} c) 4.55×10^{-3}
d) 5.68×10^{-3} e) 7.95×10^{-3}

10. Calculate the mass percent of O in calcium phosphite, $Ca_3(PO_3)_2$.
(molar masses (g/mol): Ca = 40.1; P = 31.0 and O = 16.0, $Ca_3(PO_3)_2$ = 278.3)

a) 34.5 b) 41.3 c) 72.8 d) 49.0 e) 56.1

11. Calculate the mass of one HNO_3 molecule.

(Atomic weights : H =1.0 ; N = 14.0 and O = 16.0,

N(Avogadro's number = 6.02×10^{23})

a) 3.82×10^{-23} g b) 7.81×10^{-23} g c) 1.40×10^{-22} g

d) 1.05×10^{-22} g e) 1.36×10^{-22} g

$\frac{100 - 40.3}{35.5} = 1.68$

12. A compound containing only chlorine and oxygen is 40.3 % oxygen by mass. What is the empirical formula of the compound?
(Atomic weights: Cl = 35.5, O = 16.0)

$\frac{40.3}{16.0} = 0.268$

$\frac{0.268}{2.518}$

a) Cl_2O b) Cl_2O_3 c) Cl_2O_5 d) Cl_2O_7 e) ClO_3

13. Consider the unbalanced reaction:

$$Al + O_2 \rightarrow Al_2O_3$$

Calculate the mass (in g) of Al_2O_3 produced from the reaction mixture of 16.2 g Al with excess amount of oxygen.
(Molar masses (g/mol): Al = 27.0; O = 16.0)

a) 15.3 b) 20.4 g c) 8.42 d) 25.5 e) 30.6

14. Consider the balanced equation:

$$CaO_{(s)} + 3\ C_{(s)} \rightarrow CaC_{2(s)} + CO_{(g)}$$

When a mixture of 5.61 g of CaO and 4.80 g of C was allowed to react, 4.49 g of CaC_2 were produced. Calculate the % yield of CaC_2.
(Molar masses (g/mol): CaO = 56.1, C = 12.0; CaC_2 = 64.1)

a) 80.0% b) 60.1% c) 70.0% d) 90.0% e) 39.9%

15. Which of the following compounds is a strong electrolyte?

a) Na_2SO_4 b) $C_6H_{12}O_6$ (glucose) c) CH_3CH_2OH

d) H_2O e) CH_3COOH

16. Which of the following pairs of aqueous solutions produces a precipitate when mixed?

a) $Mg(NO_3)_2 + H_2SO_4$ b) $NaOH + BaCl_2$ c) $Na_2SO_4 + FeCl_3$

d) $Mg(NO_3)_2 + NaOH$ e) $NaNO_3 + CuSO_4$

17. What is the oxidation number of P in $Ca_3(PO_3)_2$

a) + 3 b) +7 c) +2 d) +4 e) +5

18. Balance the following redox reaction in acidic solution.

$$Br^- + MnO_4^- \rightarrow Br_2 + Mn^{2+}$$

The ratio of coefficients of Br^- /H_2O in the balanced equation is:

a) 4 / 1 b) 16/5 c) 5 /4 d) 8/1 e) 8/5

19. Calculate the mass of AgCl produced from the reaction of 120.0 mL of 0.20 M $AgNO_3$ and 120.0 mL of 0.15 M $CaCl_2$ solutions. (Atomic weights: Ag = 107.9 ; Cl = 35.5)

a) 3.4 g b) 4.0 g c) 4.6 g d) 2.9 g e) 1.4 g

20. The net ionic equation for the following reaction is:

$$HCN + NaOH \rightarrow NaCN + H_2O$$

a) $HCN_{(aq)} + NaOH_{(aq)} \rightarrow NaCN_{(aq)} + H_2O_{(l)}$
b) $CN^-_{(aq)} + Na^+_{(aq)} \rightarrow NaCN_{(aq)}$
c) $HCN_{(aq)} + Na^+_{(aq)} \rightarrow NaCN_{(aq)} + H^+_{(aq)}$
d) $HCN_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)} + CN^-_{(aq)}$
e) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

Question (1):

$(24.562 - 24.062) \times 12.40$

Here, we must proceed step by step. We start with the operation inside the parenthesis, then, we continue. You remember the rules of significant figures, which are summarized as the following:

1. All nonzeroes are always significant figures.
2. Leading zeroes are never significant figures.
3. Captive zeroes are always significant figures.
4. Trailing zeroes are significant in the presence of decimal point.
5. Exact no. limits the no. of significant figures in calculation.

انظر كتاب طريق التميز في الكيمياء (1) ص ٢٤.

Now, when we subtract two numbers, we have to count no. of decimal places, as shown below:

$$24.562 - 24.062 = 0.500$$

(3 decimal places)

Then, we multiply the previous answer with 12.40, as shown below:

0.500×12.40

3 Significant Figures — 4 Significant Figures

للمزيد انظر القواعد الموضحة والمفصلة في كتاب طريق التميز، الطبعة الاولى ص ٢٥ - ٢٦

Finally, the answer should be rounded to three significant figures.

$6.2 \xrightarrow{\text{corrected to}} \boxed{6.20}$ 3 Significant Figures Choice [b].

COMMENT:

There is another solution; There is no need to perform the mathmatical operation, because we can pick up the answer that contains 3 significant figures.

Question (2):

radius = 341 cm, $V_{sphere} = (4/3)\pi r^3$, one gallon = 277 in^3

V = ?? (gallons). one inch = 2.54 cm, $\pi = 3.142$

In order to calculate the volume (gallons), we have to use the radius in (in^3)

So, we can convert the radius as shown below:

cm ⟶ in ⟶ in^3 ⟶ gallon

Continued Question (2):

$$341\ cm \times \frac{1\ in}{2.54\ cm} = 134.2519685\ in$$

Now, the volume is calculated using the previous law:

$$V_{sphere} = \frac{4}{3}\pi r^3 = \frac{4}{3}(3.142)(134.2519685\ in)^3$$
$$= 10136940.67\ in^3 = 10.13694067 \times 10^6\ in^3$$

$$10.13694067 \times 10^6\ \text{in}^3 \times \frac{1\ gallon}{277\ \text{in}^3} = 3.659545366 \times 10^9\ gallon$$

corrected to $\rightarrow 3.66 \times 10^9$ gallon. Choice C

بإمكانك التعرف على التوضيحات التفاصيل والايضاحات فيما يتعلق بطرق التحويل من خلال دراستك كتاب طريق التميز في الكيمياء (1)، الطبعة الاولى، ص 41، 42.

Question (3):

All statements shown in question (3) represent a chemical change or chemical reaction except for choice (e) which represents a physical change.

Choice e

بإمكانك التعرف على الفرق بين التغير الكيميائي (Chemical change) والتغير الفيزيائي من خلال دراستك لكتاب طريق التميز في الكيمياء (1)، الطبعة الاولى، ص 10، 11.

Question (4):

$T(^\circ F) = -22.0\ ^\circ F$; $T(K) = ??$

First of all, we have to convert the temperature from (°F) into (°C), using $T(^\circ C) = T(F) - 32F \times \frac{5^\circ C}{9^\circ F}$ .... 1.7 ⟸ طريق التميز ص IV

Then, we convert the temperature from (°C) in (K) using:

$T(K) = T(^\circ C) + 273$ .... 1.9 ⟸ طريق التميز ص IV

Continued of Question (4):

So;

$$T(°C) = -22.0°F - 32°F \times \frac{5°C}{9°F} = -54.0°F \times \frac{5°C}{9°F} = -30.0°C$$

Then:

$$T(K) = -30 + 273 = 243\ K.$$ Choice [d]

Question (5):

We can calculate the average atomic mass of magnesium (in amu) using the following law:

$$\text{Average atomic mass of certain element (magnesium)} = \left[\begin{pmatrix}\text{mass of 1st}\\ \text{isotope } (^{24}Mg)\end{pmatrix} \times \begin{pmatrix}\text{Fractional}\\ \text{Abundance}\end{pmatrix} + \begin{pmatrix}\text{mass of 2nd}\\ \text{isotope } (^{25}Mg)\end{pmatrix} \times \begin{pmatrix}\text{Fractional}\\ \text{Abundance}\end{pmatrix} + \begin{pmatrix}\text{mass of 3rd}\\ \text{isotope } (^{26}Mg)\end{pmatrix} \times \begin{pmatrix}\text{Fractional}\\ \text{Abundance}\end{pmatrix}\right] \quad \ldots\ldots [2.2]$$ ⇐ طريق التميز ص ٤٤

Then:

Average atomic mass of Mg = (23.9850 amu × 0.7899) + (24.9858 amu × 0.1000) + (25.9826 amu × 0.1101) = 24.31612184 $\xrightarrow{\text{rounded and corrected to}}$ 24.312 Choice [a]

(1) العلاجة، التميز، بإمكانك متابعة الحرفيين من خلال كتاب طريق التميز ص ٤٣-٤٥.

Question (6):

BrO_2^- has an acid formula of $HBrO_2$.

(Bromite, BrO_2^-)

Oxoacids are named by taking the root of anion followed by -ic or -ous. then followed by the word acid.

Here, we will choose the suffix (-ous), because the common ion takes the suffix(-ic), BrO_3^- (Bromate). Or ate ⟶ ic, ite ⟶ ous

Continued of Question (6):

So, the correct name is: bromous acid choice [b]

انظر موضوع تسمية الحموض في كتاب طريق التميز في الكيمياء (1) ، ص ٧٤، ٧٥، ٧٦.

Question (7):

The name of $CoBr_2$ = ??

First of all, Co is transition metal element, Therefore, this type (type II in route of excellence in Chemistry (1)) requires a Roman numeral specifies the charge of the cation. And because the no. of atoms is not equivalent; we can guess the charges as shown below:

$CoBr_2 \Rightarrow Co^{2+} Br_2^{1-}$

Therefore:

Metal (Roman Numeral) Anion
Cobalt (II) bromide choice (e)

انظر موضوع تسمية المركبات بشرح مفصل وسهل مع عدد كبير من الامثلة في كتاب طريق التميز في الكيمياء (1) ص ٥٩ - ٦٨.

Question (8):

Tetraphosphorus trisulfide : ??

Tetra means 4, and tri means 3; therefore the formula is P_4S_3 choice [d]

انظر موضوع ايجاد الصيغ الكيميائية من أسماء المركبات في كتاب طريق التميز في الكيمياء (1) CHAPTER (2)

Question (9):

mass of CO_2 = 0.400 g CO_2 ; Atomic Weight C = 12.0 amu, O = 16.0 amu
moles of CO_2 = ??

Formula Weight $CO_2 = 12 + 2(16) = 44.0$ amu $\Rightarrow$ molar mass = 44.0 g/mol

Then moles = mass / molar mass ... 3.4 @ Page 94 (Route of Excellence in CHEMISTRY (1))

Continued SE Question (9):

Then :

$$\text{moles } CO_2 = \frac{0.400\,g\ CO_2}{44.0\,g/1\,mol} = 0.0090909 \longrightarrow 9.09 \times 10^{-3}\ \text{mole } CO_2.$$

Choice (b)

Another solution:

$$0.400\,g\ CO_2 \times \frac{1\ mol\ CO_2}{44.0\ g\ CO_2} = 9.09 \times 10^{-3}\ mol\ CO_2$$

انظر موضوع المول في كتاب طريق التميز في الكيمياء (1) ، ص (89-97).
هناك مجموعة كبيرة من الأسئلة المتعددة والمسائل ...

Question (10):

mass percent of O in $Ca_3(PO_4)_2$ = ?

	Ca	P	O
molar mass (g/mol) →	40.1	31.0	16.0

$\rightarrow Ca_3(PO_4)_2 = 278.3$

$$\%\,O = \frac{\text{no. of Oxygen atoms} \times \text{molar mass of O}}{\text{molar mass of } Ca_3(PO_4)_2} \times 100\%$$

القانون الأساسي [3.6] ...

Route of Excellence in Chemistry (1) 1st Edition, Page 99.

Then

$$\%\,O = \frac{8 \times 16.0\ g}{278.3\ g} \times 100\% = 34.49514912\,\%$$

$$= 34.5\,\%$$

Choice (a)

Question (11):

the mass of one HNO_3 molecule is ?? (g).

We have to find the weight using (amu), then we can convert it to (g).

Formula weight of HNO_3 = 1(H) + 1(N) + 3(O)

= 1(1.0) + 1(14.0) + 3(16.0) = 63.0 amu / molecule.

Continue : Question (11)

Then: we know that $1\ g = 6.022 \times 10^{23}$ amu. ....[3.1] Route of Excellence in CHEMISTRY (1) Page 90, 1st edition.

Therefore:

$$63.0 \frac{\text{gram}}{\text{molecule}} \times \frac{1\ g}{6.022 \times 10^{23}\ \text{gram}} = 1.046640 \times 10^{-22}\ g/\text{molecule}.$$

$$= 1.05 \times 10^{-22}\ \frac{g}{\text{molecule}} \quad \text{choice } \boxed{d}$$

Another solution:

molar mass of HNO_3 = 1(H) + 1(N) + 3(O)

= 1(1) + 1(14) + 3(16) = 63.0 g/mol.

Then:

$$63.0\ \frac{g}{mole} \times \frac{1\ mole}{6.022 \times 10^{23}\ molecule} = 1.05 \times 10^{-22}\ g/molecule.$$

Question (12):

Compound contains only Cl and O.

% O = 90.3 % : (Atomic Weights Cl = 35.5 ; O = 16.0)

Empirical Formula : ??

In order to write the empirical formula, we have to follow these steps:

1) We have to determine how many Elements are there in the formula
2) " " " find the masses of the above elements.
3) We must convert the masses into moles using molar masses.
4) We writ each element followed by the calculated number of moles, then we look for the simplest ratio of whole numbers. If we do not have small whole numbers, we devide all numbers on the smallest number (except 1) to obtain the simplest ratio of small whole numbers.

يمكنك رؤية هذه الخطوات بالعربية والمزيد عن الامثلة في كتاب طريق التميز في الكيمياء (1) : ص ١٠٣ - ١٠٤

Continue of Question (12):

1. We have only two elements : Cl and O.

the available data is : % O = 40.3 % , then % Cl = 100% - % O

$\Rightarrow$ % Cl = 59.7 %

Now, we assume that we have 100 g of our compound, therefore

2. mass of O = 40.3 g and mass of Cl = 59.7 g.

3. moles of O = $\frac{40.3\ g}{16.0\ g/mol}$ = 2.51875 mol O

moles of Cl = $\frac{59.7\ g}{35.5\ g/mol}$ = 1.681690141 mol Cl.

4. Then, we divide on 1.681690141, this leads to:

$Cl_{1.00}\ O_{1.4977}$ $\Rightarrow$ $Cl_{1.00}\ O_{1.50}$

5. We have to obtain integers by multiplying the previous formula by 2:

$Cl_{1.00}\ O_{1.50} \times 2$ $\Rightarrow$ $Cl_{2.00}\ O_{3.00}$ $\Rightarrow$ Cl_2O_3 choice (b)

Question (13):

1. First of all, we have to balance the equation.
2. Then, we use the following diagram to obtain the mass of product:

mass of Al $\xrightarrow{\div \text{ molar mass}}$ moles of Al $\xrightarrow{\text{mole ratio}}$ moles of Al_2O_3 $\xrightarrow{\times \text{ molar mass}}$ mass of Al_2O_3

Now; the balanced equation is:

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

للمزيد كيف تزن المعادلة الكيميائية
انظر كتاب طريق التميز في الكيمياء (1)
الطبعة الأولى، ص ٧٩ - ٨٠

molar mass of Al_2O_3 = 2(Al) + 3(O)

= 2 (27.0) g/mol + 3 (16.0 g/mol)

= 102 g/mol.

Continued Question (13):

because I want to convert moles Al to moles of Al_2O_3, moles of Al should be written in the denominator of the mole ratio, which is derived from the balanced equation as shown below:

$$\frac{2 \text{ moles of } Al_2O_3}{4 \text{ moles of Al}}$$

طريقة المزيد عليه كيفية كتابة النسبة المولية (mole ratio)
اقرأ الموضوع ٣-٧ صفحة ١١٠ في كتاب طريق التميز في الكيمياء (١) الطبعة الثانية

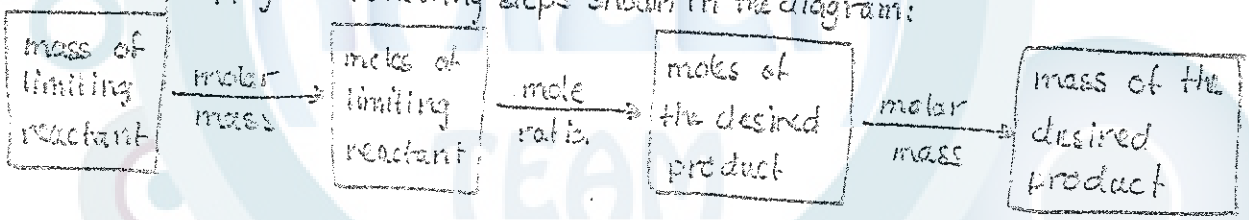
Now, we can go through calculation easily:

$$16.2 \text{ g Al} \times \underbrace{\frac{1 \text{ mol Al}}{27.0 \text{ g Al}}}_{\text{molar mass}} \times \underbrace{\frac{2 \text{ mol } Al_2O_3}{4 \text{ mole Al}}}_{\text{mole ratio}} \times \underbrace{\frac{102 \text{ g } Al_2O_3}{1 \text{ mol } Al_2O_3}}_{\text{molar mass}} = 30.6 \text{ g}$$

Choice (e)

Question (14):

1. We check whether the equation is balanced or not; if not we balance it.
2. We determine the limiting reactant.
3. Then, we apply the following steps shown in the diagram:



$$CaO_{(s)} + 3C_{(s)} \longrightarrow CaC_{2(s)} + CO_{(g)}$$

- the chemical equation is balanced.
- now have to calculate no. of moles of each compound:

$$5.61 \text{ g CaO} \times \frac{1 \text{ mol CaO}}{56.1 \text{ g CaO}} = 0.100 \text{ mol CaO} \quad \text{(Actually present)}$$

$$4.80 \text{ g C} \times \frac{1 \text{ mol C}}{12.0 \text{ g C}} = 0.400 \text{ mol C} \quad \text{(Actually present)}.$$

Continue of Question 14:

now, we calculate how many moles are needed to react with actual compounds

$0.100 \text{ mol } CaO \times \frac{3 \text{ mol } C}{1 \text{ mol } CaO} = 0.300 \text{ mol C}$ is needed to react with 0.1 mol of CaO, do not forget that we have 0.400 mol C, so 0.100 mol C will remain as excess reactant. Consequently, the limiting reactant is CaO.

then, we can calculate the mass of CaC_2 using the following diagram:

mass of CaO → (molar mass) → moles of CaO → (mole ratio) → moles of CaC_2 → (molar mass) → mass of CaC_2

Because we have calculated the moles of CaO, we will start with it.

$0.100 \text{ mol } CaO \times \frac{1 \text{ mol } CaC_2}{1 \text{ mol } CaO} \times \frac{64.1 \text{ g } CaC_2}{1 \text{ mol } CaC_2} = 6.41 \text{ g } CaC_2.$ (theoretical mass)

$$\text{Percentage Yield} = \frac{\text{actual mass}}{\text{theoretical mass}} \times 100\%$$ ... [3.8] ⇐ Route of Excellence in CHEMISTRY (1) Page 121, 1st edition

$$\% \text{ Yield} = \frac{4.49 \text{ g}}{6.41 \text{ g}} \times 100\% = 70.0\%$$ Choice (c)

عزيزي الطالب، كان بالإمكان حل هذا السؤال بالرجوع إلى الأسئلة المبنية على موضوع المادة المحددة للتفاعلات الكيميائية في كتاب طريق التميز في الكيمياء (1)، ص ١٢٢ - ١٢٦، الطبعة الأولى.

Question (15):

Strong electrolytes involves strong acids, strong bases and salt. Choice (d)

Therefore, Na_2SC_4 is only the strong electrolyte, because it is a salt.

للمزيد حول هذا الموضوع، انظر كتاب طريق التميز، الطبعة الأولى، ص ١٣١ - ١٣٥.

Question (16) :

The idea here is to go back the solubility rules presented in table (4-1) in page 186 in route of excellence in chemistry (1), we can revise some of them :

- most nitrates, sulfates and acetates are soluble.
- most halides are soluble except if they combine with Ag^+, Pb^{2+}, Hg_2^{2+} and Hg^{2+}
- most salts of Group 1 elements are soluble.

Furthermore, strong acids and strong bases are strong electrolytes.

Then :

(a) $Mg(NO_3)_{2\,(aq)} + H_2SO_{4\,(aq)} \longrightarrow MgSO_{4\,(aq)} + 2HNO_{3\,(aq)}$ No reaction.

(b) $2NaOH_{(aq)} + BaCl_{2\,(aq)} \longrightarrow 2NaCl_{(aq)} + Ba(OH)_{2\,(aq)}$ No reaction.

(c) $3Na_2SO_{4\,(aq)} + 2FeCl_{3\,(aq)} \longrightarrow 6NaCl_{(aq)} + Fe_2(SO_4)_{3\,(aq)}$ No reaction

(d) $Mg(NO_3)_{2\,(aq)} + 2NaOH_{(aq)} \longrightarrow Mg(OH)_{2\,(s)}\downarrow + 2NaNO_{3\,(aq)}$ Reaction occurs

(e) $2NaNO_{3\,(aq)} + CuSO_{4\,(aq)} \longrightarrow Na_2SO_{4\,(aq)} + Cu(NO_3)_{2\,(aq)}$ No reaction.

Remember that mixing of soluble compounds that does not produce solid or liquid or gas is not considered as chemical reaction.

Question (17) :

There are a set of oxidation number rules written in route of excellence in Chemistry (1), 1st edition, pages 157 - 158 (Arabic - english). Therefore :

The charge of a compound or an ion = (no. of atoms of 1st element) × (charge of 1st element) + (no. of atoms of 2nd element) × (charge of 2nd element) + ...

↓ the same as oxidation numbers.

So, our compound is $Ca_3(PO_3)_2$, and we want to assign oxidation state of P :

$0 = 3 \times Ca + 2 \times P + 6O \Rightarrow 0 = 3\times 2+ + 2P + 6\times 2-$

$\Rightarrow 0 = 6 + 2P - 12 \Rightarrow 0 = 2P - 12 \Rightarrow 2P = +6 \Rightarrow P = +3$ Choice a

Question (15):

$$Br^- + MnO_4^- \longrightarrow Br_2 + Mn^{2+}$$

Strategy:

1. Assign the oxidation state to each atom.

$$\overset{-1}{Br^-} \quad \overset{+7\ -2}{MnO_4^-} \xrightarrow{\text{reduction}} \overset{0}{Br_2} + \overset{+2}{Mn^{2+}}$$

oxidation state

oxidation

2. We separate equations for oxidation and reduction half-reactions.

oxidation half-rxn: $Br^- \longrightarrow Br_2$

reduction half-rxn: $MnO_4^- \longrightarrow Mn^{2+}$

3. For each half-reaction:

a. we balance all atoms except for H & O:

$$2\,Br^- \longrightarrow Br_2$$

$$MnO_4^- \longrightarrow Mn^{2+}$$

b. we balance Oxygen atoms by adding H_2O molecules to side which has a lower no. of oxygen atoms:

$$2\,Br^- \longrightarrow Br_2$$

$$MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$$

c. we balance hydrogen atoms by adding H^+ ions to the side which has a lower no. of hydrogen atoms:

$$2\,Br^- \longrightarrow Br_2$$

$$8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$$

d. balance the charge by adding suitable no. of electrons to half reactions.

$$2\,Br^- \longrightarrow Br_2 + 2e^-$$

$$5e^- + 8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$$

Continue : Question (18):

4. Multiply one or both half-reactions, when needed, by an integer to equalize the no. of electrons transferred in the two half-reactions.

$5 \times (2Br^- \longrightarrow Br_2 + 2e^-)$

$2 \times (5e^- + 8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O)$

$10\,Br^- \longrightarrow 5\,Br_2 + \cancel{10e^-}$

$\cancel{10e^-} + 16H^+ + 2MnO_4^- \longrightarrow 2Mn^{2+} + 8\,H_2O$

5. Add the two halves to each other, and cancel electrons and identical species.

$10Br^- + 16H^+ + 2MnO_4^- \longrightarrow 5\,Br_2 + 2Mn^{2+} + 8\,H_2O$

6. Check that all atoms and charges are balanced.

10 Br	10 Br
16 H	16 H
2 Mn	2 Mn
8 O	8 O

$(10\times-1) + (16\times1) + (2\times-1) \overset{??}{=} (2\times2)$

$-10 + 16 - 2 \overset{??}{=} +4$

$+4 = +4$

صانك الحزين لهو سئلة
والشرح المفصل لموضوع موازنة
المعادلات الكيميائية ومعادلات
التأكسد والاختزال في كتاب طريق
التميز في الكيمياء (1)، الطبعة الأولى
الصفحات ١٢٨ - ١٢٦ .

Then the ratio coefficient of Br^- / H_2O is $10/8 = 5/4$ Choice c

Question (19):

we must write a balanced equation, as shown below:

$2\,AgNO_3\,(aq) + CaCl_2\,(aq) \longrightarrow 2\,AgCl\,(s) + Ca(NO_3)_2\,(aq)$

Then, we go through the following digram:

Molarity and Volume of $AgNO_3$ → moles of $AgNO_3$

Molarity and Volume of $CaCl_2$ → moles of $CaCl_2$

→ Limiting reactant → moles $AgCl$ → mass $AgCl$

Now, we can calculate the moles of each reactant, as shown below:

moles = Molarity (mol/L) * Volume (L) $\Rightarrow$

- moles of $AgNO_3$ = $120.0\ \cancel{mL} \times \frac{1\ \cancel{L}}{10^3\ \cancel{mL}} \times 0.20\ \frac{mol}{\cancel{L}} = 0.024\ mol\ AgNO_3$ (Actually Present)
- moles of $CaCl_2$ = $120.0\ mL \times \frac{1\ L}{10^3\ mL} \times 0.15\ \frac{mol}{L} = 0.018\ mol\ CaCl_2$.

Let us start by moles of $CaCl_2$:

$0.018\ mol\ CaCl_2 \times \frac{2\ mol\ AgNO_3}{1\ mol\ CaCl_2}$ = 0.036 mol $AgNO_3$ is needed to react with 0.018 mol $CaCl_2$. But, we do not have enough amount to react. Therefore $AgNO_3$ is the limiting reactant.

Now, we can calculate the mass of AgCl after using the molar mass of AgCl.

molar mass of AgCl = Ag + Cl = 107.9 g/mol + 35.5 g/mol = 143.4 g/mol.

Then:

$0.024\ \cancel{mol\ AgNO_3} \times \underbrace{\frac{2\ \cancel{mol\ AgCl}}{2\ \cancel{mol\ AgNO_3}}}_{\text{mole ratio from balanced equation}} \times \underbrace{\frac{143.4\ g\ AgCl}{1\ \cancel{mol\ AgCl}}}_{\text{molar mass of AgCl}} = 3.4416\ g\ AgCl$

corrected and rounded → 3.4 g AgCl

Choice a

يمكنك التنقل الى كتاب طريق التميز في الكيمياء (1) الطبعة الثانية : ص - ٧٦ - ٧٨

Question (20):

In order to write the net ionic equation, we have to separate each compound except for solids, liquids, gases, weak acid and weak bases.

Now, HCN is considered as weak acid, so it is not ionized completely and H_2O is a liquid, therefore it cannot be ionized completely.

Continue: Question (20) :

Now, the molecular equation is:

$$HCN_{(aq)} + NaOH_{(aq)} \longrightarrow NaCN_{(aq)} + H_2O_{(l)}$$

the ionic equation is:

$$HCN_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \longrightarrow Na^+_{(aq)} + CN^-_{(aq)} + H_2O_{(l)}$$

the net ionic equation is:

$$HCN_{(aq)} + OH^-_{(aq)} \longrightarrow CN^-_{(aq)} + H_2O_{(l)}$$

which is choice d .

يمكنك النظر إلى هذا الموضوع بطريقة تفاصيله في كتاب طريق التميز في الكيمياء (1) الطبعة الأولى، الصفحات ١٤٠ - ١٤٢ .

عزيزي الطالب :

بعد استرسينا وبحمد الله تعالى من حل هذا النموذج، لعلك لاحظت أنني كنت بالاستناد إلى أن هذه المواضيع مستمرة بشكل دورة وعلناً في كتاب طريق التميز ، والهدف من الاستناد هي الاستزادة وربط الكتاب بأسئلة السنوات السابقة .

- اهدأ قبل دخول قاعة الامتحان.
- كن واثقاً لحظة استلام ورقة الامتحان.
- استعن بالله تعالى ، واترك ما لا تعرفه .
- عد إلى الأسئلة التي راهنت بها صعوبات ، وبعونه الله تعالى ، لن تجد أي صعوبة يصعب عليك حله .

مع أمنيات النجاح للجميع

إبراهيم دياب

عزيزي الطالب:
هذا النموذج مختلف عن
نفس نموذج الاسئلة فقط

General Chem. 101
First Exam

Date: 11/11/2006
Time: 60 min.

الاسم :
ابراهيم زيان
٠٧٨٨٨٨٠٥٨
٠٧٨٨٨٥٦٠٩

Student Name: ..... Reg. No.: .....

Instructor's Name: ..... Seat No.: .....

ANSWER SHEET

1.	a	b	c	d	e	9.	a	b	c	d	e
2.	a	b	c	d	e	10.	a	b	c	d	e
3.	a	b	c	d	e	11.	a	b	c	d	e
4.	a	b	c	d	e	12.	a	b	c	d	e
5.	a	b	c	d	e	13.	a	b	c	d	e
6.	a	b	c	d	e	14.	a	b	c	d	e
7.	a	b	c	d	e	15.	a	b	c	d	e
8.	a	b	c	d	e	16.	a	b	c	d	e

1. Perform the following calculation and give the answer rounded to the correct number of significant figures.

$$(6.56 + 5.679)\,(2.00 + 9.0) / 17.9$$

(2 decimal; 1 decimal.)

a) 7.52 b) 7.523 c) 7.5 d) 7.5218 e) 8

Ibrahim Diab. $(12.239)(11.0) / 17.9$ (4 S.F; 3 S.F; 3 S.F)

See Question 1 19/1/2005

2. Calculate the volume (in^3 units) of an 0.640 lb object which has a density of 1.326 g/cm^3. Given: 1 lb = 454 g, 1 in = 2.54 cm

a) 15.5 b) 11.3 c) 17.6 d) 13.4 e) 36.2

density $= \frac{1.326\ g}{1\ cm^3} = \frac{1\ lb}{454\ g}$ ×

$0.640\ lb \times \frac{454\ g}{1\ lb} \times \frac{1\ cm^3}{1.326\ g} \times \frac{1\ in^3}{(2.54\ cm)^3}$

Ibrahim Diab.

3. Which of the following statements defines a compound:

a) A substance that can not be separated into simpler substance by chemical changes.
b) A substance composed of two or more elements chemically combined.
c) A homogeneous mixture of two or more substances.
d) A heterogeneous mixture of two or more substances.
e) None of the above

Ibrahim Diab

4. There are two naturally occurring isotopes of copper, ^{63}Cu (mass 62.93 amu) and ^{65}Cu (mass = 64.93 amu). If the fractional abundance of ^{63}Cu is 0.515, then the average atomic mass of Cu (in amu units) in this sample is:

a) 63.3 b) 63.7 c) 63.5 d) 63.1 e) 63.9

Ibrahim Diab

average atomic mass of Cu = mass of ^{63}Cu × natural Abundance + mass of ^{65}Cu × natural Abundance

$= 62.93\ amu \times 0.515 + 64.93\ amu \times (1 - 0.515)$

$= 32.405 + 31.484 = 63.89$

5. Which of the following combinations of name-formula is **not correct?**

a) Ammonium bicarbonate, NH_4HCO_3
b) Nitric acid, HNO_3
c) Sodium chlorate, $NaClO_2$ ← This is Sodium Chlorite
d) Calcium hydride, CaH_2
e) Dichlorine trioxide, Cl_2O_3

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6. Which of the following is the correct name for the compound:

$Co_3(PO_4)_2$

Cobalt is type II element.
PO_4 is called Phosphate.

a) Cobalt phosphate.
b) Cobalt(II) phosphate.
c) Cobalt(II) diphosphate.
d) Cobalt(II) phosphite.
e) Tricobalt diphosphate.

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7. How many sulfur S atoms are there in 25 g of Al_2S_3?
($N = 6.02 \times 10^{23}$, molar masses (g/mol) : Al= 27.0 ; S = 32.1).

a) 4.2×10^{23} b) 5.4×10^{23} c) 6.8×10^{21}
d) 3.0×10^{23} e) 1.8×10^{23}

Ibrahim Diab

$$25\ g\ Al_2S_3 \times \frac{1\ mol\ Al_2S_3}{(2\times 27.0 + 3\times 32.1)\ g\ Al_2S_3} \times \frac{3\ mol\ S}{1\ mol\ Al_2S_3} \times \frac{6.022\times 10^{23}\ atoms\ S}{1\ mol\ S}$$

$$= 3.0 \times 10^{23}$$

8. Calculate the mass percent of N in ammonium phosphate, $(NH_4)_3PO_4$.
(molar masses(g/mol): N = 14.0; H =1.0 ; P = 31.0 and O = 16.0)

a) 28.2 b) 43.0 c) 21.2 d) 48.5 e) 32.7

Ibrahim Diab.

$$\% N = \frac{\text{Number of atoms of N} \times \text{molar mass of N}}{\text{molar mass of } (NH_4)_3PO_4} \times 100\%$$

$$= \frac{3 \times 14.0\ g/mol}{[3((4\times 1.0)+14)+31+(4\times 16.0)]} = \frac{42}{149} \times 100\%$$

$$= 28.18\ \%$$

See Question Q8 3/4/2005

9. A sample of 0.960 g of a compound containing carbon, oxygen and hydrogen was combusted (burnt) with excess oxygen to produce 1.32 g CO_2 and 1.08 g H_2O. The empirical formula of the compound is:
(molar masses(g/mol): C= 12.0, H= 1.0, O =16.0)

a) CHO b) CH_3O c) CHO_2 d) CH_2O e) CH_4O

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$1.32\ g\ CO_2 \times \frac{1\ mol\ CO_2}{(12.0+2\times16.0)\ g\ CO_2} \times \frac{1\ mol\ C}{1\ mol\ CO_2} = 0.03\ mol\ C$

$1.08\ g\ H_2O \times \frac{1\ mol\ H_2O}{((2\times1.0)+16)\ g\ H_2O} \times \frac{2\ mol\ H}{1\ mol\ H_2O} = 0.12\ mol\ H$

$0.03\ mol\ C \times \frac{12\ g\ C}{1\ mol\ C} = 0.36\ g$

$0.12\ mol\ H \times \frac{1\ g\ H}{1\ mol\ H} = 0.12\ g$

mass O = 0.960 g − (0.36 g + 0.12 g) = 0.48 g

$0.48\ g \times \frac{1\ mol\ O}{16\ g\ O} = 0.03\ mol\ O$

Ratio C : H : O = 0.03 : 0.12 : 0.03 = 1 : 4 : 1 = CH_4O

10. Consider the balanced equation:

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

A sample of 8.50 g NH_3 was combusted with excess oxygen. The reaction produced 12.0 g of NO. Calculate the percentage yield of NO:(molar masses (g/mol): N = 14.0, H = 1.0; O =16.0)

a) 100% b) 80.0% c) 60.0% d) 40.0% e) 20.0%

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$8.50\ g\ NH_3 \times \frac{1\ mol\ NH_3}{(14+3\times1)\ g\ NH_3} \times \frac{4\ mol\ NO}{4\ mol\ NH_3} \times \frac{(14+16)\ g\ NO}{1\ mol\ NO} = 15.0\ g\ NO$ Theoritical

$\% \text{ yield} = \frac{\text{actual mass}}{\text{Theoritical mass}} \times 100\% = \frac{12.0\ g}{15.0\ g} \times 100\% = 80\%$

11. Consider the unbalanced reaction:

$$4\ Al + 3O_2 \rightarrow 2Al_2O_3$$

Calculate the mass of Al_2O_3(in g) produced from the reaction mixture of 5.40 g Al and 3.42 g O_2 .
(molar masses (g/mol): Al = 27.0; O = 16.0)

a) 8.12 b) 8.95 c) 7.67 d) 12.4 e) 7.27

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We have to determine the limiting reactant.

$5.40\ g\ Al \times \frac{1\ mol\ Al}{27\ g\ Al} = 0.2\ mol\ Al$ actually found.

$3.42\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} = 0.107\ mol\ O_2$ actually found.

12. The net ionic equation for the reaction of nitrous acid with lithium hydroxide is

a) $HNO_{3(aq)} + LiOH_{(aq)} \rightarrow LiNO_{3(aq)} + H_2O_{(l)}$
b) $HNO_{3(aq)} + LiOH_{(aq)} \rightarrow Li^+_{(aq)} + NO_3^-{}_{(aq)} + H_2O_{(l)}$
c) $HNO_{2(aq)} + OH^-_{(aq)} \rightarrow NO_2^-{}_{(aq)} + H_2O_{(l)}$
d) $H^+_{(aq)} + NO_2^-{}_{(aq)} + Li^+_{(aq)} + OH^-_{(aq)} \rightarrow Li^+_{(aq)} + NO_2^-{}_{(aq)} + H_2O_{(l)}$
e) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

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$0.2\ mol\ Al \times \frac{3\ mol\ O_2}{4\ mol\ Al} = 0.15\ mol\ O_2$ is needed, but we have 0.107 mol O_2.

Therefore, O_2 is the limiting reactant.

$0.107\ mol\ O_2 \times \frac{2\ mol\ Al_2O_3}{3\ mol\ O_2} \times \frac{(2\times27+3\times16)\ g\ Al_2O_3}{1\ mol\ Al_2O_3} = 7.27\ g$

13. Which of the following pairs of aqueous solutions **would not** produce a precipitate when mixed?

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a) $BaCl_2$ and Na_2CO_3 b) K_2SO_4 and $Fe(ClO_4)_3$

c) $(NH_4)_3PO_4$ and $Ca(NO_3)_2$ d) Na_2S and $FeCl_2$

d) $AgNO_3$ and HCl

14. In the following oxidation - reduction reaction,

oxidation

$$H^+_{(aq)} + Cl^-_{(aq)} + Sn_{(s)} + NO_3^-{}_{(aq)} \rightarrow SnCl_6^{2-}{}_{(aq)} + NO_{2(g)} + H_2O_{(l)}$$

Oxidation Number: +1 −1 0 +5 −2 +4 −1 +4 −2 +1 −2

reduction.

The reducing agent is

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a) NO_2 b) Cl^- c) Sn d) NO_3^- e) H_2O

reducing agent.

15. Which of the following reactions is a decomposition, redox reaction?

اختزال

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a) $2Cu_2O(s) \rightarrow 4Cu(s) + O_2(g)$ Decomposition, redox.
b) $CaCO_3(s) \rightarrow CO_2(g) + CaO(s)$ Decomposition
c) $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$ Substitution
d) $Ca(s) + O_2(g) \rightarrow CaO(s)$ Combination
e) $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(aq) + 2NaCl(aq)$ Double Displacement

16. An excess amount of sodium sulfate was added to 50.00 ml aqueous solution of $BaCl_2$. If the mass of the precipitate formed was 1.467 g, calculate the molar concentration of chloride ions in the $BaCl_2$ solution.(molar masses(g/mol): Ba =137.3; S =32.1 , O =16.0, Cl = 35.5)

a) 0. 217 b) 0.269 c) 0.234 d) 0.327 e) 0.251

$$1.467\ g\ BaSO_4 \times \frac{1\ mol\ BaSO_4}{(137.3+32+4\times16)\ g\ BaSO_4} \times \frac{2\ mol\ Cl^-}{1\ mol\ BaCl_2} = 0.0125\ mol\ Cl^-$$

$$\text{Molarity} = \frac{\text{mole}}{\text{volume}} = \frac{0.0125\ mol\ Cl^-}{0.0500\ L} = 0.251$$

General Chem. 101
First Exam

Date: 28/3/2009
Time: 60 min.

Name: ..... Reg. No.: .....
Instructor Name: ..... Seat No.: .....

$$°F = (°C \times \frac{9}{5}) + 32 \quad , \quad K = °C + 273$$

ANSWER SHEET

1.	a	b	c	d	**e**	9.	a	b	**c**	d	e
2.	a	**b**	c	d	e	10.	a	**b**	c	d	e
3.	a	b	**c**	d	e	11.	**a**	b	c	d	e
4.	**a**	b	c	d	e	12.	**a**	b	c	d	e
5.	a	**b**	c	d	e	13.	a	**b**	c	d	e
6.	a	b	c	**d**	e	14.	a	b	c	**d**	e
7.	a	b	**c**	d	e	15.	a	b	c	d	**e**
8.	a	**b**	c	d	e	16.	a	b	c	**d**	e

GOOD LUCK

1. Perform the following calculation and give the answer rounded to the correct number of significant figures

$$(15.562 - 15.512) \times 1000.0 =$$

a) 5 b) 5.0 c) 5.5 d) 5×10^{0} e) 5.0×10^{1}

2. Convert 3.6×10^{-5} g/L to mg/cm^3.

a) 3.6×10^{2} b) 3.6×10^{-1} c) 3.6×10^{-2}
d) 3.6×10^{-5} e) 3.6×10^{-3}

3. The boiling point of a liquid substance is 95.0 K. What is this temperature in Fahrenheit?

a) -321 b) -288 c) -353 d) 139 e) 171

4. Which is the correct formula for copper(II) phosphite?

a) Cu_2PO_3 b) $Cu_3(PO_4)_2$ c) Cu_2PO_3
d) $Cu(PO_4)_2$ e) $Cu_3(PO_3)_2$

5. Which of these choices is the formula for hydrobromic acid?

a) KBr b) HBr c) HBrO d) $HBrO_2$ e) $HBrO_3$

6. Calculate the number of moles of copper in 2.50×10^{-3} kg copper

a) 39.5 b) 3.93×10^{-2} c) 3.93 d) 39.7 e) 39.3

7. A compound containing only oxygen and chlorine is 47.4 % oxygen by mass. What is the empirical formula?

a) ClO b) Cl_2O c) ClO_2 d) Cl_2O_5 e) Cl_2O_3

8. Methanol burns up in air according to

$$2\ CH_3OH + 3\ O_2 \rightarrow 2\ CO_2 + 4\ H_2O$$

What mass of methanol should burn to produce 185 g H_2O?

a) 147 b) 164 c) 393 d) 73.3 e) 1.4×10^2

9. According to the reaction

$$NO + O_3 \rightarrow O_2 + NO_2$$

If 0.670 g NO reacts with 1.240 g O_3, how many grams of NO_2 will be produced?

a) 1.41 b) 0.709 c) 1.03 d) 0.709 e) 0.740

10. Given $6Li_{(s)} + N_{2(g)} \rightarrow 2\ Li_3N_{(s)}$. If 12.3 g of Li react with 33.6 g of N_2 to produce 11.3 g Li_3N calculate the percent yield

a) 16.7 b) 85.0 c) 68.0 d) 55.0 e) 54.0

11. Based on the solubility rules, which of these processes will occur if solutions of $CuSO_{4(aq)}$ and $BaCl_{2(aq)}$ are mixed?

a) $BaSO_4$ will precipitate; Cu^{2+} and Cl^- are spectator ions.
b) $CuSO_4$ will precipitate; Ba^{2+} and Cl^- are spectator ions.
c) $CuCl_2$ will precipitate; Ba^{2+} and SO_4^{2-} are spectator ions.
d) $BaSO_4$ will precipitate; Cu^{2+} and SO_4^{2-} are spectator ions.
e) No precipitate will form.

12. The oxidation number of S in Na_2SO_4 is

a) +6 b) +5 c) +3 d) -3 e) -5

13. Which of these equations does *not* represent an oxidation-reduction reaction?

a) $3\ Al + 6\ HCl \rightarrow 3\ H_2 + AlCl_3$
b) $2\ NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 2\ NaNO_3$
c) $2\ H_2O \rightarrow 2\ H_2 + O_2$
d) $2\ NaI + Br_2 \rightarrow 2\ NaBr + I_2$
e) $Cu(NO_3)_2 + Zn \rightarrow Zn(NO_3)_2 + Cu$

14. Complete and balance the following redox equation in a basic medium. What is the coefficient of H_2O when the equation is balanced using the set of smallest whole-number coefficients?

$$MnO_4^- + I^- \rightarrow MnO_2 + IO_3^- \text{ (basic solution)}$$

a) 10 b) 4 c) 2 d) 1 e) none of these

15. Calculate the mass of $MgCl_2$ in grams required to prepare 5.00×10^2 mL of a 1.78 M $MgCl_2$ solution.
(Molar mass of $MgCl_2$ = 95.2 g/mol)

a) 133 b) 160 c) 106 d) 66.5 e) 84.7

16. How many milliliters (mL) of a 0.552 M HNO_3 are needed to neutralize completely 125 mL of 0.0120 M $Ba(OH)_2$ solution?

a) 35.5 b) 15.0 c) 1.15 d) 5.43 e) 10.9

Circle the right answer for each of the following questions and put "X" on the corresponding choice on the front page:-

1. How many significant figures are there in 1.307010

a)3 b) 4 c) 5 d)6 (e)7

2. Calculate the following arithmetic and express the result to the correct number of significant figures.

$$\frac{3.027 + 13.70}{8.221}$$

a)2.03 b) 2.15 (c)2.035 d) 2.06 e) 2.059

3. The average distance from earth to the sun is 7.3×10^7 miles. How many kilometers is this distance? (1mile=1760 yard, 1 m= 1.094 yard)

7.3×10^7 miles $\times \frac{1760 \text{ yard}}{1 \text{ mile}} \times \frac{1 \text{ meter}}{1.094 \text{ yard}} = 11744 \times 10^7$ m

(a) 1.2×10^8 b) 7.3×10^7 c) 5.3×10^6 d) 1.5×10^8 e) 8.5×10^6

4. A metal melts at 701.0 °C. What temperature is this in °F ?

$\frac{TF + 40}{TC + 40} \times \frac{9}{5}$

$6669 = 5 \times 40 + 5TF$

a) 753.8 (b)1294 c) 566.4 d) 933.8 e) 1114

5. The chemical formula of Calcium phosphate is:

a) $CaPO_4$. b) Ca_3P_2 c) $Ca_2(PO_4)_3$ (d) $Ca_3(PO_4)_2$ e) $Ca_3(PO_3)_2$

6. The name of the chemical substance with the formula $CrSO_3$ is:

(a) chromium(II) sulfite b) chromium(II) sulfate c) chromium sulfide

d) chromium(III) sulfite e) chromium sulfur oxide

7. The element oxygen consists of three naturally occurring isotopes: ^{16}O, ^{17}O and ^{18}O. The atomic mass of oxygen is 16.0 amu. What can you learn about the relative abundances of these isotopes? (Atomic mass for ^{16}O = 16.0, ^{17}O = 17.0, ^{18}O = 18.0 amu)

a) More than 50% of all oxygen isotopes are ^{17}O.

(b) The abundances of ^{17}O and ^{18}O are very small.

c) Almost all oxygen atoms are ^{17}O.

d) All isotopes have equal abundance of 33.3%.

e) Almost all oxygen atoms are ^{18}O.

8. When 0.952 g of an organic compound containing C, H and O is burned completely in an excess of oxygen, 1.35 g of CO_2 and 0.826 g of H_2O are produced. What is the empirical formula of the compound?

(a) C_2H_6O b) $C_3H_5O_2$ c) CH_3O d) $C_4H_7O_4$ e) $C_3H_5O_3$

9. The percentage composition of a chemical compound is: 32.01 % C, 4.03 % H and 63.96 % O. Given that the molecular mass of this compound is 300 amu, what is its molecular formula?

a) CH_2O_6 b) $C_2H_3O_3$ c) $C_4H_6O_6$ (d) $C_6H_9O_9$ e) $C_8H_{12}O_{12}$

10. The average mass (in grams) of one hundred iron (Fe) atoms is

a) 6.02×10^{23} g (b) 9.28×10^{-21} g c) 9.28×10^{-23} g

d) 55.85 g e) 5.585×10^{-23} g

Question 1 : 1.307010 = 7 significant figures. choice e

Remember that (i) zeroes between nonzeroes are significants.
(ii) " to the right of no. are significant if they preceeded by decimal point.
(iii) zeroes located between (0.00) decimal point & the 1st non zero no. are not significant.

Question 2 :
$$\frac{3.027 + 13.70}{8.221}$$

1) We must the two no., keep in mind that the answer should have 2 decimal places.
2) The answer in 1) should be divided on 8.221, the answer would have 4 significant figures

$\Rightarrow 3.027 + 13.70 = 16.727 \simeq 16.73$

$\Rightarrow 16.73 / 8.221 = 2.035$ choice c

Question 3 : using factor label method :

7.3×10^7 mile $\longrightarrow$?? Km.

$$7.3 \times 10^7 \text{ mile} \times \frac{1760 \text{ yard}}{1 \text{ mile}} \times \frac{1 \text{ m}}{1.094 \text{ yard}} \times \frac{1 \text{ Km}}{1000 \text{ m}}$$

$= 1.2 \times 10^8$ Km choice a

Question 4 :
$$T_F = \left(T_C \times \frac{9\,^\circ F}{5\,^\circ C}\right) + 32\,^\circ F$$

$$\Rightarrow T_F = 701.0\,^\circ C \times \frac{9\,^\circ F}{5\,^\circ C} + 32\,^\circ F = 1294\,^\circ F.$$

Question 5 : Calcium Phosphate.

Ca takes fixed charge = 2+
PO_4 " " " = 3-
We combine them, but the total charge must equal to zero.

$Ca^{2+} (PO_4)^{3-} \longrightarrow Ca^{[2+1]} (PO_4)^{[3-1]} \longrightarrow Ca_3(PO_4)_2$ choice d

Question 6 : $Cr-SO_3$

(a) Cr : means Chromium

(b) SO_3 : means sulfite anion with a charge of -2.

(c) because the ratio between the two components is 1:1.

(d) Cr^{2+} must be 2+, because the overall charge must equal to zero.

(e) Cr is transition Metal Element, oxidation no. should be put between two brackets.

(f) The name starts from cation (Left) to Anion (Right)

Chromium (II) sulfite Choice a

Question 7 : Oxygen consists of 3 different isotopes $^{16}O, ^{17}O, ^{18}O$

The average atomic mass of oxygen = 16 amu.

It is clear that Relative Percent abundances of ^{17}O & ^{18}O are very very small because the average is almost equal to 16.

The answer is choice b

Question 8 : mass of organic sample = 0.952 g

C H O

organic sample + O_2 ⟶ CO_2 + H_2O

1.35g 0.826 g

From CO_2, we can find the mass of C.

From H_2O, " " " " " of H.

Then, mass of sample - (C + H) = mass of oxygen

After that, we have to calculate no. of moles of each, then find the empirical formula.

Now: $1\,CO_2 \longrightarrow 1\,C + 2O$

1.35g ??g

$$1.35\,g \times \frac{1\,mol\,CO_2}{44.0\,g\,CO_2} \times \frac{1\,mol\,C}{1\,mol\,CO_2} \times \frac{12.01\,g}{1\,mol\,C} = 0.368\,g\ C.$$

$1\,H_2O \longrightarrow 2H + O$

0.826g ??g

$$0.826\,g\ of\ H_2O \times \frac{1\,mol\,H_2O}{18.0\,g\,H_2O} \times \frac{2\,mol\,H}{1\,mol\,H_2O} \times \frac{1.00\,g\,H}{1\,mol\,H} = 0.0918\,g\ H.$$

Mass of O = total mass of organic - (mass of C + mass of H) = (0.952 - (0.368 + 0.0918)

= 0.492 g O.

If you looked carefully, you would find that we have calculated no. of moles of C and H.

$$\text{moles of C} = 1.35\text{ g of } CO_2 \times \frac{1\text{mol } CO_2}{44.0\text{ g } CO_2} \times \frac{1\text{mol C}}{1\text{mol } CO_2} = 0.0307\text{ mol C.}$$

$$\text{moles of H} = 0.826\text{ of } H_2O \times \frac{1\text{mol } H_2O}{18.0\text{ g } H_2O} \times \frac{2\text{mol H}}{1\text{mol } H_2O} = 0.0918\text{ mol H.}$$

$$\text{moles of O} = 0.492\text{ g of O} \times \frac{1\text{mol O}}{16.0\text{ g O}} = 0.0308\text{ mol O}$$

Now;

$C\ H\ O \Rightarrow C_{0.0307}\ H_{0.0918}\ O_{0.0308}$ & divide on 0.0307

$C_1\ H_3\ O_1$ choice (c)

Question (9) & Assume we have 100g sample, therefore all percentages will be converted to masses.

% C = 32.01 , % H = 4.03 , % O = 63.96

So the masses are:

mass of C = 32.01 g , mass of H = 4.03 g , mass of O = 63.96 g.

$$32.01\text{ g of C} \times \frac{1\text{mol C}}{12.0\text{ g C}} = 2.667\text{ mol C.}$$

$$4.03\text{ g of H} \times \frac{1\text{mol H}}{1.008\text{g H}} = 4.000\text{ mol H.}$$

$$63.96\text{ g of O} \times \frac{1\text{mol O}}{16.00\text{g O}} = 4.000\text{ mol O.}$$

$C_{2.667}\ H_{4.000}\ O_{4.000}$

$C_8\ H_{12}\ O_{12}$ After multiply by 3

$C_8\ H_{12}\ O_{12}$.

Molar mass of $C_8H_{12}O_{12} = 8(C) + 12(H) + 12(O) = 8(12) + 12(1) + 12(16)$

$= 300$ amu.

$$n = \frac{\text{molar mass of real compound}}{\text{molar mass of empirical formula}} = \frac{300}{300} = 1$$

The molecular formula = n x the empirical formula.

The molecular formula = $C_8\ H_{12}\ H_{12}$ Choice (e)

Question [10] : Strategy :

atom ⟶ mol ⟶ mass

$$100 \text{ Fe atom} \times \frac{1 \text{ mol Fe}}{6.02 \times 10^{23} \text{ atom}} \times \frac{55.85 \text{ g}}{1 \text{ mol Fe}} = 9.28 \times 10^{-21} \text{ g Fe.}$$

UNFORETUNATELY, the 3rd page of exam is lost, therefore, there is no solutions.

مع أطيب التمنيات
بالنجاح للجميع

المؤلف
د. إبراهيم ذياب
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طريق التميز في
الكيمياء (١)

Good Luck

General Chem. 101
First Exam

Date: 22/11/2004
Time: 60 min.

Name: ..... Reg. No.: .....

Instructor: ..... Seat No.: .....

Section:.....2.....

ANSWER SHEET

1.	a	b	c	d	e	9.	a	b	c	d	e
2.	a	b	c	d	e	10.	a	b	c	d	e
3.	a	b	c	d	e	11.	a	b	c	d	e
4.	a	b	c	d	e	12.	a	b	c	d	e
5.	a	b	c	d	e	13.	a	b	c	d	e
6.	a	b	c	d	e	14.	a	b	c	d	e
7.	a	b	c	d	e	15.	a	b	c	d	e
8.	a	b	c	d	e	16.	a	b	c	d	e

Answer each of the following questions and put "X" on the correct choice on front page:

1. The number of significant figures in the value (0.0020300) is:

a) 3 b) 4 c) 5 d) 6 e) 7

2. Perform the following calculation and report the result to the correct number of significant figures:

$$(1.57 \times 10^{-4} + 2.710 \times 10^{-3}) \times 2.4246$$

a) 6.951×10^{-3} b) 6.95133×10^{-3} c) 6.95×10^{-3}

d) 7.0×10^{-3} e) 6.9513×10^{-3}

3. If the density of an object is 5.62 g/cm^3, calculate the mass (in pounds) of the same object whose volume is 2.00 ft^3. (Given: one pound = 454 g, one ft = 30.5 cm).

a) 452 b) 446 c) 827 d) 702 e) 577

4. The correct name for $Al(HSO_4)_3$ is:

a) aluminum hydrogen sulfate. b) aluminum sulfate.
c) aluminum(III) hydrogen sulfate. d) aluminum hydrogen sulfite.
e) aluminum hydrogen sulfide

5. Which of the following combinations of name and formula is wrong ?.

a) hydrosulfuric acid ; $H_2S_{(aq)}$.
b) dichlorine pentoxide ; Cl_2O_5
c) mercury(I) peroxide ; Hg_2O_2 .
d) iron nitrate ; $Fe(NO_3)_3$.
e) sodium hydrogen phosphate; Na_2HPO_4

6. Mg has three stable isotopes. Given a sample of Mg with the following masses and percent abundances:

^{24}Mg : 23.9850 amu , 70.42%
^{25}Mg : 24.9858 amu , 15.22%
^{26}Mg : 25.9826 amu , 14.36%

The average atomic mass (in amu) is:

a) 24.31 b) 24.66 c) 24.82 d) 24.54 e) 24.42

7. Aspirin has the molecular formula $C_9H_8O_4$ (molar mass = 180.15 g/mol). Calculate the number of carbon atoms in 300. mg sample of aspirin.
(mg = 10^{-3}g , Avogadro's number = 6.02×10^{23})

a) 1.20×10^{22} b) 9.02×10^{21} c) 1.80×10^{22}
d) 1.50×10^{22} e) 2.41×10^{22}

8. A compound containing only carbon and hydrogen is 82.8 % carbon by mass. If the molar mass of the compound is 58.0 g/mol, calculate the molecular formula of the compound?

a) C_4H_{10} b) C_6H_{14} c) C_7H_{16} d) C_5H_{12} e) C_8H_{18}

9. A sample of compound contains 7.20 g carbon, 1.20 g hydrogen and 4.20 g nitrogen. The empirical formula of the compound is:

a) CH_3N b) CH_6N_2 c) C_2H_4N d) $C_2H_8N_3$ e) CH_3N_3

10. Consider the reaction:

$$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$$

When 23.9 g sample of $CHCl_3$ was reacted with excess Cl_2, 25.2 g of CCl_4 were produced. Calculate the percentage yield of CCl_4.
(Molar masses ; $CHCl_3$: 119.5 g/mol ; CCl_4 : 153.8 g/mol.)

a) 72.2 b) 94.9 c) 81.9 d) 88.4 e) 62.8

11. Calculate the mass of sulfur, S, produced from the reaction of 18.6 g H_2S and 6.52 g O_2 according to the **unbalanced equation**:

$$H_2S + O_2 \rightarrow S + H_2O$$

(Molar masses (in g/mol) ; H_2S = 34.08 ; O_2: 32.00 ; S : 32.06)

a) 13.1 g b) 11.5 g c) 13.5 g d) 18.4 g e) 15.4 g

12. Calculate the mass of K_3PO_4 (molar mass = 212.27 g/mol) needed to prepare 250.0 mL of an aqueous solution in which PO_4^{3-} concentration is 0.0220 M.

a) 2.33 g b) 4.26 g c) 2.92 g d) 1.17 g e) 1.75 g

13. Which of the following pairs of aqueous solutions would not produce a precipitate when mixed ?

a) $Na_2SO_{4(aq)} + Pb(NO_3)_{2(aq)}$
b) $NaOH_{(aq)} + AlCl_{3(aq)}$
c) $HCl_{(aq)} + AgNO_{3(aq)}$
d) $CuCl_{2(aq)} + Na_2SO_{4(aq)}$
e) $Na_3PO_{4(aq)} + CaCl_{2(aq)}$

14. If 45.87 mL of 0.254 M NaOH were required to completely neutralize 18.42 mL of H_2SO_4 solution (to produce Na_2SO_4). Calculate the molar concentration of H_2SO_4 solution.

a) 0.316 b) 0.624 c) 0.229 d) 0.269 e) 0.398

15. The oxidation number of carbon in C_2H_6O is:

a) - 1 b) -2 c) 0 d) +1 e) +3

16. Balance the following reaction (in acidic medium)

$$Cl_2 + S_2O_3^{2-} \rightarrow Cl^- + SO_4^{2-}$$

The ratio H_2O / SO_4^{2-} in the balanced equation is:

a) 5/8 b) 5/3 c) 5/2 d) 5/4 e) 5/1

Question [1] : We have 5 significant figures, because the zeroes to the right end of the number (Trailing zeroes) and (the captive Zeroes): zeroes between non zeroes numbers.

So, 0.0020300 : 5 significant figures. choice [c]

Question [2] : $(1.57 \times 10^{-4} + 2.710 \times 10^{-3}) \times 2.4246$

(a) we add the Numbers between Two brackets, keep in mind we must have only two decimal places

$\Rightarrow 28.67 \times 10^{-4} \times 2.4246$

(b) Now, we multiply the two numbers, also keep in mind, the total Number of significant figures equal to 4 significant figures.

$\Rightarrow 69.513282 \times 10^{-4} \Longrightarrow 6.951 \times 10^{-3}$ choice [a]

Question [3] : Volume = 2.00 ft^3, Density = 5.62 g/cm^3 ; (Given 1 pound = 454 g, 1 ft = 30.5 cm)

Calculate mass (in pounds).

using factor label method and using the following procedure

Volume (ft^3) ⟶ Volume (cm^3) ⟶ mass (g) ⟶ mass (pounds)

$$2.00\ ft^3 \times \frac{(30.5)^3\ cm^3}{1^3\ ft^3} \times \frac{5.62\ g}{1\ cm^3} \times \frac{1\ pound}{454\ g} = 702.44 \text{ pounds}$$

The answer should be rounded to 3 significant figures, because all values given have 3 significant figures

Answer = 702 pounds ⟹ choice d

Question 4 : $Al(HSO_4)_3$:

According to Naming / Nomenclature Rules:

(a) Al forms an ionic compounds normally. ⇒ anions number is not mentioned in name

(b) Al is a representative group element. ⇒ cation does not have any (Number) like transition Elements.

So, According to the specific requirements now, we start with the cation name followed by the anion name.

⇒ $Al(HSO_4)_3$: Aluminium Hydrogen Sulfate Choice [a]

Keep in mind:

SO_4^{2-} : Sulfate SO_3^{2-} : Sulfite S^{2-} : Sulfide.

Question 5 :

(a) hydrosulfuric acid ; H_2S : It is correct name because
(a) It is an acid
(b) It does not have an oxygen ⇒ we add hydro.
(c) we add anion root ⇒ sulfur : sulfur
(d) we add syllabus (ic) to the root anion ⇒ sulfuric

H_2S So, hydrosulfuric acid.

(b) dichlorine pentoxide : It is correct name because
Cl_2O_5
(a) It is a covalent compound
(b) Normally, we start from left (the more positive normally) adding prefix indicating the number of atoms, then the right element (the more negative normally) also adding prefix indicating the Number of atoms.

Note: Covalent compounds consists of nonmetals

Cl_2O_5 ⇒ Dichloropentaoxide ⇒ Dichloropentoxide.

(c) mercury (I) peroxide : It is correct name because
Hg_2O_2
(a) It is an ionic compound
(b) Hg is transition element ⇒ should take (Number)
(c) O atom has an oxidation No. = -1 ⇒ peroxide.

Hg_2O_2 ⇒ we ignore the Numberal atoms
Mercury (I) peroxide.

(d) iron nitrate
$Fe(NO_3)_3$: It is wrong name because choice 3

It has Fe atom, which is transition metal element, so it must take (Number) indicates the oxidation Number of Fe which is equal to +3

So, Iron (III) Nitrate.

(e) Sodium Hydrogen phosphate : It is correct name because
Na_2HPO_4
(a) It is an ionic compound (cation: Na, anion: HPO_4^{2-})
(b) Na is representative metal element ⇒ No need to write the oxidation No. of Na.
(c) we ignore the No. of atoms involved in compound

⇒ Na_2HPO_4 : Sodium Hydrogen Phosphate

from left (positive ion) ⟶ Right (negative ion)

Continuation of Question [B]:

We are given molar mass of the compound (actual) = 58.0 g/mol

Molecular Formula = n x (Empirical Formula)

where $n = \frac{\text{molar mass of actual compound}}{\text{molar mass of Empirical formula.}}$

$\Rightarrow n = \frac{58.0 \text{ g/mol (Given as a data)}}{29.0 \text{ g/mol (calculated previously)}} = \frac{2}{1}$

Molecular Formula = 2 x Empirical Formula

$= 2 \times C_2H_5 = C_4H_{10} \Rightarrow$ choice [A]

Question [9]: The sample procedure in Question [8]:

We have mass of C = 7.20 g ; mass of H = 1.20 g , mass of nitrogen = 4.2g

Now, we will calculate no. of moles of each atom.

$7.20 \text{ g C} \times \frac{1 \text{ mol C}}{12 \text{ g C}} = 0.6 \text{ mol C}$; $1.20 \text{ g of H} \times \frac{1 \text{ mol H}}{1 \text{ g H}} = 1.20 \text{ mol.}$

$4.20 \text{ g N} \times \frac{1 \text{ mol N}}{14 \text{ g N}} = 0.3 \text{ mol N}$

Now,

$C_{0.6}\ N_{0.3}\ H_{1.2} \Rightarrow$ getting rid of decimal places

$C_6\ N_3\ H_{12} \Rightarrow$ dividing by the lowest No. = 3

$C_2\ N\ H_4 \Rightarrow C_2H_4N$ choice [C]

Question [10]: $CHCl_3 + Cl_2 \longrightarrow CCl_4 + HCl$

the equation is balance

Now, we want to calculate the percentage yield of CCl_4.

We are given the mass of $CHCl_3$ = 28.9 g (Limiting Reactant).

" " " the actual mass of CCl_4 = 25.2 g.

$\text{Percentage Yield} = \frac{\text{Actual mass}}{\text{Theoretical mass}} \times 100\%$

We can calculate the theoritical mass of CCl_4 using:

mass of $CHCl_3 \longrightarrow$ mole $CHCl_3 \longrightarrow$ mol $CCl_4 \longrightarrow$ mass CCl_4.

$28.9 \text{ g} \times \frac{1 \text{ mol } CHCl_3}{119.5 \text{ g}} \times \frac{1 \text{ mol } CCl_4}{1 \text{ mol } CHCl_3} \times \frac{153.8 \text{ g}}{1 \text{ mol } CCl_4} = 30.8 \text{ g } CCl_4$ theoritically produced

Continuation of Question 10 :

$$\text{Percentage yield} = \frac{\text{The Actual mass}}{\text{The Theoretical mass}} \times 100\%$$

$$= \frac{25.2\,g}{30.8\,g} \times 100\% = 81.9\% \quad \text{Choice } \boxed{C}$$

Question 11 : using the equation after balancing it:

$$2H_2S + O_2 \longrightarrow 2S + 2H_2O$$

Now we have | | 18.5 g | 6.52 g

and we want to obtain the mass of sulfur, so we must specify the limiting reactant.

$$18.5\,g \text{ of } H_2S \times \frac{1\,mol\ H_2S}{34.08\,g\ H_2S} = 0.546 \text{ mol } H_2S \text{ really found.}$$

$$6.52\,g \text{ of } O_2 \times \frac{1\,mol\ O_2}{32.00\,g} = 0.204 \text{ mol } O_2 \text{ really found.}$$

Theoretically: 2 mol of H_2S $\xrightarrow{\text{needed to react with}}$ 1 mol O_2

We have : 0.546 $\xrightarrow{\text{needs}}$ X

$$X = \frac{1 \times 0.546}{2} = 0.273 \text{ mol of } O_2 \text{ is needed to react with } 0.546$$

But, we have only 0.204 mol O_2 which is less than what is required to react 0.273 mol.

$\Longrightarrow$ So, the O_2 is the limiting reactant.

mass O_2 $\longrightarrow$ moles O_2 $\longrightarrow$ moles S $\longrightarrow$ mass S

$$6.52\,g\ O_2 \times \frac{1\,mol\ O_2}{32.00\,g\ O_2} \times \frac{2\,mol\ S}{1\,mol\ O_2} \times \frac{32.06\,g\ S}{1\,mol\ S} = 13.08$$

$$\simeq 13.1\,g\ S$$

Choice $\boxed{a}$

Question 12 : K_3PO_4 dissolves into water in accordance with

$$K_3PO_4(s) + H_2O(l) \longrightarrow 3K^+(aq) + PO_4^{3-}(aq)$$

$[PO_4^{3-}] = 0.022\ M$; The volume is 250.0 mL

$$\text{moles of } PO_4^{3-} = M \times V = 0.022\,\frac{mol}{L} \times 250.0 \times 10^{-3}\,L = 5.5 \times 10^{-3} \text{ mol } PO_4^{3-}$$

Continuation of Question 12 :

moles of $PO_4^{3-} = 5.5 \times 10^{-3}$ mol.

$$5.50 \times 10^{-3}\ mol\ PO_4^{3-} \times \frac{1\ mol\ K_3PO_4}{1\ mol\ PO_4^{3-}} * \frac{212.27\ g\ K_3PO_4}{1\ mol\ K_3PO_4} = 1167.485 \times 10^{-3}$$

$= 1.167485$

$\simeq 1.17$ g of K_3PO_4

Choice d

Question 13 : According to Solubility Rules Listed in your book, you find that

(a) $Na_2SO_{4(aq)} + Pb(NO_3)_{2(aq)} \longrightarrow 2NaNO_{3(aq)} + PbSO_{4(s)}$

(b) $3NaOH_{(aq)} + AlCl_{3(aq)} \longrightarrow 3NaCl_{(aq)} + Al(OH)_{3(s)}$

(c) $HCl_{(aq)} + AgNO_{3(aq)} \longrightarrow HNO_{3(aq)} + AgCl_{(s)}$

(d) $CuCl_{2(aq)} + Na_2SO_{4(aq)} \longrightarrow CuSO_{4(aq)} + NaCl_{(aq)}$ *** Choice d

(e) $2Na_3PO_{4(aq)} + 3CaCl_{2(aq)} \longrightarrow 6NaCl_{(aq)} + Ca_3(PO_4)_{2(s)}$

Question 14 $2NaOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$

I write here full balanced equation, thus

We have

$V_{NaOH} = 45.87$ mL $\quad M_{NaOH} = 0.254$

$V_{H_2SO_4} = 18.42 \quad M_{H_2SO_4} = ??$

Volume NaOH (L) $\longrightarrow$ mole NaOH $\longrightarrow$ mol H_2SO_4 $\longrightarrow$ Molarity H_2SO_4

$$= 45.87\ mL\ NaOH \times \frac{1\ L}{1000\ mL} \times \frac{0.254\ mol\ NaOH}{1\ L\ NaOH} \times \frac{1\ mol\ H_2SO_4}{2\ mol\ NaOH}$$

$= 0.005833 = 5.83 \times 10^{-3}$ mol. H_2SO_4

$$M_{H_2SO_4} = \frac{mole\ H_2SO_4}{Volume} = \frac{5.83 \times 10^{-3}\ mol}{18.42 \times 10^{-3}\ L} = 0.316\ M.$$ Choice a

---

Question 15 : oxidation No. of Carbon in C_2H_6O =

oxidation No. of H = +1

oxidation No. of O = −2

$C_2H_6O = 2X + 6(+1) + 1(-2) = zero \Rightarrow 2X + 6 - 2 = zero$

$\Rightarrow 2X + 4 = zero \Rightarrow 2X = -4 \Longrightarrow X = -2$ Choice b

الأستاذ ابراهيم زياد

Question 16 : Balance

$$Cl_2 + S_2O_3^{2-} \xrightarrow{H^+} Cl^- + SO_4^{2-}$$

Separate the equation into 2 different equations.

$$Cl_2 \longrightarrow Cl^-$$

a) balance each atom but O, H

$$Cl_2 \longrightarrow 2Cl^-$$

b) balance the oxygen atoms such that the side which has lower No. of O atoms to add H_2O molecule to each O not available

$$Cl_2 \longrightarrow 2Cl^-$$

c)

$$Cl_2 \longrightarrow 2Cl^-$$

(0 → −2)

d) Now, add $\bar{e}$ to the side which more positive to make it equal to the less positive one.

$$2\bar{e} + Cl_2 \longrightarrow 2Cl^-$$

e) Cancel the Electrons in each side and the total net reaction to be one reaction. Sometimes, we need to multiply by a factor to eliminate the electrons.

$$4(2\bar{e} + Cl_2 \longrightarrow 2Cl^-)$$

$$8\bar{e} + 4Cl_2 \longrightarrow 8Cl^-$$

the net equation:

$$4Cl_2 + S_2O_3^{2-} + 5H_2O \longrightarrow 8Cl^- + 2SO_4^{2-} + 10H^+$$

$$S_2O_3^{2-} \dashrightarrow SO_4^{2-}$$

a) balance each atom but H, O

$$S_2O_3^{2-} \longrightarrow 2SO_4^{2-}$$

b)

$$S_2O_3^{2-} \longrightarrow 2SO_4^{2-}$$

(3O → 8O)

$$5H_2O + S_2O_3^{2-} \longrightarrow 2SO_4^{2-}$$

c) balance H atoms by adding H^+ to the side which has lower No. of H atoms

$$5H_2O + S_2O_3^{2-} \longrightarrow 2SO_4^{2-} + 10H^+$$

(−2 → +6)

d)

$$5H_2O + S_2O_3^{2-} \longrightarrow 2SO_4^{2-} + 10H^+ + 8\bar{e}$$

e)

$$5H_2O + S_2O_3^{2-} \longrightarrow 2SO_4^{2-} + 10H^+ + 8\bar{e}$$

$$4Cl_2 + S_2O_3^{2-} + 5H_2O \longrightarrow 8Cl^- + 2SO_4^{2-} + 10H^+$$

New The Ratio $H_2O/SO_4^{2-} = (5/2)$ choice E

The End of Exam

Question [6] : using the law :

The average atomic mass of an element (in amu) = [mass of 1st isotope × Percent Abundance] + [mass of 2nd isotope × Percent Abundance] + ...

Applying the given data in the above law :

The average atomic mass of Mg in (amu) = [mass of $^{24}_{12}Mg$ × %] + [mass of $^{25}_{12}Mg$ × %] + [mass of $^{26}_{12}Mg$ × %]

$$= \left[23.9850\ \text{amu} \times \frac{78.42}{100}\right] + \left[\frac{24.9858\ \text{amu} \times 15.22}{100}\right] + \left[\frac{25.9826\ \text{amu} \times 14.36}{100}\right]$$

$$= 18.809\ \text{amu} + 3.803\ \text{amu} + 3.731\ \text{amu}$$

$$= 24.424 \Longrightarrow \text{rounded to two decimal places}$$

$$= 24.42 \Longrightarrow \text{choice [e]}$$

Question [7] : using the following procedure and applying factor Label Method:

mass of aspirin (mg) ⟶ mass of aspirin (g) ⟶ moles of aspirin (mol) ⟶ moles of carbon (mol) ⟶ No. of atoms of carbon

$$= 300\ \text{mg Aspirin} \times \underbrace{\frac{10^{-3}\ \text{g Aspirin}}{1\ \text{mg Aspirin}}}_{\text{Ratio}} \times \underbrace{\frac{1\ \text{mol Aspirin}}{180.15\ \text{g Aspirin}}}_{\text{molar mass}} \times \underbrace{\frac{9\ \text{mol of C}}{1\ \text{mol Aspirin}}}_{\text{look to *}} \times \underbrace{\frac{6.02 \times 10^{23}\ \text{atom C}}{1\ \text{mol of C}}}_{\text{Avogadro's No.}}$$

$$= 90.22 \times 10^{20} \rightsquigarrow \text{rounded to 3 significant figures and writing the no. in scientific notation}$$

$$= 9.02 \times 10^{21} \qquad \text{choice [b]}$$

Note : 1 $C_9H_8O_4$ ⟶ 9 C + 8 H + 4 O *

Question [8] : Compound ⟶ C, H only

C% = 82.8% & H% = 100 − C% = 17.2%

Assume we have 100 g of Sample compound ⟹ so

mass of carbon = 82.8 g , mass of Hydrogen = 17.2 g

Calculating moles of C, H :

$$82.8\ \text{g C} \times \frac{1\ \text{mol C}}{12\ \text{g C}} = 6.89\ \text{mol C} \quad ; \quad 17.2\ \text{g H} \times \frac{1\ \text{mol H}}{1\ \text{g H}} = 17.2\ \text{mol H}$$

Empirical Formula calculations : $C_{6.89}H_{17.2}$, dividing by 6.89 (lowest No)

$\Rightarrow C_1H_{2.5}$, the No. should be an integer No's ⟹ multiplying by [2]

$\Rightarrow C_2H_5$ (Empirical Formula). ⟹ Molecular mass of Empirical formula = 29.0 g/mol

Molecular mass of C_2H_5 = 2 × M. wt C + 5 × M. wt H = 29.0 g/mol.

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