

## IB Chemistry / 2<sup>nd</sup> Year Summer Assignment - 2011

1. Complete the attached stoichiometry worksheet. **You must show your work for every problem (even the multiple choice).** The multiple choice questions are paper one questions and should be answered without the use of a calculator. I must receive this assignment, at the school, ***no later than noon on Monday, August 15<sup>th</sup>.***
2. As always, review your polyatomics and sig figs.

Please feel free to contact me via e-mail at [Christine.Dech@cpschools.com](mailto:Christine.Dech@cpschools.com) or call me on my cell phone (757-646-1087). I will be in and out all summer, though I will be out of the country, and therefore incommunicado, from July 11<sup>th</sup> to July 27<sup>th</sup>. Good luck and enjoy your summer!

## Stoichiometry Review

1. What amount of oxygen, O<sub>2</sub>, (in moles) contains  $1.8 \times 10^{22}$  molecules?

- A. 0.0030
- B. 0.030
- C. 0.30
- D. 3.0

(1)

2. Which compound has the empirical formula with the greatest mass?

- A. C<sub>2</sub>H<sub>6</sub>
- B. C<sub>4</sub>H<sub>10</sub>
- C. C<sub>5</sub>H<sub>10</sub>
- D. C<sub>6</sub>H<sub>6</sub>

(1)

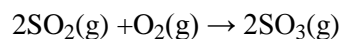
3.  $\_\_ \text{C}_2\text{H}_2(\text{g}) + \_\_ \text{O}_2(\text{g}) \rightarrow \_\_ \text{CO}_2(\text{g}) + \_\_ \text{H}_2\text{O}(\text{g})$

When the equation above is balanced, what is the coefficient for oxygen?

- A. 2
- B. 3
- C. 4
- D. 5

(1)

4. 3.0 dm<sup>3</sup> of sulfur dioxide is reacted with 2.0 dm<sup>3</sup> of oxygen according to the equation below.



What volume of sulfur trioxide (in dm<sup>3</sup>) is formed? (Assume the reaction goes to completion and all gases are measured at the same temperature and pressure.)

- A. 5.0
- B. 4.0
- C. 3.0
- D. 2.0

(1)

5. The relative molecular mass of aluminium chloride is 267 and its composition by mass is 20.3% Al and 79.7% chlorine. Determine the empirical and molecular formulas of aluminium chloride.

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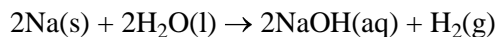
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(Total 4 marks)

6. Sodium reacts with water as follows.



1.15 g of sodium is allowed to react completely with water. The resulting solution is diluted to 250 cm<sup>3</sup>. Calculate the concentration, in mol dm<sup>-3</sup>, of the resulting sodium hydroxide solution.

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(Total 3 marks)

7. (i) Calcium carbonate is added to separate solutions of hydrochloric acid and ethanoic acid of the same concentration. State **one** similarity and **one** difference in the observations you could make.

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(2)

(ii) Write an equation for the reaction between hydrochloric acid and calcium carbonate.

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(2)

- (iii) Determine the volume of  $1.50 \text{ mol dm}^{-3}$  of hydrochloric acid that would react with exactly 1.25 g of calcium carbonate.

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(3)

- (iv) Calculate the volume of carbon dioxide, measured at 273 K and  $1.01 \times 10^5 \text{ Pa}$ , which would be produced when 1.25 g of calcium carbonate reacts completely with the hydrochloric acid.

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(2)

(Total 9 marks)

8. What volume (in  $\text{dm}^3$ ) of  $0.30 \text{ mol dm}^{-3}$  NaCl solution can be prepared from 0.060 mol of solute?

- A. 0.018
- B. 0.20
- C. 0.50
- D. 5.0

(1)

9. What amount (in moles) is present in 2.0 g of sodium hydroxide, NaOH?

A. 0.050

B. 0.10

C. 20

D. 80

(1)

10. A hydrocarbon contains 90 % by mass of carbon. What is its empirical formula?

A. CH<sub>2</sub>

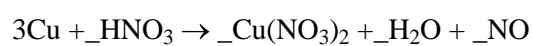
B. C<sub>3</sub>H<sub>4</sub>

C. C<sub>7</sub>H<sub>10</sub>

D. C<sub>9</sub>H<sub>10</sub>

(1)

11. Copper can react with nitric acid as follows.



What is the coefficient for HNO<sub>3</sub> when the equation is balanced?

A. 4

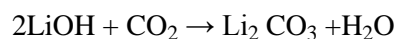
B. 6

C. 8

D. 10

(1)

12. Lithium hydroxide reacts with carbon dioxide as follows.



What mass (in grams) of lithium hydroxide is needed to react with 11 g of carbon dioxide?

- A. 6
- B. 12
- C. 24
- D. 48

(1)

13. Which solution contains the smallest amount of  $\text{H}^+$  ions?

- A.  $10.0 \text{ cm}^3$  of  $0.250 \text{ mol dm}^{-3}$  HCl
- B.  $20.0 \text{ cm}^3$  of  $0.250 \text{ mol dm}^{-3}$  HCl
- D.  $10.0 \text{ cm}^3$  of  $0.500 \text{ mol dm}^{-3}$  HCl
- C.  $10.0 \text{ cm}^3$  of  $0.250 \text{ mol dm}^{-3}$   $\text{H}_2\text{SO}_4$

(1)

14. How many hydrogen atoms are contained in one mole of ethanol,  $\text{C}_2\text{H}_5\text{OH}$ ?

- A. 5
- B. 6
- C.  $1.0 \times 10^{23}$
- D.  $3.6 \times 10^{24}$

(1)

15. The percentage by mass of the elements in a compound is

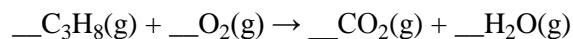
$$C = 72\%, \quad H = 12\%, \quad O = 16\%.$$

What is the mole ratio of C : H in the empirical formula of this compound?

- A. 1 : 1
- B. 1 : 2
- C. 1 : 6
- D. 6 : 1

(1)

16. What is the coefficient for O<sub>2</sub> (g) when the equation below is balanced?<sub>2</sub>



- A. 2
- B. 3
- C. 5
- D. 7

(1)

17. What amount of NaCl (in moles) is required to prepare 250 cm<sup>3</sup> of a 0.200 mol dm<sup>-3</sup> solution?

- A. 50.0
- B. 1.25
- C. 0.800
- D. 0.0500

(1)

18. 100 cm<sup>3</sup> of ethene, C<sub>2</sub>H<sub>4</sub>, is burned in 400 cm<sup>3</sup> of oxygen, producing carbon dioxide and some liquid water. Some oxygen remains unreacted.

(a) Write the equation for the complete combustion of ethene.

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(2)

(b) Calculate the volume of carbon dioxide produced and the volume of oxygen remaining.

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(2)  
**(Total 4 marks)**

19. (a) Write an equation for the formation of zinc iodide from zinc and iodine.

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(1)

(b) 100.0 g of zinc is allowed to react with 100.0 g of iodine producing zinc iodide. Calculate the amount (in moles) of zinc and iodine, and hence determine which reactant is in excess.

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(3)

(c) Calculate the mass of zinc iodide that will be produced.

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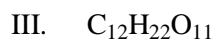
(1)  
**(Total 5 marks)**

20. Which of the following contains the greatest number of molecules?

- A. 1 g of  $\text{CH}_3\text{Cl}$
- B. 1 g of  $\text{CH}_2\text{Cl}_2$
- C. 1 g of  $\text{CHCl}_3$
- D. 1 g of  $\text{CCl}_4$

(1)

21. Which of the following compounds has/have the empirical formula  $\text{CH}_2\text{O}$ ?



A. II only

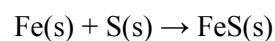
B. III only

C. I and II only

D. II and III only

(1)

22. Consider the equation below.



If 10.0 g of iron is heated with 10.0 g of sulfur to form iron(II) sulfide, what is the theoretical yield of FeS in grams?

A.  $10.0 + 10.0$

B.  $\frac{87.91 \times 10.0}{55.85}$

C.  $\frac{87.91 \times 10.0}{32.06}$

D.  $\frac{55.85 \times 10.0}{32.06}$

(1)

23. Assuming complete reaction, what volume of  $0.200 \text{ mol dm}^{-3}$   $\text{HCl(aq)}$  is required to neutralize  $25.0 \text{ cm}^3$  of  $0.200 \text{ mol dm}^{-3}$   $\text{Ba(OH)}_2\text{(aq)}$ ?

A.  $12.5 \text{ cm}^3$

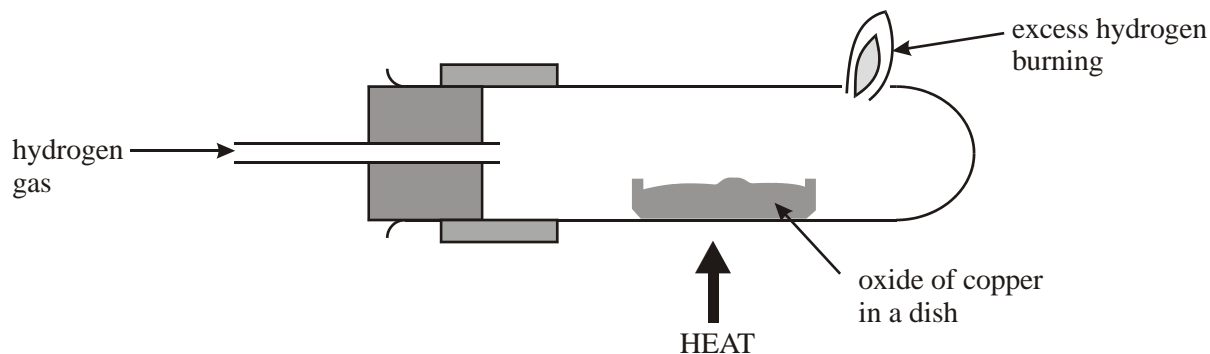
B.  $25.0 \text{ cm}^3$

C.  $50.0 \text{ cm}^3$

D.  $75.0 \text{ cm}^3$

(1)

24. An oxide of copper was reduced in a stream of hydrogen as shown below.



After heating, the stream of hydrogen gas was maintained until the apparatus had cooled.

The following results were obtained.

Mass of empty dish = 13.80 g

Mass of dish and contents before heating = 21.75 g

Mass of dish and contents after heating and leaving to cool = 20.15 g

(a) Explain why the stream of hydrogen gas was maintained until the apparatus cooled.

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(1)

(b) Calculate the empirical formula of the oxide of copper using the data above, assuming complete reduction of the oxide.

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(3)

(c) Write an equation for the reaction that occurred.

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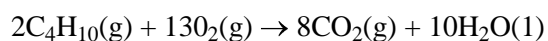
(1)

(d) State **two** changes that would be observed inside the tube as it was heated.

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(2)  
(Total 7 marks)

25. Consider the following equation.

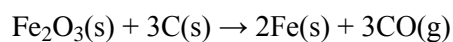


How many moles of  $\text{CO}_2(\text{g})$  are produced by the complete combustion of 58 g of butane,  $\text{C}_4\text{H}_{10}(\text{g})$ ?

- A. 4
- B. 8
- C. 12
- D. 16

(1)

26. 6.0 moles of  $\text{Fe}_2\text{O}_3(\text{s})$  reacts with 9.0 moles of carbon in a blast furnace according to the equation below.



What is the limiting reagent and hence the theoretical yield of iron?

	Limiting reagent	Theoretical yield of iron
A.	$\text{Fe}_2\text{O}_3$	6.0 mol
B.	$\text{Fe}_2\text{O}_3$	12.0 mol
C.	carbon	9.0 mol
D.	carbon	6.0 mol

(1)

27. What volume of  $0.500 \text{ mol dm}^{-3} \text{ HCl(aq)}$  is required to react completely with  $10.0 \text{ g}$  of calcium carbonate according to the equation below?



- A.  $100 \text{ cm}^3$
- B.  $200 \text{ cm}^3$
- C.  $300 \text{ cm}^3$
- D.  $400 \text{ cm}^3$

(1)

28.  $27.82 \text{ g}$  of hydrated sodium carbonate crystals,  $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ , was dissolved in water and made up to  $1.000 \text{ dm}^3$ .  $25.00 \text{ cm}^3$  of this solution was neutralized by  $48.80 \text{ cm}^3$  of hydrochloric acid of concentration  $0.1000 \text{ mol dm}^{-3}$ .

- (a) Write an equation for the reaction between sodium carbonate and hydrochloric acid.

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(2)

- (b) Calculate the molar concentration of the sodium carbonate solution neutralized by the hydrochloric acid.

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(3)

(c) Determine the mass of sodium carbonate neutralized by the hydrochloric acid and hence the mass of sodium carbonate present in the  $1.000\text{dm}^3$  of solution.

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(3)

(d) Calculate the mass of water in the hydrated crystals and hence find the value of  $x$ .

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(4)

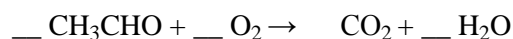
(Total 12 marks)

29. Which is a correct definition of the term *empirical formula*?

- A. formula showing the numbers of atoms present in a compound
- B. formula showing the numbers of elements present in a compound
- C. formula showing the actual numbers of atoms of each element in a compound
- D. formula showing the simplest ratio of numbers of atoms of each element in a compound

(1)

30. The reaction of ethanal and oxygen can be represented by the unbalanced equation below.

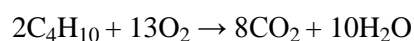


When the equation is balanced using the smallest possible integers, what is the coefficient for  $\text{O}_2$ ?

- A. 3
- B. 4
- C. 5
- D. 6

(1)

31. The equation for the complete combustion of butane is



What is the amount (in mol) of carbon dioxide formed by the complete combustion of three moles of butane?

- A. 4
- B. 8
- C. 12
- D. 24

(1)

32. Which solution contains the greatest amount (in mol) of solute?

- A.  $10.0 \text{ cm}^3$  of  $0.500 \text{ mol dm}^{-3}$  NaCl
- B.  $20.0 \text{ cm}^3$  of  $0.400 \text{ mol dm}^{-3}$  NaCl
- C.  $30.0 \text{ cm}^3$  of  $0.300 \text{ mol dm}^{-3}$  NaCl
- D.  $40.0 \text{ cm}^3$  of  $0.200 \text{ mol dm}^{-3}$  NaCl

(1)

33. The percentage composition by mass of a hydrocarbon is C = 85.6 % and H = 14.4 %.

(a) Calculate the empirical formula of the hydrocarbon.

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(2)

(b) A 1.00 g sample of the hydrocarbon at a temperature of 273 K and a pressure of  $1.01 \times 10^5$  Pa (1.00 atm) has a volume of  $0.399 \text{ dm}^3$ .

(i) Calculate the molar mass of the hydrocarbon.

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(2)

(ii) Deduce the molecular formula of the hydrocarbon.

(1)

(Total 5 marks)

34. How many oxygen atoms are present in 0.0500 mol carbon dioxide?

- A.  $3.01 \times 10^{22}$
- B.  $6.02 \times 10^{22}$
- C.  $6.02 \times 10^{23}$
- D.  $1.20 \times 10^{24}$

(1)