SCTCE4 – FINAL EXAM REVIEW from Mr. Germain's class(answers are mine)

1

An element has two isotopes that occur naturally. The following table gives some information about these two isotopes.

Isotope	Mass Number	Relative Abundance
1	63	69.1%
2	65	30.9%

According to this information, what is the atomic mass of this element?

0.691*63 + 0.309*65 = 63.618 amu

2

Element X has three isotopes whose characteristics are given in the following table.

Isotope	Relative abundance
$^{190}_{84}X$	55%
$^{192}_{84}X$	30%
$^{194}_{84}X$	15%

Given this information, what is the atomic mass of element X?

191.2

3

Richard recorded data on the three stable isotopes of a newly discovered element. Unfortunately, a coffee spill in the late hours of the night resulted in smudged data. Richard was able to recover data on the average atomic mass (24.72 a.m.u.), as well as data on the first two isotopes in the chart below.

Isotope	Natural abundance (%)
^{24}W	78.99
^{26}W	11.01
$^{?}W$	?

What is the atomic mass of the missing isotope?

24(0.7899) + 26(0.1101) + 0.10 x = 24.72

Why 0.10? 10 % is the difference between the 100% and the other percentages?

X = 28.99800000 = 29

4 Using an electronic balance, in the laboratory, a lab technician measures out 227.8 g of magnesium nitrate, $Mg(NO_3)_2$.
How many moles (mol) are contained in this sample of magnesium nitrate?

1.54 moles

5 What is the mass of a 0.25 mole sample of calcium phosphate, $Ca_3(PO_4)_2$?

77.6 g

6 How much solute is needed to prepare 600 mL of a 2 mol/L solution of Na_2CO_3?

127.2 g

7 A student prepared 1250 mL of a solution by using 17.1 g of aluminum sulfate, $Al_2(SO_4)_3$.
What is the molar concentration of this solution?

0.04 moles/L

8 You have a 2 litre solution of lead nitrate ($Pb(NO_3)_2$) at a concentration of 2 mol/L. You have to prepare 1600 mL of the lead nitrate solution at a concentration of 1.5 mol/L.

What volume of the initial solution will be required to prepare the new solution?

1200 ml or 1.2 L

9 The combustion of ethyl alcohol (C_2O_5OH) produces carbon dioxide (CO_2) and water vapour (H_2O), as indicated in the following unbalanced equation:

$$C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$$

Balance this equation.

10 The combustion of heptane, C_7H_{16}, produces carbon dioxide, CO_2, and water vapour, H_2O, as indicated in the following unbalanced equation:

$$C_7H_{16} + O_2 \rightarrow CO_2 + H_2O$$

Balance this equation.

11 One way of producing iron (Fe) is to combine ferric oxide (Fe_2O_3) with carbon (C). This reaction produces carbon dioxide (CO_2) and iron (Fe).
The unbalanced equation for this reaction is given below.

$$Fe_2O_3 + C \rightarrow CO_2 + Fe$$

Balance this equation correctly.

12 You spill some hydrochloric acid (HCl) on the counter.

To neutralize its effect, you use magnesium hydroxide $Mg(OH)_2$. The neutralization reaction is represented by the following equation:

$$2\ HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2\ H_2O$$

What mass of $Mg(OH)_2$ is required to neutralize 4 moles of HCl?

116.6 g

13 If 60 g of propane (C_3H_8) is burned on a stove, carbon dioxide (CO_2) and water (H_2O) are produced, as shown in the balanced equation below :

$$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$$

What mass of CO_2 will be released into the environment?

60 g (mole/ 44g) = 1.36 moles C_3H_8
1.36 moles C_3H_8 ($3CO_2$/ 1 C_3H_8) =4.08 moles CO_2
4.08 moles CO_2 (44g//mole) = 179.5 g CO_2

14 Methanol, CH_3OH, and ethanol, C_2H_5OH, can be used as fuel for a burner. The following diagrams show the energy released during the combustion of one mole of each substance.

If you burn one mole of methanol you will release 730 kJ
If you burn one mole of ethanol you will release 1370 kJ

Which of the two combustion reactions illustrated above releases more energy when 1 g of substance is burned?

1 g CH_3OH (mole/ 32 g) = 0.03125 moles CH_3OH
1 g C_2H_5OH (mole/ 46 g) = 0.0217moles C_2H_5OH

Methanol : 730 kJ/mole (0.03125 moles CH_3OH) = 22.81 kJ
Ethanol: 1370 kJ(0.0217moles C_2H_5OH) = 29.72 kJ

15 While you are running, your body requires 2500 kJ/hr. It has been determined that 60% of this energy requirement is provided by the combustion of glucose ($C_6H_{12}O_6$) metabolized in your body.
The equation for the combustion of glucose is:

$$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + 2816\ kJ$$

How many grams of glucose will be metabolized during a two-hour run?

You need 2500 kJ/hr (2 hr) = 5000 kJ

0.60(5000 kJ) = 3000 kJ will come from glucose

1mole/2816kJ* (3000 kJ) = 1.06 moles of glucose

1.06 moles $C_6H_{12}O_6$ (180 g/mole) =190.8 g

16 Patrick wonders which gas he should choose for a gas fireplace for his country cottage. He is hesitating between propane (C_3H_8) and butane (C_4H_{10}).

The combustion equations are:

$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O + 2233\ kJ$

$2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O + 5306\ kJ$

Knowing that the containers of gas are 5 kg each:

A) Which gas provides the most energy?

5000 g (1 mole C_3H_8 /44 g) = 113.63 moles C_3H_8

2233 kJ /mole (113.63 moles C_3H_8) = 253 735.79 kJ

5000 g (1 mole C_4H_{10} /58 g) = 86.2 moles C_4H_{10}

5306 kJ /2 moles (86.2 moles C_4H_{10}) = 228 688 kJ ; propane releases more.

B) Which gas produces less carbon dioxide?

5000 g (1 mole C_3H_8 /44 g) = 113.63 moles C_3H_8

113.63 moles C_3H_8 (3 CO_2/ C_3H_8) = 340.89 moles of CO_2

5000 g (1 mole C_4H_{10} /58 g) = 86.2 moles C_4H_{10}

86.2 moles C_4H_{10} (8 CO_2/2 moles C_4H_{10}) = 344.8 moles CO_2 ; butane produces more

17 Gasoline (octane), C_8H_{18}, has a density of 703 g/L. Knowing that a car has a gas consumption of 6.0 L/100 km on a highway, how many moles of carbon dioxide are produced by the car after travelling 200 km on the highway? (Don't forget to write a balanced equation)

200 km(6 L/ 100km) = 12 L

12 L (703 g/L) = 8436 g of gasoline have to be burnt

8436 g of gasoline(mole/114 g) = 74 moles

74 moles C_8H_{18} (8 CO_2/ 1 C_8H_{18}) = 592 moles

18 What is the necessary condition for the nucleus of an atom to be stable?

Need the correct number of neutrons

19 Classify the following reactions as a nuclear fusion or a nuclear fission. Complete the reactions, if necessary.

A) $^{239}Pu + {}^{1}n \rightarrow {}^{236}U + {}^{4}He + {}^{0}\gamma$

B) $^{2}H + {}^{2}H \rightarrow {}^{3}He + {}^{1}n$

C) $^{2}H + \rightarrow {}^{4}He + {}^{1}n$

D) $^{235}U + {}^{1}n \rightarrow {}^{92}Sr + ? + 2\ {}^{1}n$

B and C are fusion