Term 1 Test 2: Topic 0, 11, 1.1 (2016)

Name and chemistry block: _____

There is a total of 45 points in this test. You have 5 minutes of reading time and 50 min to complete this test.

1 Multiple Choice

[1] 1. How many significant figures are in 0.08050?

A. 2

B. 4

C. 5

D. 6

[1] 2. $(800 \pm 8) - (50 \pm 5) = ?$

A. 750 ± 3

B. 750 ± 13

C. 750 ± 75

D. 750 ± 83

[1] 3. $(800 \pm 8) \div (50 \pm 5) = ?$

A. $16 \pm \frac{8}{5}$

B. 16 ± 1.76

C. 16 ± 3

D. 16 ± 13

[1] 4. Precision of an experiment may be reduced by:

I. repeating the experiment

II. using more precise instruments

A. I

B. II

C. I and II

D. None of the above

[1] 5. Systematic errors in an experiment may be reduced by:

I. repeating the experiment

II. using more precise instruments

A. I

B. II

C. I and II

D. None of the above

[1] 6. Express 3.50 dm^3 in cm^3.

A. $3.50 \times 10^{1} cm^3$

B. $3.50 \times 10^{-1} cm^3$

C. $3.50 \times 10^{-3} cm^3$

D. $3.50 \times 10^{3} cm^3$

[1] 7. Which of the following is considered a mixture?

A. 1.00 g of mercury $Hg^0_{(l)}$

B. 1.00 dm^3 carbon dioxide $CO_{2(g)}$

C. 1.00 mol dm^{-3} nitric acid $HNO_{3(aq)}$

D. 1.00 mol $Ca^{2+}SO_4^{2-}{}_{(s)}$

[1] 8. Which of the following is an example of a homogenous mixture?

A. ice $H_2O_{(s)}$

B. dry ice $CO_{2(s)}$

C. blood

D. sea water

[1] 9. A homogenous mixture can be separated by:

A. Filtration

B. Decantation (carefully pouring off some liquid)

C. Centrifugation

D. None of the above

[1] 10. Which of the following describes $CO_{2(g)} \longrightarrow CO_{2(s)}$?

A. Freezing

B. Condensation

C. Sublimation

D. Deposition

[1] 11. Which of the following have the same chemical properties?

I $^{37}_{17}X_{(g)}$

II $^{35}_{17}X_{2(g)}$

III $^{35}_{16}X_{2(g)}$

IV $^{37}Cl_{2(g)}$

A. I and II

B. II and IV

C. II and III

D. II, III, and IV

[1] 12. Molar mass has a unit of

I. g

II. $\frac{g}{mol}$

III. $gmol^{-1}$

A. I

B. I and II

C. II and III

D. None of the above

[1] 13. Relative molecular mass has a unit of

I. g

II. $\frac{\text{g}}{\text{mol}}$

III. gmol^{-1}

A. I

B. I and II

C. II and III

D. None of the above

[1] 14. Calculate the number of neutrons in $\frac{1}{4}$ mol of $^{35}Cl_{2(g)}$.

A. $(\frac{35}{4} \cdot 6.02) \times 10^{23}$

B. $(\frac{36}{4} \cdot 6.02) \times 10^{23}$

C. $(35 \cdot 6.02) \times 10^{23}$

D. $(36 \cdot 6.02) \times 10^{23}$

[1] 15. Which of the following statements are true?

I The nucleus occupies a small volume in all atoms

II The mass of the atom is concentrated in its nucleus

III The nucleus is positively charged

A. I and II

B. I and III

C. II and III

D. I, II, and III

[1] 16. In one $^{37}_{17}Cl^{-}_{(g)}$ ion, there is a highest number of

A. Protons

B. Neutrons

C. Electrons

D. There are same number of protons, neutrons, and electrons.

[1] 17. Calculate the moles of Al atoms present in x g of $Al_{(s)}$. The relative atomic mass of aluminium is 27.0 amu, and its atomic number is 13.

A. $x \times 13.0$

B. $x \div 13.0$

C. $x \times 27.0$

D. $x \div 27.0$

[1] 18. 0.500 mol of $Cl_{2(g)}$ has a mass of:

A. $\frac{35.0}{2}$

B. $\frac{35.5}{2}$

C. 35.0

D. 35.5

[1] 19. Which formula can be determined by using only the % mass composition of an unknown compound?

I. Molecular formula

II. Structural formula

III. Empirical formula

A. I

B. II

C. III

D. I and III

[1] 20. Which of the following species has the most electrons?

I. $^{35}Cl^{2-}$

II. ^{37}Cl

III. $^{35}Cl_2$

A. I

B. II

C. III

D. I and II has the same number of electrons

2 Extended responses

21. Alice prepared $BaCO_{3(s)}$ by adding $BaCl_{2(aq)}$ from a pipette into a solution of Na_2CO_3 and subsequently filtering and drying. (This is similar to the procedure you used in the preparation of $CaCO_{3(s)}$ in the lab.) She repeated the procedure three times.

[1] (a) i. State the name of the CO_3^{2-} ion

i. _____

[1] ii. Deduce the total number of protons present in **one** CO_3^{2-} ion.

ii. _____

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[2] iii. Deduce the total number of electrons present in **one** CO_3^{2-} ion.

iii. _____

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[1] iv. Calculate the number of electrons present in 1 mol of CO_3^{2-} ion.

iv. _____

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[2] v. State and explain whether $^{12}CO_3^{2-}$ and $^{14}CO_3^{2-}$ will have the same chemical reactivity.

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[1] (b) i. State and explain whether $Na_2CO_{3(aq)}$ is a pure substance, a homogenous mixture, or a heterogenous mixture.

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[2] ii. Predict, outlining your reason, what the freezing point of $Na_2CO_{3(aq)}$ will likely be.

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(c) Alice first centrifuged the sample before using a Buchner funnel to filter the solids.

[1] i. State the precaution that must be undertaken when using a centrifuge.

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[2] ii. Sketch and label a filtration setup using a Buchner funnel.

(d) For the first experiment, after filtration, Alice obtained 3.234 ± 0.002 g of a wet paste. After drying in the oven the mass decreased to 1.292 ± 0.002 g.

[1] i. Calculate the mass of the water lost. Include uncertainties and correct number of significant figures in your answer.

i. _____

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[1] ii. Deduce the percentage of the wet paste that was water.

ii. _____

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[2] iii. Calculate the number of moles of $BaCO_{3(s)}$ made. Include uncertainties and correct number of significant figures in your answer.

iii. _____

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[2] (e) Given the amounts of reagents used, Alice calculated that she should have made 1.500 g of $BaCO_{3(s)}$. (This is called the *theoretical yield*) Propose a reason for why her yield is lower than expected, and how this may be improved.

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(f) The results of the three syntheses are shown in the Table 1.

Table 1 Results for the synthesis of $BaCO_{3(s)}$

	Filter paper / g (± 0.002)	Dried filter paper with $BaCO_{3(s)}$ / g (± 0.002)	Mass of $BaCO_{3(s)}$ / g
Trial 1	0.507	1.799	1.292
Trial 2	0.500	1.313	0.813
Trial 3	0.451	1.650	1.199

[1] i. Calculate the average amount of $BaCO_{3(s)}$ prepared.

i. _____

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[1] ii. Deduce the instrumental uncertainty for the mass of $BaCO_3$ prepared.

ii. _____

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[1] iii. Calculate the reproducibility uncertainty from the three preparations.

iii. _____

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[1] iv. State and explain which of the two uncertainties (from part ii and iii) should be used in reporting the yield of the synthesis.

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[2] v. Report, *as a final value*, the amount of $BaCO_{3(s)}$ prepared by Alice's synthesis.

v. _____

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