

KEY

Please read all the questions VERY carefully before answering. If you do not understand any question, please ask. Use the reverse side of the question paper as scratch. Use the periodic table and constant chart in the last page. No outside paper is allowed. Total points = $34 + (27 \times 3) = 81 = 115$

SHORT ANSWER. Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

- 1) Calculate the mass (in grams) of 1.56×10^{21} atoms of magnesium. (6 pts.)

1) $6.30 \times 10^{-2} \text{ g Mg}$

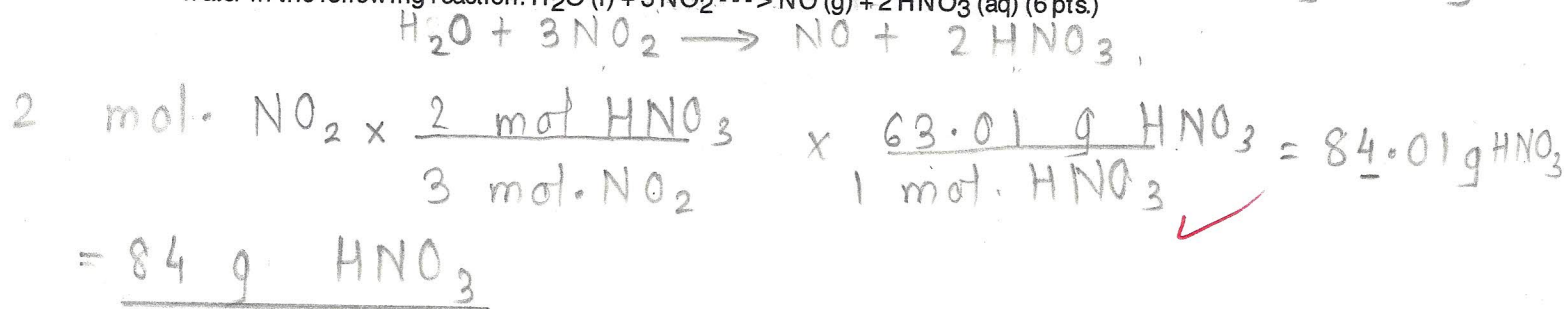
$$1.56 \times 10^{21} \text{ atoms Mg} \times \frac{1 \text{ mol Mg}}{6.022 \times 10^{23} \text{ atoms Mg}} \times \frac{24.31 \text{ g Mg}}{1 \text{ mol Mg}} = 0.062975 \text{ g Mg}$$

$$= 0.0630 \text{ g Mg}$$

$$= \underline{6.30 \times 10^{-2} \text{ g Mg}}$$

- 2) Calculate how many grams of HNO_3 is produced when 2.0 moles of NO_2 reacts with water in the following reaction: $\text{H}_2\text{O}(\text{l}) + 3\text{NO}_2 \rightarrow \text{NO}(\text{g}) + 2\text{HNO}_3(\text{aq})$ (6 pts.)

2) 84 g HNO_3



- 3) Use a noble gas core to draw the ground state electron configuration for (4 pts./each; Total = 8 pts.)

3) _____

(a) Vanadium (V; Z=23):

(b) Bromine (Br, Z=35)

a) Vanadium: $[\text{Ar}] 4s^2 3d^3$

b) Bromine: $[\text{Ar}] 4s^2 3d^{10} 4p^5$ ✓

- 4) Given the following isotope symbol, circle the element it represents in the choices (3 pts.).



4) c) P

- (a) Ge (b) Cl (c) P (d) Ag (e) Xe

- 5) Circle the best choice among the following elements that has the largest atomic radius (3 pts.).

5) d) Na

- (a) Cl (b) Si (c) Mg (d) Na (e) S

- 6) A sample of gas in an expandable container is heated from 200 K to 400K while maintaining constant pressure. If the starting volume was 1.0 liter, what volume after heating? Circle the best possible choice (4 pts.).

6) b) 2.0 liters

- (a) 1.0 liters (b) 2.0 liters (c) 0.5 liters
(d) 1.5 liters (e) 2.5 liters

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Pressure is constant

$$\frac{1 \text{ L}}{200 \text{ K}} = \frac{V_2}{400 \text{ K}}$$

$$V_2 = \frac{400 \times 1}{200}$$

$$V_2 = 2 \text{ L}$$

- 7) How many moles of NaCl (aq) will be produced when 3.5 moles of $\text{Na}_2\text{CO}_3(\text{s})$ react according to the given balanced chemical reaction?

7) c) 7.0 moles

Circle the best possible choice. (4 pts.).



- (a) 3.5 moles (b) 2.0 moles (c) 7.0 moles
(d) 1.0 mole (e) 1.8 moles

$$3.5 \text{ mol. } \text{Na}_2\text{CO}_3 \times \frac{2 \text{ mol. NaCl}}{1 \text{ mol. } \text{Na}_2\text{CO}_3} = 7.0 \text{ mol. NaCl}$$

MULTIPLE CHOICE. On scantron, fill up the circles of the same number as that of the question number. Choose the one alternative that best completes the statement or answers the question. (3 points each)

- 8) Determine the answer to the following equation with correct number of significant figures:

$(17.103 + 2.03) \times 1.02521 =$ _____

A) 20

B) 19.6

C) 19.6153

☒ D) 19.62

E) none of the above

$(17.103 + 2.03) \times 1.02521$
 $= 19.133 \times 1.02521$
 $= 19.615$
 $= 19.62$

8) D

- 9) An atom that has the same number of neutrons as $^{138}_{56}\text{Ba}$ is:

☒ A) $^{136}_{54}\text{Xe}$

B) $^{138}_{55}\text{Cs}$

C) $^{136}_{56}\text{Ba}$

D) $^{137}_{57}\text{La}$

E) none of the above

9) A

- 10) What is the formula mass of copper(II) fluoride?

A) 146.10

B) 165.10

☒ C) 101.55

D) 90.00

E) none of the above

Copper(II) Fluoride



$63.55 + 2 \times 19 = 101.55$

10) C

- 11) How many atoms are in 5.80 moles of He?

A) 1.03×10^{23}

☒ B) 3.49×10^{24}

C) 6.02×10^{23}

D) 4.00

E) none of the above

$5.80 \text{ mol He} \times \frac{6.022 \times 10^{23} \text{ atoms He}}{1 \text{ mol He}}$
 $= 3.49 \times 10^{24} \text{ atoms He}$

11) B

- 12) What is the mass percent of chlorine in hydrochloric acid?

A) 70.1

B) 2.8

C) 35.5

☒ D) 97.2

E) none of the above



$\text{Cl} \% \rightarrow \frac{35.45}{36.45} \times 100 \% = 97.25 \% \approx 97.2 \%$

12) D

- 13) The elements with the highest electronegativity values tend to be found in the:

A) upper left- side of the periodic table.

B) center of the periodic table.

C) lower right- side of the periodic table.

D) lower left- side of the periodic table.

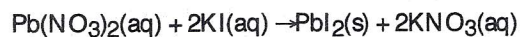
☒ E) upper right- side of the periodic table.

Fluorine $\rightarrow$ Upper right



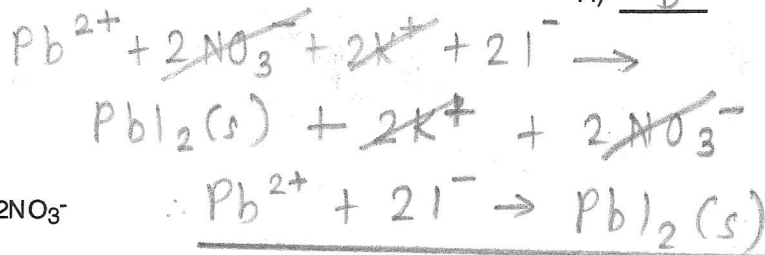
13) E

14) Considering the following precipitation reaction:



What is the correct net ionic equation?

- A) $\text{Pb}^{2+} + \text{I}_2^- \rightarrow \text{PbI}_2(\text{s})$
- B) $\text{Pb}^{2+} + 2\text{NO}_3^- + 2\text{K}^+ + 2\text{I}^- \rightarrow \text{PbI}_2(\text{s}) + 2\text{K}^+ + 2\text{NO}_3^-$
- C) $2\text{NO}_3^- + 2\text{K}^+ \rightarrow 2\text{KNO}_3$
- ☒ D) $\text{Pb}^{2+} + 2\text{I}^- \rightarrow \text{PbI}_2(\text{s})$
- E) none of the above

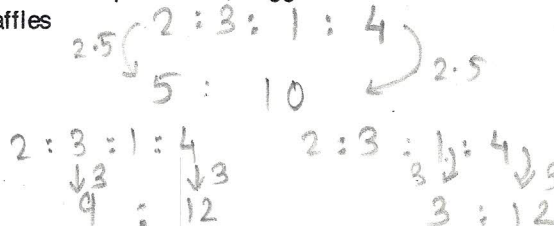


14) D

15) What is the theoretical yield of waffles if you have 5 cups of flour, 9 eggs and 3 tbs of oil?

Given: $2 \text{ cups flour} + 3 \text{ eggs} + 1 \text{ tbs oil} \rightarrow 4 \text{ waffles}$

- A) 6
- B) 4
- ☒ C) 10
- D) 12
- E) not enough information



15) C

16) Which color of the visible spectrum has photons with the most energy?

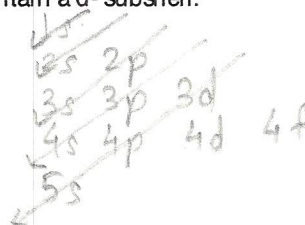
- A) green
- B) red
- C) yellow
- D) orange
- ☒ E) violet

16) E

17) The $n =$ _____ principal shell is the lowest that may contain a d-subshell.

- A) 4
- B) 1
- C) 2
- ☒ D) 3
- E) not enough information

3d



17) D

18) What is the electron configuration for P?

- A) $[\text{Ar}]3s^23p^3$
- B) $[\text{Ne}]1s^21p^62s^22p^3$
- C) $[\text{Ar}]3s^23p^64s^23d^{10}4p^3$
- ☒ D) $[\text{Ne}]3s^23p^3$
- E) none of the above



18) D

19) Which of the following elements has the electron configuration of $3s^23p^4$ in its outermost shell?

- ☒ A) S
- B) Si
- C) Al
- D) Cl
- E) none of the above



19) A

- 20) A 3.76 g sample of a noble gas is stored in a 2.00 L vessel at 874 torr and 25°C. What is the noble gas? 20) C
(R= 0.0821 L atm/ mol K)

A) He

B) Ne

C) Ar

D) Kr

E) not enough information

$$874 \text{ torr} = 1.15 \text{ atm}$$

$$n = \frac{PV}{RT} = \frac{1.15 \times 2}{0.0821 \times (273 + 25)} = 0.094 \text{ mol.}$$

$$\text{Molar mass} = \frac{\text{mass(g)}}{n} = \frac{3.76}{0.094} = 39.99 \approx 40 \text{ g/mol}$$

- 21) The vapor pressure of water at 20.0°C is 17.5 mm Hg. If the pressure of a gas collected over water was measured to be 453.0 mm Hg. What is the pressure of the pure gas? 21) D

A) 0.0230 atm

B) 0.596 atm

C) 0.619 atm

D) 0.573 atm

E) none of the above

$$P_{\text{gas}} = P_{\text{tot}} - P_{\text{H}_2\text{O}}$$

$$= (453.0 - 17.5)$$

$$= 435.5 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.573 \text{ atm.}$$

- 22) When you make ice cubes:

A) the heat of vaporization must be removed.

B) the process is referred to scientifically as sublimation.

C) it is an endothermic process.

D) it is an exothermic process.

E) none of the above

22) D

- 23) A 250 gram sample of water at the boiling point had 45.0 kJ of heat added. How many grams of water were vaporized? Heat of vaporization for water is 40.6 kJ/mole. 23) A

A) 20.0

B) 1.11

C) 0.902

D) 16.2

E) none of the above

$$q = \Delta H_{\text{vap}} \times \text{moles subs.}$$

$$45 \text{ kJ} = 40.6 \text{ kJ/mol} \times \text{moles}$$

$$\text{moles} = \frac{45 \text{ kJ}}{40.6 \text{ kJ/mol}} = 1.108 \text{ mol.}$$

$$1.108 \text{ mol} \times \frac{18 \text{ g}}{1 \text{ mol}} = 19.95 \text{ g H}_2\text{O}$$

$$= 20.0 \text{ g H}_2\text{O}$$

- 24) Which statement is TRUE in describing what occurs when a solid melts to a liquid? 24) C

A) The process is exothermic and the heat of fusion is positive.

B) The process is endothermic and the heat of fusion is negative.

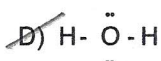
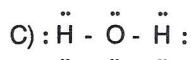
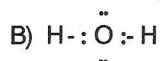
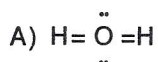
C) The process is endothermic and the heat of fusion is positive.

D) The process is exothermic and the heat of fusion is negative.

E) not enough information

25) What is the correct Lewis structure for water?

25) D



E) none of the above



$$\begin{array}{r} 6 \\ + 2 \times 1 \\ \hline 8 \\ - 4 \\ \hline 4 \\ - 4 \\ \hline 0 \end{array}$$

26) What is the mass percent of an ammonium carbonate solution prepared by dissolving 33.2 grams of solid into 39.5 grams of water?

26) A

~~A) 45.7%~~

B) 72.7%

C) 84.1%

D) 54.3%

E) none of the above

$$33.2 + 39.5 = 72.7$$

$$\frac{33.2}{72.7} \times 100\% = 45.667\% = 45.7\%$$

27) What is the molarity of a solution prepared by dissolving 10.7 g NaI in 0.250 L?

27) D

A) 2.86×10^{-4}

B) 0.0714

C) 42.8

~~D) 0.286~~

E) none of the above

$$10.7 \text{ g NaI} \times \frac{1 \text{ mol NaI}}{149.89 \text{ g NaI}} = 0.0714 \text{ mol NaI}$$

$$M = \frac{0.0714 \text{ mol}}{0.250 \text{ L}} = 0.28554 \text{ M} = 0.286 \text{ M}$$

TRUE/FALSE. On scantron, choose "A" for a true answer and "B" for wrong answer. (3 points each)

28) Zeros located after a number and after a decimal point are significant.

28) A

29) Protons and neutrons have similar masses and similar electrical charges.

29) B

30) One mole of chlorine gas has a mass of 35.45 grams.

$$1 \text{ mol Cl}_2 = 70.9 \text{ g Cl}_2$$

30) B

31) The conversion factor for pressure is 1 mm Hg = 1 atm.

$$1 \text{ atm} = 760 \text{ mm Hg}$$

31) B

32) A saturated solution holds the maximum amount of solute under the solution conditions.

32) A

33) The Lewis structure for O_2 contains a triple bond.



33) B

34) The minor component in a solution is called the solvent.

solute

34) B