Exam 1 - F22 - McCord - ch301n

last name ____________ first name ____________ signature ____________

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (267)	105 Db (268)	106 Sg (269)	107 Bh (270)	108 Hs (270)	109 Mt (278)	110 Ds (281)	111 Rg (282)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (290)	116 Lv (293)	117 Ts (294)	118 Og (294)

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (266)

constants

$R = 0.08206$ L atm/mol K

$R = 0.08314$ L bar/mol K

$R = 62.36$ L Torr/mol K

$R = 8.314$ L kPa/mol K

$R = 8.314$ J/mol K

$N_A = 6.022 \times 10^{23}$ /mol

conversions

1 atm = 760 torr

1 atm = 101325 Pa

1 atm = 1.01325 bar

1 bar = 10^5 Pa

°F = °C(1.8) + 32

K = °C + 273.15

conversions

1 in = 2.54 cm

1 ft = 12 in

1 yd = 3 ft

1 mi = 5280 ft

1 lb = 453.6 g

1 ton = 2000 lbs

1 tonne = 1000 kg

1 gal = 3.785 L

1 gal = 231 in^3

1 gal = 128 fl oz

1 fl oz = 29.57 mL

water data

$C_{s,ice} = 2.09$ J/g °C

$C_{s,water} = 4.184$ J/g °C

$C_{s,steam} = 2.03$ J/g °C

$\rho_{water} = 1.00$ g/mL

$\rho_{ice} = 0.9167$ g/mL

$\rho_{seawater} = 1.024$ g/mL

$\Delta H_{fus} = 334$ J/g

$\Delta H_{vap} = 2260$ J/g

$K_w = 1.0 \times 10^{-14}$

This exam should have exactly 20 questions. Each question is equally weighted at 5 points each. You will enter your answer choices on the virtual bubblehseet after you have finished. Your score is based on what you submit on the virtual bubblesheet and not what is circled on the exam.

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1. What is the temperature of 3.25 moles of an ideal gas that occupies 62.0 L at 150 kPa?

a. 103.2 °C

b. 59.6 °C

●c. 71.0 °C

d. 84.3 °C

e. 340.5 °C

Explanation: Use the ideal gas law to solve for T. Must convert pressure from kPa to atm or easier, use 8.314 for R (the kPa one). Finally, convert temperature from Kelvin to Celsius. 62(150)/3.25/8.314 = 344.18 K minus 273.15 = 71.0 °C.

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2. According to Avogadro's Law, when temperature and pressure are held constant, volume and the number of moles for an ideal gas are...

●a. directly proportional

b. independently related

c. exponentially proportional

d. not proportional

e. inversely proportional

Explanation: They are indeed directly proportional, if you double one, the other will also double.

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3. The gas known as the silent killer is the primary culprit in fatalities caused by the unsafe use of personal generators. This gas is produced by the incomplete combustion of a fuel. What gas is this?

a. O_3

b. NO_x

●c. CO

d. CO_2

e. H_2O_2

Explanation: Carbon monoxide is a product of incomplete combustion and is known as the silent killer.

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4. How many significant figures are in the recorded measurement 0.003070 lbs?

a. 2

●b. 4

c. 6

d. 5

e. 3

Explanation: Start counting on the first non-zero digit (the 3). All digits count after that point. Refer to chembook 1.4.

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5. A sample of 3 moles of AX_3 fully decomposes according to the equation:

$$AX_3(g) \longrightarrow A(g) + 3X(g)$$

If the resulting gases have a total pressure of 488 Torr, what is the partial pressure of X in the final system?

a. 325 torr

b. 122 torr

c. 390 torr

d. 293 torr

e. 244 torr

●f. 366 torr

Explanation: The products will form in 1/4 and 3/4 mole fractions of the total. Gas X is 3/4 of the total of 488 which is 366.

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6. Which of the following expressions represents the number of moles (n) for an ideal gas under a set of stated conditions?

a. $n = RT/PV$

b. $n = PVR/T$

c. $n = PVT/R$

d. $n = VT/RP$

●e. $n = PV/RT$

Explanation: Simple ideal gas law algebraic rearrangement. Solve for n. Refer to chembook 2.5.

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7. Silicon reacts with nitrogen gas under the right conditions to produce silicon nitride.

$$Si + N_2 \rightarrow Si_3N_4$$

Balance the reaction. How much silicon is needed to react with excess nitrogen gas to produce about 514.4 g of silicon nitride? (answer to nearest whole number amount)

a. 287 g

b. 154 g

c. 322 g

d. 103 g

●e. 309 g

Explanation: balanced...

$$3Si + 2N_2 \rightarrow Si_3N_4$$

For every mole of silicon nitride made, 3 moles of silicon is needed. 514.4 g / 140.3 g/mol = 3.67 mol of Si_3N_4. Now triple it to get 11.0 mol Si which has a mass of 309 g.

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8. List the layers of the atmosphere in order from highest to lowest altitude.

a. stratosphere, exosphere, mesosphere, troposphere, thermosphere

b. exosphere, mesosphere, thermosphere, stratosphere, troposphere

●c. exosphere, thermosphere, mesosphere, stratosphere, troposphere

d. thermosphere, mesosphere, exosphere, stratosphere, troposphere

e. exosphere, stratosphere, mesosphere, thermosphere, troposphere

Explanation: Refer to chembook 2.3.

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9. A sample of methane gas at 15 °C occupies 515 mL in an expandable/compressible container at a constant pressure of 800 torr. Will the volume increase or decrease when the temperature is raised **by** 25 °C? By how much?

a. The volume will decrease by 51 mL

b. The volume will increase by 51 mL

●c. The volume will increase by 45 mL

d. The volume will increase by 63 mL

e. The volume will decrease by 63 mL

f. The volume will decrease by 45 mL

Explanation: The starting T is 288.15 K and the final T is +25 to that, or 313.15 K. That ratio is 1.08676. Using that on the volume of 515 mL scales it up to 560 L, which is an increase of 45 mL. Pressure and moles can be ignored because it they are constant - this is Charles Law.

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10. Consider the following ski resort cities and their elevations. Which city will have the lowest predicted atmospheric pressure?

a. Taos, NM : 6969 ft

b. Aspen, CO : 8000 ft

c. Park City, UT : 4685 ft

●d. Brian Head, UT : 9800 ft

Explanation: You can predict that the lowest atmospheric pressure will be the highest elevation. This corresponds to Brian Head.

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11. Write and balance the equation for the complete combustion of propane gas (an alkane). What is the sum of the coefficients when the equation is balanced with the lowest possible whole numbers?

a. 10

b. 11

c. 12

d. 15

●e. 13

Explanation: $1C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$, therefore, 1+5+3+4 =13

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12. A cold engine start in a gasoline fueled car will generally *not* contribute this pollutant into the air:

a. CO

b. NO_x

●c. SO_x

d. VOCs

Explanation: There really isn't any sulfur in gasoline.

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13. A gold coin weighs 1.00 Troy ounces. If 1 Troy ounce is equal to 31.104 grams, how many atoms of gold are in the gold coin?

a. 9.32×10^{25} Au atoms

b. 1.94×10^{22} Au atoms

●c. 9.51×10^{22} Au atoms

d. 1.87×10^{25} Au atoms

Explanation: 31.104 g Au / 196.97 g/mol = 0.1579 mol $\times 6.022 \times 10^{23} = 9.51 \times 10^{22}$ atoms of Au.

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14. A 372 g sample of unknown metal is found to be about 15.3 moles. What is the identity of this metal?

a. Fe

b. Al

c. Cu

d. Zn

●e. Mg

Explanation: This is a composition stoichiometry problem. Solve directly for the molar mass and use the periodic table to identify the metal.

$$\frac{372\,\text{g}}{15.3\,\text{mol}} = 24.3\,\text{g/mol}$$

Refer to the periodic table to see that this best matches Mg.

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15. A 4.10 gram sample of gas was collected in a 1.50 L container at 295 K and 600 Torr. Which of these molecules listed below could be the identity of the gas sample.

a. C_3H_8

b. Ar

c. O_2

d. Cl_2

e. H_2

●f. Kr

Explanation: get moles via IGL: $n = PV/RT = 600(1.5)/(62.36(295)) = 0.0489$ mol. MWt = mass/mol = 4.10/0.0489 = 83.8 g/mol which is Kr.

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16. Consider the chemical equation below which needs to be balanced first:

$$NaOH(aq) + H_3PO_4(aq) \rightarrow Na_3PO_4(aq) + H_2O(l)$$

40 98 164 18

Note: numbers under each compound is its molar mass. Now we let 60 g of NaOH completely react with 66 g of H_3PO_4. How many grams of Na_3PO_4 are formed? What is the excess reactant and how many grams are left over?

a. 82 g Na_3PO_4 formed; 33 g excess NaOH

●b. 82 g Na_3PO_4 formed; 17 g excess H_3PO_4

c. 110 g Na_3PO_4 formed; 17 g excess H_3PO_4

d. 110 g Na_3PO_4 formed; 33 g excess NaOH

Explanation: You need 3 mol of NaOH for each H_3PO_4 reacted and each Na_3PO_4 made. 60g /(3(40)) = 0.5 mol rxn run based on limiting reactant NaOH. So you only make 0.5 mol of Na_3PO_4 which is 82 g. You only use .5(98) = 49 g H_3PO_4 which leaves 66-49 or 17 g in excess.

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17. As far as human-based air pollution goes... There is abundant evidence that one specific fuel source is the major cause of all the SO_x's put into our atmosphere. Which fuel is it? _______.

●a. coal

b. natural gas

c. diesel

d. nuclear power

e. gasoline

Explanation: Coal has more sulfur in it than all the other fuels listed and is (was) a major source of sulfur in our atmosphere.

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18. A sample of gas occupies 52 in^3 inside of a piston and cylinder system at an absolute pressure of 27 psi. The piston is then pushed in until the volume is compressed to 39 in^3 while keeping the temperature constant. What is the absolute pressure at this new volume?

a. 45 psi

b. 32 psi

c. 54 psi

d. 20 psi

●e. 36 psi

Explanation: Boyle's Law: $P_2 = P_1(V_1/V_2) = 27(52/39) = 36$ psi

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19. Which one of these is not a pure substance?

●a. fresh air

b. pure water

c. pentane

d. carbon monoxide

e. ozone

Explanation: Air is a mixture, not a pure substance.

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20. What is the molecular weight (molar mass) of butane?

a. 56.10 g/mol

b. 72.15 g/mol

c. 44.09 g/mol

●d. 58.12 g/mol

e. 42.07 g/mol

Explanation: You have to know that butane is C_4H_{10} which means the molecular weight is 58.12 g/mol.

After you are finished and have all your answers circled, go to the front of the room and then use the QR code there to pull up the virtual answer page. Enter the appropriate info plus all your answers - click the SUBMIT button. Make sure you get the confirmation screen and show it to the TA or proctor. After that, turn in your exam and scratch paper. You're free to leave after that.

https://mccord.cm.utexas.edu/helium