General Chemistry 1 *(CHEM 1141)*

Shawnee State University – Fall 2018

November 15, 2018

Exam # 3A

Name _____

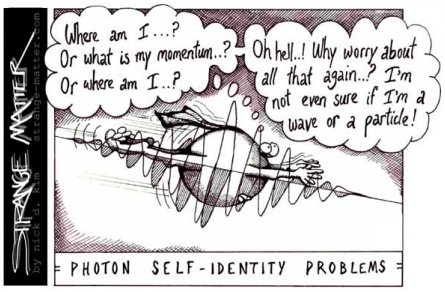
Please write your full name, and the exam version (3A) that you have on the scantron sheet !
(Bubble in the best answer choice for each question on the green & white scantron sheet in pencil !)

Please ☑ check the box next to your correct section number.

Section #:

- ❒ 1. (Monday Lab, 10:00 AM – 12:53 PM) – Dr. Wendi Fleeman
- ❒ 2. (Wednesday Lab, 10:00 AM – 12:53 PM)
- ❒ 3. (Monday Lab, 2:00 PM – 4:53 PM) – Dr. Andy Napper
- ❒ 4. (Wednesday Lab, 2:00 PM – 4:53 PM)
- ❒ 6. (Tuesday Lab, 12:30 PM – 3:23 PM) – Dr. Daniel Finnen

Multiple Choice:	_____	**/ 50**
Q21:	_____	**/ 10**
Q22:	_____	**/ 10**
Q23:	_____	**/ 10**
Q24:	_____	**/ 10**
Q25:	_____	**/ 10**
BONUS:	_____	**/ 5**
TOTAL:	_____	**/ 100**



Each problem in this section (multiple choice) is worth 2.5 points !

Q1. A 0.465 g sample of an unknown compound occupies 245 mL at 298 K and 1.22 atm. What is the molar mass of the unknown compound?

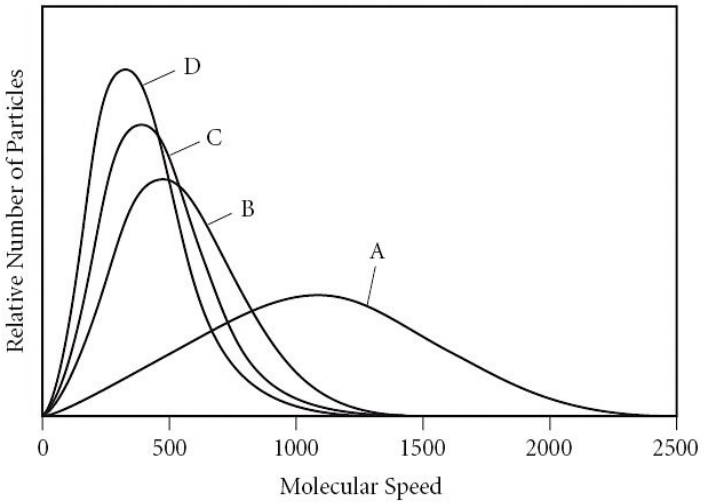
A) 38.0 g/mol

B) 33.9 g/mol

C) 26.3 g/mol

D) 12.2 g/mol

Q2. Which of the gases in the graph below has the largest molar mass?



A) A

B) B

C) C

D) D

Q3. An endothermic reaction has

A) a negative ΔH, absorbs heat from the surroundings, and feels cold to the touch.

B) a positive ΔH, absorbs heat from the surroundings, and feels cold to the touch

C) a positive ΔH, gives off heat to the surroundings, and feels warm to the touch

D) a positive ΔH, absorbs heat from the surroundings, and feels warm to the touch

Q4. According to the following thermochemical equation, what mass of HF (in g) must react in order to produce 345 kJ of energy? Assume excess SiO_2.

$$SiO_2(s) + 4\ HF(g) \rightarrow SiF_4(g) + 2\ H_2O(l) \qquad \Delta H^\circ_{rxn} = -184\ kJ$$

A) 37.5 g

B) 42.7 g

C) 150. g

D) 177 g

Q5. Define *specific heat capacity*:

A) the quantity of heat required to raise the temperature of 1 mol of a substance by 1 °C

B) the quantity of heat required to change a system's temperature by 1 °C

C) the quantity of heat required to raise the temperature of 1 g of a substance by 1 °C

D) the quantity of heat required to raise the temperature of 1 L of a substance by 1 K

Q6. Identify a substance that is NOT in its standard state at 25 °C.

A) $N_2(g)$

B) Ca(s)

C) $Br_2(l)$

D) $I_2(g)$

Q7. Calculate the wavelength (in nm) of the light emitted by a mercury lamp with a frequency of 6.88×10^{14} Hz.

A) 675 nm

B) 436 nm

C) 229 nm

D) 206 nm

Q8. The vertical height of a wave is called

A) wavelength

B) amplitude

C) frequency

D) wavefunction

Q9. The number of wave cycles that pass through a stationary point is called

A) wavelength

B) amplitude

C) frequency

D) wavefunction

Q10. The distance between adjacent crests of a wave is called

A) wavelength

B) amplitude

C) frequency

D) wavefunction

Q11. A 1.05 g sample of a metal requires 35.5 J of heat energy to raise the temperature from 21.5 °C to 285.5 °C. The identity of this metal would be _____ based on the specific heat calculated from the data given above.

A) Au (C_s = 0.128 J/g·°C)

B) Ag (C_s = 0.235 J/g·°C)

C) Cu (C_s = 0.380 J/g·°C)

D) Al (C_s = 0.896 J/g·°C)

Q12. In the van der Waals gas equation, what does the parameter "*a*" correct for?

A) The forces of attraction between the gas particles

B) The exothermic nature of real gases

C) The conversion of the temperature scale to Kelvin

D) The interaction between the gas particles and the walls of the container

Q13. Given the following thermochemical equation:

$$2A \longrightarrow 3B + C \qquad \Delta H = -24 \text{ kJ}$$

determine the value of ΔH for the reaction:

$$2C + 6B \longrightarrow 4A \qquad \Delta H = ??$$

A) +24 kJ

B) +48 kJ

C) −48 kJ

D) −24 kJ

Q14. The chemical equation corresponding to ΔH_f^o of $CH_3CH_2NH_2(l)$ is:

A) $CH_3CH_2NH_2(l) + {}^{13}/_2\ O_2(g) \longrightarrow 2\ CO_2(g) + NO_2(g) + {}^7/_2\ H_2O(l)$

B) $CH_3(g) + CH_2(g) + NH_2(l) \longrightarrow CH_3CH_2NH_2(l)$

C) $4\ C(s, \text{graphite}) + 7\ H_2(g) + N_2(g) \longrightarrow 2\ CH_3CH_2NH_2(l)$

D) $2\ C(s, \text{graphite}) + {}^7/_2\ H_2(g) + {}^1/_2\ N_2(g) \longrightarrow CH_3CH_2NH_2(l)$

Q15. Calculate the energy of the red light emitted by a neon atom with a wavelength of 703.2 nm.

A) 1.54×10^{-19} J

B) 2.83×10^{-19} J

C) 4.10×10^{-19} J

D) 4.27×10^{-19} J

Q16. Which series of EM radiation is ordered correctly from shorter to longer wavelengths?

A) infrared < visible < radio

B) radio < visible < x-ray

C) visible < microwave < gamma-ray

D) ultraviolet < visible < microwave

Q17. Which of the following gases will have the **greatest** density at STP?

A) hydrogen

B) nitrogen

C) oxygen

D) neon

Q18. Which electronic transition in a hydrogen atom would correspond to an **emission** of the **shortest wavelength**?

A) $3 \rightarrow 1$

B) $2 \rightarrow 1$

C) $1 \rightarrow 4$

D) $3 \rightarrow 4$

Q19. If 427 g of gold at a temperature of 68.0 °C loses 1.50 kJ of heat, what will its final temperature be? The specific heat capacity of gold is 0.128 J/g·°C

A) 27.4 °C

B) 40.6 °C

C) 67.6 °C

D) 95.4 °C

Q20. A balloon contains 1.725 moles of N_2, 0.135 moles of O_2, 0.0415 moles of He, and 0.0175 moles of H_2 at a total pressure of 785 mmHg. Calculate the partial pressure of He inside the balloon.

A) 619 mmHg

B) 115 mmHg

C) 32.6 mmHg

D) 17.0 mmHg

Each problem in this section (short answer) is worth 10 points !

All work must be show in order to receive credit !

You must use the factor–label (conversion–factor) method for all conversions !

Be sure to include units where applicable !

All numeric answers must be rounded to the correct number of significant figures !

Q21. Given the balanced chemical equation:

$Mg(s) + 2HBr(aq) \rightarrow MgBr_2(aq) + H_2(g)$

What volume of H_2 gas can be formed from an excess of Mg and 65.0 mL of 1.50 M HBr(aq) at a temperature of 23 ^{o}C and a pressure of 0.890 atm?

Q22. Calculate ΔH_{rxn} for the reaction:

$5\ C(s) + 6\ H_2(g) \longrightarrow C_5H_{12}(l)$

Use the following reactions and given ΔH's:

(1) $C_5H_{12}(l) + 8\ O_2(g) \longrightarrow 5\ CO_2(g) + 6\ H_2O(g)$ $\Delta H = -3244.8$ kJ

(2) $C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -393.5$ kJ

(3) $2\ H_2(g) + O_2(g) \longrightarrow 2\ H_2O(g)$ $\Delta H = -483.5$ kJ

Clearly show your work!

Q23. Calculate the **<u>wavelength</u>** of light (in nm) emitted from a hydrogen atom undergoing a transition from $n = 3$ to $n = 1$.

Q24. Solid silicon dioxide reacts with gaseous hydrochloric acid to form gaseous silicon tetrachloride and water vapor as shown in the reaction equation below.

$SiO_2(s) + 4\ HCl(g) \rightarrow SiCl_4(g) + 2\ H_2O(g)$

A) Calculate the heat of this reaction (ΔH_{rxn}°) given the standard heats of formation below;

B) Indicate if this reaction is endothermic or exothermic;

C) Calculate how much heat is given off or absorbed (state which) if 12.0 g of HCl(g) reacts with excess $SiO_2(s)$.

Substance	$H_2O(g)$	$HCl(g)$	$SiO_2(s)$	$SiCl_4(g)$
ΔH_f° (kJ/mol)	−241.8	−92.3	−910.9	−657.0

Q25. A 50.0 g copper sphere at a temperature of 98.4 °C is placed in 25.0 g of water which is at a temperature of 18.0 °C. Show how to determine *(and then calculate)* the final temperature of the water. You may assume that this is an isolated system and with no heat is lost to the surroundings.

(the specific heat of copper is 0.385 $\frac{\text{J}}{\text{g °C}}$ *and the specific heat of water is 4.184* $\frac{\text{J}}{\text{g °C}}$ *)*

5 Point Bonus Question

[1 pt.] Check this box ☐ if you have written the exam version on your scantron sheet.

[1 pt.] Check this box ☐ if you have checked the lab section box on the front of the exam.

[3 pts.] Clearly define what STP means when dealing with gases. Be sure to list the exact values, and not just spell-out the definition.

Useful Information: $PV = nRT$ $P\mathcal{M} = dRT$

$$\left[P + a\left(\frac{n}{V}\right)^2\right] \times (V - nb) = nRT \qquad R = 0.08206 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}}$$

$N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$ $q = m \cdot C_s . \Delta T$ $q = C \cdot \Delta T$

$c = \nu\lambda$ $E = h\nu = hc/\lambda$ $c = 3.00 \times 10^8$ m/s $h = 6.626 \times 10^{-34}$ J·s

$$E_n = -R_H\left(\frac{1}{n^2}\right) \qquad R_H = 2.18 \times 10^{-18}\ \text{J}$$

$$\lambda = \frac{h}{mv} \qquad \Delta E = -R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1																	*18*
1 **H** 1.008	*2*											*13*	*14*	*15*	*16*	*17*	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	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	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** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92160	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** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.60	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba*** 137.3	71 **Lu** 175.0	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** [210]	85 **At** [210]	86 **Rn** [222]
87 **Fr** [223]	88 **Ra**** [226]	103 **Lr** [262]	104 **Rf** [261]	105 **Db** [262]	106 **Sg** [266]	107 **Bh** [264]	108 **Hs** [265]	109 **Mt** [268]	110 [269]	111 [272]	112 [277]	113	114 [285]	115	116 [289]	117	118 [293]

*	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** [145]	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.50	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0
**	89 **Ac** [227]	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	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]