Booklet A		<b>KIM 10</b>	1E			Ν	lidtei	rm 2				Dec	embe	r 24, 2	2022
Group Number	:				Surnar	ne :							Sign	ature	
List Number	:				Name	:									
Student Number	:				e-mail	:									
1				-	-							-			18
1 H 1,008 2										13	14	15	16	17	2 He 4,003
2 Li Be 6,94 9,012										5 B 10,81	6 C 12,01	7 N 14,01	8 0 16,00	9 F 19,00	10 Ne 20,18
<sup>3</sup> Na Mg 22,99 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 32,06	17 Cl 35,45	18 Ar 39,95
19 20 <sup>4</sup> K Ca 39,10 40,08	21 Sc 44,96 47	22 23 Ti V 7,87 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 72,63	33 As 74,92	34 Se 78,97	35 Br 79,90	36 Kr 83,80
37 38 5 Rb Sr 85,47 87,62	39 Y 88,91 91	40 41 Zr Nb .,22 92,91	42 Mo 95,95	43 Tc	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 127,6	53 I 126,9	54 Xe 131,3
<sup>55</sup> 56 <sup>6</sup> Cs Ba 132,9 137,3	57-71	72 73 Hf Ta 78,5 180,9	74 W 183,8	75 Re 186,2	76 Os 190,2	77 ]r 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	85 At	86 Rn
7 Fr Ra	89-103 1	04 105 Rf Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 0g
	13	57 58 La Ce 18,9 140,1	59 Pr 140,9	60 Nd 144,2	61 Pm	62 Sm 150,4	63 Eu 152,0	64 Gd 157,3	65 Тb 158,9	66 Dy 162,5	67 Ho 164,9	68 Er 167,3	69 Tm 168,9	70 Yb 173,0	71 Lu 175,0
	2	89 90 Ac Th 232,0	91 Pa 231,0	92 U 238,0	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr
c = 2.	.998×10 <sup>8</sup>	<sup>8</sup> m.s <sup>-1</sup> g	= 9.8	m.s <sup>-2</sup>	h =	6.626	×10 <sup>-34</sup>	<sup>4</sup> J.s	R <sub>H</sub> =	2.179	×10 <sup>-1</sup>	<sup>8</sup> J (	) °C =	273.1	5 K
N <sub>A</sub> =	6.02×10	) <sup>23</sup> 1 ca	1 = 4.1	84 J	1 m	$=10^{9}$	nm =	1010	Å = 1	0 <sup>12</sup> pi	m 1g	$g = 10^{-1}$	<sup>3</sup> mg =	= 10 <sup>6</sup>	μg
1 atm	a = 760	) mmHg	= 76	0 torr	=	101	325 Pa	a =	101.32	25 kPa	= 1	.0132	5 bar		
$\mathbf{R} = 0$	.08206 L	atm mol	$^{-1}K^{-1}$ =	= 0.08	314 L	bar m	ol <sup>-1</sup> K	$^{-1} = 8$	8.314 J	mol <sup>-</sup>	$^{1}K^{-1} =$	= 8.314	4 L kP	a mol	<sup>-1</sup> K <sup>-1</sup>
For w	ater: c =	= 4.184 J g	g <sup>-1</sup> K <sup>-1</sup>	l	$K_{f} = 1$	1.86 K	kg m	ol <sup>-1</sup>	КĮ	b = 0.5	512 K	kg mo	1-1		
1 Nev	wton (N)	= 1 kg m	s <sup>-2</sup>	1 Jo	oule (J	) = 1 ľ	N m =	1 kg n	n <sup>2</sup> s <sup>-2</sup>	-	l Wat	t (W)	= 1 J :	<sub>s</sub> -1	

1) A balloon filled with 39.1 moles of helium has a volume of 876 L at 0.0 °C and 1.00 atm pressure. The temperature of the balloon is increased to 38.0 °C as it expands to a volume of 998 L, the pressure remaining constant. What is the  $\Delta U$  for the helium in the balloon?

(The molar heat capac	city for helium gas is 20	.8 J K <sup>-1</sup> mol <sup>-1</sup> )		
A) 19.2 kJ	B) 37.0 kJ	C) 9.1 kJ	D) 18.5 kJ	E) 21.3 kJ

2) An alloy sample was prepared using 5.00 g aluminum (specific heat capacity = 0.89 J /K g) and 10.00 g iron (specific heat capacity = 0.45 J /K g). Then the sample was heated to 100.0 °C. The alloy sample was then dropped into 97.3 g water at 22.0 °C. Calculate the final temperature of the alloy and water system, assuming no heat loss to the surroundings.
A) 21.3 °C
B) 35.5 °C
C) 23.7 °C
D) 14.5 °C
E) 47.4 °C

3) Considering below reaction calculate the final temperature when 100.0 mL of 0.500 M HCl is mixed with 300.0 mL of 0.100 M Ba(OH)<sub>2</sub> in a coffee cup calorimeter. Assuming that the temperature of all solutions was initially 25.0 °C,

densities are 1.00 g/mL, specific heat capacities of 4.18 J/ K g, and no heat is lost to the surroundings. 2 HCl(aq) + Ba(OH)<sub>2</sub>(aq)  $\rightarrow$  BaCl<sub>2</sub>(aq) + 2 H<sub>2</sub>O(l)  $\Delta$ H = -118 kJ A) 26.8 °C B) 19.6 °C C) 13.9 °C D) 53.6 °C E) 36.2 °C

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4) 2 NH <sub>3</sub> (g) + 3 N <sub>2</sub> O(g) $\rightarrow$ 4 N <sub>2</sub> (g) + 3 H <sub>2</sub> O(l)	$\Delta H = -1010 \text{ kJ}$		
$N_2O(g) + 3 H_2(g)  \rightarrow  N_2H_4(l) +  H_2O(l)$	$\Delta H = -317 \text{ kJ}$		
$2 \operatorname{NH}_3(g) + \frac{1}{2} \operatorname{O}_2(g) \rightarrow \operatorname{N}_2\operatorname{H}_4(l) + \operatorname{H}_2\operatorname{O}(l)$	$\Delta H = -143 \text{ kJ}$		
$H_2(g)  + \frac{1}{2} \operatorname{O}_2(g)  \rightarrow  H_2O(l)$	$\Delta H = -286 \text{ kJ}$		
According to the given data calculate $\Delta H$ for the	following reaction		
$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2 H_2O(l)$			
A) -2490 kJ B) +2490 kJ	C) 1245 kJ	D) -623 kJ	E) +9960 kJ
5) Which of the following could be the atom X in the	e following neutral (u X 	ncharged) molecule?	

		X <sup>N</sup> F		
A) Cl	B) F	C) C	D) N	E) O

6) Which of the following has a **square planar** shape?

A)  $IO_4^-$  B)  $SO_4^{2-}$  C)  $BH_4^-$  D)  $CIO_4^-$  E)  $BrCl_4^-$ 

7) Which of the following species is not paired correctly with its VSEPR Notation?

A)  $CH_4 \rightarrow AX_4$ B)  $SF_4 \rightarrow AX_4E$ C)  $BrF_5 \rightarrow AX_5E$ D)  $ICl_3 \rightarrow AX_3$ E)  $ICl_4 \rightarrow AX_4E_2$ 

8) Which of the follow	ing species has <b>sp<sup>3</sup>d</b> hyb	ridization type?		
A) PF <sub>6</sub>	B) COS	C) SiCl <sub>4</sub>	D) NO <sub>3</sub> -	E) AsF5
9) According to the mo	olecular orbital theory (M	O), which one of the foll	lowing species is paramag	gnetic?
A) C <sub>2</sub>	B) N <sub>2</sub> <sup>2-</sup>	C) Ne <sub>2</sub> <sup>2+</sup>	D) B <sub>2</sub> <sup>2-</sup>	E) O <sub>2</sub> <sup>2-</sup>
10) How many σ-bonds	and $\pi$ -bonds, respectively	y, are there in the acetoni	trile (CH <sub>3</sub> CN)?	
Α) 6 σ, 1 π	B) 4 σ, 3 π	C) 5 σ, 0 π	D) 5 σ, 2 π	Ε) 5 σ, 1 π

11) Which of the following facts regarding bond order is not true?

- A) Bond order is the number of bonds between two atoms in a molecule.
- B) As the bond order increases, the bond length decreases.
- C) Isoelectronic molecules and ions have identical bond orders.
- D) The higher the bond order, the higher the bond energy.
- E) With decrease in bond order, bond strength increases.
- 12) A compound alloy of gold (Au) and copper (Cu) crystallizes in a cubic lattice in which Cu atoms occupy the lattice points at the corners of a cube and Au atoms occupy the centers of each of the cube edges and the cubic space. What would be the formula of this compund?

A) Aucus D) Auscu C) Aucu D) Aucua L) Aucu	A) AuCu3	B) Au <sub>3</sub> Cu	C) Au4Cu	D) AuCu4	E) AuCu
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- 13) Flask A has a volume of 0.5 L and contains 500 g of a volatile liquid. Flask B has a volume of 1 L and contains 125 g of the same liquid. Both flasks are stoppered and both are at 30 °C. What is the ratio of the vapor pressure of the liquid in Flask A to that in Flask B (P<sub>A</sub>:P<sub>B</sub>)?
  - A) 2 B) 0.5 C) 1 D) 4 E) 0.25

## Booklet A

14) The vapor pressure of methyl alcohol (CH<sub>4</sub>O) is 40 mmHg at 5 °C, and normal boiling point is 66 °C. Estimate how much heat is required to evaporate 319 g of methyl alcohol.

A) 725 kJ	B) 216 kJ	C) 993 kJ	D) 377 kJ	E) 686 kJ
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	Substance	P <sub>critical</sub> (atm)	$T_{ciritical}$ (°C)	$P_{triple}(atm)$	$T_{triple}(^{\circ}C)$
Ι	Nitrous oxide (N <sub>2</sub> O)	71.4	36.4	0.87	-90.8
II	Ethylene ( $C_2H_4$ )	50.0	9.4	0.001	-169.2
III	Hydrogen Chloride (HCl)	81.6	51.6	0.14	-114.2
IV	Carbon dioxide (CO <sub>2</sub> )	72.8	31.2	5.10	-56.6
A)	I B) I, III	C) III, IV	D) I	II, IV	E) I, II, III

15) Which of the following compound(s) can be liquified by applying pressure at 35 °C?

16) What is the mole percent of ethylene glycol  $(C_2H_6O_2, d = 1.1132 \text{ g mL}^{-1})$  in a solution composed of ethylene glycol and water (d = 1.0000 g mL<sup>-1</sup>) which has a density of 1.0816 g mL<sup>-1</sup>? A) 42.8 % B) 87.9 % C) 2.6 % D) 39.7 % E) 7.8 %

17) Normal boiling point of water is 100 °C. What is the vapor pressure of an aqueous solution at 100 °C containing 15.1% ethylene glycol (C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>) by mass?

A) 372 mmHg	B) 723 mmHg	C) 377 mmHg	D) 389 mmHg	E) 702 mmHg
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- 18) How much glucose (a nonelectrolyte, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) is required to prepare a solution which has the same osmotic pressure of the blood as 7.65 atm at 37 °C?
  A) 10.6 g L<sup>-1</sup>
  B) 21.2 g L<sup>-1</sup>
  C) 54.2 g L<sup>-1</sup>
  D) 102.4 g L<sup>-1</sup>
  E) 61.5 g L<sup>-1</sup>
- 19) The average volume of fatty tissue in a human brain is around 1200 cm<sup>3</sup>. When the partial pressure of  $N_2(g)$  is 2 atm (at a depth of 1.5 m below sea level), the amount of dissolved  $N_2(g)$  in a human brain is 134.5 mg. Regarding that, what is the Henry's constant for  $N_2$  in fatty tissue?
  - A)  $8 \times 10^{-3} \text{ mol } \text{L}^{-1} \text{ atm}^{-1}$ B)  $6 \times 10^{-3} \text{ mol } \text{L}^{-1} \text{ atm}^{-1}$ C)  $4 \times 10^{-4} \text{ mol } \text{L}^{-1} \text{ atm}^{-1}$ D)  $7 \times 10^{-4} \text{ mol } \text{L}^{-1} \text{ atm}^{-1}$ E)  $2 \times 10^{-3} \text{ mol } \text{L}^{-1} \text{ atm}^{-1}$
- 20) The boiling point of a solution prepared by dissolving a 4.95 g of a nonelectrolyte volatile substance in 84.2 g of water at 760 mmHg is 100.2 °C. What is the molar mass of this substance?

A) $250 \text{ g mol}^{-1}$ B) $94 \text{ g mol}^{-1}$ C) $100 \text{ g mol}^{-1}$ D) $50 \text{ g mol}^{-1}$ E) $150 \text{ g}$	A) 230 g mol-1	B) 94 g mol <sup>-1</sup>	C) 106 g mol <sup>-1</sup>	D) 30 g mol <sup>-1</sup>	E) 150 g m
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Answer Key Testname: 24.12.2022\_EN\_A

1) D 2) C 3) A 4) D 5) E 6) E 7) D 8) E 9) B 10) D 11) E 12) C 13) C 13) C 14) D 15) B 16) A 17) B 18) C 19) E 20) E