NAME

CHEMISTRY 102FALL 2001EXAM 1FORM DSECTIONS 512-522DR. KEENEY-KENNICUTT

Directions: (1) Put your name, S.I.D. number and signature on the free response part of the exam where indicated.

- (2) Each multiple choice question is actually 2 questions on your scanning sheet. If you are sure of an answer, put the same answer down for both questions for 5 pts. If you cannot decide between two answers, put one answer down for one question and the other answer down for the other question. If you get one correct you'll get half credit for 2.5 pts. If there is an ambiguous multiple choice question, use the last page to explain your answer.
 - (3) Do NOT write on the envelope.
 - (4) Bubble in OPTION A on the scanning sheet IF you want your grade posted.
 - (5) When finished, put the free response answers in the envelope with the scanning sheet. You can keep the multiple choice part the answers will be given to you as you leave.
 - (6) There are a total of 28 questions (16 actual questions).

PART 1

- **1&2.** When a reaction releases heat to its surroundings, it is said to be
 - (a) spontaneous
- (b) nonspontaneous
- (c) increasing in entropy

- (d) endothermic
- (e) exothermic
- **3&4.** A system has 40 J of heat added to it and at the same time does 70 J of work. What is the change in the internal energy of the system?
 - (a) +30 J (b) -30 J (c) +110 J (d) -110 J (e) +55 J

- **5&6.** Which one of the following thermodynamic quantities is NOT a state function?
 - (a) P (b) ΔS (c) (q + w) (d) q (e) ΔH

7&8. The value of which of the following is equal to zero?

- (b) $\Delta G_{f_{298}}^{o} Fe(s)$ (e) $\Delta H_{f_{298}}^{o} N_2(\ell)$ (a) $S_{298}^{\circ} H_2(g)$ (c) $\Delta H_{f_{298}}^{o} C$ (s, diamond)
- (d) $\Delta G_{f_{298}}^{o} H_2O(\ell)$

9&10. Consider the following spontaneous reaction at constant pressure. Which response is FALSE?

 $CaCO_3(s) + 2HBr(aq) \rightarrow CaBr_2(aq) + CO_2(g) + H_2O(\ell)$

- (a) The value of the change in Gibbs free energy is negative.
- (b) The heat measured is equal to ΔH .
- (c) The entropy of the system is decreasing.
- (d) The work done by the system is a negative value.
- (e) The heat involved is measured in a coffee cup calorimeter.
- **11&12.** Consider the following reaction: $2HCI(g) + F_2(g) \rightarrow 2HF(g) + CI_2(g)$. Which of the following is always TRUE?

(a) w < 0 (b) $\Delta G = 0$ (c) $\Delta E = \Delta H$ (d) $\Delta G = \Delta H$ (e) $\Delta H = 0$

13&14. Which of the following name/formula combinations are CORRECT?

(1)	ethanol	CH₃OH				
(2)	sodium chlorate	Na ₂ ClO ₃				
(3)	methylamine	CH_3NH_2				
(4)	copper(II) phosphate	CuPO ₄				
(5)	calcium nitrite	Ca(NO ₂) ₂				
(a)	3, 5 only (b) 2, 4 d	only ((c) 1, 3, 4 only	(d) 2 only	(e)	another combination

15&16. What is the enthalpy change of the reaction below at 298 K and 1 atm pressure?

		2ZnS(s)	+	3O ₂ (g)	\rightarrow	2ZnO(s)	+	2SO ₂ (g)
	$\Delta H_{\rm f298}^{\rm o}$ (kJ/mol)	-205.6		0		-348.3		-296.8
(a) -65 ⁻	1.0 kJ	(b) -879	9.0 kJ			(c) -7	62.1 k	J
(d) -270	0.6 kJ	(e) +15	24.1	٢٦				

17&18. For a reaction where ΔH is +255 kJ/mol rxn and $\Delta S = +52$ J/K, _____.

- (a) the reaction is spontaneous at all temperatures.
- (b) the reaction is nonspontaneous at all temperatures
- (c) the reaction is spontaneous only at temperatures above a certain value.
- (d) the reaction is spontaneous only at temperatures below a certain value.
- (e) It is impossible to tell if the reaction is or is not spontaneous.

19&20. Which of the following processes correspond to an positive value of ΔS ?

- (1) the boiling of water
- (2) the raising of the temperature of solid iron from 0 K to 298 K.
- (3) the sublimation of iodine, $I_2(s)$
- (4) the condensation of gaseous ethanol

	(a) 1, 2, 3 only	(b) 2, 4 only	(c) 1, 4 only	(d) 3 only	(e) another combination
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21&22. Consider the reaction below at 25°C for which $\Delta G^{\circ} = +159 \text{ kJ/mol rxn.}$ Calculate ΔS° at 25°C. CH₄(g) + N₂(g) + 163.8 kJ \rightarrow HCN(g) + NH₃(g)

(a) +1.54 J/K	(b) +444 J/K	(c) +67.8 J/K	(d) +109 J/K	(e) +16.1 J/K
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23&24. Estimate the sublimation temperature of the metal, calcium (in °C) using thermodynamic data taken from Appendix K given below:

Ca(s) $\stackrel{\rightarrow}{\leftarrow}$ Ca(g)

	$\Delta H^{ m o}_{ m f_{298}}$ (kJ/mol)	S° (J/mol·K)	$\Delta G^{ m o}_{ m f_{298}}$ (kJ/mol)
Ca(g)	192.6	154.8	158.9
Ca(s)	0	41.6	0

(d) 1428°C

(e) 1650°C

(c) 1531°C

(a) 933°C

(b) 1194°C

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NAME_____

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Form D

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Signature _____

PART 2

25. The following drawing represents a spontaneous gaseous reaction of $A_3(g)$ molecules forming gaseous products:



- (2 pt) (a) Write the balanced equation for the reaction.
- (6 pts) (b) What are the signs of ΔH° , ΔS° , and ΔG° for the reaction? Explain your reasoning.

OVER **Þ**

(8 pts) 26. (a) A 6.620 g sample of decane, C₁₀H₂₂(ℓ) was burned in a bomb calorimeter whose heat capacity had been determined to be 2.450 kJ/°C. The temperature of 1250.0 grams of water rose from 24.600°C to 26.380°C. Calculate ΔE for the reaction in kJ/mole of decane. The specific heat of water is 4.184 J/g•°C.

(3 pts) (b) Write the balanced combustion reaction:

(5 pts) (c) Calculate the work when 1 mole of decane undergoes complete combustion. Use the final temperature.

27. Consider the following balanced reaction:

 $4AI(s) + 3MnO_2(s) \rightarrow 3Mn(s) + 2AI_2O_3(s)$ $\Delta H^\circ = -1792 \text{ kJ/mol rxn}$

(5 pts) (a) If 200.0 kJ of heat are released, how many grams of Al₂O₃ must have been formed?

(5 pts) (b) Now, consider this reaction combined with the reaction given above:

 $4 \text{Al}(s) \ + \ 3 \text{O}_2(g) \ \rightarrow \ 2 \text{Al}_2 \text{O}_3(s) \qquad \Delta \text{H}^\circ = \ -3352 \ \text{kJ/mol rxn}$

Using Hess's Law, determine the enthalpy of formation of MnO₂(s).

OVER **Þ**

- **28.** Consider the following reaction: $2NO(g) + Br_2(g) \rightarrow 2 NOBr(g)$
- (3 pts) (a) Express the rate of reaction as a function of each of the compounds using Δ [compound]/ Δ t.

(3 pts) (b) If NO is reacting at a rate of 1.00 M/min at a certain time, at what rate is Br_2 reacting at that same time?

SCRAP PAPER OR COMMENTS ON EXAM

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