


Chemistry 12
Exam IV Form A
August, 10 2005

Name _____
Section _____
Student No. _____

IMPORTANT: On the scantron (answer sheet), you **MUST** clearly fill your **name**, your **student number**, **section number**, and **test form** (white cover = test form A; yellow cover = test form B). Use a #2 pencil.

PENNSTATE University Testing Services Form 5CH94

 NAME _____

Print: _____
Name _____
Course _____
Date _____

* USE A NO. 2 PENCIL ONLY.
* MARK ONLY ONE ANSWER FOR EACH ITEM.

STUDENT NUMBER	SEC. NO	BOOK NO.	SCORE
0 0 0 0 0 0 0 0 0 0	0 0 0	0 0 0 0	0 0 0
1 1 1 1 1 1 1 1 1 1	1 1 1	1 1 1 1	1 1 1
2 2 2 2 2 2 2 2 2 2	2 2 2	2 2 2 2	2 2 2
3 3 3 3 3 3 3 3 3 3	3 3 3	3 3 3 3	3 3 3
4 4 4 4 4 4 4 4 4 4	4 4 4	4 4 4 4	4 4 4
5 5 5 5 5 5 5 5 5 5	5 5 5	5 5 5 5	5 5 5
6 6 6 6 6 6 6 6 6 6	6 6 6	6 6 6 6	6 6 6
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9 9 9 9 9 9 9 9 9 9	9 9 9	9 9 9 9	9 9 9

Code: _____
Student Number _____
Section Number _____
Test Form _____

TEST FORM	A B C D E F G H I J
SPECIAL CODE	1 2 3 4

There are 27 questions on this exam. Check that you have done all of the problems and filled in the first 27 bubbles on the scantron. Your score will be reported in percents (max 100%).

Exam policy

- Calculators with text-programmable memory **are not** allowed.
- Relevant data and formulas, including the periodic table, are attached at the end of this exam.
- Your grade will be based only on what is on the scantron form.
- The answer key will be posted on the web after the exam (under "News").

Hints

- As you read the question, underline or circle key words to highlight them for yourself. Avoid errors from "mis-reading" the question.
- Pay attention to units and magnitudes (decimal places) of numbers obtained from calculations.
- There is no penalty for guessing.

Chemistry 12 Exam 4

Basic Skills

1.) Which one of the following is the ground state electron configuration of Zn?

- a) [Kr] 4s² 3d¹⁰
- b) [Ar] 4s¹ 3d¹⁰
- c) [Ar] 4s² 3d¹⁰
- d) [Ar] 3s² 3d¹⁰
- e) [Kr] 3s² 3d¹⁰

2.) What is the balanced net ionic equation for precipitation of CaCO₃ when aqueous solutions of Na₂CO₃ and CaCl₂ are mixed?

- a) 2Na⁺(aq) + CO₃²⁻(aq) → Na₂CO₃(aq)
- b) 2Na⁺(aq) + 2Cl⁻(aq) → 2 NaCl(aq)
- c) Na⁺(aq) + Cl⁻(aq) → NaCl(aq)
- d) Ca²⁺(aq) + CO₃²⁻(aq) → CaCO₃(s)
- e) Na₂CO₃(aq) + CaCl₂(aq) → 2NaCl(aq) + CaCO₃(s)

3.) Which one of the follow has 54 electrons?

- i ${}_{56}^{137}\text{Ba}^{+2}$
- ii ${}_{52}^{128}\text{Te}^{2-}$
- iii ${}_{54}^{132}\text{Xe}^{2+}$

- a) i only
- b) ii only
- c) iii only
- d) i and ii
- e) ii and iii

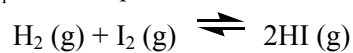
4.) A stock solution is prepared by adding 27.00 mL of 2.19 M MgCl₂ to enough water to make 122.00 mL. What is the Cl⁻ concentration of 40.00 mL of the stock solution?

- a) 0.0388 M
- b) 0.485 M
- c) 0.969 M
- d) 1.48 M
- e) 2.96 M

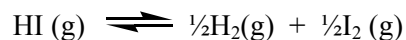
- 5.) How many valence electrons are there in ClO_4^- ?
- a) 32
 - b) 30
 - c) 29
 - d) 28
 - e) 25
- 6.) An ionic compound has the formula MPO_4 . What is the identity of M?
- a) Na
 - b) Mg
 - c) H
 - d) Al
 - e) Ca
- 7.) What are the spectator ions in the reaction between aqueous hydrochloric acid and aqueous ammonia?
- a) H^+ and NH_3
 - b) H^+ , Cl^- , NH_3 , and NH_4^+
 - c) Cl^- and NH_4^+
 - d) H^+ , Cl^- , and NH_4^+
 - e) Cl^- only
- 8.) Put these atoms in order of increasing size (radius).
- Ba O F S Mg
- a) $\text{O} < \text{F} < \text{S} < \text{Mg} < \text{Ba}$
 - b) $\text{F} < \text{S} < \text{O} < \text{Mg} < \text{Ba}$
 - c) $\text{F} < \text{O} < \text{S} < \text{Ba} < \text{Mg}$
 - d) $\text{O} < \text{F} < \text{S} < \text{Ba} < \text{Mg}$
 - e) $\text{F} < \text{O} < \text{S} < \text{Mg} < \text{Ba}$

End of Basic Skills

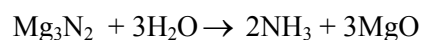
9.) The value of K_{eq} for the equilibrium



is 54.0 at 427 °C. What is the value of K_{eq} at 427 °C for the equilibrium below?

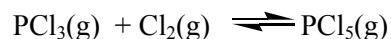


- a) 27
 - b) 7.35
 - c) 0.136
 - d) 2.92×10^3
 - e) 3.43×10^{-4}
- 10.) A 3.82 g sample of magnesium nitride is reacted with 7.73 g of water and 3.60 g of MgO is recovered.



What is the percent yield of the reaction?

- a) 94.5%
 - b) 78.8%
 - c) 46.6%
 - d) 49.4%
 - e) 99.9%
- 11.) Phosphorous trichloride and phosphorous pentachloride equilibrate in the presence of molecular chlorine according to the reaction:



An equilibrium mixture at 450 K contains

$$P_{\text{PCl}_3} = 0.202 \text{ atm}$$

$$P_{\text{Cl}_2} = 0.256 \text{ atm}$$

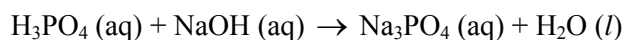
$$P_{\text{PCl}_5} = 3.45 \text{ atm}$$

What is the value of K_p at this temperature?

- a) 66.7
- b) 1.50×10^{-2}
- c) 1.78×10^{-1}
- d) 2.99
- e) 7.54

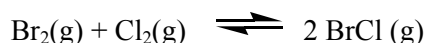
- 12.) A solution is prepared by mixing 50.0 mL of 0.100 M HCl and 10.0 mL of 0.200 M NaCl. What is the molarity of chloride ion in this solution?
- 0.183M
 - 8.57M
 - 3.50M
 - 0.0500M
 - 0.117M

- 13.) When the following equation is balanced, the coefficient of H_3PO_4 is _____.



- 1
 - 2
 - 3
 - 4
 - 0
- 14.) In which species does sulfur have the highest oxidation number?
- S_8 (elemental form)
 - H_2S
 - SO_2
 - H_2SO_3
 - K_2SO_4

- 15.) At 400 K, the equilibrium constant for the reaction below is $K_p = 7.0$.

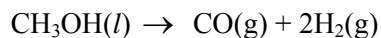


A closed vessel at 400 K is initially charged with 1.00 atm of $\text{Br}_2(\text{g})$, 1.00 atm of $\text{Cl}_2(\text{g})$, and 2.00 atm of $\text{BrCl}(\text{g})$. Which one of the statements below is true?

- The equilibrium partial pressures of $\text{Br}_2(\text{g})$, $\text{Cl}_2(\text{g})$, and $\text{BrCl}(\text{g})$ will be the same as the initial values.
- The equilibrium partial pressure of $\text{Br}_2(\text{g})$ will be greater than 1.00 atm.
- At equilibrium, the total pressure in the vessel will be less than the initial total pressure.
- The equilibrium partial pressure of $\text{BrCl}(\text{g})$ will be greater than 2.00 atm.
- The reaction will go to completion (i.e., all of the reactants will be used up) since initially there are equal amounts of $\text{Br}_2(\text{g})$ and $\text{Cl}_2(\text{g})$.

- 16.) Write the balanced equation for the reaction that occurs when methanol, $\text{CH}_3\text{OH}(l)$, is burned in air. What is the coefficient of oxygen in the balanced equation?
- 1
 - 2
 - 3
 - 4
 - $5/2$

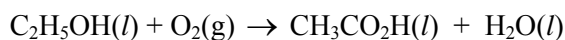
- 17.) The value of ΔH° for the reaction below is +128.1 kJ:



How many kJ of heat are consumed when 15.5 g of $\text{CH}_3\text{OH}(l)$ decomposes as shown in the equation?

- 0.48 kJ
 - 62.0 kJ
 - 1.3×10^2 kJ
 - 32 kJ
 - 8.3 kJ
- 18.) What volume (mL) of $7.48 \times 10^{-2}\text{M}$ perchloric acid (HClO_4) can be neutralized with 115 mL of 0.244 M sodium hydroxide?
- 125 mL
 - 8.60 mL
 - 188 mL
 - 750 mL
 - 375 mL
- 19.) For which one of the following reactions is $\Delta H^\circ_{\text{rxn}}$ equal to the heat of formation of the product?
- $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)$
 - $(1/2)\text{N}_2(g) + \text{O}_2(g) \rightarrow \text{NO}_2(g)$
 - $6\text{C}(s) + 6\text{H}(g) \rightarrow \text{C}_6\text{H}_6(l)$
 - $\text{PH}_3(g) + 4\text{HBr}(g) \rightarrow \text{PH}_4\text{Br}(l)$
 - $6\text{C}(s) + 11\text{H}_2\text{O}(g) \rightarrow \text{C}_6\text{H}_{22}\text{O}_{11}(s)$
- 20.) Which of the following is an oxidation-reduction reaction?
- $\text{Cu}(s) + 2\text{AgNO}_3(\text{aq}) \rightarrow 2\text{Ag}(s) + \text{Cu}(\text{NO}_3)_2(\text{aq})$
 - $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(l) + \text{NaCl}(\text{aq})$
 - $\text{AgNO}_3(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{AgCl}(s) + \text{HNO}_3(\text{aq})$
 - $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(s) + 2\text{NaC}_2\text{H}_3\text{O}_2(\text{aq})$
 - $\text{H}_2\text{CO}_3(\text{aq}) + \text{Ca}(\text{NO}_3)_2(\text{aq}) \rightarrow 2\text{HNO}_3(\text{aq}) + \text{CaCO}_3(s)$

21.) Given the data in the table below, what is $\Delta H^\circ_{\text{rxn}}$ for the reaction:



Substance	ΔH_f° (kJ/mol)
$\text{C}_2\text{H}_4(g)$	52.3
$\text{C}_2\text{H}_5\text{OH}(l)$	-277.7
$\text{CH}_3\text{CO}_2\text{H}(l)$	-484.5
$\text{H}_2\text{O}(l)$	-285.8

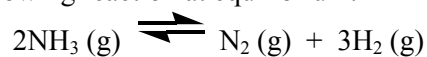
- a) -79.0 kJ
- b) -1048.0 kJ
- c) -476.4 kJ
- d) -492.6 kJ
- e) There is insufficient information to answer this question.

22.) Given the following bond enthalpies, estimate ΔH° for the complete combustion of one mole of (CH_3CH_3) in oxygen.

C—O	336 kJ/mol	O—H	467 kJ/mol
C—C	356 kJ/mol	O ₂	498 kJ/mol
C—H	416 kJ/mol	C=O	803 kJ/mol

- a) -1419 kJ/mol
- b) -648 kJ/mol
- c) +648 kJ/mol
- d) -2838 kJ/mol
- e) None of these are correct to within 1% of the answer.

23.) Consider the following reaction at equilibrium:

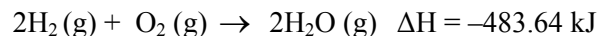


Which one of the following changes will cause an increase in the moles of H_2 in the reaction container?

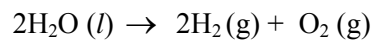
- a) The removal of some NH_3 from the reaction vessel (V and T constant)
- b) A decrease in the total pressure by changing the volume (T constant)
- c) Addition of some N_2 to the reaction vessel (V and T constant)
- d) A decrease in the total volume of the reaction vessel (T constant)
- e) An increase in total pressure by addition of helium gas (V and T constant)

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24.) Given the following reactions:

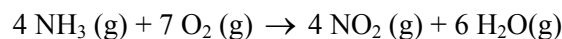


what is the enthalpy for the decomposition (shown below) of liquid water into gaseous hydrogen and oxygen?



- a) -395.62 kJ
- b) -527.65 kJ
- c) 439.63 kJ
- d) 571.66 kJ
- e) 527.65 kJ

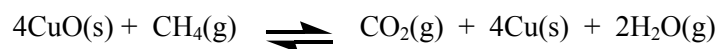
25.) The combustion of ammonia in the presence of excess oxygen yields NO_2 and H_2O :



If 34.0 g of ammonia is consumed, how many moles of oxygen will be consumed?

- a) 2.0 moles
- b) 4.0 moles
- c) 7.0 moles
- d) 14 moles
- e) 3.5 moles

26.) What is the expression for K_p for the reaction below?



- a) $\frac{P_{\text{CH}_4}}{P_{\text{CO}_2} P_{\text{H}_2\text{O}}^2}$
- b) $\frac{[\text{Cu}] P_{\text{CO}_2} P_{\text{H}_2\text{O}}^2}{[\text{CuO}]^4 P_{\text{CH}_4}}$
- c) $\frac{P_{\text{CO}_2} P_{\text{H}_2\text{O}}^2}{P_{\text{CH}_4}}$
- d) $\frac{P_{\text{CO}_2} P_{\text{H}_2\text{O}}^2}{P_{\text{CuO}}}$
- e) $\frac{P_{\text{CH}_4}}{P_{\text{H}_2\text{O}}^2 P_{\text{CO}_2}}$

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- 27.) 27.0 g of Al are mixed with 32.0 g of O₂. Assuming the reaction goes to completion, how many moles of Al₂O₃ will form?
- a) 0.500 moles
 - b) 0.667 moles
 - c) 1.0 mole
 - d) 2.00 moles
 - e) 1.5 moles

Form A

1. C
2. D
3. D
4. C
5. A
6. D
7. E
8. E
9. C
10. B
11. A
12. E
13. A
14. E
15. D
16. C
17. B
18. E
19. B
20. A
21. D
22. A, $D=1/2$
23. B
24. D
25. E
26. C
27. A