AS
ACADEMIC STUDIO

PRACTICE EXAM

General Chemistry 2

15 problems · one per page · show all your work

Name _____ Date _____ Score / 15

Constants

R = 0.08206 L·atm/(mol·K) = 8.314 J/(mol·K) · $K_w = 1.0 \times 10^{-14}$ at 25 °C · F = 96,485 C/mol

How to use this exam

Give yourself about 2 hours with a calculator and a periodic table. Work each problem on its own page, then check your answers with the separate answer key.

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PROBLEM 1 OF 15

Freezing point depression

10.0 g of NaCl dissolves in 250. g of water. What is the freezing point? (K_f of water = 1.86 °C/m.)

PROBLEM 2 OF 15

Rate law from initial rates

For A + B → products:

Experiment	[A] (M)	[B] (M)	Initial rate (M/s)
1	0.10	0.10	4.0×10^{-4}
2	0.20	0.10	1.6×10^{-3}
3	0.10	0.30	4.0×10^{-4}

Find the rate law and k.

PROBLEM 3 OF 15

First-order kinetics and half-life

N_2O_5 decomposes by first-order kinetics with k = 6.2 × 10^{-4} s^{-1}. (a) What is the half-life? (b) How long does it take for [N_2O_5] to drop from 0.50 M to 0.10 M?

PROBLEM 4 OF 15

Activation energy (Arrhenius)

A reaction's rate doubles when the temperature rises from 300 K to 310 K. Find E_a.

PROBLEM 5 OF 15

Reaction quotient Q vs K

$N_2 + 3\ H_2 \rightleftharpoons 2\ NH_3$, $K_c = 0.105$. A mixture has $[N_2] = 0.50$ M, $[H_2] = 0.20$ M and $[NH_3] = 0.10$ M. Which way does it shift?

PROBLEM 6 OF 15

ICE table

$H_2 + I_2 \rightleftharpoons 2\ HI$, $K_c = 49.0$. You start with 0.200 M H_2 and 0.200 M I_2. Find the equilibrium concentrations.

PROBLEM 7 OF 15

Le Chatelier's principle

$N_2 + 3\ H_2 \rightleftharpoons 2\ NH_3$, $\Delta H = -92$ kJ. Which way does it shift if you (a) raise the temperature, (b) add H_2, (c) halve the volume, (d) add a catalyst?

PROBLEM 8 OF 15

pH of a strong base

What is the pH of 0.0050 M $Ba(OH)_2$?

PROBLEM 9 OF 15

pH of a weak acid

Find the pH and percent ionization of 0.10 M acetic acid ($K_a = 1.8 \times 10^{-5}$).

PROBLEM 10 OF 15

pH of a salt solution

What is the pH of 0.20 M NaF? (K_a of HF = 6.8×10^{-4}.)

PROBLEM 11 OF 15

Buffers

A 1.00 L buffer has 0.25 M acetic acid and 0.40 M sodium acetate (pK_a = 4.74). (a) What is its pH? (b) What is the pH after adding 0.020 mol HCl?

PROBLEM 12 OF 15

Titration of a weak acid

25.0 mL of 0.100 M acetic acid is titrated with 0.100 M NaOH. Find the pH (a) at 12.5 mL NaOH and (b) at 25.0 mL NaOH. (K_a = 1.8 × 10^{-5}.)

PROBLEM 13 OF 15

K_{sp} and the common-ion effect

K_{sp} of CaF_2 = 3.9×10^{-11}. Find its molar solubility (a) in pure water and (b) in 0.010 M NaF.

PROBLEM 14 OF 15

Gibbs free energy

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$, $\Delta H° = +178.3$ kJ, $\Delta S° = +160.5$ J/K. (a) Is it spontaneous at 25 °C? (b) Above what temperature is it spontaneous? (c) What is K at 25 °C?

PROBLEM 15 OF 15

Electrochemistry

A galvanic cell uses Zn | Zn^{2+} and Cu^{2+} | Cu. $E°(Cu^{2+}/Cu)$ = +0.34 V, $E°(Zn^{2+}/Zn)$ = −0.76 V. Find (a) $E°_{cell}$, (b) $\Delta G°$, and (c) E_{cell} when $[Zn^{2+}]$ = 1.0 M and $[Cu^{2+}]$ = 0.010 M.