

General Chemistry 2 Exam 1 Summer 2008

Kingsborough Community College Dept. of Physical Sciences

Each question is worth 3 points. Mark your answers on the exam and on the scantron form.

First-order decay kinetics

$$\ln(A/A_0) = -kt$$

$$\ln(A) = -kt + \ln(A_0)$$

$$kt_{1/2} = 0.693$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = K_w = K_a K_b = 10^{-14}$$

$$\text{pH} + \text{pOH} = 14.00$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$E = \Delta mc^2$$

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$p = 10^{-12}$$

$$n = 10^{-9}$$

$$u = 10^{-6}$$

$$m = 10^{-3}$$

$$c = 10^{-2}$$

$$k = 10^3$$

$$M = 10^6$$

$$G = 10^9$$

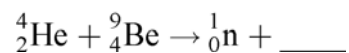
1. Alpha particles are identical to

- A. protons.
- B. helium atoms.
- C. hydrogen atoms.
- D. helium nuclei.
- E. electrons.

2. How many neutrons and protons (nucleons) does an atom with the symbol ${}_{16}^{33}\text{S}$ have?

- A. 33
- B. 16
- C. 49
- D. 16
- E. None of these.

3. When atoms of beryllium-9 are bombarded with alpha particles, neutrons are produced. What new isotope is also formed?



- A. ${}^{12}_6\text{C}$
- B. ${}^5_3\text{Li}$
- C. ${}^8_3\text{Li}$
- D. ${}^{10}_5\text{B}$
- E. ${}^{12}_5\text{B}$

4. What is the missing symbol in this plutonium fission reaction?



- A. ${}_{56}^{148}\text{Ba}$
- B. ${}_{-1}^0\beta$
- C. ${}_{54}^{143}\text{Xe}$
- D. ${}_{38}^{91}\text{Sr}$
- E. ${}_{56}^{146}\text{Ba}$

5. A typical radius of an atomic nucleus is about

- A. 100 μm
- B. 5000 mm
- C. 100 nm
- D. 5×10^{-3} pm
- E. 500 pm

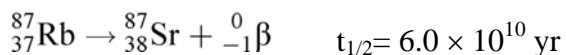
6. What is the nuclear binding energy per nucleon, in joules, for ${}_{12}^{25}\text{Mg}$ (atomic mass 24.985839 amu). [Data: ${}_0^1\text{n}$ (atomic mass) = 1.008665 amu; ${}_1^1\text{p}$ (mass) = 1.007825 amu; 1 kg = 6.022 $\times 10^{26}$ amu; $c = 3.00 \times 10^8$ m/s, 1 amu = 1.661 $\times 10^{-27}$ kg]

- A. 0.22076 J/nucleon
- B. 3.30×10^{-11} J/nucleon
- C. 1.32×10^{-12} J/nucleon
- D. 0.999 J/nucleon
- E. None of these.

7. What fraction of radioactive atoms remains in a sample after six half-lives?

- A. zero
- B. 1/6
- C. 1/16
- D. 1/32
- E. 1/64

8. A rock contains 0.37 mg of Pb-206 and 0.95 mg of U-238. The half-life of the decay series U-238 \rightarrow Pb-206 is 4.5×10^9 yr. Assuming no Pb-206 was present in the rock initially, how old is the rock?
- A. 1.7×10^9 yr
 B. 5.2×10^9 yr
 C. 2.7×10^6 yr
 D. 4.5×10^9 yr
 E. 2.4×10^9 yr
9. Charcoal found under a stone at Stonehenge, England, has a carbon-14 activity that is 0.60 that of new wood. How old is the charcoal? (The half-life of carbon-14 is 5,730 years.)
- A. Less than 5,730 yr
 B. Between 5,730 and 11,460 yr
 C. Between 11,460 and 17,190 yr
 D. More than 17,190 yr
10. The Rb-87/Sr-87 method of dating rocks is often used by geologists:



Estimate the age of a rock sample in which the present-day mole ratio of Rb-87 to Sr-87 is 36:1.

- A. 2.4×10^9 yr
 B. 1.7×10^9 yr
 C. 3.1×10^{11} yr
 D. 4.1×10^{-11} yr
 E. 3.6×10^{11} yr

11. Which is the formula for the hydronium ion?

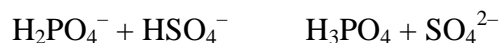
- A. OH^-
- B. H_2O
- C. H_3O^+
- D. H_3O^-
- E. H_2O^+

12. In the reaction $\text{HSO}_4^-(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{SO}_4^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$, the conjugate acid-base pairs are

	<i>pair 1</i>	<i>pair 2</i>
Row 1	HSO_4^- and SO_4^{2-} ;	H_2O and OH^- .
Row 2	HSO_4^- and H_3O^+ ;	SO_4^{2-} and OH^- .
Row 3	HSO_4^- and OH^- ;	SO_4^{2-} and H_2O .
Row 4	HSO_4^- and H_2O ;	OH^- and SO_4^{2-} .
Row 5	HSO_4^- and OH^- ;	SO_4^{2-} and H_3O^+ .

- A. Row 1
- B. Row 2
- C. Row 3
- D. Row 4
- E. Row 5

13. Identify the conjugate base of HSO_4^- in the reaction



- A. H_2PO_4^-
- B. H_2SO_4
- C. H_2O
- D. H_3PO_4
- E. SO_4^{2-}

14. Which one of these statements about strong acids is *true*?

- A. All strong acids have H atoms bonded to electronegative oxygen atoms.
- B. Strong acids are 100% ionized in water.
- C. The conjugate base of a strong acid is itself a strong base.
- D. Strong acids are very concentrated acids.
- E. Strong acids produce solutions with a higher pH than weak acids.

15. One liter of an aqueous solution contains 6.02×10^{21} H_3O^+ ions. Therefore, its H_3O^+ ion concentration is
- A. 0.0100 mole per liter.
 - B. 0.100 mole per liter.
 - C. 1.00 mole per liter.
 - D. 6.02×10^{21} mole per liter.
 - E. 6.02×10^{23} mole per liter
16. What is the concentration of H^+ in a 2.5 M HCl solution?
- A. 0
 - B. 1.3 M
 - C. 2.5 M
 - D. 5.0 M
 - E. 10 .M
17. The OH^- concentration in a 2.5×10^{-3} M $\text{Ba}(\text{OH})_2$ solution is
- A. 4.0×10^{-12} M.
 - B. 2.5×10^{-3} M.
 - C. 5.0×10^{-3} M.
 - D. 1.2×10^{-2} M.
 - E. 0.025 M.
18. Calculate the H^+ ion concentration in a 8.8×10^{-4} M $\text{Ca}(\text{OH})_2$ solution.
- A. 8.8×10^{-4} M
 - B. 1.8×10^{-3} M
 - C. 2.2×10^{-11} M
 - D. 1.1×10^{-11} M
 - E. 5.7×10^{-12} M
19. A 0.14 M HNO_2 solution is 5.7% ionized. Calculate the H^+ ion concentration.
- A. 8.0×10^{-3} M
 - B. 0.057 M
 - C. 0.13 M
 - D. 0.14 M
 - E. 0.80 M

20. A 0.10 M NH_3 solution is 1.3% ionized. Calculate the H^+ ion concentration.



- A. 1.3×10^{-3} M
- B. 7.7×10^{-2} M
- C. 7.7×10^{-12} M
- D. 0.13 M
- E. 0.10 M

21. Calculate the H_3O^+ ion concentration in lemon juice having a pH of 2.4.

- A. 4.0×10^{-2} M
- B. 250 M
- C. 0.38 M
- D. 4.0×10^{-3} M
- E. 12 M

22. Calculate the pH of a 6.71×10^{-2} M NaOH solution.

- A. 12.83
- B. 2.17
- C. 11.82
- D. 6.71
- E. 1.17

23. What is the pH of a 0.001 M $\text{Ca}(\text{OH})_2$ solution?

- A. 3.0
- B. 11.0
- C. 2.7
- D. 17.0
- E. 11.3

24. The pOH of a solution is 9.60 Calculate the hydrogen ion concentration in this solution.

- A. 2.5×10^{-10} M
- B. 6.0×10^{-9} M
- C. 4.0×10^{-5} M
- D. 2.4×10^{-4} M
- E. 1.0×10^{-14} M

25. Which solution will have the lowest pH?
- A. 0.10 M HCN
 - B. 0.10 M HNO₃
 - C. 0.10 M NaCl
 - D. 0.10 M H₂CO₃
 - E. 0.10 M NaOH
26. Which one of these responses is *true* with regard to a 0.1 M solution of a weak acid HA?
- A. $[H^+] > [A^-]$
 - B. $pH = 1.0$
 - C. $[H^+] < [A^-]$
 - D. $pH > 1.0$
 - E. $[OH^-] > [H^+]$
27. Acid strength increases in the series: $HCN < HF < HSO_4^-$. Which of these species is the *strongest* base?
- A. H₂SO₄
 - B. SO₄²⁻
 - C. F⁻
 - D. CN⁻
 - E. HSO₄⁻
28. Arrange the acids HOCl, HClO₃, and HClO₂ in order of increasing acid strength.
- A. $HOCl < HClO_3 < HClO_2$
 - B. $HOCl < HClO_2 < HClO_3$
 - C. $HClO_2 < HOCl < HClO_3$
 - D. $HClO_3 < HOCl < HClO_2$
 - E. $HClO_3 < HClO_2 < HOCl$
29. Which one of these net ionic equations represents the reaction of a *strong acid* with a *weak base*?
- A. $H^+(aq) + OH^-(aq) \rightarrow H_2O(aq)$
 - B. $H^+(aq) + CH_3NH_2(aq) \rightarrow CH_3NH_3^+(aq)$
 - C. $OH^-(aq) + HCN(aq) \rightarrow H_2O(aq) + CN^-(aq)$
 - D. $HCN(aq) + CH_3NH_2(aq) \rightarrow CH_3NH_3^+(aq) + CN^-(aq)$

30. Which of these species will act as a Lewis acid?

- A. NH_3
- B. NH_4^+
- C. H_2O
- D. BF_3
- E. F^-

31. In the reaction $\text{CaO}(\text{s}) + \text{SO}_2(\text{g}) \rightarrow \text{CaSO}_3(\text{s})$,

- A. O^{2-} acts as a Lewis base, and SO_2 acts as a Lewis acid.
- B. Ca^{2+} acts as a Lewis base, and SO_4^{2-} acts as a Lewis acid.
- C. SO_4^{2-} acts as a Lewis base, and SO_2 acts as a Lewis acid.
- D. SO_2 acts as a Lewis base, and O^{2-} acts as a Lewis acid.
- E. SO_2 acts as a Lewis base, and Ca^{2+} acts as a Lewis acid.

32. Which one of the following salts will form an *acidic* solution on dissolving in water?

- A. LiBr
- B. NaF
- C. KOH
- D. FeCl_3
- E. NaCN

33. What mass of sodium nitrite must be added to 350. mL of water to give a solution with $\text{pH} = 8.40$? [$K_a(\text{HNO}_2) = 5.6 \times 10^{-4}$]

- A. 68 g
- B. 1.7×10^{-4} g
- C. 0.039 g
- D. 8.3 g
- E. 24 g

ANSWERS

- 1 D
- 2 A
- 3 A
- 4 E
- 5 D
- 6 C
- 7 E
- 8 E
- 9 A
- 10 A
- 11 C
- 12 A
- 13 E
- 14 B
- 15 A
- 16 C
- 17 C
- 18 E
- 19 A
- 20 C
- 21 D
- 22 A
- 23 E
- 24 C
- 25 B
- 26 D
- 27 D
- 28 B
- 29 B
- 30 D
- 31 A
- 32 D
- 33 D