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

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

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

$kt_{1/2} = 0.693$

$[H_3O^+][OH^-] = K_W = K_aK_b = 10^{-14}$

$pH + pOH = 14.00$

$pH = -\log [H_3O^+]$

$pOH = -\log[OH^-]$

$E = \Delta mc^2$

$c = 3.0 \times 10^8$ 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 $^{33}_{16}S$ 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?

   $$^{4}_{2}He + ^{9}_{4}Be \rightarrow ^{1}_{0}n + \_\_\_\_$$

   A. $^{12}_{6}C$
   B. $^{5}_{3}Li$
   C. $^{8}_{3}Li$
   D. $^{10}_{5}B$
   E. $^{12}_{5}B$

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

$$^{239}_{94}\text{Pu} + {}^{1}_{0}\text{n} \rightarrow \_\_\_\_ + {}^{91}_{38}\text{Sr} + 3{}^{1}_{0}\text{n}$$

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

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 $^{25}_{12}\text{Mg}$ (atomic mass 24.985839 amu). [Data: $^{1}_{0}\text{n}$ (atomic mass) = 1.008665 amu; ^{1}p (mass) = 1.007825 amu; 1 kg = 6.022×10^{26} amu; c = 3.00×10^{8} m/s, 1 amu = 1.661×10^{-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 → 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:

$^{87}_{37}Rb \rightarrow ^{87}_{38}Sr + ^{0}_{-1}\beta$ $\quad t_{1/2} = 6.0 \times 10^{10}$ yr

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 $HSO_4^-(aq) + OH^-(aq)$ $SO_4^{2-}(aq) + H_2O(l)$, the conjugate acid-base pairs are

	pair 1	*pair 2*
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

$$H_2PO_4^- + HSO_4^- \qquad H_3PO_4 + SO_4^{2-}$$

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 $Ba(OH)_2$ 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 $Ca(OH)_2$ 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.

$$NH_3 + H_2O \qquad NH_4^+ + OH^-$$

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 $Ca(OH)_2$ 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 HNO_3
C. 0.10 M $NaCl$
D. 0.10 M H_2CO_3
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. H_2SO_4
B. SO_4^{2-}
C. F^-
D. CN^-
E. HSO_4^-

28. Arrange the acids $HOCl$, $HClO_3$, and $HClO_2$ 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 $CaO(s) + SO_2(g)$ $CaSO_3(s)$,

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 pH = 8.40? [$K_a(HNO_2) = 5.6 \times 10^{-4}$]

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