Equilibrium

Question 1.
Which of the following fluoro-compounds is most likely to behave as a Lewis base?
(a) BF_3
(b) PF_3
(c) CF_4
(d) SiF_4

▼ Answer

Answer: (b) PF_3
Explanation:
BF_3 → Lewis acid (incomplete octet)
PF_3 → Lewis base (presence of lone pair on p atom)
CF_4 → Complete octet
SiF_4 → Lewis acid (empty d-orbital in Si-atom)

Question 2.
Calculate the pOH of a solution at 25°C that contains 1×10^{-10} M of hydronium ions, i.e. H_3O^+.
(a) 4.000
(b) 9.000
(c) 1.000
(d) 7.000

▼ Answer

Answer: (a) 4.000
Explanation:
Given H_3O^+ ion concentration = 1×10^{-10}
$pH = -\log[H^+]$, $pH = -\log[1 \times 10^{-10}]$,
pH= + 10log10, pH = 10
We know that, pH + pOH = 14 …….. (i)
Put the value of pH in eq. (i)
10 + pOH = 14
pOH = 4.

Question 3.
When two reactants, A and B are mixed to give products C and D, the reaction quotient, Q, at the initial stages of the reaction
(a) is zero
(b) Decreases With Time
(c) Is Independent Of Time
(d) Increases With Time

▼ Answer

Answer: (d) Increases With Time
Explanation:
Reaction quotient, Qc is equal to ratio of concentration of products to concentration of reactants at any instant of time. In the beginning of reaction, the concentration of products is negligible as compared to reactants. Therefore, the value of reaction quotient is very less.

Question 4.
1 M NaCl and 1 M HCl are present in an aqueous solution. The solution is
(a) Not a buffer solution with pH < 7
(b) Not a buffer solution with pH > 7
(c) A buffer solution with pH < 7
(d) A buffer solution with pH > 7

▼ Answer

Answer: (a) Not a buffer solution with pH < 7
Explanation:
Buffer can accept and donate protons at the same time and HCl is an acid. So, it has pH < 7
So, this is not a buffer and the solution will be acidic.

Question 5.
If, in the reaction N_2O_4 $2NO_2$, x is that part of N_2O_4 which dissociates, then the number of molecules at equilibrium will be
(a) 1
(b) 3
(c) (1 + x)
(d) $(1 + xy)^2$

▼ Answer

Answer: (a) 1
Explanation:
$N_2O_4 \leftrightarrow 2NO_2$
1 0 (1 – x) 2x
So total number of moles at equilibrium (if initially 1 mole of N_2O_4 was taken) = (1 – x) + 2x = (1 + x)

Question 6.
The solubility product of a salt having general formula MX_2. In water is : 4×10^{-12}. The concentration of M^{2+}ions in the aqueous solution of the salt is
(a) 4.0×10^{-10} M
(b) 1.6×10^{-4} M
(c) 1.0×10^{-4} M
(d) 2.0×10^{-6} M

▼ Answer

Answer: (c) 1.0×10^{-4} M
Explanation:
$(MX2) \Leftrightarrow M^{2+}{}_s + 2X^{-}{}_{2s}$
$K_{SP}M_{S2} = 4S^3$
$= 4 \times 10^{-12}$
Therefore, $S = 10^{-4}$
Therefore $[M^{2+}] = 1.0 \times 10^{-4}$M

Question 7.
Equimolar solutions of the following were prepared in water separately. Which one of the solutions will record the highest pH?
(a) $CaCl_2$
(b) $SrCl_2$

(c) $BaCl_2$
(d) $MgCl_2$

▼ Answer

Answer: (c) $BaCl_2$
Explanation:
Equimolar solutions of the given chlorides when prepared in water forms their respective hydroxides.
The pH of salt $BaCl_2$ = 7, whereas $SrCl_2$ and $CaCl_2$ = 7 and $MgCl_2$ < 7.

Question 8.
Oxidation number of Iodine varies from
(a) -1 to +1
(b) -1 to +7
(c) +3 to +5
(d) -1 to +5

▼ Answer

Answer: (b) -1 to +7
Explanation:
Various oxidation numbers of Iodine are -1, 0, +1, +3, +5, +7.
So, Iodine shows -1 to +7 oxidation state.

Question 9.
Which of the following molecualr species has unpaired electrons?
(a) N_2
(b) F_2
(c) O^-_2
(d) O_2^{-2}

▼ Answer

Answer: (c) O^-_2
Explanation:
In O_2^- total electrons are 17 moiecular orbital configuration.
O^-_2 has one unpaired electron.

Question 10.
A certain buffer solution contains equal concentration of X^- and HX. The ka for HX is 10^{-8}. The pH of the buffer is
(a) 3
(b) 8
(c) 11
(d) 14

▼ Answer

Answer: (b) 8
Explanation:
$k_a\ k_b = k_w$
$k_b = 10^{-8}$
$k_a \times 10^{-8} = 10^{-14}$

$k_a = 10^{-6} = [H^+]$
$pH = -\log [H^+]$
$pH = -\log 10^{-6}$
$= 6pH + pOH$
$= 14\ pOH$
$= 14 - 6$
$= 8$

Question 11.
Among the following the weakest Bronsted base is
(a) F^-
(b) Cl^-
(c) Br^-
(d) I^-

▼ Answer

Answer: (d) I^-
Explanation:
According to this theory, an acid is a proton donor and a base is a proton acceptor. Every strong Bronsted acid has a weak conjugate base and every strong base has a weak conjugate acid. The acidity increases in halogen group atoms,
HF < HCl < HBr < HI.
So, HI is highly acidic and their conjugate bases decrease in order $F^- > Cl^- > Br^- > I^-$.

Question 12.
Which of the following statements is correct about the equilibrium constant?
(a) Its value increases by increase in temperature
(b) Its value decreases by decrease in temperature
(c) Its value may increase or decrease with increase in temperature
(d) Its value is constant at all temperatures

▼ Answer

Answer: (c) Its value may increase or decrease with increase in temperature
Explanation:
Increase in the temperature decreases the value of equilibrium constant because forward reaction is exothermic. When the forward reaction is endothermic increase the temperature increases the value of equilibrium constant. These occurs when chemical equilibrium shifts toward the products or reactants.

Question 13.
pH value of which one of the following is NOT equal to one?
(a) 0.1 M CH_3COOH
(b) 0.1 M HNO_3
(c) 0.05 M H_2SO_4
(d) 50 cm^3 0.4 M HCl + 50 cm^3 0.2 M NaOH

▼ Answer

Answer: (a) 0.1 M CH_3COOH
Explanation:
Since CH_3COOH does not dissociate completely, its 10^{-1} M solution does not have pH = 1

Question 14.
[OH^-] in a solution is 1 mol L^-. The pH the solution is
(a) 1
(b) 0
(c) 14
(d) 10^{-14}

▼ Answer

Answer: (c) 14
Explanation:
$[H_3O^+] = (K_w)/ [OH^-]$
$= (10^{-14})/ (1)$
pH = 14

Question 15.
What is the pH of a 0.10 M solution of barium hydroxide, Ba $(OH)_2$?
(a) 11.31
(b) 11.7
(c) 13.30
(d) None of these

▼ Answer

Answer: (c) 13.30
Explanation:
pH = 13.30
Barium hydroxide is a strong base for both stages of dissociation:
Ba $(OH)_2$ (s) $\rightarrow Ba^{2+} + 2OH^-$
So the solution will have 0.20 M hydroxide ions. Now use the auto dissociation product for water:
$[H^+][OH^-] = 1.0 \times 10^{-14}M$
$[OH^-] = 2.0 \times 10^{-1}M$
$[H^+] = 5.0 \times 10^{-14}M$
And then pH $= -\log_{10} ([H^+] = 5.0 \times 10^{-14})$
= 13.30.

Question 16.
The K_{sp} for Cr $(OH)_3$ is 1.6×10^{-30}. The molar solubility of this compound in water is:
(a) $\sqrt{} (1.6 \times 10^{-30})$
(b) $(\sqrt{}(1.6 \times 10^{-30}))^{(1/4)}$
(c) $(\sqrt{}(1.6 \times 10^{-30})/(27)))^{(1/4)}$
(d) $(1.6 \times 10^{-30})/(27)$

▼ Answer

Answer: (c) $(\sqrt{}(1.6 \times 10^{-30})/(27)))^{(1/4)}$

Question 17.
The solubility product of CuS, Ag_2S and HgS are 10^{-31}, 10^{-44} and 10^{-54} respectively. The solubilities of these sulphides are in the order
(a) HgS > Ag_2S > CuS
(b) CuS > Ag_2S > HgS

(c) Ag_2S > CuS > HgS
(d) AgS > HgS > CuS

▼ Answer

Answer: (c) Ag_2S > CuS > HgS
Explanation:
For CuS & HgS $K_{sp} = S^2$ (where s= solubility) & for Ag_2S ; $K_{sp} = {}^{4S3}$ (s= solubility) now put the values of K_{sp} and check in which case the value of S is highest & lowest.
Solubility of CuS : $(10^{-31})^{(1/2)} = (10^{(-31/2)})$;
Ag_2S: $(10^{-44})^{(1/3)} = (10^{(-44/3)})$;
HgS;
$(10^{-54})^{(1/2)} = (10^{-54/2}) = (10^{-27})$;
The order of solubility will be as per above values:
Hence , the order of solubility is: Ag_2S > CuS > HgS

Question 18.
Buffer solutions have constant acidity and alkalinity because
(a) They have large excess of H^+ or OH^- ions
(b) They have fixed value of pH
(c) These give unionised acid or base on reaction with added acid or alkali
(d) Acids and alkalies in these solutions are shielded from attack by other ions

▼ Answer

Answer: (c) These give unionised acid or base on reaction with added acid or alkali
Explanation:
Consider a buffer of $CH_3COOH + CH_3COONa$
Addition of acid: $H^+ + CH_3COO^- \rightarrow CH_3COOH$
Weak acid
Addition of alkali:
$OH^- + CH_3COOH \rightarrow H_2O + CH_3COO^-$
Weak electrolyte
Thus, the addition of acid or alkali does not cause any change in pH.

Question 19.
The position of some metals in the electrochemical series in decreasing electropositive character is Mg > Al > Zn > Cu > Ag. In a chemical factory, a worker by accident used a copper rod to stir a solution of aluminium nitrate; he was scared that now there would be some reaction in the solution, so he hurriedly removed the rod from the solution and observed that
(a) The rod was coated with Al
(b) An alloy of Cu and Al was being formed.
(c) The solution turned blue in colour
(d) There was no reaction.

▼ Answer

Answer: (d) There was no reaction.
Explanation:
Mg > Al > Zn > Cu > Ag Copper rod is used to stir solution of $Al(NO_3)_3$ so no reaction as one above in series will displace metal lower in series.

Question 20.
An amount of solid NH_4HS is placed in a flask already contaniing ammonia gas at a certain

temperature and 0.50 atm pressure. Ammonium hydrogen sulphide decomposes to yield NH_3 and H_2S gases in the flask. When the decomposition reaction reaches equilibrium , the total pressure in the flask rises to 0.84 atm? The equilibrium constant for NH_4HS decomposition at this temperature is
(a) 0.11
(b) 0.17
(c) 0.18
(d) 0.30

▼ Answer

Answer: (a) 0.11
