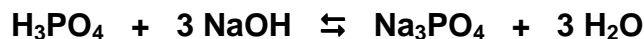


1. Which of the following represents the correct formula for aluminum oxide?

- (a) AlO (b) Al₂O (c) AlO₂ (d) Al₂O₃

2. If sodium phosphate is added to the following reaction, what will happen to the overall reaction?



- (a) Less of the reactants will react in order to compensate for the additional Na₃PO₄.
(b) More of the reactants will react in order to produce more H₂O, which balances the excess Na₃PO₄.
(c) The reaction will not be changed at all.
(d) The equilibrium constant will be changed to a larger number.

3. An equilibrium constant of 1 for a reaction means that the reaction is...

- (a) one that will yield 50% products and 50% reactants left over.
(b) very favorable and proceeds to mostly products with very little reactants left over.
(c) not very favorable and will not form very much product.
(d) This number does not relate to the favorability of the reaction.

4. How many grams of NaOH are present in 2000 mL of 0.1 M NaOH? The molecular mass of NaOH is 40 amu.

- (a) 40 g (b) 80 g (c) 4 g (d) 8 g

5. Which of the bonds shown by a dash — has the greatest polarity?

- (a) H—CH₃ (b) H—NH₂ (c) H—OH (d) H—F

6. Which of the following compounds should have the highest boiling point?

- (a) H₂O (b) NH₃ (c) CH₄ (d) HF

7. How many calories are required to raise the temperature of 10 grams of water from 10°C to 25°C?

- (a) 150 calories (b) 100 calories (c) 15 calories (d) 10 calories

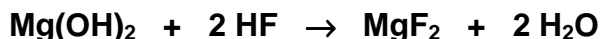
8. The half-life of carbon-14 is 5,730 years. If an artifact was found to have a carbon-14 percent that was 12.5%, how old would the artifact be?

- (a) 11,460 years (b) 17,190 years (c) 22,920 years (d) 28,650 years

9. If phosphorus-32 emits a beta particle, an isotope of ___ is formed.

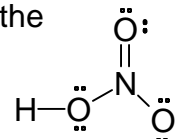
- (a) sulfur (b) chlorine (c) silicon (d) aluminum

10. How many grams of HF are needed to react completely with 29 g of $\text{Mg}(\text{OH})_2$? The molecular mass of $\text{Mg}(\text{OH})_2 = 58$ amu and $\text{HF} = 20$ amu. The balanced chemical reaction is...



- (a) 10 grams of HF
- (b) 20 grams of HF
- (c) 40 grams of HF
- (d) 80 grams of HF

11. What is the charge on the nitrogen atom in the following compound? All of the valence electrons are shown.



- (a) + 1
- (b) + 2
- (c) - 1
- (d) - 2

12. Which of the following compounds is the strongest **acid**?

- (a) H_2SO_4
- (b) $\text{CH}_3\text{CO}_2\text{H}$
- (c) HNO_3
- (d) all have the same strength

13. Which of the following compounds is the strongest **acid**?

- (a) CH_4
- (b) NH_3
- (c) H_2O
- (d) HF

14. Which of the following compounds is the strongest **base**?

- (a) NaOH
- (b) NaNH_2
- (c) NaCH_3
- (d) NaF

15. The products obtained when the following chemical reaction is completed and balanced are...



- (a) $\text{CaNO}_3 + \text{H}_2\text{O}$
- (b) $\text{Ca}(\text{NO}_3)_2 + 2 \text{H}_2\text{O}$
- (c) $\text{CaO} + 2 \text{NO}_2 + 3 \text{H}_2\text{O}$
- (d) $\text{Ca} + 2 \text{NO}_3 + 2 \text{H}_2\text{O}$

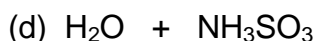
16. What is the pH of a 1 molar solution of an acid that has a $K_a = 10^{-8}$?

- (a) 1
- (b) 4
- (c) 8
- (d) 10

17. The products obtained when the following chemical reaction is completed and balanced are...



- (a) $(\text{NH}_4)_2\text{SO}_4$
- (b) $4 \text{H}_2\text{O} + \text{N}_2\text{S}_3$
- (c) NH_4SO_4

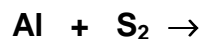


18. The products obtained when the following chemical reaction is completed and balanced are...



- (a) $\text{Al}_2(\text{PO}_4)_3 + 6 \text{H}_2\text{O}$
- (b) $\text{Al}_2\text{O}_3 + \text{P}_2\text{O}_3 + 8 \text{H}_2\text{O}$
- (c) $\text{AlPO}_3 + 4 \text{H}_2\text{O}$
- (d) $\text{AlPO}_4 + 3 \text{H}_2\text{O}$

19. The products obtained when the following chemical reaction is completed and balanced are...



- (a) Al_3S_2
- (b) Al_2S
- (c) AlS_2
- (d) Al_2S_3

20. How many **valence** electrons does **carbon (C)** have?

- (a) 12
- (b) 6
- (c) 4
- (d) 2

21. The products obtained when the following chemical reaction is completed and balanced are...



- (a) Ca_2F
- (b) CaF
- (c) CaF_2
- (d) Ca_2F_3

22. **Calcium (Ca)** atoms tend to ? electrons when they form chemical compounds with oxygen atoms.

- (a) lose
- (b) gain
- (c) they tend to neither gain nor lose electrons...they usually share electrons equally with oxygen atoms.
- (d) calcium atoms do not form chemical compounds with any other atoms...calcium is an inert gas.

23. **Chlorine (Cl)** atoms tend to ? electrons when they form chemical compounds with metals.

- (a) lose
- (b) gain
- (c) they tend to neither gain nor lose electrons...they usually share electrons equally with metals.
- (d) they tend to neither gain nor lose electrons because chlorine is an inert gas.

24. Which of the following describes the gas state of matter?

- (a) A gas has both a definite shape and volume.
- (b) A gas has a definite shape but not a definite volume.
- (c) A gas has a definite volume but not a definite shape.
- (d) A gas has neither a definite shape nor volume.

25. Which of the following electron configurations represents a **fluoride anion (F⁻)**?

- (a) $1s^2 2s^2 2p^5$
- (b) $1s^2 2s^2 2p^6$
- (c) $1s^2 2s^2 2p^6 3s^1$
- (d) $1s^2 2s^2 2p^6 3s^2$

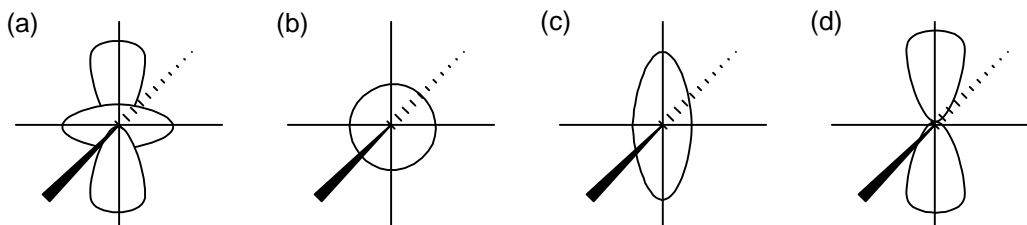
26. Which of the following elements is considered to be a metal?

- (a) N
- (b) S
- (c) B
- (d) Be

27. Which of the following electron configurations represents the electron configuration for an **inert gas**?

- (a) $1s^2 2s^2 2p^6 3s^2 3p^6$
- (b) $1s^2 2s^2 2p^6 3s^2$
- (c) $1s^2 2s^2 2p^6 3s^1$
- (d) $1s^2 2s^2 2p^6 3s^2 3p^3$

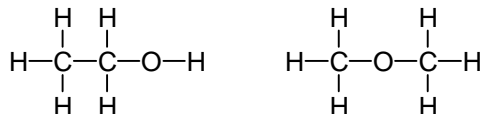
28. The probability area that best represents the shape of an atomic **4s orbital** is...



29. Which of the following electron configurations represents a **sodium cation (Na⁺)**?

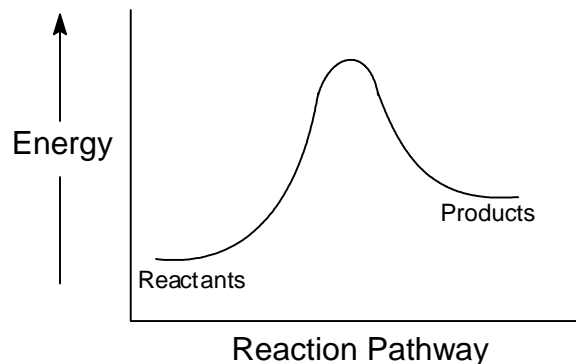
- (a) $1s^2 2s^2 2p^6 3s^2$
- (b) $1s^2 2s^2 2p^6 3s^2 3p^1$
- (c) $1s^2 2s^2 2p^6$
- (d) $1s^2 2s^2 2p^6 3s^1$

30. The following compounds are related as...



- (a) isomers.
(b) isotopes.
(c) isoelectronic species.
(d) these compounds are not related at all.
31. **Potassium (K)** has ? neutrons in its nucleus.
- (a) 1 (b) 19 (c) 20 (d) 39
32. What is the major attraction between water molecules in the liquid state?
- (a) dipole-dipole interactions
(b) electrostatic attractions
(c) hydrogen-bonds
(d)) there are no attractions between the water molecules, that is why it is a liquid.
33. Potassium bromate, KBrO_3 is an additive to some flour (brominated flour) used to improve texture in the dough. It is a suspected carcinogen and some consumer groups want to ban this additive. Some say it decomposes when the bread is baked to KBr and O_2 by the reaction... $\text{KBrO}_3 \rightarrow \text{KBr} + \text{O}_2$ and is thus not a problem. When this equation is balanced, the number of moles of oxygen will be...
- (a) 1 (b) 2 (c) 3 (d) 4
34. What element is formed by the following nuclear **fusion** reaction?
- $${}^2_1\text{H} + {}^3_1\text{H} \longrightarrow$$
- (a) beryllium
(b) lithium
(c) helium
(d) a new isotope of hydrogen
35. If the **concentration of a reactant** in a chemical reaction is **tripled**, the reaction rate will be ? times as fast.
- (a) 1/3
(b) 2
(c) 3
(d) The reaction rate will stay the same.
36. What is the **molar mass** of $\text{CH}_3\text{CO}_2\text{H}$?
- (a) 60 g (b) 59 g (c) 32 g (d) 29 g
37. **One mole** of ammonium hydrogen phosphate $(\text{NH}_4)_2\text{HPO}_4$ contains ? moles of hydrogen atoms.
- (a) 1 (b) 4 (c) 8 (d) 9

38. The following reaction coordinate diagram represents an ? reaction.



- (a) endothermic
- (b) exothermic
- (c) neither an exothermic nor an endothermic reaction

39. When the **temperature** of a gas is **doubled**, the **pressure** of the gas will be ? at constant volume.

- (a) doubled
- (b) halved
- (c) stay the same

40. The **solubility** of a gas in a solution will ? when the solution is **heated**.

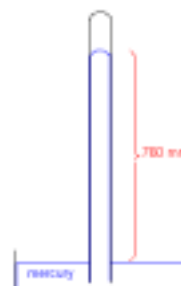
- (a) stay the same
- (b) increase
- (c) decrease

41. What form of harmful electromagnetic radiation from the sun does the **ozone** layer partially filter out?

- (a) infrared
- (b) gamma
- (c) radio
- (d) ultraviolet

42. Why is the mercury in the diagram elevated in the tube?

- (a) There is a vacuum in the tube, which sucks the mercury up the tube.
- (b) Air pressure pushes down on the mercury in the bowl which forces the mercury up the tube.



- (c) The mercury rises in the tube by the physical attraction of the mercury for the glass.
(d) This diagram violates the laws of science...the mercury will not rise in the tube.

43. The addition of NaCl to water will ? the freezing point of the water.

- (a) lower
(b) raise
(c) not change

44. The addition of which salt will have the greatest effect on **raising the boiling point** of water?

- (a) CaCl₂
(b) SnCl₄
(c) NaCl
(d) FeCl₃

45. When the atmospheric **pressure** is **increased by three times as much** on the outside of a balloon, the **volume** of the balloon will ? at constant temperature.

- (a) increase by three times
(b) decrease by one third
(c) decrease by one ninth
(d) stay the same

46. What is the **oxidation number** of oxygen in the molecule O₂?

- (a) 0 (b) 1 (c) 2 (d) 4

47. The **modern** definition of **oxidation** is...

- (a) loss of oxygen.
(b) gain of oxygen.
(c) loss of one or more electrons.
(d) gain of one or more electrons.

48. In the following reaction, the element that is **oxidized** is ? and the element that is the **oxidizing agent** is ? .

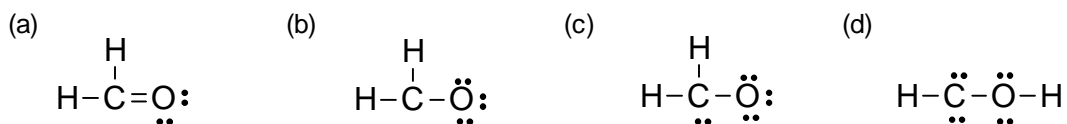


- (a) aluminum.....aluminum
(b) bromine.....bromine
(c) aluminum.....bromine
(d) bromine.....aluminum

49. Which of the following compounds is butane?

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- (b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- (c) $\text{CH}_3\text{CH}_2\text{CH}_3$
- (d) CH_3CH_3

50. Which of the following is the correct electron-dot formula for H_2CO ?



51. In the laboratory we learned that one mole of any gas at standard temperature and pressure (STP) will occupy 22.4 liters. How many liters will 8 grams of O_2 gas occupy at STP. The formula mass of O_2 is equal to 32 amu.

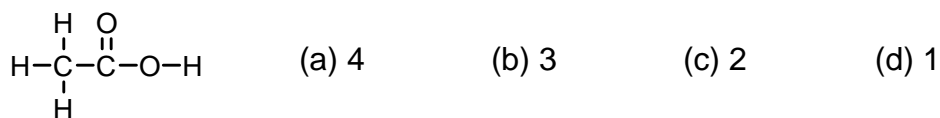
- (a) 33.6 L
- (b) 22.4 L
- (c) 11.2 L
- (d) 5.6 L

52. If an air bag in a car needs 44.8 L of gas when filled, how many moles of NaN_3 are needed to fill the bag at STP? One mole of any gas occupies 22.4 L at STP. The balanced chemical equation for this reaction is ...

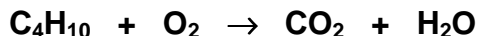


- (a) 1/3 mole
- (b) 2/3 mole
- (c) 1 mole
- (d) 4/3 mole

53. Acetic acid has ___ acidic hydrogen atoms.



54. When the following chemical reaction is balanced, the number of moles of O_2 will be...



- (a) 3
- (b) 7
- (c) 9
- (d) 13

55. Buffer solutions...

- (a) are strong acids
- (b) resist change in pH
- (c) decrease the pH of a solution
- (d) increase the pH of a solution

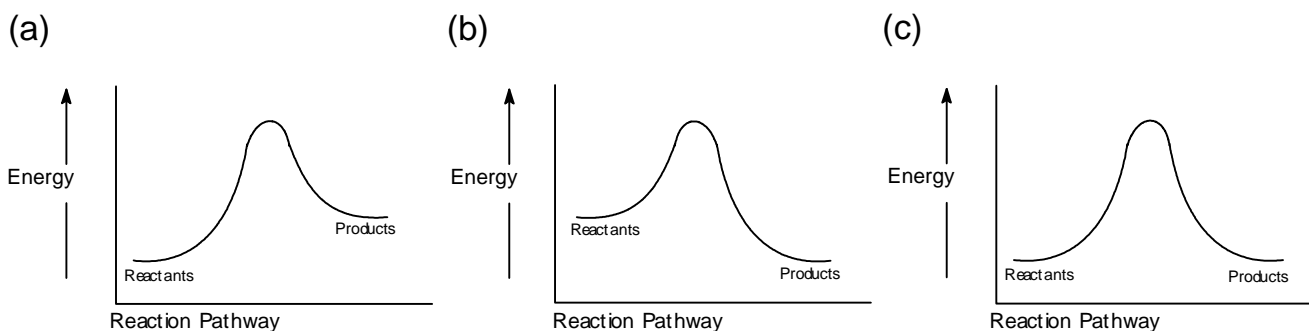
56. Which of the following compounds is most responsible for depletion of the ozone layer?

- (a) SO_2
- (b) N_2
- (c) CO_2
- (d) CHClF_2

57. Which of the following compounds should be the most effective "Greenhouse Gas"?

- (a) CO₂ (b) H₂O (c) CF₄ (d) N₂

58. Which of the following reaction coordinate diagrams could represent a reaction that has an equilibrium constant of 10⁻³?



59. What would be the **volume** in **liters** of 640 grams of oil if the density of oil is 0.8 g/mL at 20°C?

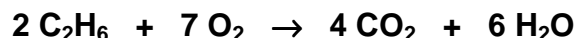
- (a) 0.5 L (b) 0.8 L (c) 5 L (d) 8 L

60. If 16 grams of O₂ react with excess C₂H₆, how many **grams of CO₂** will be formed? The formula mass of O₂ = 32 amu and CO₂ = 44 amu.



- (a) 3.1 g (b) 13 g (c) 22 g (d) 88 g

61. How many **grams of CO₂** will be produced if 45 g of C₂H₆ react with 32 grams of O₂? The formula mass of C₂H₆ = 30 amu, H₂O = 18 amu and O₂ = 32 amu

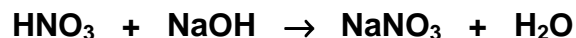


- (a) 26 g (b) 44 g (c) 66 g (d) 132 g

62. How many **liters** of **4 M NaCl** solution are required to make **10 liters** of **0.2 M NaCl** solution?

- (a) 0.5 L (b) 5 L (c) 8 L (d) 20 L

63. How many milliliters of 4.0 M NaOH should be added to 100.0 mL of a 0.2000 M HNO₃ solution to completely neutralize the acid? The reaction equation is...



- (a) 50 mL (b) 500 mL (c) 5 mL (d) 10 mL

Answers to the Problems

- | | | | |
|----------------------------|----------------------------|----------------------------|--|
| 1. [a] [b] [c] [d] | 22. [a] [b] [c] [d] | 43. [a] [b] [c] [d] | |
| 2. [a] [b] [c] [d] | 23. [a] [b] [c] [d] | 44. [a] [b] [c] [d] | |
| 3. [a] [b] [c] [d] | 24. [a] [b] [c] [d] | 45. [a] [b] [c] [d] | |
| 4. [a] [b] [c] [d] | 25. [a] [b] [c] [d] | 46. [a] [b] [c] [d] | |
| 5. [a] [b] [c] [d] | 26. [a] [b] [c] [d] | 47. [a] [b] [c] [d] | |
| 6. [a] [b] [c] [d] | 27. [a] [b] [c] [d] | 48. [a] [b] [c] [d] | |
| 7. [a] [b] [c] [d] | 28. [a] [b] [c] [d] | 49. [a] [b] [c] [d] | |
| 8. [a] [b] [c] [d] | 29. [a] [b] [c] [d] | 50. [a] [b] [c] [d] | |
| 9. [a] [b] [c] [d] | 30. [a] [b] [c] [d] | 51. [a] [b] [c] [d] | |
| 10. [a] [b] [c] [d] | 31. [a] [b] [c] [d] | 52. [a] [b] [c] [d] | |
| 11. [a] [b] [c] [d] | 32. [a] [b] [c] [d] | 53. [a] [b] [c] [d] | |
| 12. [a] [b] [c] [d] | 33. [a] [b] [c] [d] | 54. [a] [b] [c] [d] | |
| 13. [a] [b] [c] [d] | 34. [a] [b] [c] [d] | 55. [a] [b] [c] [d] | |
| 14. [a] [b] [c] [d] | 35. [a] [b] [c] [d] | 56. [a] [b] [c] [d] | |
| 15. [a] [b] [c] [d] | 36. [a] [b] [c] [d] | 57. [a] [b] [c] [d] | |
| 16. [a] [b] [c] [d] | 37. [a] [b] [c] [d] | 58. [a] [b] [c] [d] | |
| 17. [a] [b] [c] [d] | 38. [a] [b] [c] [d] | 59. [a] [b] [c] [d] | |
| 18. [a] [b] [c] [d] | 39. [a] [b] [c] [d] | 60. [a] [b] [c] [d] | |
| 19. [a] [b] [c] [d] | 40. [a] [b] [c] [d] | 61. [a] [b] [c] [d] | |
| 20. [a] [b] [c] [d] | 41. [a] [b] [c] [d] | 62. [a] [b] [c] [d] | |
| 21. [a] [b] [c] [d] | 42. [a] [b] [c] [d] | 63. [a] [b] [c] [d] | |