

1. A solution of sodium carbonate is treated with a solution of nitric acid. Bubbles are observed in the colorless solution. The balanced equation is
 - a. $\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g}) + 2\text{NaNO}_3(\text{aq})$
 - b. $\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{H}_2\text{CO}_3(\text{aq}) + 2\text{NaNO}_4(\text{aq})$
 - c. $\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{H}_2(\text{g}) + \text{CO}_2(\text{g}) + 3 \text{O}_2(\text{g}) + \text{N}_2(\text{g}) + \text{Na}_2\text{O}(\text{aq})$
 - d. $2\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + 2\text{CO}(\text{g}) + 3 \text{O}_2(\text{g}) + \text{NaNO}_3(\text{aq})$
 - e. $2\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + 2\text{CO}_2(\text{g}) + \text{N}_2(\text{g}) + 2\text{NaNO}_3(\text{aq})$
2. When an aqueous solution of lead(II) nitrate is treated with an aqueous solution of potassium carbonate, one may observe
 - a. the formation of a precipitate, PbCO_3 .
 - b. the formation of a gas, CO_2 .
 - c. both the formation of PbCO_3 precipitate and CO_2 gas.
 - d. the formation of two precipitates, KNO_3 and PbCO_3 .
 - e. no reaction.
3. The oxidation number of chromium in Na_2CrO_4 is
 - a. -2.
 - b. +2.
 - c. +6.
 - d. -6.
 - e. +8.
4. What volume of 0.150 M NaOH is needed to react completely with 3.45 g iodine according to the equation:
$$3 \text{I}_2 + 6\text{NaOH} \rightarrow 5\text{NaI} + \text{NaIO}_3 + 3\text{H}_2\text{O}?$$
 - a. 1.02 mL
 - b. 2.04 mL
 - c. 4.08 mL
 - d. 45.3 mL
 - e. 181 mL

5. What is the **total** concentration of ions in a 0.0360 M solution of Na_2CO_3 ?
- 0.0120 M
 - 0.0720 M
 - 0.0900 M
 - 0.108 M
 - 0.144 M
6. A solution of nitric acid contains which of the following ions in easily measurable quantities?
- H^+ , N_2^- , O_2^-
 - H^+ , NO_2^-
 - H_2^+ , NO_3^-
 - H_2^+ , 2NO_2^-
 - H^+ , NO_3^-
7. How many joules are equivalent to 37.7 cal?
- 9.01 J
 - 9.43 J
 - 1.51 J
 - 4.184 J
 - 158 J
8. When 15.0 grams of an alloy is heated from 20.0 °C to 40.0 °C it absorbs 727 joules of energy. The specific heat of the alloy is
- 2.42 J/g·K
 - 0.218 J/g·K
 - 2.42 J/g·K
 - 0.218 J/g·K
 - 0.206 J/g·K

9. When 325 grams of water at 21.0 °C is mixed with an unknown mass of water at a temperature of 45.0 °C, the final temperature of the resulting mixture is 36.0 °C. What was the mass of the second sample of water?

- a. 7.24 g
- b. 226 g
- c. 542 g
- d. 874 g
- e. 2266 g

10. What is ΔE for a system which has the following two steps:

Step 1: The system absorbs 70 J of heat while 40 J of work are performed on it.

Step 2: The system releases 40 J of heat while doing 70 J of work.

- a. 110 J
- b. 100 J
- c. 90 J
- d. 30 J
- e. zero

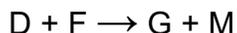
11. If 15.0 g water at 28.0 °C is added to 125.0 g water at 20.0 °C, what is the final temperature of the resulting mixture?

- a. 20.9 °C
- b. 22.6 °C
- c. 23.1 °C
- d. 24.0 °C
- e. 27.3 °C

12. Which of the following produces radiation of the highest frequency?

- a. x-rays
- b. AM radio
- c. FM radio
- d. microwave oven
- e. radar

13. Calculate the enthalpy of reaction for the process



using the following equations and data:

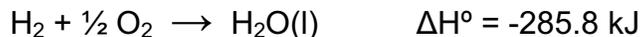
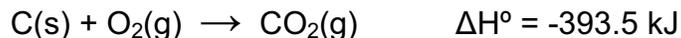
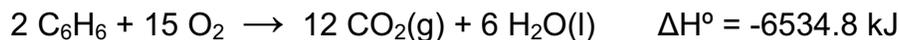


- a. -132 kJ
- b. +422 kJ
- c. +132 kJ
- d. -184 kJ
- e. -422 kJ

14. Calculate the enthalpy of reaction for the process



using the following equations and data:



- a. +49.0 kJ
- b. -49.0 kJ
- c. +98 kJ
- d. -98 kJ
- e. -7214.1 kJ

15. Planck suggested that all energy gained or lost by an atom must be some integral multiple of a minimum amount of energy called a(n)

- a. electron.
- b. spectrum.
- c. magnetic moment.
- d. quantum.
- e. orbital.

16. What type of orbital is designated $n = 3, l = 2, m_l = 0$?
- 2s
 - 3s
 - 3p
 - 3d
 - 4d
17. Which of the following electronic transitions in a hydrogen atom would have the longest wavelength?
- $n = 4$ to $n = 1$
 - $n = 4$ to $n = 2$
 - $n = 2$ to $n = 1$
 - $n = 4$ to $n = 3$
 - $n = 1$ to $n = 0$
18. What is the energy (in J) of one mole of photons of green light ($\lambda = 500$ nm). ($c = 2.998 \times 10^8$ m/s, $h = 6.626 \times 10^{-34}$ Js)
- 5.90×10^8 J/mol
 - 5.90×10^{-8} J/mol
 - 2.39×10^7 J/mol
 - 2.39×10^5 J/mol
 - 2.39×10^5 kJ/mol
19. In the photoelectric effect, no electrons are emitted from the surface of a silver foil when the frequency of the incident light is less than 1.15×10^{15} Hz. At frequencies $> 1.15 \times 10^{15}$ Hz electrons were emitted. What is the minimum energy necessary to eject an electron from the silver? (1 Hz = 1 cycle/second = 1 s^{-1} , $h = 6.626 \times 10^{-34}$ Js)
- 6.63×10^{-34} J
 - 1.26×10^{-22} J
 - 7.62×10^{-19} J
 - 3.44×10^{25} J
 - 1.74×10^{34} J

20. How much thermal energy is required to heat 500 g of ice to steam at 200 °C? Use the following values to calculate:

State	specific heat capacity [J/g·K]
ice	2.1
water	4.2
steam	2.0

Heat of fusion of water = 333.5 J/g

Heat of vaporization of water = 2256 J/g

- a. 429 kJ
- b. 1347 kJ
- c. 1391 kJ
- d. 1505 kJ
- e. 1557 kJ