

1. Potassium-40 is one of the few naturally occurring radioactive isotopes of elements of low atomic number. Its percent natural abundance among K isotopes is 0.012%. How many ^{40}K atoms are present in 225 mL of milk containing 1.65 mg K per milliliter? (K:39.1g/mol)

- A) 5.72×10^{21} B) 5.72×10^{25} C) 6.9×10^{17} D) 6.9×10^{25} E) 6.0×10^{25}

2. Quinone, which is used in the dye industry and in photography, is an organic compound containing only C, H, and O. What is the empirical formula of the compound if you find that 0.105 g of the compound give 0.257 g of CO_2 and 0.0350 g of H_2O when burned completely?

^{12}C , ^1H , ^{16}O

- A) $\text{C}_3\text{H}_2\text{O}$ B) $\text{C}_2\text{H}_2\text{O}$ C) $\text{C}_4\text{H}_2\text{O}$ D) CH_2O E) $\text{C}_3\text{H}_2\text{O}_2$

3. If you begin with 12.0 g of S_8 and 6.35 g of Cl_2 , and you isolate only 7.99 g of S_2Cl_2 , what is the percent yield of S_2Cl_2 ?
 ^{32}S , $^{35.5}\text{Cl}$

$\text{S}_8(\text{l}) + \text{Cl}_2(\text{g}) \rightarrow \text{S}_2\text{Cl}_2(\text{g})$ (not balanced)

- A) 80.4% B) 48.7% C) 33.5% D) 66.5% E) 16.6%

4. Density of a HCl solution (37% by mass) is 1.19 g/mL. If 13.08 g solid Zn reacts with 50 mL of this acid solution, how many grams of $\text{H}_2(\text{g})$ is obtained? $^{65.4}\text{Zn}$, $^{35.5}\text{Cl}$, ^1H :1.0 g/mol

$\text{Zn}(\text{s}) + \text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$ (unbalanced reaction)

- A) 0.8 B) 0.6 C) 0.4 D) 0.2 E) 0.1

5. Solubility rules predict that a precipitate will form when mixing 0.1 M aqueous solutions of

- A) NiBr_2 and AgNO_3 B) NaI and KBr C) K_2SO_4 and CrCl_3 D) KOH and $\text{Ba}(\text{NO}_3)_2$ E) Li_2CO_3 and CsI

6. If 35.21 mL of 0.1894 M KOH is required to neutralize 25.00 mL of an aqueous solution of arsenic acid (H_3AsO_4), what is the concentration of the arsenic acid solution?

$\text{H}_3\text{AsO}_4(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{K}_3\text{AsO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l})$ (not balanced)

- A) 0.2668 M B) 0.8003 M C) 0.0889 M D) 0.1345 M E) 0.1778 M

7. Which of the following statements are **correct**?

- I. Ca^{2+} and Zn^{2+} ions are diamagnetic ions.
II. Ionization energy decreases from left to right across the periodic table.
III. Metallic character increases from top to bottom in a group of the periodic table.
IV. If metallic iron loses three electrons, a paramagnetic iron ion is formed.

- A) I, III, IV B) I, IV C) I, II, III D) II, III E) I, II, III, IV

8. Arrange the following atom and ions in order of **increasing** size. ($_{10}\text{Ne}$, $_{9}\text{F}^-$, $_{12}\text{Mg}^{2+}$, $_{11}\text{Na}^+$, $_{8}\text{O}^{2-}$)

Ne F^- Mg^{2+} Na^+ O^{2-}

- A) $\text{Mg}^{2+} < \text{Na}^+ < \text{Ne} < \text{O}^{2-} < \text{F}^-$ B) $\text{Mg}^{2+} < \text{Na}^+ < \text{Ne} < \text{F}^- < \text{O}^{2-}$
C) $\text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-} < \text{Ne}$ D) $\text{Na}^+ < \text{Mg}^{2+} < \text{Ne} < \text{F}^- < \text{O}^{2-}$
E) $\text{Ne} < \text{Na}^+ < \text{Mg}^{2+} < \text{F}^- < \text{O}^{2-}$

9. Which one has **the highest** electron affinity?

 ${}_5\text{B}$ ${}_6\text{C}$ ${}_{13}\text{Al}$ ${}_{19}\text{K}$ ${}_{20}\text{Ca}$

- A) B B) Ca C) Al D) K E) C

10. Predict the electron group geometry and molecular shape of PO_3^{3-} ion using VSEPR theory.

- A) Electron group geometry: tetrahedral; molecule geometry = T-Shape
 B) Electron group geometry: tetrahedral; molecule geometry = trigonal pyramidal
 C) Electron group geometry: tetrahedral; molecule geometry = trigonal planar
 D) Electron group geometry: trigonal pyramidal; molecule geometry = trigonal pyramidal
 E) Electron group geometry: trigonal planar; molecule geometry = trigonal pyramidal

11. What is the formal charge of oxygen atom when the most plausible Lewis structure is written for POCl molecule?

- A) -1 B) +1 C) -2 D) +2 E) 0

12. Which one of below is **nonpolar**?

- A) NO_2^- B) SBr_2 C) SiBr_4 D) SO_2Cl_2 E) SO_2

13. What is the wavelength of a photon (in nanometers) emitted during a transition from the $n_i = 5$ state to the $n_f = 2$ state in the hydrogen atom? ($c = 3.00 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ Js)

- A) 434 nm B) 534 nm C) 634 nm D) 734 nm E) 834 nm

14. Calculate the wavelength (in nanometers) of a H atom (mass = 1.674×10^{-27} kg) moving at 7.00×10^2 cm/s.

- A) 5.66×10^{-1} nm B) 5.66 nm C) 56.6 nm D) 566 nm E) 5.66×10^3 nm

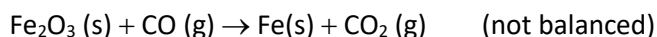
15. What is the total number of orbitals associated with the principal quantum number $n = 3$?

- A) 5 B) 6 C) 7 D) 8 E) 9

16. A medical anesthetic gas has a density of 1.50 g/L at 50 °C under 0.948 atm pressure. This gas has an empirical formula of CH₂ find the molecular weight and molecular formula of the gas. (*R* = 0,0821 L atm / mol K)

- A) 14 g/mol, CH₂ B) 28 g/mol, C₂H₄ C) 42 g/mol, C₃H₆ D) 56 g/mol, C₄H₈ E) 70 g/mol, C₅H₁₀

17. How much CO under standard conditions is needed to reduce 1 kg Fe_2O_3 ? ($_{16}\text{O}$, $_{55.8}\text{Fe}$)

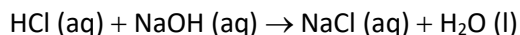


- A) 70 L B) 140 L C) 281 L **D) 421 L** E) 561 L

18. A gas sample which was collected over water at 35 °C occupies a volume of 1.000 L. Moist gas has a pressure of 1.000 atm. Dry form of the gas has a volume of 1.000 L and a pressure of 1.000 atm at 53 °C. Find the vapor pressure of water at 35 °C. ($R = 0,0821 \text{ L atm / mol K}$)

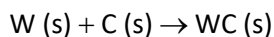
- A) 0,033 B) 0,044 C) 0,055 D) 0,066 E) 0,077

19. Suppose 33 mL of 1.20 M HCl is added to 42 mL of a solution containing excess sodium hydroxide, NaOH, in a coffee-cup calorimeter. The solution temperature, originally 25.0°C, rises to 31.8°C. Give the enthalpy change, ΔH , for the reaction in terms of the per mole H₂O produced. ($q = 4.18 \text{ J/g } ^\circ\text{C}$ for water)

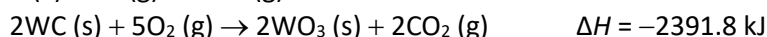


- A) 2.13 kJ/mol H₂O B) -2.13 kJ/mol H₂O C) 53.83 kJ/mol H₂O **D) -53.83 kJ/mol H₂O** E) -4.18 kJ/mol H₂O

20. What is the enthalpy of reaction, ΔH , for the formation of tungsten carbide, WC, from the elements?

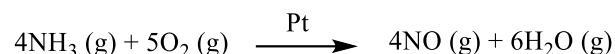


Use the following data:



- A) -40.5 kJ** B) -434.0 kJ C) -884.3 kJ D) -2432.3 kJ E) -4471.1 kJ

21. Large quantities of ammonia are used to prepare nitric acid. The first step consists of the catalytic oxidation of ammonia to nitric oxide, NO.

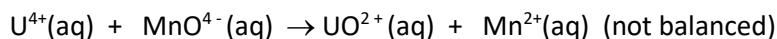


What is the standard enthalpy change for this reaction?

Substance or Ion	NH ₃ (g)	NO (g)	H ₂ O (g)	H ₂ O (l)
(kJ/mol)	-45.90	90.29	-241.8	-285.8

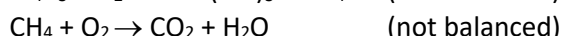
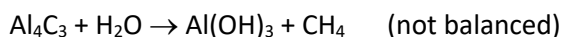
- A) -105 kJ B) -264 kJ C) -369 kJ **D) -906 kJ** E) -1170 kJ

22. Redox reaction below takes place in acidic solution. 11.6 g UF₄ (M = 314.0 g/mol), the source of U⁴⁺ ion, reacts with how many mL of 0.216 M KMnO₄?



- A) 34.2 mL** B) 3.42 mL C) 171 mL D) 6.84 mL E) 17.1 mL

23. The methane gas, CH₄, that is obtained from 50 g impure sample of Al₄C₃ is required 38.4 g of O₂ to be completely burned. What is the percentage purity of Al₄C₃ in impure sample? (Al₄C₃:144 g/mol; ¹⁶O)



- A) 14.4 B) 28.8 **C) 57.6** D) 86.4 E) 43,2

24. If you were to make an aqueous solution of silver nitrate, and take a pure copper penny and place it in the solution, the following would happen:

A) No reaction at all since silver is more active than copper.

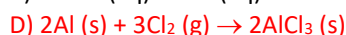
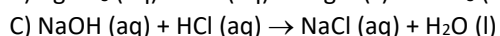
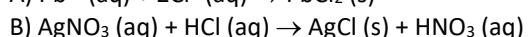
B) The copper on the surface of the penny would oxidize and a coating of silver would form.

C) All solids would dissolve.

D) Silver would be oxidized and copper would be reduced.

E) A coating of silver would form on the totally unreacted penny.

25. Which one of below is a redox reaction?



E) All of them