ANSWERS TO EXERCISES

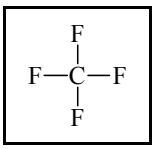
1-2. potassium, K, 20 1-3. copper, Cu, 36 1-4. radon, Rn, 136 1-7. $C_2H_4O_2$
1-8. $C_2H_5O_2N$ 1-9. $C_6H_{12}O_4N_2S_2$ 1-10. KBr 1-11. NH_4NO_3
1-12. $Mg(NO_3)_2$ 1-13. $Al_2(SO_4)_3$

2-2. $2C_6H_6 + 15O_2 \rightarrow 12CO_2 + 6H_2O$
2-3. $H_2 + Cl_2 \rightarrow 2HCl$
2-4. $CH_4 + H_2O \rightarrow CO + 3H_2$
2-5. $Fe_3O_4 + 4C \rightarrow 3Fe + 4CO$
2-6. $2NO + O_2 \rightarrow 2NO_2$
2-7. $2NaNO_3 \rightarrow 2NaNO_2 + O_2$
2-8. $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$
2-9. $2NH_3 + 2O_2 \rightarrow N_2O + 3H_2O$
2-10. $CO_2 + H_2 \rightarrow CO + H_2O$
2-11. $Tl^+(aq) + F^-(aq) \rightarrow TlF(s)$
2-12. $Cu^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CuCO_3(s)$
2-13. $3Ca^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
2-14. $Mg^{2+}(aq) + SO_4^{2-}(aq) + Ba^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s) + BaSO_4(s)$

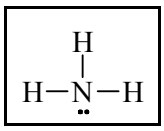
3-2. $1s^2 2s^2 p^2$ 3-3. $1s^2 2s^2 p^5$ 3-4. $1s^2 2s^2 p^6 3s^2 p^6 d^6 4s^2$
3-5. $1s^2 2s^2 p^6 3s^2 p^6 d^{10} 4s^2 p^3$ 3-6. $1s^2 2s^2 p^6 3s^2 p^6 d^{10} 4s^2 p^6 d^9 5s^2$ (on rules given, but $1s^2 2s^2 p^6 3s^2 p^6 d^{10} 4s^2 p^6 d^{10} 5s$ on chemical evidence)
3-(7-12). C, $n = 2$ $l = 0$ (*s*) or 1 (*p*); F, $n = 2$ $l = 0$ (*s*) or 1.(*p*); Fe, $n = 4$ $l = 0$ (4*s*) or $n = 3$ $l = 2$ (3*d*) As, $n = 4$ $l = 0$(*s*) or 1(*p*) Ag, $n = 5$ $l = 0$ (5*s*) or $n = 4$ $l = 2$ (4*d*)
3-14. 2*p* 3-15. 5*s* 3-16. 6*f* 3-18. group 18, 5th period, *p*-block 3-19 11, 6, *d* 3-20. 14, 3, *p* 3-21. 1, 2, *s* 3-22. Mg would be losing its second 3*s* electron, but when Na, with only one 3*s* electron loses a 2nd electron it is a 2*p* electron which is of much higher energy.

4-2. (δ+)C-O(δ-) 4-3. (δ+)Si-F(δ -) 4-4. (δ-)Cl-P(δ+) 4-5. (δ +)H-C(δ-)
4-6. (δ+)H-N(δ-) 4-7. Yes, (δ+)H-F(δ-) 4-8. No, a symmetrical molecule 4-9. No, a symmetrical molecule 4-10. Yes, S(δ+) and O's (δ-)
4.11. Yes, N(δ-) and H's(δ+) 4-12. No, a symmetrical molecule

5-1.



5-2.



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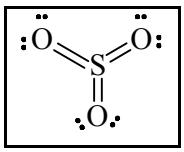

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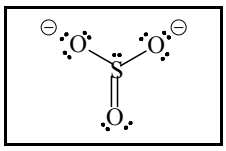

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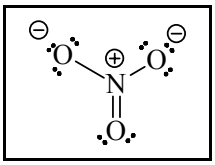

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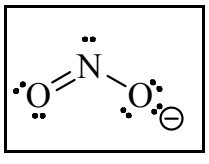

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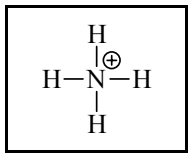
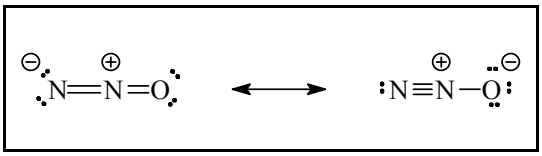


(Note: In all answers the non-bonding electrons on halogens are not shown.)

5-8.



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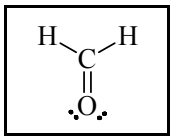

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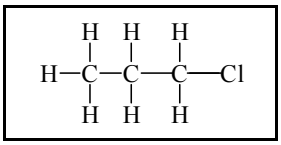
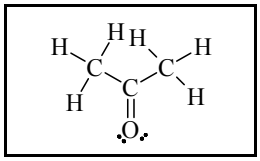


5-11.



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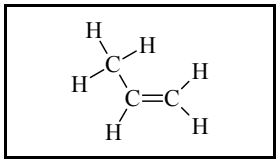

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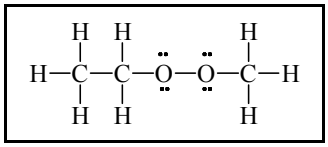
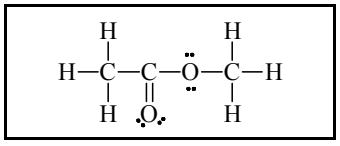


5-14



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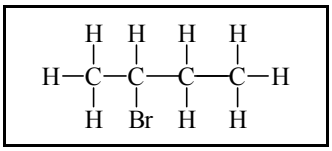
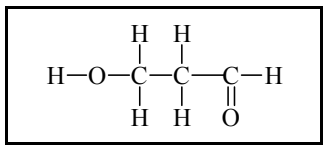
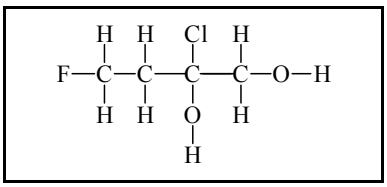


The non-bonding electrons on oxygen in answers to 5-16 - 5-18 are not shown.

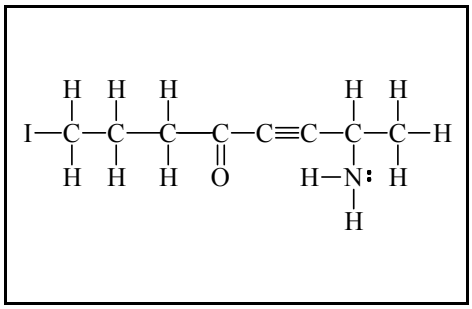
5-16.



5-17.

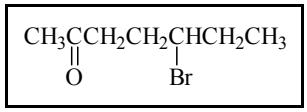


5-18.



6-2. $CH_3CH{=}CHCH_2CH_3$ 6-3. $CH_3CH_2CH_2C{\equiv}CCH_2CH_2CH_3$

In answers 6-4 - 6-9 below (=O) represents an oxygen atom bound by a double bond to the carbon atom immediately to its left. The structure of 6-4 showing all non C-C andC-H bonds is shown in the box for clarity.



6-4. $CH_3C(=O)CH_2CH_2CHBrCH_2CH_3$ 6-5. $NH_2CH_2CH_2CH_2C(=O)H$

6-6. $CH_3CH_2C(=O)OCH_2CH_2CH_2CH_2CH_3$

6-7. $CH_3CH_2CH(OH)CH_2CH(CH_2CH_2CH_3)C(=O)OH$
6-8. $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2C(=O)NH_2$
6-9. $HC(=O)NHCH_2CH_3$
6-10. (5-9) methanal 6-11. 1-chloropropane 6-12. propanone 6.13. propene
6.14. ethyl methyl peroxide 6-15. methyl ethanoate 6-16. 2-bromobutane
6-17. 3-hydroxypropanal 6-18. 2-chloro-4-fluorobutan-1,2-diol

7-2. 5.0×10^{-2} m s^{-1} 7-3. 6.4×10^{11} N m^{-2} 7-4. 2.8×10^{-3} g L^{-1} 7-6. $t = 2.3 \times 10^3$ s
7-7. $p = 7.8 \times 10^{-5}$ Pa 7-9. 300 K 7-10. 1.15×10^5 s 7-11. 8.13×10^3 Pa
7-12. 5.45×10^2 kg m^{-3}

8-2. 0.227 mol 8-3. 960 mol 8-4. 209 nmol 8-5. 540 g 8-6. 836 g 8-7. 1.79 g
8-8. 42 g 8-9. 17.4 kg 8-10. 306 t 8-11. 512 g

9-1. 32.5 L 9-2. 153 ng 9-3. 62 MPa 9-4. 168 kPa 9-5. 172 kPa

10-1. 200 g L^{-1} 0.584 mol L^{-1} 10-2. 0. 486 g L^{-1} 8.36×10^{-3} mol L^{-1}
10-3. 52.34 g L^{-1} 0.4151 mol L^{-1} 10-4. 0.4483 mol L^{-1} 10-5. 92.7
10.6 $c_f(KIO_3) = 0.02219$ mol L^{-1} $c(Na_2S_2O_3) = 0.1417$ mol L^{-1} $c(Cl_2) = 17.4$ g L^{-1}
10-7. 6.03×10^{-5} mol L^{-1} 0.565 g

11-1. 4.184 J g^{-1} K^{-1} 1.00 cal g^{-1} K^{-1} 75.4 J mol^{-1} K^{-1}
11-2. 43.0 kJ mol^{-1} 11-3. -298 kJ mol^{-1} 11-4.(i) $CS_2(l) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$
(ii) 90.0 kJ mol^{-1} 11-5. -101 kJ mol^{-1}

12-1. addition, reduction 12-2. decomposition, redox 12-3. addition, oxidation
12-4. elimination, acid-base 12-5. precipitation, redox 12-6. precipitation, redox 12-7. -3
12-8. +2 12-9. +6 12-10. H, +1 O, -1 12-11. +5 12-12. +6
12-13. $Cl_2 + 2Fe^{2+} \rightarrow 2Cl^- + 2Fe^{3+}$
12-14. $16H^+ + 2MnO_4^- + 10Br^- \rightarrow 2Mn^{2+} + 5Br_2 + 8H_2O$
12-15. $2H_2O + 2MnO_4^- + 3Mn^{2+} \rightarrow 5MnO_2 + 4H^+$
12-16. $Zn + Fe_2(SO_4)_3 \rightarrow ZnSO_4 + 2FeSO_4$

13-1. cuprous sulfate 13-2. ferric sulfate 13-3. phosphorous acid
13-4. potassium manganate

14-1. $\dfrac{[SO_3(g)]^2}{[SO_2(g)]^2[O_2(g)]}$ 14-2. $\dfrac{[NH_3(g)]^2}{[N_2(g)][H_2(g)]^3}$

14-3. $[Ba^{2+}(aq)][SO_4^{2-}(aq)]$ 14-4. $[O_2(g)]$ 14-5. $\dfrac{[H_3O^+(aq)][F^-(aq)]}{[HF(aq)]}$

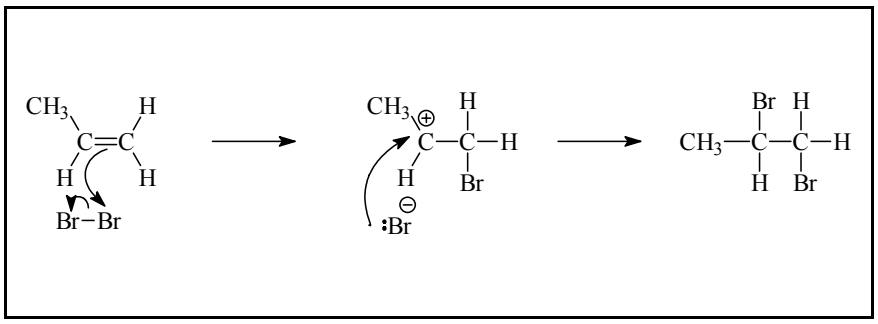
14-6. $\dfrac{[CH_3NH_3^+(aq)][OH^-(aq)]}{[CH_3NH_2(aq)]}$ 14-7. $\dfrac{[CO_3^{2-}(aq)][H_3O^+(aq)]}{[HCO_3^-(aq)]}$

14-8. $\dfrac{[HCO_3^-(aq)][OH^-(aq)]}{[CO_3^{2-}(aq)]}$ 14-9. 7.08×10^{-8} mol L^{-1}
14-10. 5.75×10^{-5} mol L^{-1} 14-11. 1.26×10^{-3} mol L^{-1} 14-12. 3.00 14-13. 3.62
14-14. 11.00 14-15. 10.38 14-16. (i) 7.20 (ii) 6.90 14-17. 6.00 14-18. 7.25

15-1. O_2 15-2. Sn 15-3. $Zn|Zn^{2+}||Fe^{3+},Fe^{2+}|Pt$, 1.53 V 15-4. $Pt|Br_2,Br^-||I_2,I^-|Pt$, 0.56 V
15-5. $Pt|Cl_2,Cl^-||Ag^+|Ag$, 0.60 V 15-6. Yes 15-7. No 15-8. No 15-9. Yes

16-1. (a) 1.0×10^{-3} mol L^{-1} s^{-1} (b) 2.3×10^{-5} mol L^{-1} s^{-1} 16-2. 2.5×10^{8} mol L^{-1} s^{-1}

16-3.



Rate law: *rate* = $k[CH_3CH{=}CH_2][Br_2]$
16-4. Substitution, free radical