

ANSWERS TO EXERCISES

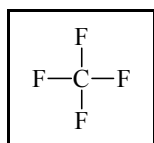
1-2. potassium, K, 20 1-3. copper, Cu, 36 1-4. radon, Rn, 136 1-7. C₂H₄O₂
 1-8. C₂H₅O₂N 1-9. C₆H₁₂O₄N₂S₂ 1-10. KBr 1-11. NH₄NO₃
 1-12. Mg(NO₃)₂ 1-13. Al₂(SO₄)₃

2-2. 2C₆H₆ + 15O₂ → 12CO₂ + 6H₂O 2-3. H₂ + Cl₂ → 2HCl
 2-4. CH₄ + H₂O → CO + 3H₂ 2-5. Fe₃O₄ + 4C → 3Fe + 4CO
 2-6. 2NO + O₂ → 2NO₂ 2-7. 2NaNO₃ → 2NaNO₂ + O₂
 2-8. 4NH₃ + 3O₂ → 2N₂ + 6H₂O 2-9. 2NH₃ + 2O₂ → N₂O + 3H₂O
 2-10. CO₂ + H₂ → CO + H₂O
 2-11. TI⁺(aq) + F⁻(aq) → TIF(s)
 2-12. Cu²⁺(aq) + CO₃²⁻(aq) → CuCO₃(s)
 2-13. 3Ca²⁺(aq) + 2PO₄³⁻(aq) → Ca₃(PO₄)₂(s)
 2-14. Mg²⁺(aq) + SO₄²⁻(aq) + Ba²⁺(aq) + 2OH⁻(aq) → Mg(OH)₂(s) + BaSO₄(s)

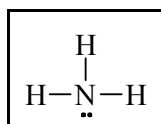
3-2. 1s²2s²p² 3-3. 1s²2s²p⁵ 3-4. 1s²2s²p⁶3s²p⁶d⁶4s²
 3-5. 1s²2s²p⁶3s²p⁶d¹⁰4s²p³ 3-6. 1s²2s²p⁶3s²p⁶d¹⁰4s²p⁶d⁹5s² (on rules given, but 1s²2s²p⁶3s²p⁶d¹⁰4s²p⁶d¹⁰5s on chemical evidence)
 3-(7-12). C, n = 2 l = 0 (s) or 1 (p); F, n = 2 l = 0 (s) or 1 (p); Fe, n = 4 l = 0 (4s) or n = 3 l = 2 (3d) As, n = 4 l = 0 (s) or 1 (p) Ag, n = 5 l = 0 (5s) or n = 4 l = 2 (4d)
 3-14. 2p 3-15. 5s 3-16. 6f 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 3s electron, but when Na, with only one 3s electron loses a 2nd electron it is a 2p 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

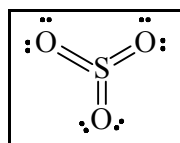
5-1.



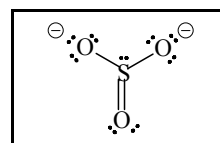
5-2.



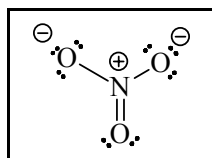
5-3.



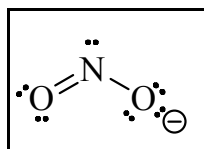
5-4.



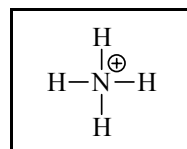
5-5.



5-6.



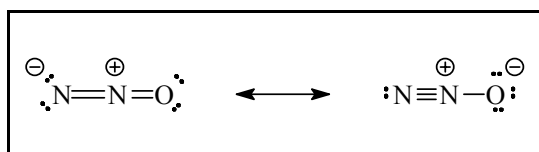
5-7.



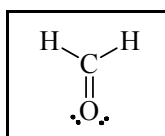
shown.)

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

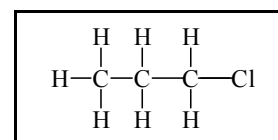
5-8.



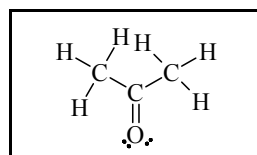
5-9.



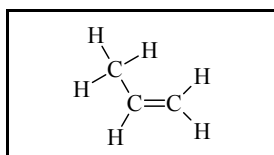
5-10.



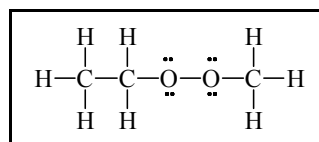
5-11.



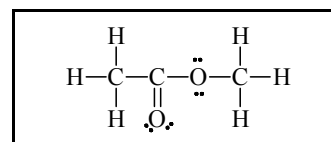
5-12.



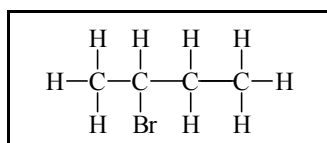
5-13.



5-14.

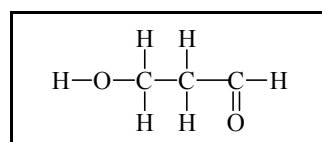


5-15.

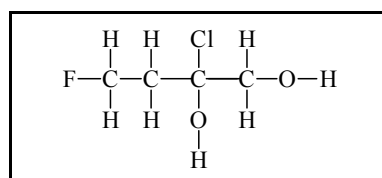


The non-bonding electrons on oxygen in answers to 5-16 - 5-18 are not shown.

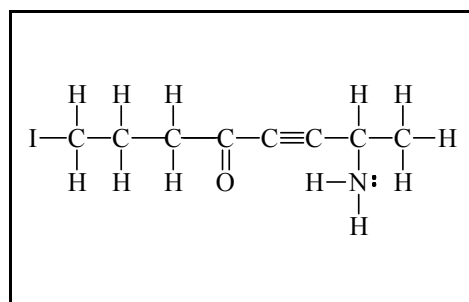
5-16.



5-17.

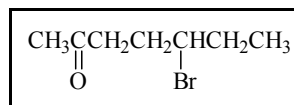


5-18.



6-2. $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$ 6-3. $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}\equiv\text{CCH}_2\text{CH}_2\text{CH}_3$

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 and C-H bonds is shown in the box for clarity.



6-4. $\text{CH}_3\text{C}(=\text{O})\text{CH}_2\text{CH}_2\text{CHBrCH}_2\text{CH}_3$ 6-5. $\text{NH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{C}(=\text{O})\text{H}$

6-6. $\text{CH}_3\text{CH}_2\text{C}(=\text{O})\text{OCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

6-7. $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}(\text{CH}_2\text{CH}_2\text{CH}_3)\text{C}(=\text{O})\text{OH}$

6-8. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{C}(=\text{O})\text{NH}_2$

6-9. $\text{HC}(=\text{O})\text{NHCH}_2\text{CH}_3$

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. $5.0 \times 10^{-2} \text{ m s}^{-1}$ 7-3. $6.4 \times 10^{11} \text{ N m}^{-2}$ 7-4. $2.8 \times 10^{-3} \text{ g L}^{-1}$ 7-6. $t = 2.3 \times 10^3 \text{ s}$

7-7. $p = 7.8 \times 10^{-5} \text{ Pa}$ 7-9. 300 K 7-10. $1.15 \times 10^5 \text{ s}$ 7-11. $8.13 \times 10^3 \text{ Pa}$

7-12. $5.45 \times 10^2 \text{ kg m}^{-3}$

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} $8.36 \times 10^{-3} \text{ mol L}^{-1}$

10-3. 52.34 g L^{-1} $0.4151 \text{ mol L}^{-1}$ 10-4. $0.4483 \text{ mol L}^{-1}$ 10-5. 92.7

10.6 $c_f(\text{KIO}_3) = 0.02219 \text{ mol L}^{-1}$ $c(\text{Na}_2\text{S}_2\text{O}_3) = 0.1417 \text{ mol L}^{-1}$ $c(\text{Cl}_2) = 17.4 \text{ g L}^{-1}$

10-7. $6.03 \times 10^{-5} \text{ mol L}^{-1}$ 0.565 g

11-1. $4.184 \text{ J g}^{-1} \text{ K}^{-1}$ $1.00 \text{ cal g}^{-1} \text{ K}^{-1}$ $75.4 \text{ J mol}^{-1} \text{ K}^{-1}$

11-2. 43.0 kJ mol^{-1} 11-3. -298 kJ mol^{-1} 11-4.(i) $\text{CS}_2(\text{l}) + 3\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{SO}_2(\text{g})$

(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. $\text{Cl}_2 + 2\text{Fe}^{2+} \rightarrow 2\text{Cl}^- + 2\text{Fe}^{3+}$

12-14. $16\text{H}^+ + 2\text{MnO}_4^- + 10\text{Br}^- \rightarrow 2\text{Mn}^{2+} + 5\text{Br}_2 + 8\text{H}_2\text{O}$

12-15. $2\text{H}_2\text{O} + 2\text{MnO}_4^- + 3\text{Mn}^{2+} \rightarrow 5\text{MnO}_2 + 4\text{H}^+$

12-16. $\text{Zn} + \text{Fe}_2(\text{SO}_4)_3 \rightarrow \text{ZnSO}_4 + 2\text{FeSO}_4$

13-1. cuprous sulfate 13-2. ferric sulfate 13-3. phosphorous acid

13-4. potassium manganate

14-1. $\frac{[\text{SO}_3(\text{g})]^2}{[\text{SO}_2(\text{g})]^2[\text{O}_2(\text{g})]}$ 14-2. $\frac{[\text{NH}_3(\text{g})]^2}{[\text{N}_2(\text{g})][\text{H}_2(\text{g})]^3}$

14-3. $[\text{Ba}^{2+}(\text{aq})][\text{SO}_4^{2-}(\text{aq})]$ 14-4. $[\text{O}_2(\text{g})]$ 14-5. $\frac{[\text{H}_3\text{O}^+(\text{aq})][\text{F}^-(\text{aq})]}{[\text{HF}(\text{aq})]}$

14-6. $\frac{[\text{CH}_3\text{NH}_3^+(\text{aq})][\text{OH}^-(\text{aq})]}{[\text{CH}_3\text{NH}_2(\text{aq})]}$ 14-7. $\frac{[\text{CO}_3^{2-}(\text{aq})][\text{H}_3\text{O}^+(\text{aq})]}{[\text{HCO}_3^-(\text{aq})]}$

14-8. $\frac{[\text{HCO}_3^-(\text{aq})][\text{OH}^-(\text{aq})]}{[\text{CO}_3^{2-}(\text{aq})]}$ 14-9. $7.08 \times 10^{-8} \text{ mol L}^{-1}$

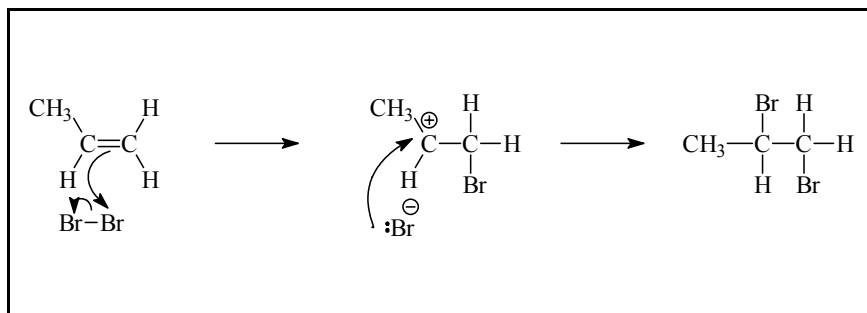
14-10. $5.75 \times 10^{-5} \text{ mol L}^{-1}$ 14-11. $1.26 \times 10^{-3} \text{ mol L}^{-1}$ 14-12. 3.00 14-13. 3.62

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) $1.0 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$ (b) $2.3 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$ 16-2. $2.5 \times 10^8 \text{ mol L}^{-1} \text{ s}^{-1}$

16-3.



Rate law: $rate = k[CH_3CH=CH_2][Br_2]$

16-4. Substitution, free radical