ANSWERS TO TOPTIC D PROBLEMS

1) a) q is positive.
   b) q is negative.
   c) q is negative.

2) a) This is a true statement…
   b) This statement is false…

3) a) 335 J
   b) 3.86 kJ
   c) 1.32 kJ
   d) 20.6˚C
   e) 15.5 g.
   f) 1610 J (1.61 kJ)

4) 28.4ºC.

5) 54.1 g.

6) 2.44 J/g·˚C

7) 79.9 J/g.
   5.57 kJ/mol.

8) The statements are both true because they are referring to different types of energy. ΔE for a chemical change is defined as the change in the <u>potential</u> energy of the chemicals. However, the energy we're talking about when we say "hot objects have more energy than cold objects" is <u>kinetic</u> energy. In this reaction, potential energy is changing into kinetic energy, so the potential energy of the chemicals decreases (ΔE is negative) and the kinetic energy of the chemicals increases (they get hot).

9) a) The mixture becomes colder, so the kinetic energy of the chemicals decreases.
   b) The potential energy of the chemicals increases. This must be true because the overall amount of energy in the universe must remain constant. Therefore, since the kinetic energy decreases, the potential energy must increase by the same amount.
   c) ΔE is a positive number. ΔE for any reaction equals the change in the potential energy of the chemicals. Since the potential energy is increasing (as we saw in part b), ΔE is positive.

10) a) 55.28 kJ
   a) b) 23.9 kJ
   b) c) 94.6 mL
   c) d) 194.2 kJ

11) $\Delta E_{standard}$ = -1054 kJ

12) $\Delta E_{standard}$ = -8260 kJ

13) When the pressure is constant, the reaction will do work if it produces gases, and the surroundings will do work if the reaction consumes gases. Either way, work is done, so w is not zero. By contrast, when the volume is constant, no work can be done, because there is no motion; nothing expands or contracts. Therefore, w is zero when the volume is constant.
The overall energy change in the reaction (ΔE) only depends on the reactants and products in a reaction, because ΔE is the change in the potential energy of the chemicals. Therefore, ΔE is a constant; it is the same number at constant pressure and at constant volume. Since $\Delta E = q + w$, and w <u>does</u> depend on the conditions, q depends on the conditions also.

14) a) The reaction mixture will become hotter. When ΔE is a negative number, the reaction releases energy, and some (or all) of that energy is in the form of heat.
b) This is an exothermic reaction. The word "exothermic" means "produces heat" (more or less).
c) After the reaction has occurred, the potential energy of the mixture will be lower than it was before the reaction. ΔE is the change in the potential energy of the mixture, and the negative sign means that the potential energy decreases.
d) After the reaction has occurred, the kinetic energy of the universe will be higher than it was before the reaction. Since the potential energy of the chemicals has decreased, the kinetic energy of the chemicals and their surroundings must increase to obey the law of conservation of energy.

15) a) exactly 10 kJ.
b) larger than 10 kJ
c) part b.
d) the PV work is negative.

16) a) exactly 10 kJ
b) larger than 10 kJ
c) part b.
d) the PV work is positive.

17) a) exactly 10 kJ
b) smaller than 10 kJ.
c) part b.
d) the PV work is negative.

18) a) -9.31 kJ
b) 9.31 kJ

19) a) -9684 kJ *(rounded from -9684.352 kJ)*
b) $\Delta E_{nonstandard}$ = -337.3 kJ, so the reaction gives off 337.3 kJ of heat.
c) $\Delta H_{nonstandard}$ = -337.9 kJ, so the reaction gives off 337.9 kJ of heat.

d) w_{PV} = 0 kJ
e) w = 0.6 kJ
f) 4.883 g
g) 82.69 kJ of heat
h) 4.295 L
i) $\Delta E_{nonstandard}$ = -946.2 kJ, so we get 946.2 kJ of heat.

20)
a) ΔH = -3021 kJ ΔE = -3013 kJ
b) $\Delta E_{nonstandard}$ = -439.0 kJ, so the reaction produces 439.0 kJ of heat.

21) ΔE = -3652 kJ *and* ΔH = -3659 kJ, *note that $q=\Delta E$ for the bomb calorimeter*

22) Statement d is correct.

23) -924.3 kJ
$\Delta H_{nonstandard}$ = -13.6 kJ, so the reaction releases 13.6 kJ of heat.

24) ΔH_f^o of $C_4H_5N(l)$ = 63 kJ/mol *)*

25) a) -2166 kJ.
b) -180.5 kJ.
c) 4332 kJ.

26) -163.8 kJ

27) -699.4 kJ

28) a) $Ag(s) + \frac{1}{2} N_2(g) + \frac{3}{2} O_2(g) \rightarrow AgNO_3(s)$
b) $AgNO_3(s) \rightarrow Ag(s) + \frac{1}{2} N_2(g) + \frac{3}{2} O_2(g)$
c) $\frac{1}{2} Ag(s) + \frac{1}{4} N_2(g) + \frac{3}{4} O_2(g) \rightarrow \frac{1}{2} AgNO_3(s)$

29) You cannot calculate ΔH for the reaction in the problem.

30) V = 0.3882 L (or 388.2 mL)