Name:_____ Date:_____ Block: _____

Part 1: Balancing, Endothermic vs. Endothermic, Determining Type of Reaction

Balance the following chemical equations. If you see a polyatomic ion like (NO_3) on both sides of the arrow (→) you can balance it as a whole unit. If you **do** see a polyatomic ion like (NO_3), **draw a circle around it**. After you have balanced the equation underline the word energy and then tell whether the reaction is **endo**thermic **or exo**thermic.

Video Help: Types of rxn | Types of rxn with predicting | Balancing | Khan Balancing | Endo/Exo w/ diagrams

1. ____Mg_3N_2 (s) + energy → 3 Mg (s) + ____N_2 (g) — **endo / exo** — Rxn Type: Deco
2. ____$K_2(CO_3)$ (aq) + 2 $Ag(NO_3)$ (aq) → ____$Ag_2(CO_3)$ (s) + 2 $K(NO_3)$ (aq) + energy — **endo / exo** — Rxn Type: DI
3. ____CH_4 (g) + 2 O_2 (g) → ____CO_2(g) + 2 H_2O (l) + energy — **endo / exo** — Rxn Type: COMB
4. 2 Na(OH) (aq) + ____ $H_2(SO_4)$ (aq) → ____$Na_2(SO_4)$ (aq) + 2 H(OH) (l) + energy — **endo / exo** — Rxn Type: DR Neutrali
5. 2 Al (s) + 3 $Cu(NO_3)_2$ (aq) → 3 Cu (s) + 2 $Al(NO_3)_3$ (aq) + energy — **endo / exo** — Rxn Type: SR
6. 2 $KClO_3$ (s) + energy → 2 KCl (s) + 3 O_2 (g) — **endo / exo** — Rxn Type: Deco
7. ____ C_3H_8 (g) + 5 O_2 (g) → 3 CO_2(g) + 4 H_2O (l) + energy — **endo / exo** — Rxn Type: Comb
8. ____$K_2(SO_4)$ (aq) + ____ $Pb(OH)_2$ (aq) → ____ $Pb(SO_4)$ (s) + 2 K(OH) (aq) + energy — **endo / exo** — Rxn Type: DR
9. 6 Li (s) + ____$Zn_3(PO_4)_2$ (aq) → 3 Zn (s) + 2 $Li_3(PO_4)$ (aq) + energy — **endo / exo** — Rxn Type: SR
10. 2 $Mg(NO_3)_2$ (s) + energy → 2 MgO (s) + 4 NO_2 (g) + ____ O_2(g) — **endo / exo** — Rxn Type: Deco

Part 2: Determine if the following are soluble or insoluble. Then indicate if a precipitate or an aqueous solution forms.

11. $CaCO_3$ insoluble; precipitate
12. Potassium iodide soluble; aqueous
13. NH_4OH soluble; aqueous
14. $PbSO_4$ insoluble; ppt

Soluble/Insoluble/net ionic

15. Silver chloride insoluble; ppt
16. $KC_2H_3O_2$ soluble; aqueous

Part 3: Determine Type, Predict Products, and Balance.

17. Zn Zinc + 2 HCl hydrochloric acid → $H_2(g)$ + $ZnCl_2(aq)$ SR

18. 2 $FeCl_3$ + 3 $Hg(NO_3)_2$ → 3 $HgCl_2(s)$ + 2 $Fe(NO_3)_3(aq)$ DR

19. ____As + ____$BaSO_4$ → NO RXN (As cannot replace Ba; see Activity series.

20. ____C_2H_5OH + 3 O_2 → 2 $CO_2(g)$ + 3 $H_2O(l)$ COMBUSTION

Questions 21-25 refer to Figure 1

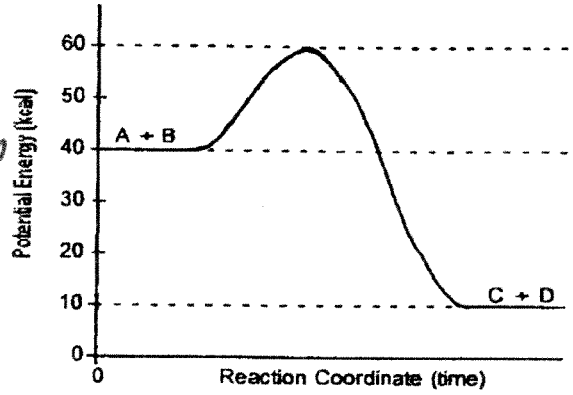


Figure 1

21. Is the reaction endothermic or exothermic? Explain your reasoning.
Exothermic. Products have less E than reactants, thus net loss of E.

22. What is the potential energy of the products?
10 kcal

23. What is the potential energy of the activated complex?
60 kcal

24. What is the value of the activation energy?
E_a = activated complex − reactants = 60 − 40 = 20 kcal

25. What is value of the ΔH_{rxn}?
ΔH = products − reactants = 10 − 40 = −30 kcal

Questions 26-30 refer to Figure 2

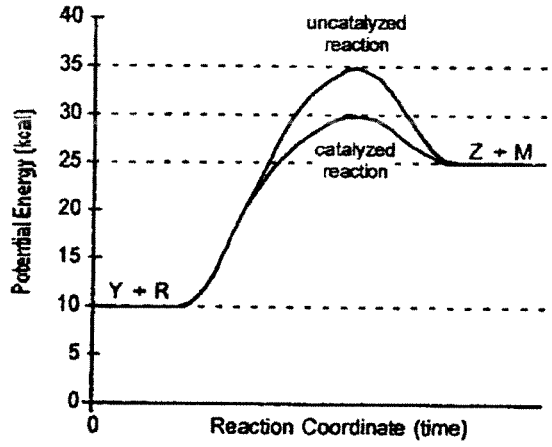


Figure 2

26. Is the reaction endothermic or exothermic? Explain your reasoning.
Endo. Products have more E than reactants, thus net gain of E

27. What is the potential energy of the activated complex of the catalyzed reaction?
30 kcal

28. What is the value of the activation energy of the catalyzed reaction?
30 − 10 = 20 kcal

29. What is the value of the activation energy of the uncatalyzed reaction?
35 − 10 = 25 kcal

30. How does ΔH for the catalyzed compare to ΔH for the uncatalyzed reaction? (same, greater or less) Explain your reasoning.
ΔH is the same b/c adding a catalyst does not change the E of neither products nor reactant.

31. To the right, draw a reaction path diagram with the following criteria:

a. Label the x-axis and y-axis with appropriate units.

b. Use and label an appropriate scale for the y-axis.

c. Reactants have 250 kJ of potential energy stored in their bonds

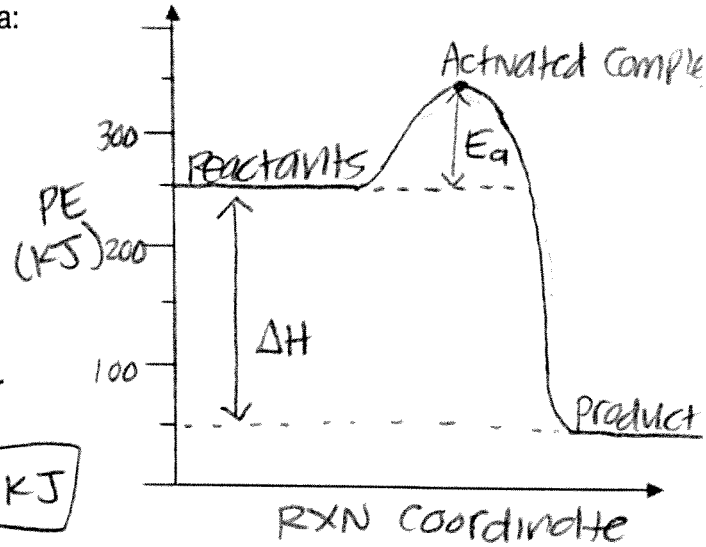
d. An activation energy of 100 kJ

e. Products have 50 kJ of potential energy stored in their bonds

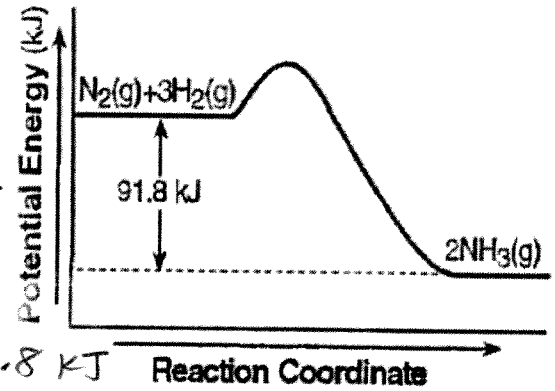
f. Calculate enthalpy (ΔH) = 50 - 250 = -200 kJ

g. Is the reaction endothermic or exothermic?

Exothermic



32. Write a thermochemical equation based off the information found in the energy path diagram below.



$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + 91.8$ kJ

OR

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta H = -91.8$ kJ

33. Write the f[illegible]ctions with the change in enthalpy as a reactant or product.

$2\,Fe + 3\,CO_2 \rightarrow Fe_2O_3 + 3\,CO$ $\Delta H = +26.3$ kJ

26.3 kJ + $2\,Fe + 3\,CO_2 \rightarrow Fe_2O_3 + 3\,CO$

34. In the thermochemical equation below, the energy has been written on the reactants side or the products side. Write the energy as a ΔH value with the correct sign for the reaction below.

$CrO_3 + H_2O \rightarrow H_2CrO_4 + 5.4$ kJ

$CrO_3 + H_2O \rightarrow H_2CrO_4$ $\Delta H = -5.4$ kJ

35. Compute the quantity of heat released when 50. g of iron (III) oxide are produced in the following reaction: $4\,FeO + O_2 \rightarrow 2\,Fe_2O_3 + 560$ kJ

$$\frac{50.\text{ g } Fe_2O_3}{} \left| \frac{1 \text{ mol } Fe_2O_3}{159.7 \text{ g } Fe_2O_3} \right| \frac{560 \text{ kJ}}{2 \text{ mol } Fe_2O_3} = 88 \text{ kJ}$$

36. How many molecules (particles) of carbon dioxide are produced by the decomposition of 53 gram of Nitroglycerin? $4\ C_3H_5(NO_3)_3 \rightarrow 6\ N_2 + O_2 + 12\ CO_2 + 10\ H_2O + 1804\ kJ$

$$\frac{53\ g\ C_3H_5(NO_3)_3}{} \left| \frac{1\ mol\ C_3H_5(NO_3)_3}{227.11\ g\ C_3H_5(NO_3)_3} \right| \frac{6.02 \times 10^{23}\ molecules}{1\ mol\ C_3H_5(NO_3)_3}$$

$= \boxed{1.4 \times 10^{23}\ molecules\ C_3H_5(NO_3)_3}$

37. What is a chemical change?

Breaking and making of chemical bonds to form a new substance.

38. Describe the four indications of a chemical reaction?

1. color change
2. formation of a solid (ppt)
3. formation of a gas (bubbles, fizzing, odor)
4. E transfer (heat, light)

39. What are the two criteria for an effective collision?

1. sufficient Energy - must collide w/ enough force
2. proper orientation - must collide in the "sweet spot"

40. Describe five ways to speed up a reaction.

1. increase concentration of reactants - more particles = more collisions
2. state of matter - gases react fastest = more collisions
3. increase temperature - particles move faster = more collisions
4. increase surface area (smaller pieces) = more collisions
5. add a catalyst - lowers Ea = more particles have the necessary E to react