

**MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question.

1) Which of the following is insoluble in water at 25 °C? 1) \_\_\_\_\_

- A)  $\text{Ca}(\text{OH})_2$   
 B)  $(\text{NH}_4)_2\text{CO}_3$   
 C)  $\text{Ba}(\text{C}_2\text{H}_3\text{O}_2)_2$   
 D)  $\text{Mg}_3(\text{PO}_4)_2$   
 E)  $\text{Na}_2\text{S}$

$\text{C}_2\text{H}_3\text{O}_2^-$   
acetate

2) Which of the following are strong electrolytes? 2) \_\_\_\_\_

- HCl  
 -  $\text{HC}_2\text{H}_3\text{O}_2$   
 -  $\text{NH}_3$   
 - KCl  
 A) HCl,  $\text{NH}_3$ , KCl  
 B) HCl,  $\text{HC}_2\text{H}_3\text{O}_2$ , KCl  
 C) HCl, KCl  
 D)  $\text{HC}_2\text{H}_3\text{O}_2$ , KCl  
 E) HCl,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{NH}_3$ , KCl

3) The balanced net ionic equation for precipitation of  $\text{CaCO}_3$  when aqueous solutions of  $\text{Na}_2\text{CO}_3$  and  $\text{CaCl}_2$  are mixed is \_\_\_\_\_ 3) \_\_\_\_\_

- A)  $\text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{NaCl}(\text{aq})$   
 B)  $\text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CaCO}_3(\text{s})$   
 C)  $2\text{Na}^+(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq})$   
 D)  $2\text{Na}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{Na}_2\text{CO}_3(\text{aq})$   
 E)  $\text{Na}_2\text{CO}_3(\text{aq}) + \text{CaCl}_2(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{CaCO}_3(\text{s})$

$\text{Ca}^{2+} + \text{CO}_3^{2-}$

4) The net ionic equation for the reaction between aqueous nitric acid and aqueous sodium hydroxide is \_\_\_\_\_ 4) \_\_\_\_\_

- A)  $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$   
 B)  $\text{H}^+(\text{aq}) + \text{HNO}_3(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{NO}_3^-(\text{aq})$   
 C)  $\text{H}^+(\text{aq}) + \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{Na}^+(\text{aq})$   
 D)  $\text{HNO}_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$   
 E)  $\text{HNO}_3(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{NO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$

$\text{HNO}_3 + \text{NaOH} \rightarrow$

$\text{H}_2\text{O}$

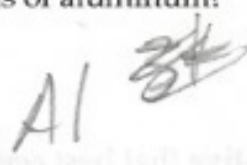
5) Which of the following are weak acids? 5) \_\_\_\_\_

- A) HF, HBr  
 B) HI, HF  
 C) HI,  $\text{HNO}_3$ , HBr  
 D) HF  
 E) none of the above

6) Which of these metals will be oxidized by the ions of aluminum?

6) \_\_\_\_\_

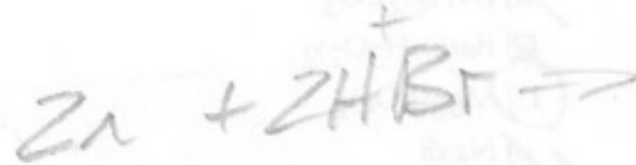
- A) zinc
- B) chromium
- C) magnesium
- D) nickel
- E) iron



7) The net ionic equation for the dissolution of zinc metal in aqueous hydrobromic acid is

7) \_\_\_\_\_

- A)  $2Zn(s) + H^+(aq) \rightarrow 2Zn^{2+}(aq) + H_2(g)$
- B)  $Zn(s) + 2HBr(aq) \rightarrow ZnBr_2(aq) + 2H^+(aq)$
- C)  $Zn(s) + 2HBr(aq) \rightarrow ZnBr_2(s) + 2H^+(aq)$
- D)  $Zn(s) + 2Br^-(aq) \rightarrow ZnBr_2(aq)$
- E)  $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$



8) Oxidation is the \_\_\_\_\_ and reduction is the \_\_\_\_\_.

8) \_\_\_\_\_

- A) gain of oxygen, loss of mass
- B) gain of oxygen, loss of electrons
- C) loss of electrons, gain of electrons
- D) loss of oxygen, gain of electrons
- E) gain of electrons, loss of electrons

$(5M)(0.02) = (.5)$

9) Which of the following is an oxidation-reduction reaction?

9) \_\_\_\_\_

- A)  $H_2CO_3(aq) + Ca(NO_3)_2(aq) \rightarrow 2HNO_3(aq) + CaCO_3(s)$
- B)  $Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$
- C)  $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$
- D)  $HCl(aq) + NaOH(aq) \rightarrow H_2O(l) + NaCl(aq)$
- E)  $Ba(C_2H_3O_2)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaC_2H_3O_2(aq)$

$\frac{.2 mol}{L}$

10) A 0.200 M  $K_2SO_4$  solution is produced by \_\_\_\_\_.

10) \_\_\_\_\_

- A) dissolving 43.6 g of  $K_2SO_4$  in water and diluting to a total volume of 250.0 mL
- B) diluting 20.0 mL of 5.00 M  $K_2SO_4$  solution to 500.0 mL
- C) dissolving 20.2 g of  $K_2SO_4$  in water and diluting to 250.0 mL, then diluting 25.0 mL of this solution to a total volume of 500.0 mL
- D) dilution of 1.00 mL of 250 M  $K_2SO_3$  to 1.00 L
- E) dilution of 250.0 mL of 1.00 M  $K_2SO_4$  to 1.00 L

$20.0 mL \times 5.00 M = 0.1 mol$   
 $0.1 mol \times 172.2 g/mol = 17.22 g$

11) How many grams of NaOH (MW = 40.0) are there in 500.0 mL of a 0.225 M NaOH solution?

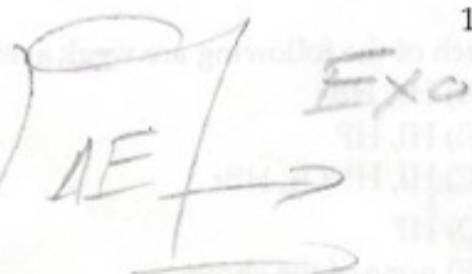
11) \_\_\_\_\_

- A) 114
- B) 0.00219
- C) 4.50
- D) 14.0
- E) 0.113

12) When a system \_\_\_\_\_,  $\Delta E$  is always negative.

12) \_\_\_\_\_

- A) gives off heat and has work done on it
- B) absorbs heat and does work
- C) gives off heat and does work
- D) absorbs heat and has work done on it
- E) none of the above is always negative.



$.5L \times 0.225 mol/L \times \frac{40g}{mol} = 4.5g$

13)  $\Delta H$  for an endothermic process is + while  $\Delta H$  for an exothermic process is -. 13) \_\_\_\_\_

- A) zero, negative
- B) positive, negative
- C) negative, positive
- D) positive, zero
- E) zero, positive

14) The specific heat capacity of liquid water is  $4.18 \text{ J/g}\cdot\text{K}$ . How many joules of heat are needed to raise the temperature of  $5.00 \text{ g}$  of water from  $25.1 \text{ }^\circ\text{C}$  to  $65.3 \text{ }^\circ\text{C}$ ? 14) \_\_\_\_\_

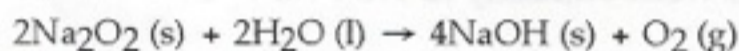
- A) 48.1
- B)  $2.08 \times 10^{-2}$
- C)  $1.89 \times 10^3$
- D) 54.4
- E) 840

$$(5 \text{ g}) \left( \frac{4.18 \text{ J}}{\text{g K}} \right) (65.3 - 25.1) = 840 \text{ J}$$

15) For which one of the following reactions is  $\Delta H^\circ_{\text{rxn}}$  equal to the heat of formation of the product? 15) \_\_\_\_\_

- A)  $\text{P (g)} + 4\text{H (g)} + \text{Br (g)} \rightarrow \text{PH}_4\text{Br (l)}$
- B)  $\text{N}_2 \text{ (g)} + 3\text{H}_2 \text{ (g)} \rightarrow 2\text{NH}_3 \text{ (g)}$
- C)  $(1/2)\text{N}_2 \text{ (g)} + \text{O}_2 \text{ (g)} \rightarrow \text{NO}_2 \text{ (g)}$
- D)  $6\text{C (s)} + 6\text{H (g)} \rightarrow \text{C}_6\text{H}_6 \text{ (l)}$
- E)  $12\text{C (g)} + 11\text{H}_2 \text{ (g)} + 11\text{O (g)} \rightarrow \text{C}_6\text{H}_{22}\text{O}_{11} \text{ (g)}$

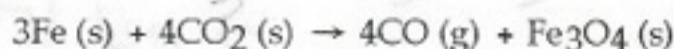
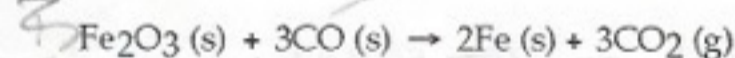
16) The value of  $\Delta H^\circ$  for the reaction below is  $-126 \text{ kJ}$ . The amount of heat that is released by the reaction of  $20.0 \text{ g}$  of  $\text{Na}_2\text{O}_2$  with water is \_\_\_\_\_ kJ. 16) \_\_\_\_\_



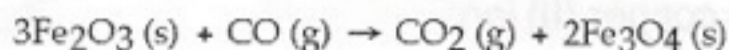
- A) -126
- B) 67.5
- C) 64.6
- D) 32.3
- E) 16.2

$$20 \text{ g Na}_2\text{O}_2 \times \frac{78 \text{ g}}{78 \text{ g}} \times \frac{-126 \text{ kJ}}{2 \times 78 \text{ g Na}_2\text{O}_2} = 32.3 \text{ kJ}$$

17) Given the following reactions 17) \_\_\_\_\_



the enthalpy of the reaction of  $\text{Fe}_2\text{O}_3$  with CO



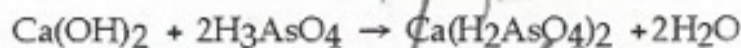
is \_\_\_\_\_ kJ.

- A) -15.5
- B) +109
- C) 40.5
- D) -59.0
- E) -109

$$= \left[ -2346 + 2(-285.9) \right]$$

18) Given the data in the table below,  $\Delta H^\circ_{\text{rxn}}$  for the reaction

18) \_\_\_\_\_



is \_\_\_\_\_ kJ.

Substance	$\Delta H_f^\circ$ (kJ/mol)
Ca(OH) <sub>2</sub>	-986.6
H <sub>3</sub> AsO <sub>4</sub>	-900.4
Ca(H <sub>2</sub> AsO <sub>4</sub> ) <sub>2</sub>	-2346.0
H <sub>2</sub> O	-285.9

$$\left[ 2(-900.4) + (-986.6) \right]$$

$$\Delta H^\circ_{\text{rxn}} = -130.4 \text{ kJ}$$

A) -130.4

B) -76.4

C) -744.9

D) -4519

E) -4219

19.

In which of the following compounds is sulfur's oxidation state 4+?

(A) SCl<sub>2</sub>

(C) Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

(E) SO<sub>3</sub>

(B) H<sub>2</sub>S

(D) CaSO<sub>3</sub>

20.

A 2.200 g sample of a hydrocarbon (C<sub>6</sub>H<sub>4</sub>O<sub>2</sub>) is burned in a bomb calorimeter whose total heat capacity is 7.84 kJ/°C.



The temperature of the bomb calorimeter increased from 23.44 °C to 30.57 °C. What is the heat of combustion per gram of C<sub>6</sub>H<sub>4</sub>O<sub>2</sub>?

(A) -25.5 kJ

(C) -24.0 kJ

(E) -56.0 kJ

(B) -240 kJ

(D) -30.0 kJ

$$\frac{55.89 \text{ kJ}}{2.2 \text{ g}}$$

$$- \frac{7.84 \text{ kJ}}{30.57 - 23.44}$$

21.

Silver metal is added to a solution of copper (II) nitrate, in the chemical reaction that occurs copper (II) ion:

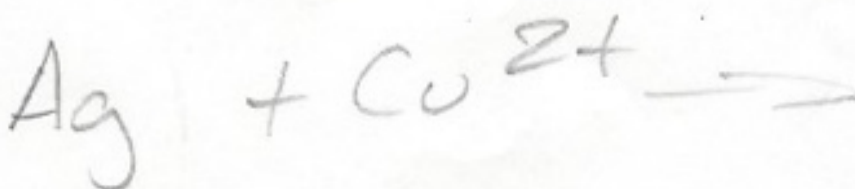
(A) precipitates

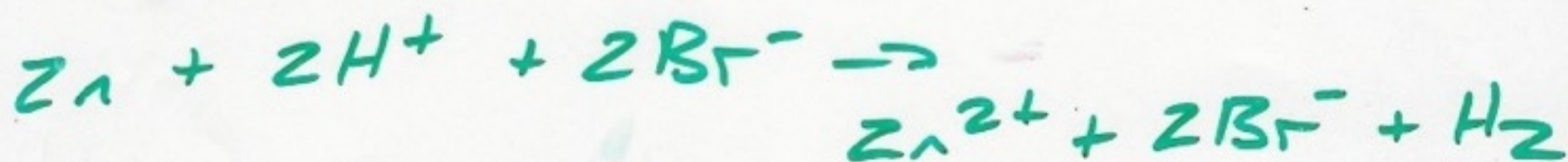
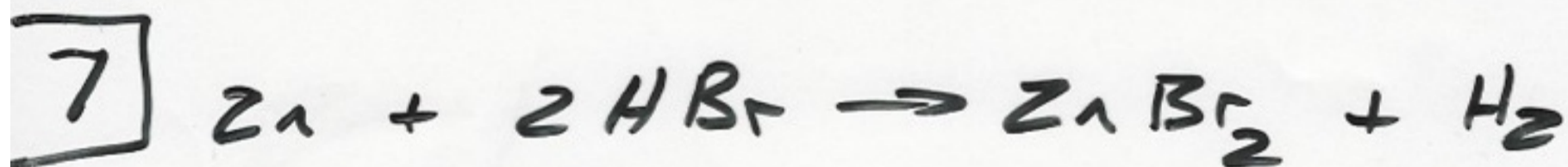
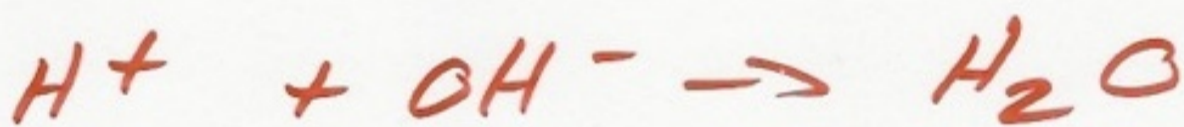
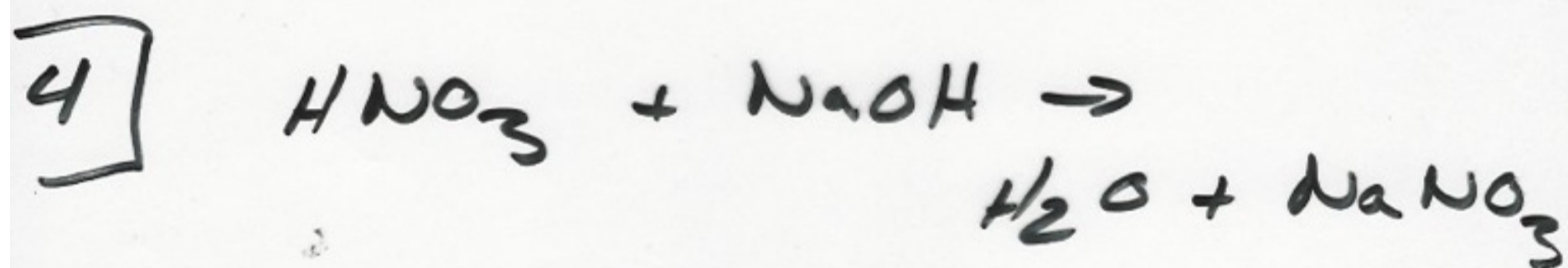
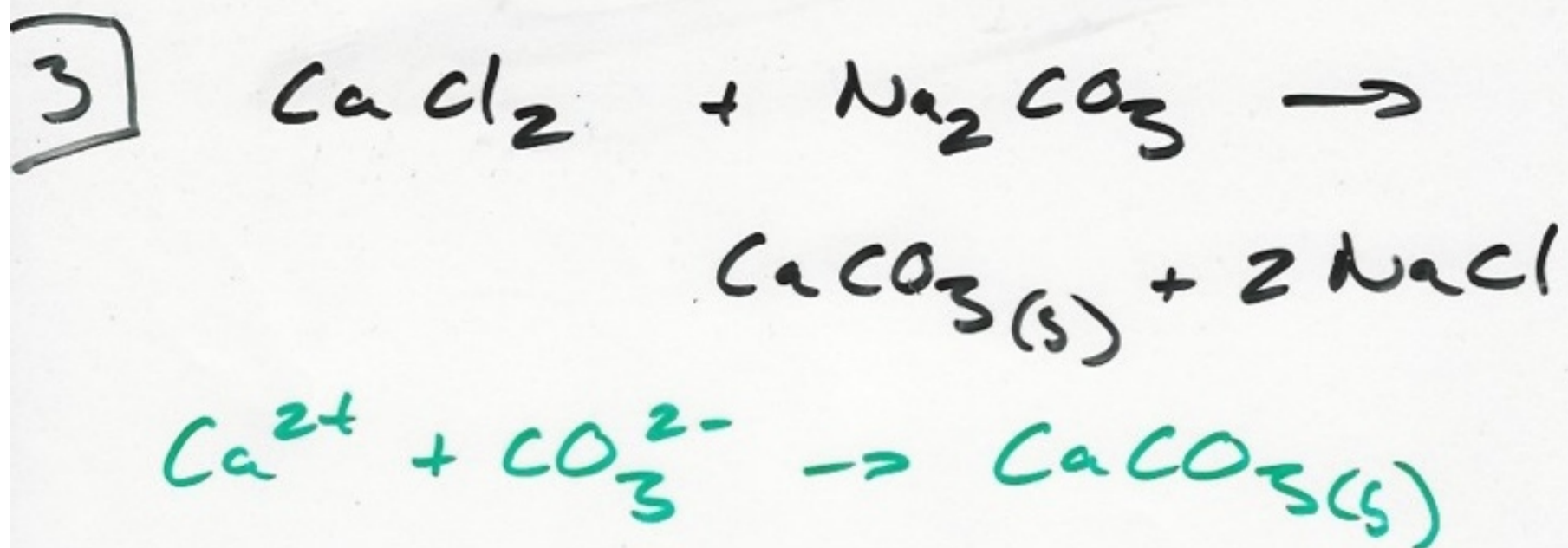
(C) is reduced

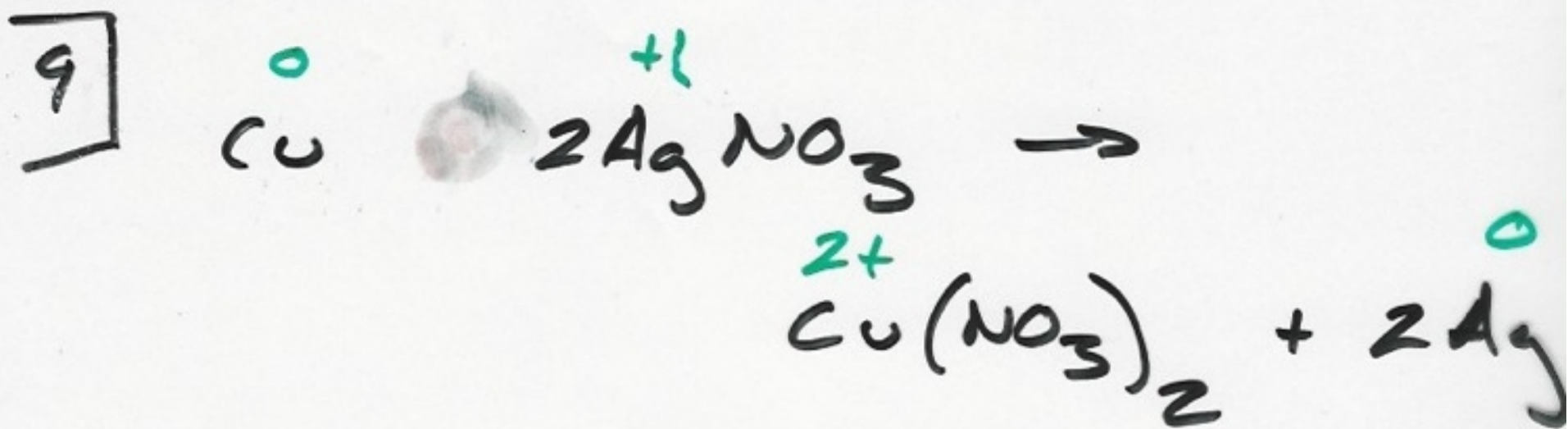
(E) no reaction occurs

(B) is a spectator ion

(D) is oxidized







10

$$M_1 V_1 = M_2 V_2$$

$$\left(\frac{0.5 \text{ mol}}{\text{L}}\right)(0.02 \text{ L}) = (M_2)(0.5 \text{ L})$$

$$M_2 = 0.2 \text{ M K}_2\text{SO}_4$$

11

$$0.5 \text{ L NaOH} \times \frac{0.225 \text{ mol NaOH}}{1 \text{ L}}$$

$$\times \frac{40 \text{ g NaOH}}{1 \text{ mol}} = 4.5 \text{ g NaOH}$$

14

$$q = mc\Delta T$$

$$= (5g) \left( \frac{4.18J}{g^{\circ}C} \right) (65.3 - 25.1)$$

$$q = 840J$$

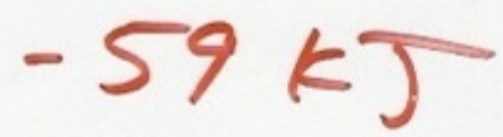
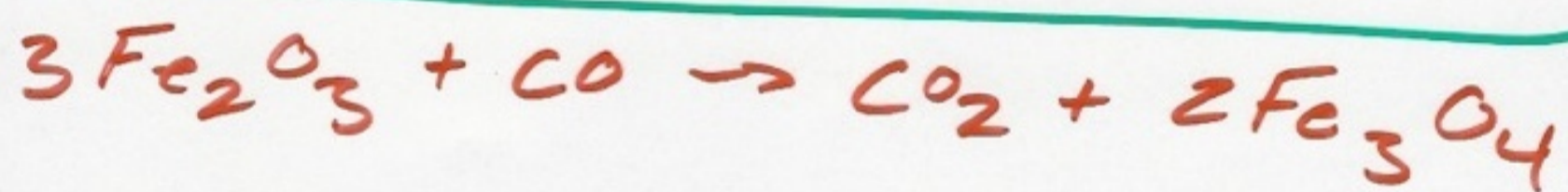
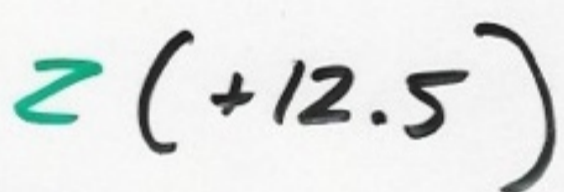
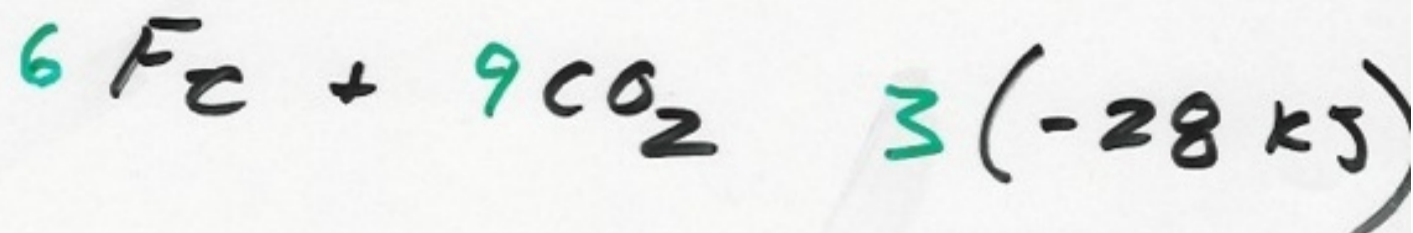
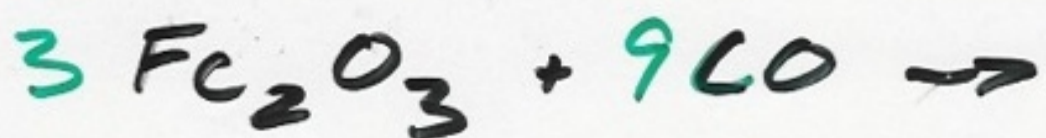
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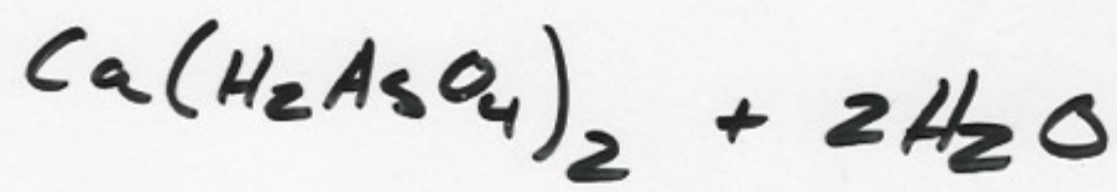
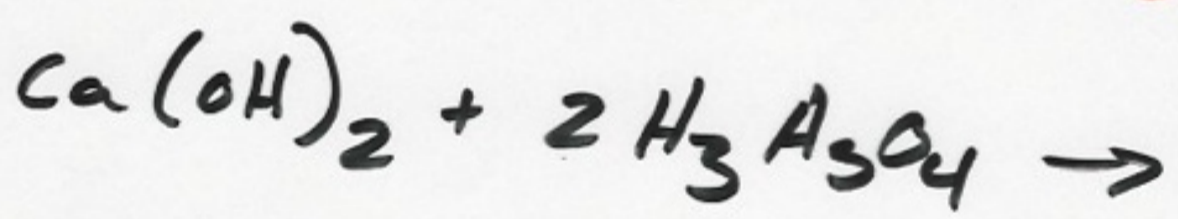
$$20g Na_2O_2 \times \frac{1mol}{78g} \times \frac{-126kJ}{2mol} =$$

$$-16.2kJ$$

17



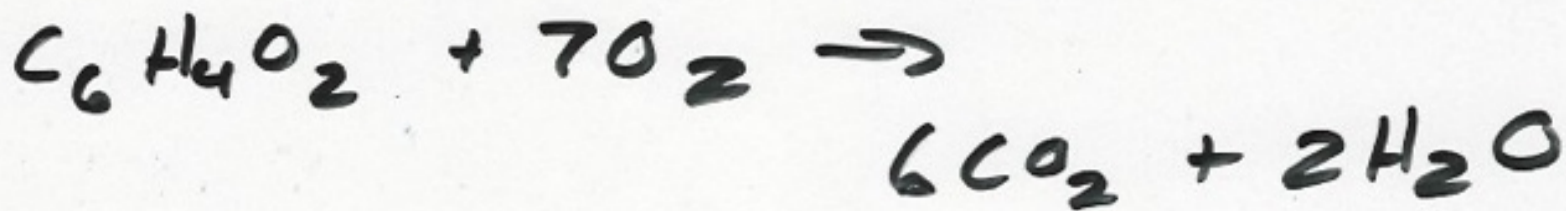
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$$\begin{aligned} \Delta H_{\text{rxn}} &= \left[ -2346 \text{ kJ} + 2(-285.9 \text{ kJ}) \right] \\ &\quad - \left[ 2(-900.4 \text{ kJ}) + (-986.6) \right] \\ &= -130.4 \text{ kJ} \end{aligned}$$



20



$$q = C \Delta T$$

$$= \left( \frac{7.84 \text{ kJ}}{C^\circ} \right) (30.57 - 23.44)$$

$$= 55.89 \text{ kJ}$$

$$= \frac{55.89 \text{ kJ}}{2.2 \text{ g}}$$

$$= -25.5 \text{ kJ}$$

