JARDUERA ETA PROBLEMA EBATZIAK

1. H_2SO_4 (aq) + 2 NaCl (s) $\rightarrow$ Na_2SO_4 (aq) + 2 HCl (aq)

   V = 25 mL 1 g

   0,1 M

   M (NaCl) = 58,5 g·mol^{-1}

   $$25\ \text{mL disoluzio}\ \frac{1\ \cancel{L}}{1\,000\ \cancel{mL}} \cdot \frac{0{,}1\ \text{mol}\ H_2SO_4}{1\ \text{L disoluzio}} = 0{,}0025\ \text{mol}\ H_2SO_4$$

   $$1\ \cancel{g\ NaCl}\ \frac{1\ \text{mol NaCl}}{58{,}5\ \cancel{g\ NaCl}} = 0{,}017\ \text{mol NaCl}$$

   0,0025 mol H_2SO_4 erabat kontsumi daitezen, NaCl-aren kantitate hau beharko genuke: 2 · 0,0025 = 0,005 NaCl, baina guk 0,017 ditugu; hortaz, ez da osorik kontsumituko.

   Azido sulfurikoa kontsumituko da erabat.

2. NaOH (aq) + HCl (aq) $\rightarrow$ NaCl (aq) + H_2O (l)

   V = 25 mL V = 40 mL

   0,4 M 0,3 M

   $$25\ \text{mL disoluzio}\ \frac{1\ \cancel{L}}{1\,000\ \cancel{mL}} \cdot \frac{0{,}4\ \text{mol NaOH}}{1\ \text{L disoluzio}} = 0{,}01\ \text{mol NaOH}$$

   $$40\ \text{mL disoluzio}\ \frac{1\ \cancel{L}}{1\,000\ \cancel{mL}} \cdot \frac{0{,}3\ \text{mol HCl}}{1\ \text{L disoluzio}} = 0{,}012\ \text{mol HCl}$$

   Erreakzioan, erreaktibo bakoitzaren mol kopuru berberak kontsumitzen dira; beraz, mol kopuru txikiena duena agortuko da, NaOH-a, alegia.

   Erreaktibo mugatzailea sodio hidroxidoa da.

3. 3 H_2SO_4 (aq) + 2 Al (s) $\rightarrow$ $Al_2(SO_4)_3$ (aq) + 3 H_2 (g)

   0,5 M V = 3,25 L
   BN

   $$3{,}25\ \cancel{\text{L}\ H_2}\ \frac{1\ \cancel{\text{mol}\ H_2}}{22{,}4\ \cancel{\text{L}\ H_2}} \cdot \frac{3\ \cancel{\text{mol}\ H_2SO_4}}{3\ \cancel{\text{mol}\ H_2}} \cdot \frac{1\ \cancel{L}\ \text{disoluzio}}{0{,}5\ \cancel{\text{mol}\ H_2SO_4}} \cdot \frac{1\,000\ \text{mL}}{1\ \cancel{L}} = 290\ \text{mL disoluzio}$$

   Azido sulfurikoaren 0,5 M motako disoluzioaren 290 L-k erreakzionatu beharko dute.

4. 2 Na (s) + 2 H_2O (l) $\rightarrow$ 2 NaOH (aq) + H_2 (g)

   1 g V = 150 mL

   M (Na) = 23 g·mol^{-1}

   $$\text{n (NaOH)} = 1\ \cancel{g\ Na}\ \frac{1\ \cancel{\text{mol Na}}}{23\ \cancel{g\ Na}} \cdot \frac{2\ \text{mol NaOH}}{2\ \cancel{\text{mol Na}}} = 0{,}043\ \text{mol NaOH}$$

   $$\text{V}\ (H_2O) = 1\ \cancel{g\ Na}\ \frac{1\ \cancel{\text{mol Na}}}{23\ \cancel{g\ Na}} \cdot \frac{2\ \cancel{\text{mol}\ H_2O}}{2\ \cancel{\text{mol Na}}} \cdot \frac{18\ \cancel{g\ H_2O}}{1\ \cancel{\text{mol}\ H_2O}} \cdot \frac{1\ \text{mL}\ H_2O}{1\ \cancel{g\ H_2O}} = 0{,}78\ \text{mL}$$

   $V(H_2O)_{\text{amaiera}}$ = 150 mL − 0,78 mL = 149,22 mL

   $$\text{M (NaOH)} = \frac{0{,}043\ \text{mol NaOH}}{149{,}22\ \cancel{mL}\ \text{disoluzio}} \cdot \frac{1\,000\ \cancel{mL}}{1\ \text{L}} = 0{,}29\ \text{mol}\cdot\text{L}^{-1}$$

   Disoluzioaren molartasuna: 0,29 mol·L^{-1}

2. $Na_2S\ (s) + SnCl_2\ (aq) \rightarrow SnS\ (s) + 2\ NaCl\ (aq)$

   $M\ (SnCl_2) = 189{,}7\ g \cdot mol^{-1}$

   $M\ (SnS) = 150{,}7\ g \cdot mol^{-1}$

$$20\ \cancel{g\ SnCl_2}\ \frac{1\ \cancel{mol\ SnCl_2}}{189{,}7\ \cancel{g\ SnCl_2}} \cdot \frac{1\ \cancel{mol\ SnS}}{1\ \cancel{mol\ SnCl_2}} \cdot \frac{150{,}7\ g\ SnS}{1\ \cancel{mol\ SnS}} = 15{,}9\ g\ SnS$$

   15,9 g eztainu (II) sulfuro lortuko dira.

3. $Zn\ (s) + CuSO_4\ (aq) \rightarrow ZnSO_4\ (aq) + Cu\ (s)$

   a) $M\ (CuSO_4) = 159{,}5\ g \cdot mol^{-1}$

   $M\ (Cu) = 63{,}5\ g \cdot mol^{-1}$

$$20\ \cancel{g\ CuSO_4}\ \frac{1\ \cancel{mol\ CuSO_4}}{159{,}5\ \cancel{g\ CuSO_4}} \cdot \frac{1\ \cancel{mol\ Cu}}{1\ \cancel{mol\ CuSO_4}} \cdot \frac{63{,}5\ g\ Cu}{1\ \cancel{mol\ Cu}} = 7{,}96\ g\ Cu$$

   Hauspeatutako kobre metalikoaren masa 7,96 g-koa da.

   b) $M\ (Zn) = 65{,}4\ g \cdot mol^{-1}$

$$20\ g\ CuSO_4\ \frac{1\ mol\ CuSO_4}{159{,}5\ g\ CuSO_4} \cdot \frac{1\ mol\ Zn}{1\ mol\ CuSO_4} \cdot \frac{65{,}4\ g\ Zn}{1\ mol\ Zn} = 8{,}2\ g\ Zn$$

   8,2 g zink metaliko kontsumituko dira.

4. $CaCO_3\ (s) + 2\ HCl\ (aq) \rightarrow CaCl_2\ (aq) + CO_2\ (g) + H_2O\ (l)$

   a) $M\ (CaCO_3) = 100\ g \cdot mol^{-1}$

$$50\ g\ CaCO_3\ \frac{1\ mol\ CaCO_3}{100\ g\ CaCO_3} \cdot \frac{1\ mol\ CO_2}{1\ mol\ CaCO_3} \cdot \frac{22{,}4\ L\ CO_2}{1\ mol\ CO_2} = 11{,}2\ L\ de\ CO_2$$

   11,2 L CO_2 lortuko dira, *EN*ean neurtuta.

   b) $M\ (CaCl_2) = 111\ g \cdot mol^{-1}$

$$50\ g\ CaCO_3\ \frac{1\ mol\ CaCO_3}{100\ g\ CaCO_3} \cdot \frac{1\ mol\ CaCl_2}{1\ mol\ CaCO_3} \cdot \frac{111\ g\ CaCl_2}{1\ mol\ CaCl_2} = 55{,}5\ g\ CaCl_2$$

   55,5 g kaltzio kloruro lortuko dira.

5. $NH_4NO_2\ (s) \rightarrow N_2\ (g) + 2\ H_2O\ (l)$

   15 g

   $M\ (NH_4NO_2) = 64\ g \cdot mol^{-1}$

$$15\ g\ NH_4NO_2\ \frac{1\ mol\ NH_4NO_2}{64\ g\ NH_4NO_2} \cdot \frac{1\ mol\ N_2}{1\ mol\ NH_4NO_2} \cdot \frac{22{,}4\ L}{1\ mol\ N_2} = 5{,}2\ L\ N_2$$

   5,2 L nitrogeno (gasa) askatuko dira, *EN* ean neurtuta.

6. $6\ HCl\ (aq) + 2\ Al\ (s) \rightarrow 2\ AlCl_3\ (aq) + 3\ H_2\ (g)$

$V = 140\ L$

a) $T\ (H_2) = 20\ °C = 293\ K$

$$P\ (H_2) = 740\ mm\ Hg \frac{1\ atm}{760\ mm\ Hg} = 0{,}9737\ atm$$

$$n\ (H_2) = \frac{P\,V}{R\,T} = \frac{0{,}9737\ atm \cdot 140\ L}{0{,}082\ atm \cdot L \cdot K^{-1} \cdot mol^{-1} \cdot 293\ K} = 5{,}67\ mol\ H_2$$

$$M\ (Al) = 27\ g \cdot mol^{-1}$$

$$5{,}67\ mol\ H_2 \frac{2\ mol\ Al}{3\ mol\ H_2} \cdot \frac{27\ g\ Al}{1\ mol\ Al} = 102\ g\ Al$$

102 g aluminio beharko dira.

b) $M\ (AlCl_3) = 133{,}5\ g \cdot mol^{-1}$

$$5{,}67\ mol\ H_2 \frac{2\ mol\ AlCl_3}{3\ mol\ H_2} \cdot \frac{133{,}5\ g\ AlCl_3}{1\ mol\ AlCl_3} = 505\ g\ AlCl_3$$

505 g $AlCl_3$ lortuko dira.

7. $4\ FeS\ (s) + 7\ O_2\ (g) \rightarrow 4\ SO_2\ (g) + 2\ Fe_2O_3\ (s)$

$V = 40\ L$

$T\ (SO_2) = 400\ °C = 673\ K$

$$P\ (SO_2) = 740\ mm\ Hg \frac{1\ atm}{760\ mm\ Hg} = 0{,}974\ atm$$

$$n\ (SO_2) = \frac{P\,V}{R\,T} = \frac{0{,}974\ atm \cdot 40\ L}{0{,}082\ atm \cdot L \cdot K^{-1} \cdot mol^{-1} \cdot 673\ K} = 0{,}706\ mol\ SO_2$$

$M\ (FeS) = 87{,}8\ g$

$$0{,}706\ mol\ SO_2 \frac{4\ mol\ FeS}{4\ mol\ SO_2} \cdot \frac{87{,}8\ g\ FeS}{1\ mol\ FeS} = 62\ g\ FeS$$

62 g burdina sulfuro behar dira.

8. $3\ H_2SO_4\ (aq) + 2\ Al\ (s) \rightarrow Al_2(SO_4)_3\ (aq) + 3\ H_2\ (g)$

$M\ (Al) = 27\ g \cdot mol^{-1}$ $\quad m\ (Al) = 10\ g$

$$n\ (H_2) = 10\ g\ Al \frac{1\ mol\ Al}{27\ g\ Al} \cdot \frac{3\ mol\ H_2}{2\ mol\ Al} = 0{,}556\ mol\ H_2$$

$T\ (H_2) = 25\ °C = 298\ K$

$$P\ (H_2) = 750\ mm\ Hg \frac{1\ atm}{760\ mm\ Hg} = 0{,}987\ atm$$

$$V\ (H_2) = \frac{n\ (H_2)\ R\,T}{P} = \frac{0{,}556\ mol \cdot 0{,}082\ atm \cdot L \cdot K^{-1} \cdot mol^{-1} \cdot 298\ K}{0{,}987\ atm} = 13{,}8\ L\ H_2$$

13,8 L hidrogeno (gasa) lortuko ditugu.

9. $CaCO_3\ (s) \xrightarrow{\Delta} CaO\ (s) + CO_2\ (g)$

1 kg, % 90

M $(CaCO_3) = 100\ g \cdot mol^{-1}$

$$1\ kg\ CaCO_3 \frac{1\,000\ g}{1\ kg} \cdot \frac{90\ g\ erreal}{100\ g\ teoriko} \cdot \frac{1\ mol\ CaCO_3}{100\ g\ CaCO_3} \cdot \frac{1\ mol\ CO_2}{1\ mol\ CaCO_3} = 9\ mol\ CO_2$$

$T\ (CO_2) = 300\ °C = 573\ K$

$$P\ (CO_2) = 740\ mm\ Hg \frac{1\ atm}{760\ mm\ Hg} = 0{,}974\ atm$$

$$V\ (CO_2) = \frac{n\,R\,T}{P} = \frac{9\ mol\ CO_2 \cdot 0{,}082\ atm \cdot L \cdot K^{-1} \cdot mol^{-1} \cdot 573\ K}{0{,}974\ atm} = 434{,}16\ L\ CO_2$$

434 L karbono dioxido lortuko ditugu.

10. $2\ KClO_3\ (g) \rightarrow 2\ KCl\ (s) + 3\ O_2\ (g)$

40 g, % 95

M $(KClO_3) = 122{,}6\ g \cdot mol^{-1}$

$$40\ g\ KClO_3 \frac{95\ g\ erreal}{100\ g\ teoriko} \cdot \frac{1\ mol\ KClO_3}{122{,}6\ g\ KClO_3} \cdot \frac{3\ mol\ O_2}{2\ mol\ KClO_3} = 0{,}46\ mol\ O_2$$

$T\ (O_2) = 25\ °C = 298\ K$

$$P\ (O_2) = 740\ mm\ Hg \frac{1\ atm}{760\ mm\ Hg} = 0{,}974\ atm$$

$$V\ (O_2) = \frac{n\,R\,T}{P} = \frac{0{,}46\ mol \cdot 0{,}082\ atm \cdot L \cdot K^{-1} \cdot mol^{-1} \cdot 298\ K}{0{,}974\ atm} = 11{,}5\ L\ O_2$$

11,5 L oxigeno lortuko dira.

M $(KCl) = 74{,}6\ g \cdot mol^{-1}$

$$40\ g\ KClO_3 \frac{95\ g\ erreal}{100\ g\ teoriko} \cdot \frac{1\ mol\ KClO_3}{122{,}6\ g\ KClO_3} \cdot \frac{2\ mol\ KCl}{2\ mol\ KClO_3} \cdot \frac{74{,}6\ g\ KCl}{1\ mol\ KCl} = 23{,}1\ g\ KCl$$

23,1 g potasio kloruro lortuko dira.

11. $NaNO_3\ (aq) + H_2SO_4\ (aq) \rightarrow HNO_3\ (aq) + NaHSO_4\ (aq)$

m $(NaNO_3) = 10\ g$ m $(H_2SO_4) = 9{,}8\ g$

Lehenik, erreaktibo mugatzailea bietako zein den kalkulatuko dugu:

M $(NaNO_3) = 85\ g \cdot mol^{-1}$

M $(H_2SO_4) = 98\ g \cdot mol^{-1}$

$$10\ \cancel{g\ NaNO_3} = \frac{1\ mol\ NaNO_3}{85\ \cancel{g\ NaNO_3}} = 0{,}118\ mol\ NaNO_3$$

$$9{,}8\ \cancel{g\ H_2SO_4} = \frac{1\ mol\ H_2SO_4}{98\ \cancel{g\ H_2SO_4}} = 0{,}1\ mol\ H_2SO_4\ (mugatzailea)$$

Erreaktibo bakoitzetik mol batek erreakzionatu duenez, azido sulfurikoa kontsumituko da arinago, horretatik dagoelako gutxien.

Ondoren, erreaktibo mugatzailean oinarrituriko kalkuluak egingo ditugu:

M $(HNO_3) = 63\ g \cdot mol^{-1}$

$$9{,}8\ \cancel{g\ H_2SO_4} \frac{1\ \cancel{mol\ H_2SO_4}}{98\ \cancel{g\ H_2SO_4}} \cdot \frac{1\ \cancel{mol\ HNO_3}}{1\ \cancel{mol\ H_2SO_4}} \cdot \frac{63\ g\ HNO_3}{1\ \cancel{mol\ HNO_3}} = 6{,}3\ g\ HNO_3$$

6,3 g azido nitriko lor ditzakegu.