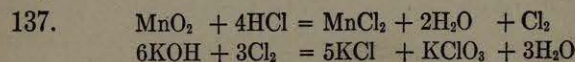


136. Limestone has the following analysis:

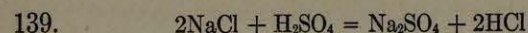
CaCO ₃	65.00 per cent.
MgCO ₃	30.00 per cent.
SiO ₂	5.00 per cent.
	100.00 per cent.

Wanted, 100 liters CO₂ gas. How many kilos of the limestone and how many kilos of hydrochloric acid 26 per cent. strong must be used?



We have MnO₂ 85 per cent. pure and are to make 200 lbs. of the chlorate (KClO₃), wasting 35 per cent. of the total chlorine in the operation. What weight of the manganese ore must be taken?

138. One gram of a mixture of chlorides of potassium and sodium is converted by heating with sulphuric acid into a mixture of K₂SO₄ and Na₂SO₄. The mixed sulphates weigh 1.1862. What are the percentages of potassium and of sodium chlorides?



Wanted, 110 lbs. HCl solution 28 per cent. strong. We have salt of 95 per cent. purity, sulphuric acid of 92 per cent. What quantities of each are to be taken?

140. We have common salt 93 per cent. pure, 4 per cent. of the impurity being MgCl₂. We have H₂SO₄, 85 per cent. pure. We are to produce 10,000 lbs. HCl solution 22 per cent. 4 per cent. of the Cl in the salt remains in the retorts, and of that evolved as HCl 5 per cent. is lost. Find lbs. of salt, H₂SO₄, and water used.

(In computing H₂SO₄ do not regard unconsumed salt.)

141. The weight of a mineral is 5 grams. Weighed in water, 3.5 grams. Weighed in a certain liquid, 2.8 grams.

Also, a solid, soluble in water, weighs 6 grams. In the above liquid, 1.602 grams. Find specific gravities of the last solid and of the liquid.



Carbon disulphide is formed by passing sulphur over excess of ignited charcoal. We are to produce 100 liters of the liquid, specific gravity 1.27. If 8 per cent. of the sulphur entering the reaction is wasted, and the sulphur used is 95 per cent. pure, what weight must be taken of the same?

143. An oxy-hydrogen light is to be displayed for five hours, with a consumption of 600 cubic centimeters of the mixed gases per minute. (H₂ + O = H₂O.) What quantities of zinc, sulphuric acid and potassium chlorate must be taken to yield the required volumes of hydrogen and oxygen? (Approx. weights.)

Also, it is required to write the two equations of production for these gases so that each one shall be molecularly correct, and at the same time the two equations shall bear the proper actual weight relationship to one another.

144. One liter of water leaves, upon evaporation, residue of 0.8470 gram. The various products of analysis weigh as follows:

For silica, SiO ₂	0.1206
For lime, CaO.....	0.0928
For sodium, NaCl.....	0.3916
For radical SO ₃ ; BaSO ₄	0.1390
For iron, Fe ₂ O ₃	0.0209
For magnesium, Mg ₂ P ₂ O ₇	0.1769
For chlorine, AgCl.....	0.5220

Write analysis in parts per 100,000, giving compounds and radicals.

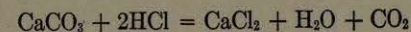
(SO₃ to CaO. Cl to Na. All the remaining bases to CO₂.)

145. 90 c.c. of KOH solution neutralize 76 c.c. of HCl acid. Ten c.c. of the latter precipitate 2.1507 grams of silver chloride (AgCl).

The two solutions are to be made "normal." How much water must be added to a liter of each respectively?

146. It is required to charge 1000 liters of water with CO₂ gas at ten atmospheres and 14° Centigrade. (Water at one atmosphere absorbs its own volume of the gas at 14°.)

What weights must be taken of limestone 97 per cent. pure, and hydrochloric acid of 22 per cent. HCl gas? What will be the volume of the gas at zero and at 14°?



147. Analysis of a salt is:

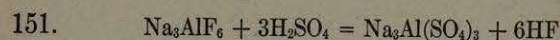
Sodium.....	16.14 per cent.
Tin.....	41.75 per cent.
Oxygen.....	16.84 per cent.
Water.....	25.26 per cent.
Total.....	99.99 per cent.

Find its formula.

148. What is the density of chromyl dichloride, CrO_2Cl_2 , referred to air as unity?

149. A gram of silver (10.5) is drawn into wire 0.000006828 meter diameter. What is the length of the wire?

150. A sheet of gold leaf (19.3) is 0.0000001 meter thick. Its area is 5181 square centimeters. What is its weight?



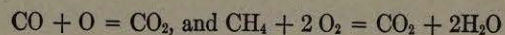
In this reaction the weight of cryolite taken being enough to yield 42.563 liters of hydrofluoric acid gas at 20° Centigrade, find weight of the cryolite decomposed.

152. Analysis of a chemical compound yields the following figures:

Hydrogen.....	1.12 per cent.
Sulphur.....	35.90 per cent.
Oxygen.....	62.98 per cent.
Total.....	100.00 per cent.

Find the formula and name the compound. Also find the percentage of water, and re-formulate, separating the water.

153. A mixture of carbonous oxide (CO) and methane (CH_4) is burned, the products of combustion being water and carbon dioxide:



These products being caught, the water in a chloride of calcium tube, the carbon dioxide in a caustic potash bulb, the increases in weight are as below:

For the chloride of calcium tube (water), 0.1609 gram. For the caustic potash bulb (CO_2 gas), 0.3928 gram.

What were original volumes of the two gases? (Call H one-sixteenth of O in this example, and 1 liter of O = 1.43 gram.)

154. The weight of a square sheet of metal, 1 millimeter thick, is 268 grams. Sp. gr. = 6.7. What is length of one side of the square?

155. Light travels 1130 feet per second. How many meters?

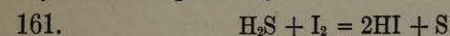
156. A cube of wood of sp. gr. 0.8504 weighs 0.62 gram. What is length of one edge of the cube?

157. A cubic meter of sea water contains 12.1 kilograms of sodium (Na). It is combined with chlorine, as NaCl. If the specific gravity of the sea water is 1.026 what percentage of sodium chloride does it contain?

158. We have 149.7 c.c. of liquid oxygen, sp. gr. 0.89. What will be its volume as gas at 20° Centigrade?

159. Barometer at 29, 30, 31 inches, how many millimeters respectively?

160. Barometer at 780, 770, 760, 750, 740 millimeters, how many inches respectively?



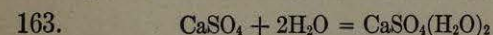
We have 16.56 grams of iodine dissolved in one liter of potassium iodide solution. 150 c.c. of this solution require 1.3146 liters of water containing sulphuretted hydrogen to discharge the blue of the starch indicator.

What volume of H_2S gas in one volume of this water?

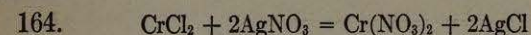
162. Analysis of a substance:

Mercury.....	77.52 per cent.
Carbon.....	18.60 per cent.
Hydrogen.....	3.88 per cent.
Total.....	100.00 per cent.

Find empirical and rational formulæ. (Hg = 200.)

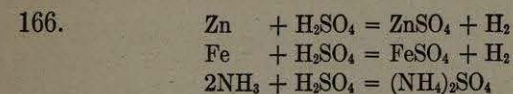


This represents the "setting" of plaster of Paris. If we have 500 grams of the dry sulphate, what volume of water must be added?



Taking 100 grams of the chromium bichloride, we precipitate 232.56 grams silver chloride. Use atomic weights, Ag = 107.93 and Cl = 35.45. Find atomic weight of chromium, assuming that CrCl_2 is correct formula.

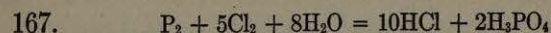
165. One half-gram of a metal "M" is converted into sulphide whose formula is known to be M_2S_3 . This being oxidized the sulphur is precipitated as BaSO_4 , whose weight is found to be 1.0402. Find atomic weight of "M." (Use exact tabular at. wts. for Ba and S.)



Sulphuric acid of specific gravity 1.320 contains 41.50 per cent. of H_2SO_4 . Into one liter of such acid we place, first, 100 grams of zinc, then 200 grams of pure iron. When solution is

complete we pass in ammonia gas, whose excess measures 350 c.c. (Excess over requirement as shown by last of above equations.)

Find total volume of the gas passed, also, what weights are formed of the various products, viz: zinc sulphate ($ZnSO_4$), ferrous sulphate ($FeSO_4$), and ammonium sulphate ($(NH_4)_2SO_4$). Use nearest whole numbers for atomic weights.



Take 46 grams of phosphorus in the above reaction.

Find volume of chlorine at zero, also at 20° Centigrade.

Find volumes at same temperatures of hydrochloric acid gas.

Find weight of the ortho-phosphoric acid produced.

168. Formulate from these analyses:

(a) Phosphorus.....	98.41 per cent.
Hydrogen.....	1.59 per cent.
Total.....	100.00 per cent.
(b) Silver.....	65.44 per cent.
Arsenic.....	15.15 per cent.
Sulphur.....	19.41 per cent.
Total.....	100.00 per cent.
(c) Potassium.....	28.26 per cent.
Chlorine.....	25.63 per cent.
Oxygen.....	46.11 per cent.
Total.....	100.00 per cent.
(d) Silver.....	85.70 per cent.
Hydrogen.....	0.40 per cent.
Oxygen.....	6.35 per cent.
Fluorine.....	7.55 per cent.
Total.....	100.00 per cent.

169. Find percentage composition of the following substances:

- Hg, NO_3, OH (Mercury basic nitrate).
- $Au_2O_3, (NH_3)_4$ (Fulminating gold).
- $Pb(CH_3)_4$ (Lead methyl).
- $SnCl_4, 2NH_4Cl$ (Stannic-ammonium chloride).

170. Liquid hydrogen has specific gravity 0.07.

What is the volume of one gram?

How many times that volume will it occupy as gas at 100° C.?

The boiling point is -397.3° F., what is it in Centigrade?

171. Air weighs 1.293 gram per liter, and contains 23.3 per cent. oxygen by weight. How many pounds of oxygen are consumed in twenty-four hours by a man who inhales 18 cubic feet per hour?

172. One hundred grams of refined copper being taken for analysis, the following weights are obtained:

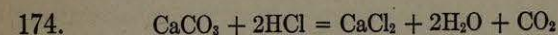
For iron; Fe_2O_3	0.0229 gram.
For arsenic; Ag (from Ag_3AsO_4).....	0.0432 gram.
For lead; $PbSO_4$	0.0263 gram.

Calculate the analysis—copper by difference.

173. The area of the earth's surface being assumed as 196,662,892 square miles, and atmospheric pressure as 1.0333 kilograms per square centimeter.

Assume that carbon dioxide forms 0.04 (four one-hundredths of one per cent.) of the weight of the atmosphere, and find:

- Mass of the carbon in atmosphere in metric tons.
- Volume of the carbonic acid gas in cubic meters.



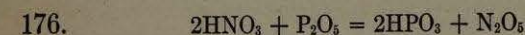
We take 50 grams $CaCO_3$ and form 72.8 grams $CaCl_2$.

- What per cent. and what weight of $CaCO_3$ remain unacted on?
- What weight used of a 15 per cent. sol. of HCl?
- What vol. of HCl gas?

175. It is supposed that about ten million million tons of limestone ($CaCO_3$) are available for quarrying, the world over. Suppose all of its carbon dioxide to be released, and ultimately returned to the earth as carbon, in the shape of coal.

If this coal weighs 80 lbs. to the cubic foot, and contains 80 per cent. total carbon, what will be its tonnage?

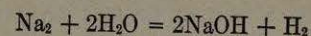
2. If it is deposited in a bed ten feet thick, what will be the area in square miles of the coal field?



Nitric acid with phosphoric anhydride produces meta-phosphoric acid and nitric anhydride. We take 100 cubic centimeters of the nitric acid, and produce 130.378 grams of the nitric anhydride (N_2O_5).

- What weight of the phosphoric anhydride is acted on?
- What is the specific gravity of the nitric acid?

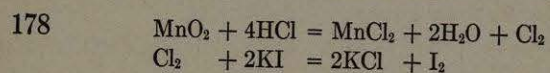
177. A spherical pellet of sodium, sp. gr. = 0.97, is plunged under water contained in an inverted cylinder whose diameter is 2 centimeters. The hydrogen marks a corrected displacement of column one meter long.



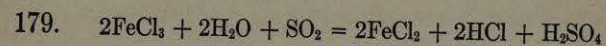
Find weight and volume of the hydrogen.

Find weight and volume of the sodium, also radius of the pellet.

Find weight of the caustic soda, NaOH, formed.



0.84 gram impure MnO_2 sets free chlorine enough to liberate 1.89 grams iodine. What is the per cent. of actual MnO_2 in the ore, and what volume of chlorine is evolved?



The volume of SO_2 gas involved in this reaction is 11.362 liters. What weight of metallic iron is involved?

180. Taking one-gram portions of a mixed ore for analysis, the various elements are determined from the following analytical products:

For sulphur.....	weight of BaSO_4 = 0.9461 gram.
For iron.....	weight of Fe_2O_3 = 0.1468 gram.
For lead.....	weight of PbSO_4 = 0.1073 gram.
For zinc.....	weight of ZnO = 0.1352 gram.
For lime.....	weight of CaO = 0.1141 gram.
For silica.....	weight of SiO_2 = 0.3618 gram.

Assume that the lime is present as carbonate (CaCO_3) and adjust the other elements as follows: Compute lead and zinc as sulphides, then apportion all the remaining sulphur to iron as FeS_2 . Calculate the remaining iron as Fe_2O_3 . Make two statements, one a summation by elements Fe, Pb, Zn, S and O (with Fe_2O_3), adding the oxides SiO_2 , CaO and CO_2 ; the other a summation by "proximates," viz: SiO_2 , FeS_2 , PbS , ZnS , Fe_2O_3 , CaCO_3 .

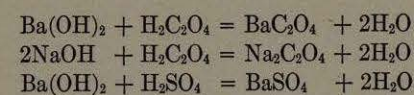
181. 1.339 grams carbon make what volume CO_2 gas at 20° Centigrade? Also, what volume of CO gas at the same temperature?

182. A metal of specific gravity 8.013 is weighed in a liquid of specific gravity 0.7024 giving an "apparent" weight of 7 grams. It is now weighed in a heavier liquid showing "apparent" weight of 6.2122 grams. What is the specific gravity of the heavier liquid?

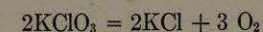
183. 0.750 gram of an iron ore is dissolved and reduced. Being now "titrated" with KMnO_4 solution, it requires 30 c.c. of a solution of which 1 c.c. = 0.0166 metallic iron. What is the percentage of iron?

184. 1 c.c. of $\text{Ba}(\text{OH})_2$ solution is neutralized by 1.226 c.c. of a solution of oxalic acid.

1 c.c. of this oxalic solution neutralizes 0.007 gram of caustic soda (NaOH). What weight of BaSO_4 will one c.c. of the solution of $\text{Ba}(\text{OH})_2$ precipitate? (Do not use the molecular weight of oxalic acid in the calculation.)



185. From one hundred pounds of potassium chlorate, how many cubic feet of oxygen will be evolved?



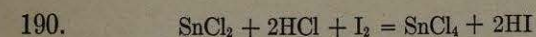
186. An undiscovered metal, "X," has a sulphate " XSO_4 " of which it forms 51.02 per cent. What is its atomic weight?

187. What weights of (a) MgO , (b) NaOH , (c) Zn , (d) CaCO_3 , will 100 c.c. of normal acid dissolve?

188. We have a new metal and an oxide of same of which we know only that the metal is sixty per cent. of the oxide.

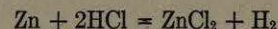
Under the various assumed formulæ X_2O , XO , X_2O_3 , XO_2 , find the resulting atomic weights for "X."

189. One liter of a compound gas at 700 mm. pressure and 20° Centigrade temperature weighs 4 grams. What is its molecular weight?

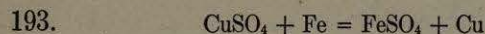


We have a solution of iodine in KI containing ten grams of iodine to the liter of solution. Using one gram of tin ore for analysis, we consume 67 c.c. of the iodine solution. What per cent. of tin in the ore?

191. If 230 c.c. of normal acid act on zinc, what weight of the metal will be dissolved, and what volume of hydrogen gas at 10° will be evolved?



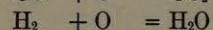
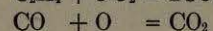
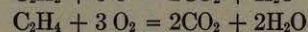
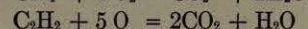
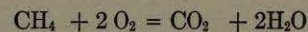
192. 100 c.c. of HCl neutralize 88 c.c. of NH₃ solution. Also, 100 c.c. of the same HCl precipitate 3.2 grams AgCl. Taking 0.5 gram of a substance for nitrogen determination, pass NH₃ from same into 50 c.c. of the HCl, then it takes 35 c.c. of the NH₃ to neutralize excess. Find per cent. of nitrogen.



When a piece of metallic iron is immersed in a copper solution the iron goes into solution, leaving metallic copper adhering to the remaining iron.

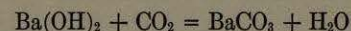
A piece of iron weighing 10 grams weighs 10.1 grams after immersion in the copper solution, what is weight of the copper? (Fe = 56; Cu = 64.)

194. 100 c.c. of mixed gases, viz: CH₄ = 40 c.c., C₂H₄ = 15 c.c., C₂H₂ = 5 c.c., CO = 15 c.c. and H₂ = 25 c.c., are burnt in oxygen, equations as below:

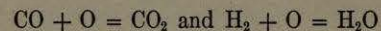


Required volume of oxygen used, also volumes of CO₂ and H₂O produced, taking the latter two at 100° Centigrade.

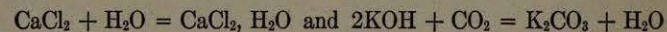
195. We have 100 c.c. of a mixture of CO₂, CO and H₂. The mixed gases are passed through Ba(OH)₂:



The precipitated BaCO₃ weighs 0.176 gram. The residual gas is burned:



Products of combustion passed through CaCl₂ tube and KOH tube:



CaCl₂ tube before operation weighed 38.3388, after same weighed 38.3667.

KOH tube before operation weighed 42.8244, after same weighed 42.9128.

From these experimental data find the analysis by volume of mixture.

196. A mixture of AgCl and AgBr weighs 0.3690 gram. The metallic silver from same weighs 0.2558 gram.

Find weights of AgCl and AgBr. Also find weight of silver in the chloride and in the bromide, and separate weights of chlorine and bromine.

(Suggestion.—Let x and y represent weights of silver in the chloride and bromide respectively. It will now be easy to find expressions for AgCl and AgBr, using the atomic weights or a relation of them as coefficients for the unknown quantities.)

197. One gram of an organic substance being taken for analysis, its nitrogen is converted into ammonia (NH₃), which is neutralized by 42.75 c.c. of decinormal acid. What per cent. of nitrogen in the substance?

198. A precipitate of mixed bromide and iodide of silver weighs 0.939 gram; being converted into silver chloride, weighs 0.637 gram. Find weights of the bromide and iodide of silver, separately.

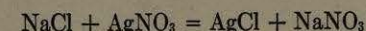
199. A limestone has following composition:

CaO.....	52.64 per cent.
CO ₂	41.36 per cent.
SiO ₂	6.00 per cent.
Total.....	100.00 per cent.

When this is "burned" at proper heat all the lime remains as CaO, but if "overburned" there is formed 2CaO, 3SiO₂.

If 1000 kilos (1 metric ton) is burned, find volume of CO₂ gas evolved. Also, weights of water required for slaking: (1) if well burned, (2) if overburned.

200. How much sodium chloride must be dissolved in 1 liter of water if 1 c.c. of the solution is to precipitate 0.01 gram of silver?

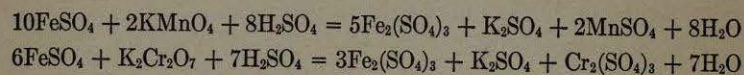


201. In a cubic meter of marble (sp. gr. = 2.7) how many cubic meters of CO₂ gas, if liberated?

In a cubic meter of water how many cubic meters of hydrogen? (Take CaCO₃ = 100; H₂O = 18.)

202. A solid weighing 10.874 grams displaces 3.593 grams of benzene, whose sp. gr. is 0.8886. Find sp. gr. of the solid.

203. What weights of potassium permanganate and of potassium dichromate, respectively, will convert 1 gram of iron from ferrous to ferric condition?



204. In taking an "assay ton" of gold ore, for assay, we make an error in weighing of one milligram. If the true assay value of the ore is one hundred dollars per ton, and the work is perfect, what error in the valuation is introduced by the error in "weighing in?"

205. If ore were weighed with absolute accuracy, what error in the weighing of the "button" would introduce the same error in valuation of the ore as the 1 milligram error in "weighing in" the ore? (Some data as to weight taken and true value as in 204.)

206. What is the weight of one liter of air, at 17° Centigrade and 800 mm. barometer?

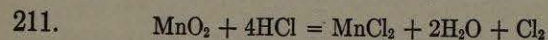
207. A sealed flask holds one gram of hydrogen gas. Capacity of flask one liter. What is the pressure at 20° Centigrade?

208. We have a compound of potassium, chlorine and oxygen which loses all its oxygen when heated. One gram of it thus treated loses 0.4609 gram oxygen. The residue is dissolved and poured into silver nitrate solution, precipitating silver chloride, the silver in which weighs 0.7749 gram.

Another one-gram portion is treated with sulphuric acid, and yields 0.6351 gram of K_2SO_4 . Find formula.

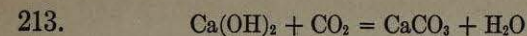
209. 1.357 grams alcohol dissolved in benzene depress the freezing point 1.448° Centigrade. Find approximate molecular weight of alcohol.

210. 5.45 grams phosphorus dissolved in 100 grams carbon disulphide raise the boiling point 1° Centigrade. Find approximate molecular weight. (In 209, $K = 50$. In 210, $L = 23.7$.)



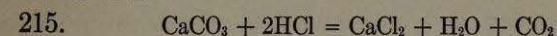
Wanted 690 pounds chlorine. How many pounds of manganese dioxide of 85 per cent. MnO_2 must we take, and what will be volume in cubic feet of the chlorine?

212. One liter of chlorine at 35° C. weighs 3.020 grams. What is the pressure in millimeters?

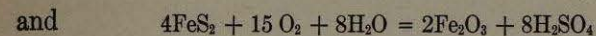
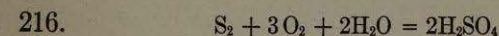


One gram $\text{Ca}(\text{OH})_2$ in solution. Add 630 c.c. CO_2 gas. Which is in excess, and by what weight?

214. A certain weight of ammonium chloride (NH_4Cl) being decomposed into its elements, the gases in toto measure 131.1275 liters, at 800 mm. and 27° C. What weight of the salt was used?



The CO_2 gas in this reaction measures 100 liters at 27.3° C., and 836 mm. pressure. What was weight of the CaCO_3 taken? What was volume of the HCl gas, and what was its weight?



Suppose sulphur, 97 per cent. pure, costs twice as much as pyrites, 91 per cent. pure, which process for the manufacture of sulphuric acid would be the cheaper, assuming that all expenses and losses balance?

217. What is the formula for HNO_3 which contains 70 per cent. acid and 30 per cent. water. (Sp. gr., 1.44.)

218. A cylinder one half-meter in diameter and one meter high, is filled with oxygen at 15° C., which suffices to burn 131.285 grams of carbon. What was the pressure of the gas in the cylinder ($\text{C} + \text{O}_2 = \text{CO}_2$)?

219. Analysis of mineral water. One liter of the water gives a residue weighing 2.4176 grams. The products weighed (in analysis) are as follows:

For CaO.....	CaO	weighs.....	0.05912 gram.
For SO_3	BaSO_4	weighs.....	0.05516 gram.
For Cl.....	AgCl	weighs.....	5.5601 grams.
For Na.....	NaCl	weighs.....	2.2868 grams.
For Mg.....	$\text{Mg}_3\text{P}_2\text{O}_7$	weighs.....	0.02465 gram.
For CO_2	CO_2	weighs.....	0.05332 gram.
For oxygen, by calculation		weighs.....	0.0063 gram.

"Adjudication" to be made as follows: (1) All SO_3 to CaO. (2) Excess of CaO to CO_2 . (3) All Mg to Cl. (4) Excess of

Cl to Na. (5) Excess of Na to CO_2 (as Na_2CO_3). Use approximate atomic weights only. This includes Ba and Ag. Direct calculations only. No "factors."

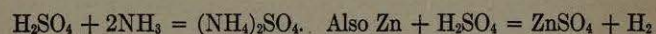
It is required to state the parts per 100,000 of the following salts, as calculated, also the parts of the "proximates" as below, viz: Calcium sulphate, calcium carbonate, magnesium chloride, sodium carbonate, sodium chloride (salts). Also calcium oxide, chlorine, sulphuric anhydride radical (SO_3), sodium, magnesium, carbon dioxide, oxygen (in Na_2CO_3), *i.e.*, the oxygen other than that in CO_2 .

These must check with original residue, making for every summation the 2.4176 grams, or 241.76 parts per 100,000.

220. A sphere of silver is 2 cm. in diameter. A cylinder of silver is 2 cm. in diameter and 2 cm. high. A cube of the same metal is 2 cm. edge. Find weight of each of these. (Sp. gr. of silver = 10.5.)

221. Into dilute sulphuric acid, which contains 30 grams of actual H_2SO_4 , we pass 10 liters ammonia gas at 16°C . and normal pressure. What weight of zinc will the acid still dissolve?

What is weight of the ammonia gas? Of the residual H_2SO_4 ?



222. Potassium (sp. gr. = 0.86) absorbs 126 times its volume of hydrogen. Formulate the alloy thus formed.

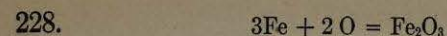
223. If a solution of NaOH contains 12 grams in one liter, how many c.c. of this solution will be neutralized by 100 c.c. of a HCl solution, of which one liter neutralizes 10 grams of calcium carbonate (CaCO_3)?

224. One c.c. of a solution of AgNO_3 precipitates 0.005 gram NaCl. Taking 1 gram of a soluble substance for analysis, we use 40 c.c. of this solution. What is percentage of chlorine?

225. One gram of a triple alloy of copper, tin and zinc is taken for analysis. The products weighed are Cu_2S , SnO_2 , and ZnS . Weights as follows: $\text{Cu}_2\text{S} = 0.7512$; $\text{SnO}_2 = 0.1269$; $\text{ZnS} = 0.4471$. Deduce analysis.

226. Ten grams of steel are taken for analysis for sulphur, phosphorus, silicon and manganese. Gravimetric products weigh as follows: $\text{BaSO}_4 = 0.0402$; $\text{Mg}_2\text{P}_2\text{O}_7 = 0.0213$; $\text{SiO}_2 = 0.0418$; $\text{Mn}_2\text{P}_2\text{O}_7 = 0.0884$. Deduce analysis.

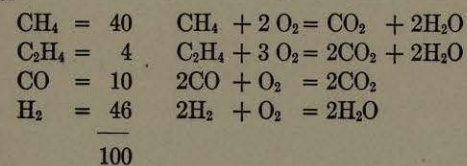
227. If 820 c.c. of gas at 10°C . and 740 mm. pressure weigh 1.265 grams, what is molecular weight of the gas?



Combustion of iron. One gram of iron is burned in one liter of air, what was the temperature of the air, pressure normal?

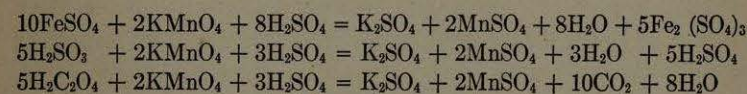
229. Wanted one liter of sulphuric acid of which 100 c.c. are equivalent to 0.1 gram ammonia (NH_3). We have sulphuric acid of which 100 c.c. precipitate 0.699 gram BaSO_4 . How many c.c. of this acid and how many of water must be taken for the required liter of acid?

230. One hundred liters of coal gas are burned in air. Composition of the gas by volume is as below, oxygen in air 21 per cent. by volume. Water being condensed out, find volume, weight and density of the resulting mixture of nitrogen and carbon dioxide.



Separate nitrogen and carbon dioxide in answering.

231. We have an indefinite amount of a solution of potassium permanganate, of which 100 c.c. are equivalent to 1.07 grams iron. Take the three equations:



We want to get one liter of solution of which 100 c.c. shall \equiv 1 gram iron. Another liter of which 100 c.c. shall \equiv to 0.5 gram SO_2 . A third liter of which 100 c.c. shall \equiv to 0.5 gram $\text{H}_2\text{C}_2\text{O}_4$. What volumes respectively must be taken of the permanganate solution? Also, if we start in each case with one liter of the permanganate solution, how much water must be added to each liter for each of the three requirements?

232. What weight of mercuric sulphide yields a quantity of mercury such that it requires the oxygen from 6.66 grams of water to form mercuric oxide?

233. We take 1.75 grams of an organic substance and derive from it 22.8 c.c. nitrogen gas at 15° C. and 720 mm. pressure. What percentage of nitrogen?

234. 295.456 grams of a hydrocarbon give 509.091 liters of carbon dioxide when burned. This same weight vaporized and calculated back to 0° and 760 mm., gives 84.8489 liters. Find formula.

(N.B.—One of these conditions will solve the problem without the use of the other. Which one? Why is the other insufficient of itself?)

235. A spherical balloon whose radius is ten meters is filled with hydrogen gas, whose weight is taken as 0.09 gram per liter. What is the size of the sphere of lead (sp. gr. = 11.37) which will weigh the same as the hydrogen?

236. The formula of diazobenzene bromide is $C_6H_5N_2Br$. Its analysis is: C = 38.92; H = 2.70; N = 15.13; Br = 43.24 (100 per cent.).

Find weights of the following products of analysis, one gram of the substance having been taken:

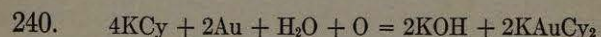
For carbon, CO_2 ; for hydrogen, H_2O ; for nitrogen, Pt (from $(NH_4)_2PtCl_6$); for bromine, AgBr.

237. A sphere of magnesium is dissolved in HCl ($Mg + 2HCl = MgCl_2 + H_2$). The hydrogen evolved measured 23.148 liters at 18° C. and 700 mm.

What weight of magnesium? What was radius of the sphere, and its volume? (Take sp. gr. of magnesium at 1.74; its atomic weight at 24.4; atomic weight of hydrogen at 1.008, its weight per liter at 0.09 gram.)

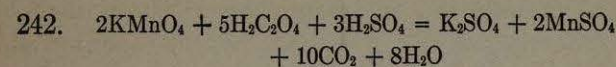
238. One gram naphthaline dissolved in 17.2 c.c. of chloroform raises boiling point 1.2° C. Find approximate molecular weight.

239. One gram organic material gave 1.433 CO_2 and 0.1959 H_2O by weight. Also, one gram gave 121.4 c.c. of nitrogen (0° and 760 mm). Find analysis and formula (oxygen by difference).

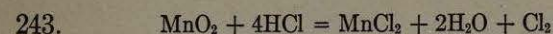


What volume of air must be taken up for each ounce of gold in solution? (Cyanide process for gold.) Take one oz. troy = 31.1 grams. Oxygen in air, 21 per cent. by volume. Take at. wt. of gold as 196.6. (Give wt. and vol. of oxygen, liters and cu. ft. of air.)

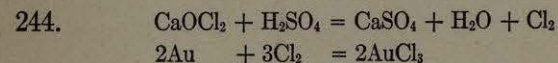
241. A chloride solution of a metal is precipitated by silver nitrate. Wt. of AgCl = 1.6679 grams. What is at. wt. of metal if a dyad? If a triad?



We use 15 grams impure $KMnO_4$ and obtain 10 liters CO_2 . What is per cent. of impurity in the permanganate?

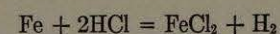


Manganese dioxide is 82 per cent. pure, HCl solution contains 20 per cent. HCl. Sp. gr. of the acid is 1.1. We want 100 liters of chlorine at 15° C. and 650 mm. pressure. Give weights of MnO_2 and HCl solution, also volume of latter.



One kilogram of bleaching powder yields 140 liters chlorine gas. What per cent. of "available" chlorine does the powder contain by weight, and what weight of gold will be dissolved by the chlorine evolved?

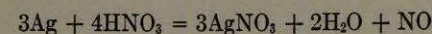
245. What volume of hydrochloric acid gas (HCl) will, when in solution, dissolve one kilometer of iron wire containing 0.4 per cent. of insoluble impurities. Diameter of the wire 0.2 millimeters. Sp. gr. = 7.8. (Atomic weight of iron = 55.9. Cl = 35.45, and H = 1.008.) Use the "22.4" rule. Assume 10° Centigrade and 670 mm. pressure for the HCl.



246. A certain quantity of sulphuric acid (98) will dissolve one pound of an alloy containing equal weights of zinc (65) and cadmium (112). The same quantity of this acid is allowed to act on one pound of iron (56).

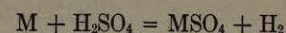
What weight of iron remains unacted on? What weight of actual H_2SO_4 is required for the alloy, and what is the deficit in the case of the iron?

247. Assuming that silver is acted upon by nitric acid according to the equation:



Take sp. gr. of silver as 10.5 and that of ice as 0.92. We have 98 c.c. of silver, what volume of ice will be produced by freezing the water from this reaction?

248. A metal dissolves in sulphuric acid:



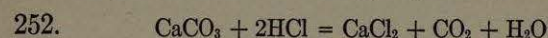
In this reaction, 100 grams of the metal yield 100 liters of hydrogen gas.

Find atomic weight of the metal, using $H = 1$ and crith = 0.0896 gram.

249. A certain weight of a dyad metal "M" yields 0.2900 gram of oxide, MO, and 0.4273 gram of chloride, MCl_2 . Find atomic weight of the metal. (Use the 1911 atomic weights from Table I.)

250. The atomic weights of two metals are in the ratio 3 to 5. The molecular weights of their oxides are as 5 to 7. Assuming that these metals are dyad (oxide = MO), find their atomic weights.

251. A cylinder, 6 meters altitude and 2 meters diameter, contains acetylene gas enough to keep 100 burners at $\frac{1}{2}$ cubic foot each, per hour, for 100 hours. What is the pressure in millimeters, and what is the weight (metric) of the gas?



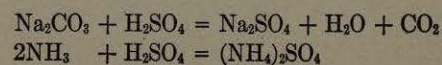
The CO_2 gas obtained by this reaction is charged into a cylinder 7 meters altitude and 2.2 meters diameter. Temperature of the gas $15^\circ C.$, and pressure 2760 mm. The HCl solution used is of sp. gr. 1.17 and contains 33.46 per cent. HCl gas by weight. What volume of this solution was used?

253. Sulphuric acid containing 63 per cent. H_2SO_4 has sp. gr. 1.535.

Sodium carbonate solution containing 9 per cent. Na_2CO_3 has sp. gr. 1.095.

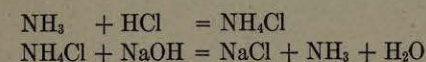
Ammonia solution containing 25 per cent. NH_3 has sp. gr. 0.91.

Into 100 c.c. of the carbonate solution, pour 10 c.c. of the acid. How many c.c. of the ammonia solution must now be used to neutralize? (Use "nearest" atomic weights.)



254. One liter of ammonia solution (sp. gr. 0.91) contains 25 per cent. NH_3 by weight. Add HCl solution (sp. gr. 1.1) containing 20 per cent. HCl, to exact neutrality. Add caustic soda solution in exact proportion by equation below. The caustic soda solution contains 9 per cent. NaOH and has sp. gr. 1.17.

What volumes of the acid and alkaline solutions are used respectively?



255. A ton of lead ore assays 6.95 per cent. lead. It is separated by concentration into "heads, middles and tails" weighing and assaying respectively as below:

Heads.....	160 lbs. assaying 65 per cent. lead.
Middles.....	110 lbs. assaying 12 per cent. lead.
Tails.....	1730 lbs. assaying 1 per cent. lead.
Total.....	2000 lbs.

These results do not check with the weight and assay of the original ore.

1. Find amount of the discrepancy.
2. Assuming that the error lies wholly in the assay of the "tails," find what that assay should be, to reconcile results on products with original.