

Stoichiometric calculations test

Chemistry IB11

Name:

Date:

Show all calculations.

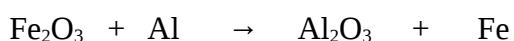
Unless stated otherwise, all results must be provided with three significant figures.

Use the atomic weights from the periodic table provided

| | | | | | | | | | | | | | | | | | |
|------------------|------------------|----------------|----------------|---------------|----------------|----------------|-----------------|-----------------|-------------------|------------------|-------------------|----------------|-----------------|----------------|----------------|------------------|-----------------|
| 1 H 1 | | | | | | | | | | | | | | | | | 2 He 4 |
| 3 Li 6 | 4 Be 8 | | | | | | | | | | | 5 B 10 | 6 C 12 | 7 N 14 | 8 O 16 | 9 F 19 | 10 Ne 20 |
| 11 Na 23 | 12 Mg 24 | | | | | | | | | | | 13 Al 27 | 14 Si 28 | 15 P 31 | 16 S 32 | 17 Cl 35.5 | 18 Ar 40 |
| 19 K 39 | 20 Ca 40 | 21 Sc 45 | 22 Ti 48 | 23 V 51 | 24 Cr 52 | 25 Mn 55 | 26 Fe 56 | 27 Co 59 | 28 Ni 58.7 | 29 Cu 63.5 | 30 Zn 65 | 31 Ga - | 32 Ge - | 33 As 75 | 34 Se 79 | 35 Br 80 | 36 Kr 85 |
| 37 Rb 84.5 | 38 Sr 87.5 | 39 Y - | 40 Zr - | 41 Nb - | 42 Mo - | 43 Tc - | 44 Ru - | 45 Rh 103 | 46 Pd 106.5 | 47 Ag 108 | 48 Cd - | 49 In - | 50 Sn 119 | 51 Sb - | 52 Te - | 53 I 127 | 54 Xe 131 |
| 55 Cs 133 | 56 Ba 137 | 57 La - | 58 Hf - | 59 Ta - | 60 W - | 61 Re - | 62 Os 190 | 63 Ir 192 | 64 Pt 195 | 65 Au 197 | 66 Hg 200.5 | 67 Tl - | 68 Pb 207 | 69 Bi - | 70 Po - | 71 At - | 72 Rn 222 |
| 73 Fr - | 74 Ra - | 75 Ac - | | | | | | | | | | | | | | | |

1. Where are there more particles, in 100g of oxygen or 125g of carbon dioxide? (5 0 0)

2. A pyrotechnic is preparing thermite for a demonstration, and he mixes 300g of iron (III) oxide Fe_2O_3 and 90g aluminium. The unbalanced reaction that takes place is



The reaction releases a large amount of heat and, although the reagents are solid, the resulting iron is extremely hot and therefore molten.

The pyrotechnic seeks to optimize the blend so that as little of the reagents as possible is wasted, so he reasons that, since there are only 90g of aluminium, he should try again with 100g of said reagent.

a) Given the initially described amounts (300 and 90 g respectively), which is the limiting reagent?
(3 2 0)

b) How much of the other one won't react? (0 2 0)

c) How many grams of iron will form if the yield is only 67%? (1 2 0)

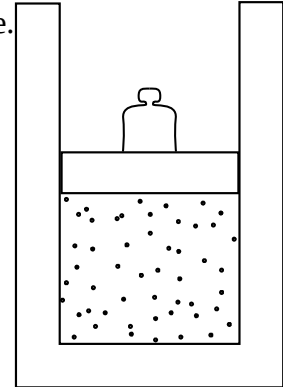
d) How could the pyrotechnic change the amounts in order to optimize the blend? (0 1 2)

3. A five litres helium tank is sold for inflating party balloons.
The pressure inside the tank is 53 atm at room temperature, which is 22°C.

a) How much helium is there inside the tank? (1 2 0)

b) The party will be on the open air, with a temperature of 15°C and the balloons have a volume of four litres and are made of latex rubber, which applies an extra 0.06 atm of pressure to the helium. How many balloons will we be able to fill with one tank? (2 2 0)

4. A gas is trapped in a container with a movable lid as shown in the figure. The weight on the lid ensures that the pressure is 3.5 atm . Prove that if the temperature rises from 0 to 100°C the volume will increase by 36.63% (0 2 2)



5. We want to prepare 5.5 l of a 0.16 M solution of sodium carbonate Na_2CO_3 . Calculate the weight of sodium carbonate we have to use. (1 1 0)

6. A lab assistant needs to prepare 1 l of sulfuric acid 4M . She has two sulfuric acid bottles, an opened one of sulfuric acid 94% in weight and density 1.8312 g/ml which only contains 230 ml and a new unopened bottle of 1 l of sulfuric acid 36% in weight and density 1.2685 g/ml

a) Is there enough sulfuric acid with the opened bottle? If so, how many millilitres does she have to use? If not, how much does she have to pick from the opened bottle? (2 3 0)

Bonus

b) The professor drops by the lab and sees the lab assistant doing the calculations, then says: "let's hope you have enough with the opened bottle, otherwise you won't be able to prepare the solution" Is he correct? why? (0 1 2)

7. Prilocaine is an anesthetic very commonly used in dentistry, and a thorough elemental analysis revealed that its weight composition was:

70.9091% C

9.09091% H

12.7273% N

7.27273% O

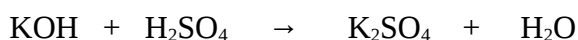
Mass spectrometry also revealed that it only contains one atom of oxygen.

Calculate its empirical and molecular formulas. (2 2 0)

8. An acid-base titration has been carried out in order to determine the concentration of sulfuric acid in an old bottle whose label is partially illegible.

The base used as a titration agent is potassium hydroxide KOH with a concentration of 0.550 M which has been accurately prepared (by the lab assistant from exercise 6) by measuring the appropriate mass of KOH and dissolving it in water until reaching a final volume of one litre.

The unbalanced reaction is:



In the erlenmeyer we put 3.50 ml of the solution found in the bottle, and in order for the indicator to change colour, 28.35 ml of the KOH solution had to be added.

a) Balance the equation (1 0 0)

b) Calculate the concentration of the sulfuric acid in the bottle. (1 2 0)

Bonus

c) There seems to have been a mistake and the substance the assistance was using turns out not to be potassium hydroxide but sodium hydroxide. Recalculate the concentration of the sulfuric acid (0 2 1)