

Formula Mass And Gram Formula Mass

- Which term represents the sum of the atomic masses of the atoms in a molecule?
 - atomic number
 - mass number
 - formula mass
 - percent composition by mass
- What is the gram-formula mass of $\text{Ca}(\text{OH})_2$?
 - 29 g/mol
 - 54 g/mol
 - 57 g/mol
 - 74 g/mol
- The formula mass of a compound is the
 - sum of the atomic masses of its atoms
 - sum of the atomic numbers of its atoms
 - product of the atomic masses of its atoms
 - product of the atomic numbers of its atoms
- Which quantity is equal to one mole of Au?
 - the atomic mass in grams
 - the atomic number in grams
 - the mass of neutrons in grams
 - the number of neutrons in grams

Base your answers to questions 5 on the information below and on your knowledge of chemistry.

A hydrate is a compound that has water molecules within its crystal structure. Magnesium sulfate heptahydrate, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, is a hydrated form of magnesium sulfate. The hydrated compound has 7 moles of H_2O for each mole of MgSO_4 . When 5.06 grams of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ are heated to at least $300.^\circ\text{C}$ in a crucible by using a laboratory burner, the water molecules are released. The sample was heated repeatedly, until the remaining MgSO_4 had a constant mass of 2.47 grams. During this laboratory activity, appropriate safety equipment was used and safety procedures were followed.

- Determine the gram-formula mass of the magnesium sulfate heptahydrate.

Base your answers to questions 6 on the information below and on your knowledge of chemistry.

The atomic mass and natural abundance of the naturally occurring isotopes of hydrogen are shown in the table below.

Naturally Occurring Isotopes of Hydrogen

Isotope	Common Name of Isotope	Atomic Mass (u)	Natural Abundance (%)
H-1	protium	1.0078	99.9885
H-2	deuterium	2.0141	0.0115
H-3	tritium	3.0160	negligible

The isotope H-2, also called deuterium, is usually represented by the symbol "D." Heavy water forms when deuterium reacts with oxygen, producing molecules of D_2O .

- Determine the formula mass of heavy water, D_2O .

Base your answers to questions 7 on the information below and on your knowledge of chemistry.

The table below contains selected information about chlorine and two compounds containing chlorine. One piece of information is missing for each of the substances in the table.

Chlorine and Two Compounds Containing Chlorine

Name	Formula	Molar Mass (g/mol)	Phase at STP
chlorine	Cl ₂	71	?
calcium chloride	CaCl ₂	?	solid
1,2-dichloroethene	?	97	liquid

7 Determine the molar mass for calcium chloride.

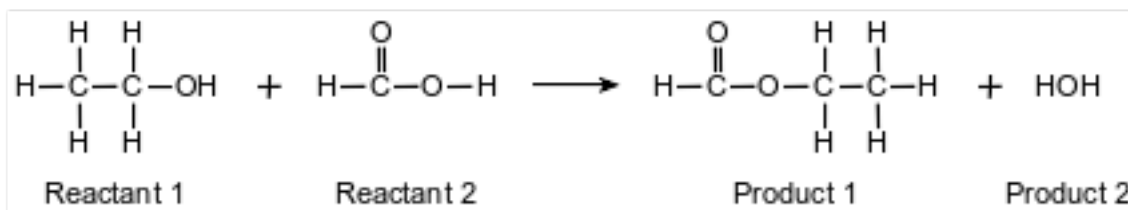
Base your answers to questions 8 on the information below and on your knowledge of chemistry.

Fruit growers in Florida protect oranges when the temperature is near freezing by spraying water on them. It is the freezing of the water that protects the oranges from frost damage. When H₂O(l) at 0°C changes to H₂O(s) at 0°C, heat energy is released. This energy helps to prevent the temperature inside the orange from dropping below freezing, which could damage the fruit. After harvesting, oranges can be exposed to ethene gas, C₂H₄, to improve their color.

8 Determine the gram-formula mass of ethene.

Base your answers to questions 9 on the information below and on your knowledge of chemistry.

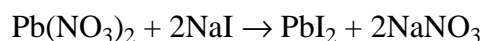
The unique odors and flavors of many fruits are primarily due to small quantities of a certain class of organic compounds. The equation below represents the production of one of these compounds.



9 Show a numerical setup for calculating the gram-formula mass for reactant 1.

Base your answers to questions 10 on the information below and on your knowledge of chemistry.

In a laboratory investigation, a solution that contains 13.2 grams of Pb(NO₃)₂ reacts completely with a solution that contains 12.0 grams of NaI, producing 18.4 grams of PbI₂ and an undetermined mass of a second product, NaNO₃. This reaction is represented by the balanced equation below.



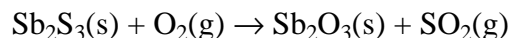
10 Determine the mass of NaNO_3 produced.

Base your answers to questions 11 on the information below and on your knowledge of chemistry.

The two naturally occurring isotopes of antimony are Sb-121 and Sb-123. The table below shows the atomic mass and percent natural abundance for these isotopes.

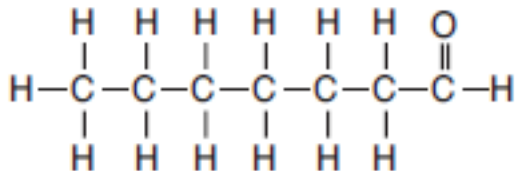
Isotope	Atomic Mass (u)	Natural Abundance (%)
Sb-121	120.90	57
Sb-123	122.90	43

Antimony and sulfur are both found in the mineral stibnite, Sb_2S_3 . To obtain antimony, stibnite is roasted (heated in air), producing oxides of antimony and sulfur. The unbalanced equation below represents one of the reactions that occurs during the roasting.



11 Determine the percent composition by mass of antimony in stibnite (gram-formula mass = 340. g/mol).

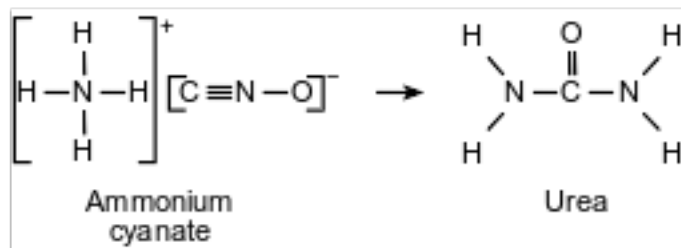
12 Given the formula for heptanal:



Determine the gram-formula mass of heptanal.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

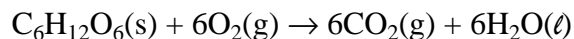
In 1828, Friedrich Wöhler produced urea when he heated a solution of ammonium cyanate. This reaction is represented by the balanced equation below.



13 Determine the gram-formula mass of the product.

Base your answers to questions 14 on the information below and on your knowledge of chemistry.

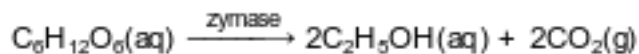
The balanced equation below represents the reaction of glucose, $C_6H_{12}O_6$, with oxygen at 298 K and 101.3 kPa.



- 14 Determine the mass of CO_2 produced when 9.0 grams of glucose completely reacts with 9.6 grams of oxygen to produce 5.4 grams of water.

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

Many breads are made by adding yeast to dough, causing the dough to rise. Yeast is a type of microorganism that produces the catalyst zymase, which converts glucose, $C_6H_{12}O_6$, to ethanol and carbon dioxide gas. The balanced equation for this reaction is shown below.



- 15 Determine the total mass of ethanol produced when 270. grams of glucose reacts completely to form ethanol and 132 grams of carbon dioxide.

Answer Keys

1 3

2 4

3 1

4 1

5 Allow 1 credit for 246 g/mol, or any value from 245.989 g/mol to 247 g/mol, inclusive.

6 Allow 1 credit for 20. u or for any value from 19.999 u to 20.03 u, inclusive.

7 Allow 1 credit for 111 g/mol or any value from 110. g/mol to 111.1 g/mol, inclusive.

8 Allow 1 credit for any value from 28 g/mol to 28.1 g/mol, inclusive.

9 Allow 1 credit. Acceptable responses include, but are not limited to:

- $2(12.011 \text{ g/mol}) + 15.9994 \text{ g/mol} + 6(1.00794 \text{ g/mol})$
- $2(12) + 16 + 6(1)$
- $24.0 + 16.0 + 6.0$

10 Allow 1 credit for 6.8 g. Significant figures do not need to be shown.

11 Allow 1 credit for 71.6% or any value from 71.55% to 72%, inclusive.

12 Allow 1 credit for 114 g/mol. Significant figures do not need to be shown.

13 Allow 1 credit for 60. g/mol. Significant figures do not need to be shown.

14 Allow 1 credit for 13.2 g or for any value from 13.155 g to 13.2042 g, inclusive.

15 Allow 1 credit for 138 g or for any value from 137.8 g to 138.3 g, inclusive.