Empirical Formulae 1

Essential Pre-Uni Chemistry A1.1

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE P2, A Level P1

Find the empirical formulae for the ten compounds in Parts A - J, from the data given below. No compound contains more than 15 atoms in total in its formula. All compositions are by mass.

Element	Atomic Mass	Element	Atomic Mass
Hydrogen	1.0	Chlorine	35.5
Carbon	12.0	Potassium	39.1
Nitrogen	14.0	Vanadium	50.9
Oxygen	16.0	Chromium	52.0
Sulfur	32.1	Lead	207.2

Part A

35.0% **Nitrogen,** 5.0% **Hydrogen,** 60.0% **Oxygen**

35.0% Nitrogen, 5.0% Hydrogen, 60.0% Oxygen

Part B

90.7% **Lead,** 9.3% **Oxygen**

90.7% Lead, 9.3% Oxygen

Part C

26.6% Potassium, 35.3% Chromium, 38.1% Oxygen

26.6% Potassium, 35.3% Chromium, 38.1% Oxygen

Part D

40.3% Potassium, 26.8% Chromium, 32.9% Oxygen

40.3% Potassium, 26.8% Chromium, 32.9% Oxygen

Part E

29.4% Vanadium, 9.2% Oxygen, 61.4% Chlorine

29.4% Vanadium, 9.2% Oxygen, 61.4% Chlorine

Part F

81.8% Carbon, 18.2% Hydrogen

81.8% Carbon, 18.2% Hydrogen

Part G

38.7% **Carbon**, 9.7% **Hydrogen**, 51.6% **Oxygen**

38.7% Carbon, 9.7% Hydrogen, 51.6% Oxygen

Part H

77.4% **Carbon**, 7.5% **Hydrogen**, 15.1% **Nitrogen**

77.4% Carbon, 7.5% Hydrogen, 15.1% Nitrogen

Part I

25.9% **Nitrogen**, 74.1% **Oxygen**

25.9% Nitrogen, 74.1% Oxygen

Part J

29.7% **Carbon**, 5.8% **Hydrogen**, 26.5% **Sulfur**, 11.6% **Nitrogen**, 26.4% **Oxygen**

29.7% Carbon, 5.8% Hydrogen, 26.5% Sulfur, 11.6% Nitrogen, 26.4% Oxygen. In your answer, place the elements in the order just given.

Empirical Formulae 2

Essential Pre-Uni Chemistry A1.2

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE C2, A Level P2

Complete combustion of $6.4\,\text{g}$ of compound K produced $8.8\,\text{g}$ of carbon dioxide and $7.2\,\text{g}$ of water.

> Calculate the empirical formula of K.

Question deck:

STEM SMART Chemistry Week 4

Empirical Formulae 3

Essential Pre-Uni Chemistry A1.3

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE C2, A Level P2

Complete combustion of $1.80\,g$ of compound L produced $2.64\,g$ of carbon dioxide, $1.08\,g$ of water and $1.92\,g$ of sulfur dioxide.

Calculate the empirical formula of L.

Question deck:

STEM SMART Chemistry Week 4

Ar & Mr and Molecular Formula 6

Essential Pre-Uni Chemistry A2.6

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE P2, A Level P1

The relative molecular mass of compound M is 135. M contains $3.7\,\%$ hydrogen, $44.4\,\%$ carbon and $51.9\,\%$ nitrogen by mass.

Find the molecular formula of M.

Question deck:

STEM SMART Chemistry Week 4

Ar & Mr and Molecular Formula 7

Essential Pre-Uni Chemistry A2.7

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE C2, A Level P2

Complete combustion of compound N occurs in a stoichiometric ratio of $1 : 6$ with oxygen gas. Complete combustion of $4.2\,g$ of compound N produces $13.2\,g$ of carbon dioxide and $5.4\,g$ of water.

Find the molecular formula of N.

Question deck:

STEM SMART Chemistry Week 4

Relative Formula Mass

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** A Level P1

Find the relative formula mass of the following substances, giving your answer to the nearest integer.

Part A

$$Na_2Cr_2O_7$$

What is the relative formula mass of $Na_2Cr_2O_7$?

Part B

$$Na_2Cr_2O_7 \cdot 2\,H_2O$$

What is the relative formula mass of $Na_2Cr_2O_7 \cdot 2\,H_2O$?

Part C

Nitric acid

What is the relative formula mass of nitric acid?

Part D
Propanol

What is the relative formula mass of propanol?

Part E
Sodium carbonate

What is the relative formula mass of sodium carbonate?

Question deck:

STEM SMART Chemistry Week 4

Solids 2

Essential Pre-Uni Chemistry B4.2

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE C2, A Level P1

Calculate the mass of the following compounds. Give your answers to the appropriate number of significant figures.

Part A

(a)

0.25 moles of H_2O_2 (l), to 2 significant figures.

Part B

(b)

6.0 moles of C_2H_6 (g), to 2 significant figures.

Part C

(c)

0.40 moles of H_2O (l), to 2 significant figures

Part D

(d)

20.0 moles of Sr (s), to 3 significant figures.

Part E

(e)

1.20 moles of aluminium oxide, to 3 significant figures.

Part F

(f)

7.4 moles of ammonium sulfate, to 2 significant figures.

Question deck:

STEM SMART Chemistry Week 4

Solutions 1

Essential Pre-Uni Chemistry B5.1

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** GCSE P2, A Level P1

Calculate the concentration in $mol\,dm^{-3}$ of the following solutions:

Part A

(a)

$0.40\,g\,NaOH$ in $100\,ml$ water

Part B

(b)

$7.3\,g\,HCl$ in $1000\,ml$ water

Part C

(c)

$2.5\,g\,H_2SO_4$ in $50\,ml$ water

Part D

(d)

15 g $FeSO_4$ in 500 ml water, to 2 significant figures

Part E

(e)

0.16 g $KMnO_4$ in 200 ml

Question deck:

STEM SMART Chemistry Week 4

Homeopathy

Subject & topics: Chemistry | Foundations | Stoichiometry   **Stage & difficulty:** A Level C2

Part A
Arsenous acid

As_2O_3 is moderately soluble in water: one dm^3 of a saturated solution at $25\,°C$ contains $20.6\,g$. When dissolved in water, the oxide reacts to form arsenous acid, H_3AsO_3.

Balance the equation for the formation of arsenous acid from As_2O_3, using the smallest possible integer coefficients (do not include state symbols).

Part B
Saturated solution concentration

As_2O_3 is moderately soluble in water: one dm^3 of a saturated solution at $25\,°C$ contains $20.6\,g$. When dissolved in water, the oxide reacts to form arsenous acid, H_3AsO_3.

Calculate the concentration of the arsenous acid in $mol\,dm^{-3}$ in the saturated solution, giving your answer to 3 significant figures.

Part C
Mass in glass

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Arsenicum album is often sold as a D30 preparation. Let us assume that the initial stock solution before dilution was the saturated solution containing $20.6\,\mathrm{g\,dm^{-3}}$ of As_2O_3.

Calculate the mass (in g) of As_2O_3 present in a $100\,\mathrm{cm^3}$ glass of the D30 *Arsenicum album* remedy, giving your answer to 3 significant figures.

Part D
Fatal dose

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give al in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Arsenicum album is often sold as a D30 preparation. Let us assume that the initial stock solution before dilution was the saturated solution containing 20.6 g dm^{-3} of As_2O_3.

Given that $0.1\,\mathrm{g}$ of As_2O_3 is usually fatal, calculate the volume (in $\mathrm{m^3}$) of the D30 solution that would be needed for a fatal dose of As_2O_3, giving your answer to 3 significant figures.

Volume equivalent

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Arsenicum album is often sold as a D30 preparation. Let us assume that the initial stock solution before dilution was the saturated solution containing $20.6\,\text{g}\,\text{dm}^{-3}$ of As_2O_3.

Given that $0.1\,\text{g}$ of As_2O_3 is usually fatal, calculate the volume of the D30 solution that would be needed for a fatal dose of As_2O_3, expressing your answer as a multiple of the volume of the Earth (approximately $1.08 \times 10^{12}\,\text{km}^3$), i.e. how many Earths would fill the same volume, to 2 significant figures.

Bottles for one atom

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Arsenicum album is often sold as a D30 preparation. Let us assume that the initial stock solution before dilution was the saturated solution containing $20.6\,\text{g}\,\text{dm}^{-3}$ of As_2O_3.

The preparations are usually sold in one ounce bottles ($1\,\text{ounce} = 28\,\text{cm}^3$).

Calculate how many bottles of the D30 solution need to be bought in order, on average, to include one atom of arsenic.

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Another 'remedy' is *Muriaticum acidum* which is actually diluted hydrochloric acid. This is available in various dilutions up to the extremely 'potent' D2000 preparation.

Assuming the original stock solution before dilution was $1.0\,\mathrm{mol\,dm^{-3}}$, what is the concentration of HCl in D2?

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Another 'remedy' is *Muriaticum acidum* which is actually diluted hydrochloric acid. This is available in various dilutions up to the extremely 'potent' D2000 preparation.

Assuming the original stock solution before dilution was $1.0\,\mathrm{mol\,dm^{-3}}$, what is the concentration of HCl in D4?

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Another 'remedy' is *Muriaticum acidum* which is actually diluted hydrochloric acid. This is available in various dilutions up to the extremely 'potent' D2000 preparation.

Assuming the original stock solution before dilution was $1.0\,\mathrm{mol\,dm^{-3}}$, what is the concentration of HCl in D6?

Part J
D8

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Another 'remedy' is *Muriaticum acidum* which is actually diluted hydrochloric acid. This is available in various dilutions up to the extremely 'potent' D2000 preparation.

Assuming the original stock solution before dilution was $1.0\,\mathrm{mol\,dm^{-3}}$, what is the concentration of HCl in D8?

In homeopathy, a decimal-scale is often used to specify the dilution of a given sample: D1 (sometimes labelled 1X) means the sample has been diluted 1 part in 10. D2 (or 2X) means the sample has been diluted 1 in 10, then 1 part of that solution has been further diluted 1 in 10 again to give a 1 in 100 dilution. A D6 (or 6X) solution has repeated this process six times to give a final dilution of 1 in 10^6.

Another 'remedy' is *Muriaticum acidum* which is actually diluted hydrochloric acid. This is available in various dilutions up to the extremely 'potent' D2000 preparation.

Assuming the original stock solution before dilution was $1.0\,\mathrm{mol\,dm^{-3}}$, what is the concentration of HCl in D10?

Adapted with permission from the Cambridge Chemistry Challenge 2012, Question 1