

Empirical Formulae 1

Essential Pre-Uni Chemistry A1.1

GCSE

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A Level

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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



Complete combustion of 6.4 g of compound K produced 8.8 g of carbon dioxide and 7.2 g of water.

Calculate the empirical formula of K.

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Empirical Formulae 3

Essential Pre-Uni Chemistry A1.3



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.

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Ar & Mr and Molecular Formula 6



Essential Pre-Uni Chemistry A2.6

Assume that the mass of an isotope in amu to 3 significant figures is equal to its mass number.

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

Find the molecular formula of M.

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Ar & Mr and Molecular Formula 7

Essential Pre-Uni Chemistry A2.7



Assume that the mass of an isotope in amu to 3 significant figures is equal to its mass number.

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.

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Relative formula mass

A Level



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

Part A $\text{Na}_2\text{Cr}_2\text{O}_7$

What is the relative formula mass of $\text{Na}_2\text{Cr}_2\text{O}_7$?

Part B $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$

What is the relative formula mass of $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$?

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?

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Solids 2

Essential Pre-Uni Chemistry B4.2

GCSE



A Level



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.

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Solutions 1

Essential Pre-Uni Chemistry B5.1



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

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Homeopathy

A Level



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 g dm^{-3} of As_2O_3 .

Calculate the mass (in g) of As_2O_3 present in a 100 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 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 g dm^{-3} of As_2O_3 .

Given that 0.1 g of As_2O_3 is usually fatal, calculate the volume (in 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.

Part E 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 g dm^{-3} of As_2O_3 .

Given that 0.1 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.

Part F 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 g 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.

Part G 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 mol dm^{-3} , what is the concentration of HCl in D2?

Part H 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 mol dm^{-3} , what is the concentration of HCl in D4?

Part I D6

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 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 mol dm^{-3} , what is the concentration of HCl in D8?

Part K D10

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 mol dm^{-3} , what is the concentration of HCl in D10?

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