Formulations

4.8.1.2 · Chemical analysis · revision notes

A formulation is a mixture designed as a useful product, with each component there for a reason. Questions ask you to recognise formulations, suggest what a component does from the information given, and do simple mass or percentage calculations.

Key facts

- Formulation = a mixture that has been designed as a useful product
- Components are mixed in carefully measured quantities so the product has the required properties
- Mass of component = percentage ÷ 100 × total mass
- All the percentages in a formulation add up to 100%
- Each component has a particular purpose
- Examples: fuels, cleaning agents, paints, medicines, alloys, fertilisers, foods
- Percentage = mass of component ÷ total mass × 100

Notes

What a formulation is

- A **formulation** is a mixture that has been designed as a useful product.
- Each component has a particular purpose (job) in the product.
- The components are mixed in **carefully measured quantities** so that the product has the properties it needs.
- A formulation is a mixture, so it is not a pure substance. Changing the amounts of the components changes how the product behaves.
- Not every mixture is a formulation. Crude oil is a mixture, but it was not designed as a useful product and its components are not mixed in measured quantities.

Examples

- Formulations include **fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods**.
- Paint: a pigment gives the colour, a binder sticks the pigment to the surface, and a solvent makes the paint runny enough to spread, then evaporates.
- Medicine tablet: the active ingredient treats the illness; other components bulk out the tablet, hold it together, improve the taste or control how fast it dissolves.
- Alloy: steel is iron mixed with set amounts of carbon (and sometimes other metals) to give it the hardness and strength needed.
- You do not need to learn the ingredients of branded products. The question gives you the information you need.

Formulation calculations

- Mass of a component = (percentage ÷ 100) × total mass.
- Percentage of a component = (mass of component ÷ total mass) × 100.
- The percentages of all the components add up to 100%, and the masses add up to the total mass.

500 g of paint (a formulation)

pigment **20%**	binder **30%**	solvent **50%**
100 g *colour*	150 g *sticks it on*	250 g *spreads, then evaporates*

20% + 30% + 50% = 100%

100 g + 150 g + 250 g = 500 g

Each component has a job; mass = percentage ÷ 100 × total mass.

- Keep the units the same: all in g or all in kg.

How to answer each type of question

Recognise formulations

1 to 2 marks | **Grade 3**

1. Use the definition: a mixture designed as a useful product.
2. Rule out single elements and compounds, such as helium or pure water: they are not mixtures.

Example. Which **two** of these are formulations?
A fertiliser
B helium
C sodium chloride
D washing-up liquid
E iron

Model answer.

A (1)

D (1)

Explain why the components are carefully measured

2 marks | Grade 5

1. Say that each component has a particular purpose in the product.
2. Say that the correct amounts give the product the properties it needs, so it works as intended.

Example. A company makes a hand-cleaning gel. The gel is a formulation.
Explain why the company must measure the amount of each component carefully.

Model answer. Each component has a particular job in the gel (1). The correct amount of each component gives the gel the properties it needs / makes sure it works properly (1).

Suggest the purpose of a component

1 to 2 marks | Grade 5

1. Read the information for clues about what the product must do.
2. Link the component to a property of the product: colour, taste, strength, how it spreads, how it dissolves.
3. Give one clear purpose for each component asked about.

Example. A tablet for treating headaches contains a painkiller, starch, a sweetener and a thin, smooth outer coating.
Suggest the purpose of:
(a) the sweetener
(b) the coating.

Model answer.

(a) To make the tablet taste pleasant (1)
(b) To make the tablet easier to swallow / to protect the tablet (1)

Calculate the mass or percentage of a component

2 to 3 marks | Grade 5

1. If a percentage is missing, subtract the others from 100%.
2. Convert to the unit asked for before you calculate (e.g. kg to g).
3. Use mass of component = percentage ÷ 100 × total mass.
4. Give the unit with your answer.

Example. A 2.5 kg tin of paint contains 24% pigment and 31% binder. The rest is solvent.
(a) Calculate the percentage of solvent in the paint.
(b) Calculate the mass of solvent in the tin. Give your answer in grams.

Model answer.

(a) 100 − 24 − 31 = 45% (1)
(b) 2.5 kg = 2500 g (1)
45 ÷ 100 × 2500 = 1125 g (1)

Don’t lose marks

- Defining a formulation as just 'a mixture'. Say it is a mixture **designed as a useful product**.
- Calling a formulation a pure substance or a compound. Its components are mixed, not chemically joined.
- Saying the amounts are measured 'to make it safe'. The mark is for giving the product the properties it needs.
- Mixing units in calculations, e.g. a total in kg and an answer in g without converting.
- Forgetting to work out a missing percentage (100% minus the others) before finding a mass.

More tips

Memory tricks

- A formulation is a recipe: chosen ingredients, in fixed amounts, each with a job.
- The seven examples: 'Fresh Crisp Pizza Makes Anyone Feel Full' = Fuels, Cleaning agents, Paints, Medicines, Alloys, Fertilisers, Foods.
- Sense check: the masses of the components must add up to the total mass.
- 10% is easy: divide by 10, then scale up (e.g. 30% = 3 × 10%).

Exam technique

- Key phrases: 'mixture designed as a useful product', 'each component has a purpose', 'carefully measured quantities', 'required properties'.
- In 'suggest' questions you are not expected to know the product: use the information in the question.
- Show every step of a calculation and give the unit.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 — **Define a formulation**
A mixture that has been designed as a useful product.

Grade 3 — **Give examples of formulations**
Fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods.

Grade 4 — **Identify formulations from given information**
Look for a product made by mixing measured amounts of components, each with a purpose.

Grade 5 — **Explain why quantities are carefully measured**
The right amount of each component gives the product the properties it needs.

Grade 5 — **Suggest the purpose of a component**
Use the information given, e.g. a pigment gives colour and a sweetener improves taste.

Grade 5 — **Calculate masses and percentages in formulations**
Mass of component = percentage ÷ 100 × total mass, and the reverse.

Grade 7 — **Predict effects of changing a formulation**
Changing the amount of one component changes the properties of the product, so it may no longer do its job.

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