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Barium nitrate solutions

Posted by Anonymous on Thu, 2019-02-21 11:35

Barium nitrate solutions: Is a 0.1M solution of barium nitrate permissible for years 7-10 in NSW Department of Education Schools? It is not clear in the CSIS chemical search. What percentage is a 1M solution of barium nitrate and is it a saturated solution? Can I make up a 0.5M solution of barium nitrate?

Voting:



Average: 5 (1 vote)

Year Level:

7

8

9

10

Senior Secondary

Laboratory Technicians:

Laboratory Technicians

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Barium nitrate solutions

Submitted by sat on 21 February 2019

Answer updated 02 February 2023

As you are in a NSW Department of Education (DoE) school, you are required to follow the directives of your jurisdiction. The Chemical Safety in Schools (CSIS) package in the NSW DoE states that the user group for barium nitrate solid and solutions greater than 1% w/v is years 11–12. Years 7–10 are only permitted to use barium nitrate solutions of less than 1% w/v.¹

The CSIS package often refers to the concentration as a percentage and many schools refer to the concentration of solutions using molarity. Therefore, we need to consider what percentage a 0.1M solution is and if its concentration is <1% w/v. We could also consider what molar solution is equivalent to a 1% w/v solution:

In brief:

- a 0.1M solution of barium nitrate is greater than a 1% solution and is not permitted for years 7–10 in NSW DoE schools
- It is not possible to make up 1M and 0.5M solutions of barium nitrate as the barium nitrate reaches its saturation point at 0.38M or 10.1% at 25°C.

Some suggestions:

- Prepare a 0.1M solution and then dilute this to make 0.025M solution (<1%)
- Prepare a 0.9% solution of barium nitrate to provide a solution <1% (equivalent of 0.038M)
- If you are conducting a precipitation activity to identify cations and anions, you could substitute with a 0.1M solution of barium chloride, which is permitted for use by years 7–10 in NSW DoE schools
- Where possible use microscale techniques

Molarity, percentage and saturated solutions

Molarity indicates the number of moles of solute dissolved in a litre of the solution; has the symbol M, and the unit, moles per litre (mol/L).

Percentage concentration indicates the mass (or volume) of solute dissolved (or diluted) in 100g or mL, as appropriate, of the solution. It can be expressed as %w/v, %v/v or %w/w.

A saturated solution is one in which, at the temperature specified, no more solute can be dissolved in the solvent.

Science ASSIST has prepared some Laboratory Notes for the preparation of solutions, which contain more detail on calculating concentrations of solutions. See <https://assist.asta.edu.au/resource/4415/laboratory-notes-preparing-chem...>

The following links are online calculation tools, which may be helpful to check your calculations:

- 'Mass Molarity Calculator', Sigma-Aldrich website, <https://www.sigmaaldrich.com/US/en/support/calculators-and-apps/mass-molarity-calculator>

(Accessed July 2019) (This also has a link to a solution dilution calculator)

- 'Molarity Calculator', Omni Calculator website,
<https://www.omnicalculator.com/chemistry/molarity> (Link updated January 2021)

Barium nitrate solutions

Molecular formula: $\text{Ba}(\text{NO}_3)_2$

Molecular weight of barium nitrate is 261.3

Solubility: 10.1g per 100mL at 25°C

The following table compares the concentration expressed as molarity and by percentage and the required mass for different volumes.

Concentration (Molarity)	Concentration (% w/v)	Final volume of solution		
		100mL	250mL	1000mL
0.1M	2.613	2.61g	6.53g	26.13g
0.5M (not soluble)	13.1 (not soluble)	NA	NA	NA
1.0M (not soluble)	26.13 (not soluble)	NA	NA	NA
0.038M	1.0	1g	2.5g	10g
Saturated (25°C) Approx. 0.39M	Saturated (25°C) Approx. 10.1%	10.1g	25.3g	101g

What percentage solution is a 0.1M solution of barium nitrate?

0.1M solution requires 2.61g in 100mL, which is the equivalent of 2.61% w/v

What molar solution is equivalent to a 1% w/v solution of barium nitrate?

A 1% w/v solution means that 1g is dissolved in 100mL water or 10g is dissolved in 1000mL

Number of moles of a chemical = mass chemical/molecular weight

Number of moles in 10g of barium nitrate = $10\text{g}/261.3\text{g} = 0.038$ moles

Molarity of 10g of barium nitrate in 1 litre = 0.038M

Alternatives

If you are conducting a precipitation activity to identify cations and anions we suggest that you use a 0.1M solution of barium chloride. Barium chloride is more soluble in water than barium nitrate and a 0.1M solution of barium chloride is permitted for use by students in years 7–12 in NSW Department of Education schools.

In addition, we suggest that you consider doing it on a microscale, by using one drop of each solution on an acetate sheet (like an overhead projector sheet), spotting tile or a laminated white or black sheet of paper (that will show up the precipitate clearly). This reduces the amount of toxic/heavy metal waste produced and can be simply washed off or cleaned with a tissue or paper towel.

Barium chloride solutions

Molecular formula: $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$

Molecular weight of barium chloride is 244.26

Solubility: 37g per 100mL at 25°C

The following table compares the concentration expressed as molarity and by percentage and the required mass for different volumes.

Concentration (Molarity)	Concentration (% w/v)	Final volume of solution		
		100mL	250mL	1000mL
0.1M	2.44	2.45g	6.11g	24.43g
0.5M	12.21	12.21g	30.53g	122.13g
1.0M	24.43	24.43g	61.07g	244.26g

0.041M	1	1g	2.5g	10g
Saturated (25°C)	Saturated (25°C)			
Approx. 1.5M	Approx. 37%	37g	92.5g	370g

Saturated solution of barium chloride

The solubility of barium chloride is 37g/100mL water at 25°C.

Therefore, it is not possible to dissolve more than 37g in 100mL water at 25°C, however it is possible to make up a 1M and 0.5M solution of barium chloride as the amount required will dissolve.

References and further reading:

¹ NSW Department of Education, 'Chemical Safety in Schools (CSIS)' resource package. NSW DoE website, <https://education.nsw.gov.au/> DoE Intranet, login required.

Science ASSIST. 2018. Laboratory notes: Preparing chemical solutions. Science ASSIST website. <https://assist.asta.edu.au/resource/4415/laboratory-notes-preparing-chemical-solutions>

Chem Supply website, (2022) '*Safety Data Sheet*'. Please search the product information page on the website for the latest version for barium chloride and barium nitrate <https://shop.chemsupply.com.au/>

Science ASSIST. 2018. Chemical Management Handbook, Edition 3. Science ASSIST website. <https://assist.asta.edu.au/resource/4193/chemical-management-handbook-australian-schools-edition-3?search-id=b7533ed>

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