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Gravimetric Calibration of Glassware

Practical 13 - Bench practical

Aim

To determine the delivered or contained volume of volumetric glassware by weighing water under recorded conditions.

Principle

A known water mass is converted to volume using the water density at the measured temperature. Calibration distinguishes glassware designed to contain a volume from glassware designed to deliver it.

Drainage, meniscus setting, cleanliness, temperature and balance performance contribute to uncertainty. The number of repeat determinations and the acceptance limit follow the chosen calibration procedure.

Materials and Requirements

- Calibrated analytical balance
- Clean glassware identified as to-deliver or to-contain
- Suitable water and calibrated thermometer
- Weighing vessel and timer

Procedure

1. Record glassware type, nominal volume, identification, class, delivery convention, temperature and applicable tolerance.
2. Check balance readiness and allow glassware and water to approach the measurement temperature.
3. For delivered volume, condition the pipette or burette as prescribed and tare the receiving vessel.
4. Set the meniscus at eye level and deliver using the specified drainage and waiting conditions. Avoid blowing out a pipette unless its design requires it.
5. Weigh the delivered water, measure temperature and repeat independent deliveries using the same documented technique.
6. Calculate volume from the applicable water-density or calibration correction factor. Evaluate mean error and repeatability.
7. Record corrections, uncertainty contributors and a justified conclusion on suitability for the intended measurements.

Observations and Record

Enter actual measurements or the supplied teaching data. Record the method, material identity, conditions and units.

Replicate	Water mass (g)	Temperature (degrees C)	Calculated volume (mL)
1	Record	Record	Calculate
2	Record	Record	Calculate
3	Record	Record	Calculate
Mean / variation	Calculate	State condition	State error

Calculations

- Volume = water mass / water density, for the simplified teaching calculation
- Volume error = mean actual volume - nominal volume
- Relative error (%) = volume error / nominal volume x 100

Worked Example

Illustrative delivery: water mass 9.970 g and density 0.9982 g/mL at the stated condition.

Delivered volume = 9.970/0.9982 = 9.988 mL approximately.

For a nominal 10.000 mL pipette, the error is about -0.012 mL. A formal calibration also evaluates the correction and uncertainty terms required by its procedure.

Result and Interpretation

- Report mean volume, repeatability, measurement conditions and the relevant tolerance.
- A correction is not the same as uncertainty; both may matter to the intended use.
- Keep the certificate or calibration worksheet with the glassware identification.

Precautions

- Avoid evaporation and handling a warm weighing vessel.
- Use an appropriate balance resolution for the nominal volume.
- Read the meniscus consistently.
- Do not transfer a to-contain convention to a to-deliver device.

Viva Questions and Answers

Why record temperature?

Water density and glassware volume depend on temperature.

Why repeat deliveries?

Repeatability is a distinct component of volumetric performance.

Why avoid fingerprints on the weighing vessel?

Handling can alter mass and temperature.

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