Draw Test Tubes with Rim Ellipses and Liquid Levels

Original tasks 1, 2 / complete keys

Task 1

Draw a test tube 8 cm tall and 2 cm wide with a liquid level 5 cm from the bottom curve start. Use rim ellipse major axis 2 cm, minor axis 0.6 cm; liquid surface ellipse major axis 2 cm, minor axis 0.3 cm. No rack.

Answer: A vertical tube with parallel sides 2 cm apart, semicircular bottom radius 1 cm, rim ellipse as specified, and liquid surface ellipse at 5 cm from the bottom curve start. Empty space above liquid is 3 cm.

Reason: The tube height is 8 cm; liquid height is 5 cm; 8 minus 5 equals 3 cm empty space. The ellipses follow the convention and are centered on the centerline.

Check: Measure the liquid line from the bottom curve start; confirm 5 cm. Subtract from 8 cm to get 3 cm. Check that the rim ellipse minor axis is 0.6 cm and the liquid ellipse minor axis is 0.3 cm.

Task 2

Draw a test tube 12 cm tall and 3 cm wide with a liquid level 7 cm from the bottom curve start. Scale the rim ellipse to major axis 3 cm and minor axis 0.9 cm; liquid surface ellipse major axis 3 cm and minor axis 0.45 cm. Place it in a rack bar 10 cm wide and 1 cm tall.

Answer: A tube with sides 3 cm apart, bottom radius 1.5 cm, rim ellipse 3 cm by 0.9 cm, liquid surface ellipse 3 cm by 0.45 cm at 7 cm from the bottom curve start, and a rack bar 10 cm by 1 cm with a centered hole ellipse. Empty space above liquid is 5 cm.

Reason: The scaled ellipses keep the same proportion as the 2 cm example. The height check is 12 minus 7 equals 5 cm. The rack hole is centered on the tube centerline.

Check: Confirm the tube width is 3 cm and the bottom radius is 1.5 cm. Measure liquid height 7 cm and subtract from 12 cm to get 5 cm. Check that the hole ellipse is centered and the tube sides align with the hole edges.

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Original tasks 3, 4 / complete keys

Task 3

A test tube is 10 cm tall and 2 cm wide. The liquid level is 4 cm from the bottom curve start. Draw the tube and liquid level using the convention. Then state the empty space above the liquid.

Answer: A tube with rim ellipse 2 cm by 0.6 cm, liquid surface ellipse 2 cm by 0.3 cm at 4 cm from the bottom curve start. Empty space is 6 cm.

Reason: Total height 10 cm minus liquid height 4 cm equals 6 cm empty space. The liquid surface ellipse is shallower than the rim ellipse and centered on the centerline.

Check: Measure 4 cm up from the bottom curve start. Subtract from 10 cm to get 6 cm. Verify the liquid ellipse ends touch the tube sides.

Task 4

Draw two test tubes side by side in a rack bar 12 cm wide and 1 cm tall. Each tube is 9 cm tall and 2 cm wide, with liquid levels 6 cm from the bottom curve start. Use the convention for rim and liquid ellipses. Space the tubes 4 cm apart center to center.

Answer: Two vertical tubes with parallel sides 2 cm apart, bottom radius 1 cm, rim ellipses 2 cm by 0.6 cm, and liquid surface ellipses 2 cm by 0.3 cm at 6 cm from the bottom curve start. The rack bar is 12 cm by 1 cm with two centered hole ellipses spaced 4 cm apart. Empty space above each liquid is 3 cm.

Reason: Each tube height 9 cm minus liquid height 6 cm equals 3 cm empty space. The center-to-center spacing is 4 cm, so the tubes do not overlap. The rack holes are centered on each tube centerline.

Check: Measure each liquid height as 6 cm and subtract from 9 cm to get 3 cm. Check that the distance between tube centerlines is 4 cm and that each hole ellipse is centered on its tube.

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Source rubric / reflection

- [ ] Tube sides are parallel and the bottom curve meets them smoothly.
- [ ] Rim ellipse follows the convention: horizontal major axis, vertical minor axis, front half darker.
- [ ] Liquid level is a shallow ellipse centered on the centerline and touches the tube sides.
- [ ] Height check uses consistent units and simple subtraction.
- [ ] Rack hole ellipse is centered on the tube centerline and the tube passes through it.
- [ ] Valid alternatives are accepted if the convention is followed and proportions are consistent.

Reflection: What did you check, what did you change, and what will you try next?