Volume of Pyramids

Investigate mistakes and missing measures

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

A pyramid has volume $V = \frac{1}{3}Bh$, where B is base area and h is perpendicular distance from the apex to the base plane. For rectangular bases, $B = lw$; for triangular bases, $B = \frac{1}{2}bt$. Base-triangle height t, pyramid height h, and face slant height are different measurements. To reverse the formula, use $h = 3V/B$ or $B = 3V/h$.

Worked example

A pyramid has rectangular base 6 by 5 and perpendicular height 9. Find volume.

1. The rectangular base area is $B = 6(5) = 30$ square units.
2. The perpendicular height is 9 units. Substitute $V = \frac{1}{3}Bh = \frac{1}{3}(30)(9) = 90$ cubic units.
3. The volume is 90 cubic units. The matching prism holds 270 cubic units, exactly three times this amount; surface slant height is not used.
Answer: 90 cubic units

Practice Problems

Show your thinking.

1. A pyramid has volume 84 and base area 28. Recover its perpendicular height.

2. A pyramid has volume 150 and height 10. Recover its base area.

3. A square pyramid has volume 75 and height 9. Recover its base side.

4. A student uses $6(4)(9) = 216$ for a rectangular pyramid. Correct its volume.

5. A square pyramid has side 6, perpendicular height 4, and face slant height 5. A student uses 5 in volume. Correct it.

6. A triangular-base pyramid has volume 60 and perpendicular height 10. Its base triangle has base 6. Recover the base-triangle height.

7. A pyramid height doubles while its base dimensions stay fixed. Original volume is 42. Find the new volume.

8. A square pyramid doubles its base side while keeping height fixed. Original volume is 18. Find the new volume.

9. A rectangular pyramid has volume 96, height 6, and base length 8. Recover base width.

10. A student says a pyramid with base area 24 and height 9 has volume $24 + 9 = 33$. Correct the operation.

Answer Key

1. 9 units
2. 45 square units
3. 5 units
4. 72 cubic units
5. 48 cubic units
6. 6 units
7. 84 cubic units
8. 72 cubic units
9. 6 units
10. 72 cubic units

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The formula gives $84 = \frac{1}{3}(28)h$. Multiply both sides by 3: $252 = 28h$.

2. Divide by 28 to get $h = 252/28 = 9$ units.

3. Check $\frac{1}{3}(28)(9) = 84$ cubic units. Dividing volume by base area without the factor 3 would give only one third of the height.

Problem 2

1. The equation is $150 = \frac{1}{3}B(10)$.

2. Multiply by 3 and divide by 10: $B = 3(150)/10 = 45$ square units.

3. The check $\frac{1}{3}(45)(10) = 150$ cubic units verifies the base area. Its units are square, not linear or cubic.

Problem 3

1. The base area is $B = 3V/h = 3(75)/9 = 25$ square units.

2. For a square, $s^2 = 25$, so its positive side is $s = 5$ units.

3. Check $\frac{1}{3}(5^2)(9) = 75$. The recovered base area 25 is not itself the requested side length.

Problem 4

1. The base area is $6(4) = 24$ square units, and the perpendicular height is 9.

2. The pyramid volume is $\frac{1}{3}(24)(9) = 72$ cubic units.

3. The student found the matching prism volume 216 and omitted the one-third factor; $216/3 = 72$ gives the correction.

Problem 5

1. The square base area is $6^2 = 36$ square units. The correct height for volume is 4.

2. Thus $V = \frac{1}{3}(36)(4) = 48$, not $\frac{1}{3}(36)(5) = 60$.

3. The slant-height substitution overstates the volume by $60 - 48 = 12$ cubic units; slant height belongs to triangular-face area calculations.

Problem 6

1. The required base area is $B = 3(60)/10 = 18$ square units.

2. For that triangle, $18 = \frac{1}{2}(6)t = 3t$, so $t = 6$ units.

3. Check $\frac{1}{3}[\frac{1}{2}(6)(6)](10) = 60$. The recovered triangle height differs from the given pyramid height 10.

Problem 7

1. The volume formula is linear in height: $V = \frac{1}{3}Bh$. The new height is $2h$.

2. Then $V\prime = \frac{1}{3}B(2h) = 2V = 2(42) = 84$ cubic units.

3. The volume factor is 2, not 8, because only height changed; the base lengths and base area did not scale.

Problem 8

1. Doubling side changes base area from s^2 to $(2s)^2 = 4s^2$.

2. Height is unchanged, so $V\prime = \frac{1}{3}(4B)h = 4V = 4(18) = 72$ cubic units.

3. The volume factor is 4, not 2 or 8. Two base dimensions changed, while the third dimension stayed fixed.

Problem 9

1. The base area is $B = 3(96)/6 = 48$ square units.

2. The rectangular base gives $8w = 48$, so $w = 48/8 = 6$ units.

3. The check $\frac{1}{3}(8)(6)(6) = 96$ cubic units confirms the width; all three factors represent distinct dimensions.

Problem 10

1. Base area times height gives the prism product $24(9) = 216$ cubic units; adding them mixes unlike units.

2. The pyramid takes one third of the product: $V = 216/3 = 72$ cubic units.

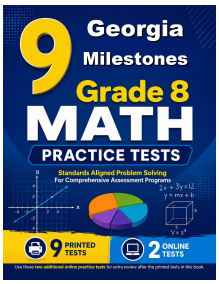
3. The correct 72 follows $V = \frac{1}{3}Bh$, while 33 is neither a valid geometric product nor a volume with consistent units.

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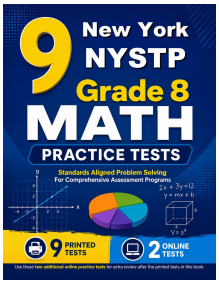
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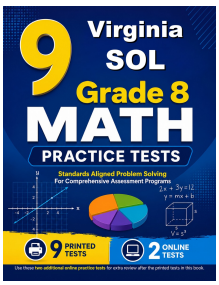
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