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Mon 18 Mar 13

9.8: The Pythagorean Theorem and Space Figures

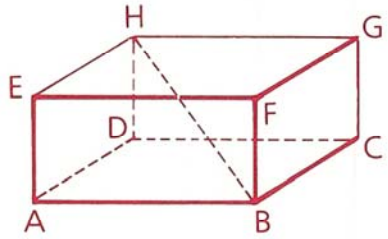
9.8: 413/1-6, 11-15

Objective

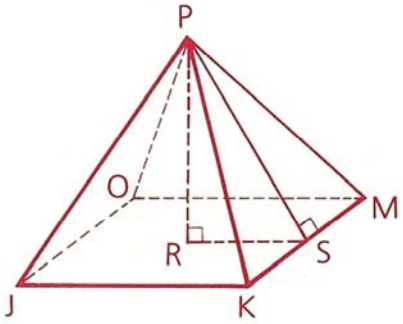
After studying this section, you will be able to

- Apply the Pythagorean Theorem to solid figures

Part One: Introduction



Rectangular Solid



Regular Square Pyramid

Many of the problems in this section will involve the two figures shown above.

In the rectangular solid:

ABFE is one of the 6 rectangular ***faces***

$\overline{AB}$ is one of the 12 ***edges***

$\overline{HB}$ is one of the 4 ***diagonals*** of the solid. (The others are $\overline{AG}$, $\overline{CE}$, and $\overline{DF}$.)

In the regular square pyramid:

JKMO is a square, and it is called the ***base***

P is the ***vertex***

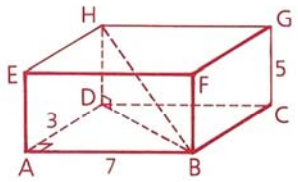
$\overline{PR}$ is the ***altitude*** of the pyramid and is perpendicular to the base at its center.

$\overline{PS}$ is called a ***slant height*** and is perpendicular to a side of the base.

Note A ***cube*** is a rectangular solid in which all edges are congruent.

Part Two: Sample Problems

Problem 1 *The dimensions of a rectangular solid are 3, 5, and 7. Find the diagonal.*



Solution It does not matter which edges are given the lengths 3, 5, and 7. Let AD = 3, AB = 7, and HD = 5, and use the Pythagorean Theorem twice.

In △ABD,

$3^2 + 7^2 = (DB)^2$

$9 + 49 = (DB)^2$

$\sqrt{58} = DB$

In △HDB,

$5^2 + (\sqrt{58})^2 = (HB)^2$

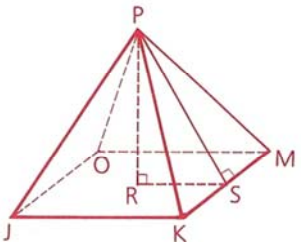
$25 + 58 = (HB)^2$

$\sqrt{83} = HB$

The measure of the diagonal is $\sqrt{83}$.

Problem 2 *Given: The regular square pyramid shown, with altitude* $\overline{PR}$ *and slant height* $\overline{PS}$*, perimeter of* JKMO = 40, PK = 13

Find: **a** JK **b** PS **c** PR



Solution

a $JK = \frac{1}{4}(40) = 10$

b The slant height of the pyramid is the ⊥ bis. of $\overline{MK}$, so PSK is a right △.

$(SK)^2 + (PS)^2 = (PK)^2$

$5^2 + (PS)^2 = 13^2$

$PS = 12$

c The altitude of a regular pyramid is perpendicular to the base at its center. Thus, $RS = \frac{1}{2}(JK) = 5$, and PRS is a right △.

$(RS)^2 + (PR)^2 = (PS)^2$

$5^2 + (PR)^2 = 12^2$

$25 + (PR)^2 = 144$

$PR = \sqrt{119}$

AMDG

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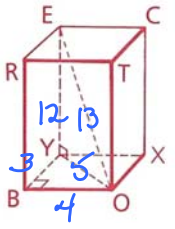
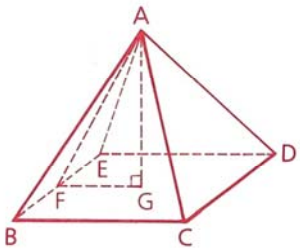
1 Given: The rectangular solid shown,
BY = 3, OB = 4, EY = 12
Find: **a** YO, a diagonal of face BOXY 5
b EO, a diagonal of the solid 13

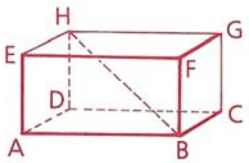


2 Find the diagonal of a rectangular solid whose dimensions are 3, 4, and 5.

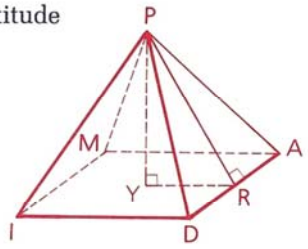
3 Given: Regular square pyramid ABCDE,
with slant height $\overline{AF}$, altitude $\overline{AG}$,
and base BCDE;
perimeter of BCDE = 40,
$\angle AFG = 60°$
Find: The altitude and the slant height



4 Given: The rectangular solid shown,
GC = 8, HG = 12, BC = 9
Find: **a** HB, a diagonal of the solid
b AG, another diagonal of the solid



5 Given: The regular square pyramid shown, with altitude $\overline{PY}$ and slant height $\overline{PR}$,
ID = 14, PY = 24



Find: **a** AD

b YR

c PR

d The perimeter of base AMID

e A diagonal of the base (not shown in the diagram)

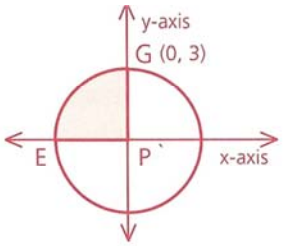
6 Find the slant height of a regular square pyramid if the altitude is 12 and one of the sides of the square base is 10.

11 Given: ⊙P as shown

Find: **a** The coordinates of point E

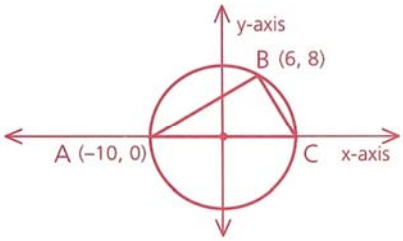
b The area of sector EPG to the nearest tenth

c The length of $\overset{\frown}{GE}$ to the nearest tenth



12 Given: Diagram as marked

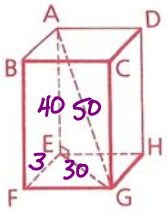
Find: AB (the length of $\overline{AB}$)

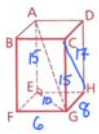


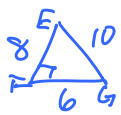
13 ABCDEFGH is a rectangular solid.

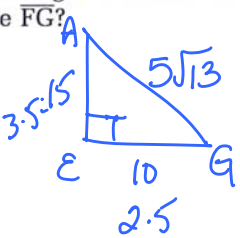
a If face diagonal $\overline{CH}$ measures 17, edge $\overline{GH}$ measures 8, and edge $\overline{FG}$ measures 6, how long is diagonal $\overline{AG}$? $5\sqrt{13}$

b If diagonal $\overline{AG}$ measures 50, edge $\overline{AE}$ measures 40, and edge $\overline{EF}$ measures 3, how long is edge $\overline{FG}$?



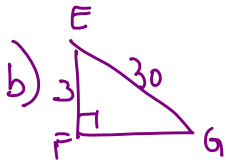






$5(2, 3, \sqrt{13})$

$5(2^2+3^2=13)$



$3(1, \_\_, 10)$

$3(1^2 + ?^2 = 10^2)$

$3(\ ?^2 = 100-1$

$3(\ ? = \sqrt{99})$

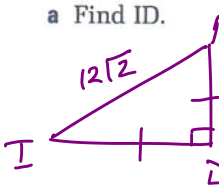
$3(\sqrt{9 \cdot 11})$

$3(3\sqrt{11})$

$9\sqrt{11}$

14 PADIM is a regular square pyramid. Slant height $\overline{PR}$ measures 10, and the base diagonals measure $12\sqrt{2}$.

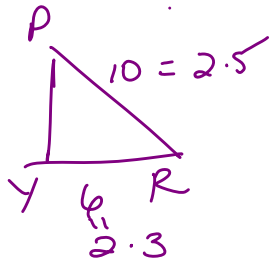
a Find ID.



45.45.90
x x x$\sqrt{2}$
$12\sqrt{2}$

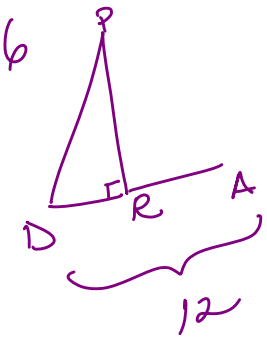
ID = 12

b Find the altitude of the pyramid. $YR = \frac{1}{2}(12) = 6$

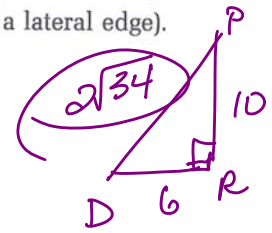


$PY = 2 \cdot 4 = 8$

c Find RD. = 6

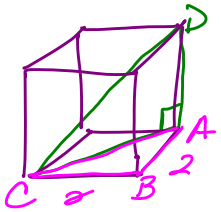


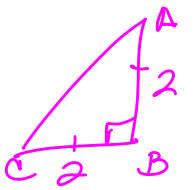
d Find PD (length of a lateral edge).



$2(3, 5, \sqrt{34})$
$2(3^2 + 5^2 = 34$

15 Find the diagonal of a cube if each edge is 2.





45 45 90
x x x$\sqrt{2}$
2 $2\sqrt{2}$

$2(1, \sqrt{2}, \sqrt{3})$
$2(1^2 + \sqrt{2}^2 = 3$