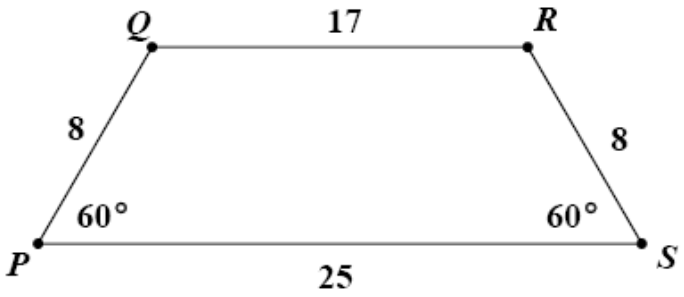
# Grade 9 Mathematics Worksheet

**Space, measurement and shape**

**Questions:**

1. i) What is the area of trapezoid *PQRS*, whose measures are shown in the diagram?




ii) An equilateral triangle has a perimeter of 24 cm. What is the area in square centimetres of the triangle formed by connecting the midpoints of the sides of the original triangle? Express your answer in simplest form.

iii) A 25 metre support beam leans against a wall as shown. The base of the beam is 7 meters from the wall. If the top of the beam is to be lowered by 4 meters, how many meters farther away from the wall will the base of the beam be after it is lowered?

iv) The diagram consists of three nested squares. Find the ratio of the area of the smallest square to the area of the largest square.

v) Find the perimeter of the polygon shown. The triangles are all right triangles.

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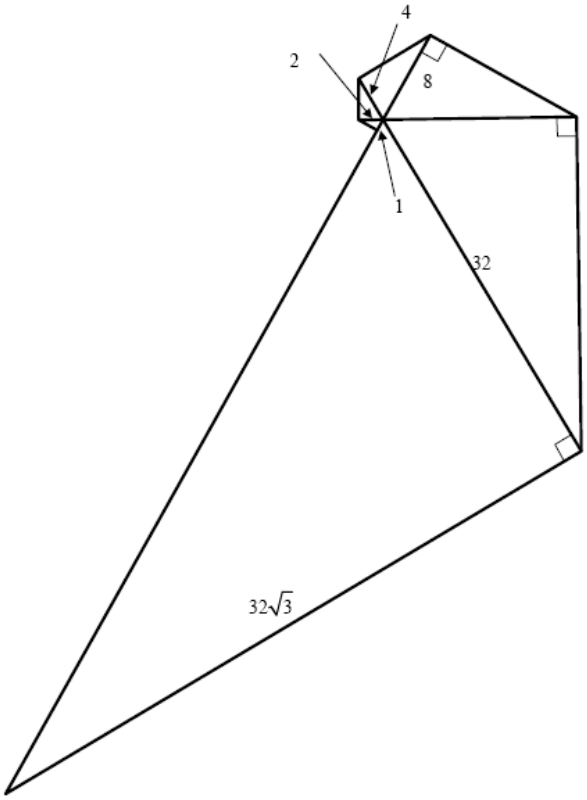
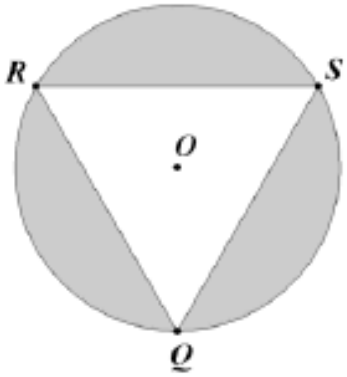



vi) Equilateral triangle *QRS* is inscribed in circle *O*. The radius of the circle is 8 units. The area of the shaded region can be expressed as $x\pi - y^3$, where *x* and *y* are positive integers. Find the ordered pair (*x*, *y*).




vii) A circular table is pushed into the corner of a square room so that a point P on the edge of the table is 8 cm from one wall and 9 cm from the other wall as shown. Find the radius of the circular table in inches.

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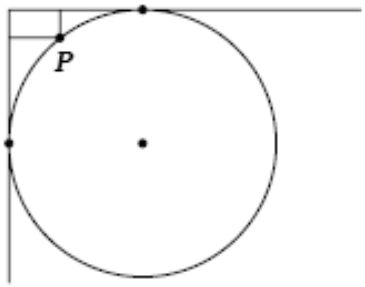
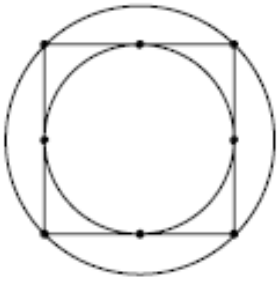
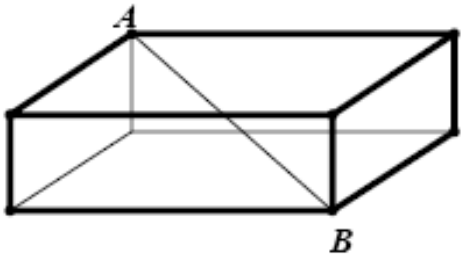



viii) The square shown is externally tangent to the smaller circle and internally tangent to the larger circle. Find the ratio of the area of the smaller circle to the area of the larger circle



ix) A rectangular solid has dimensions 3 cm by 4 cm by 12 cm. What is the length, in centimetres, of the diagonal *AB* of the solid?




x) The semicircle shown has centre O and diameter AB. A rectangle whose length is twice its width has two vertices on the semicircle. Find the ratio of the area of the semicircle to the area of the rectangle.

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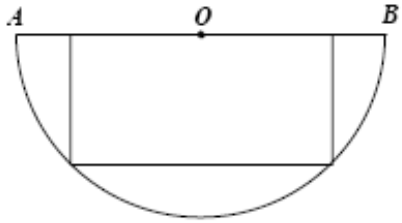
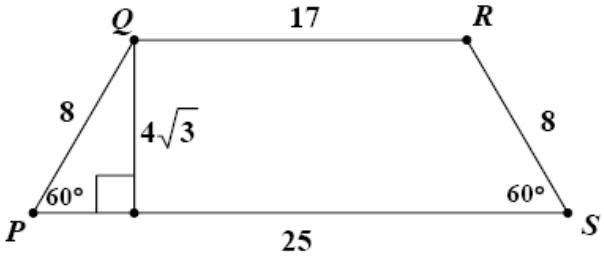


# Grade 9 Mathematics Worksheet

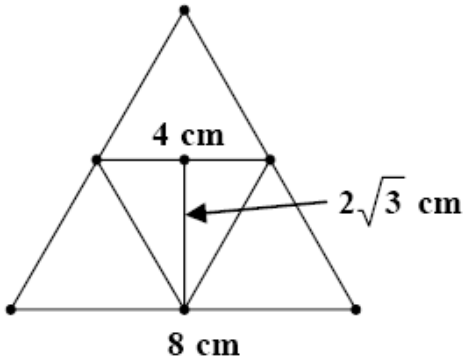
**Solution**

1. i)




Draw the perpendicular segment from Q or R to PS. The height of the trapezoid is the same as the height of the 30°-60°-90° triangle: $4\sqrt{3}$ units. The area of trapezoid PQRS is 84 $\sqrt{3}$ square units.

ii) An equilateral triangle has a perimeter of 24 cm. What is the area in square centimetres of the triangle formed by connecting the midpoints of the sides of the original triangle? Express your answer in simplest form.




Draw an equilateral triangle and the triangle formed by connecting the midpoints of its sides. Draw the altitude. Use the 1: $\sqrt{3}$ :2 ratio for a $30^{\circ}$-$60^{\circ}$-$90^{\circ}$ triangle to find the length of the altitude, 2 $\sqrt{3}$ cm. The area of the small triangle is $\frac{1}{2} 2\sqrt{3} . 4 = 4\sqrt{3}$ $cm^2$.

iii) As shown in the diagram, the beam forms a 7:24:25 triangle. When it is lowered the beam forms a 15:20:25 triangle. The base of the beam has moved 8 metres farther away from the wall.

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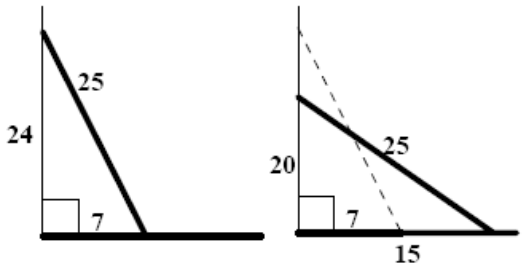
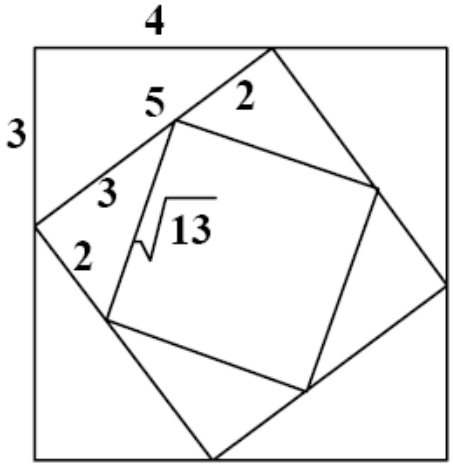



iv) The side length of the middle square is equal to the length of the hypotenuse of the right triangle with legs of length 3 and 4 units. The side length of the middle square is 5 units. The side length of the smallest square is equal to the length of the hypotenuse of a right triangle with legs of length 2 and 3 units, which is $\sqrt{13}$. The ratio of the area of the smallest square to the area of the largest square is $\frac{13}{49}$.




v) The figure comprises a series of $30^{\circ}$-$60^{\circ}$-$90^{\circ}$ triangles. The hypotenuse of the largest triangle measures 64 units. The long leg of the second largest triangle measures 16 $\sqrt{3}$ units. The long legs of the third, fourth, fifth and sixth triangles measure 8 $\sqrt{3,4}$ $\sqrt{3,2}$ $\sqrt{3}$, and 3units. The perimeter is 63 + 63 $\sqrt{3}$, the sum of the lengths of the long legs of the triangles and the 63 units remaining on the hypotenuse of the largest triangle.

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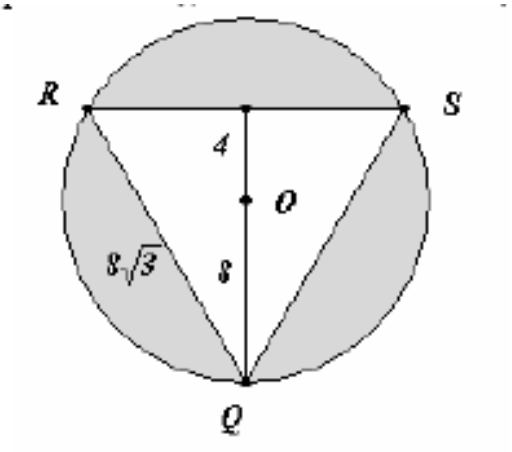
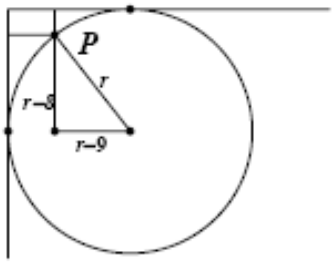
vi)




Draw an altitude of the triangle. The centre of the circle O divides the altitude into lengths that are in ratio of 2:1. The length of the radius is 8 units. The length of the altitude is 12 units and the length of a side of the triangle is $8\sqrt{3}$ units. The area of the shaded region is $8^{2}.\ \pi - \frac{1}{2} \cdot 12.\ 8\sqrt{3}$ or $64\pi - 48\sqrt{3}$ square units.
The ordered pair is (64, 48).

vii) Draw the radius to P, and the horizontal and vertical legs of the right triangle. The radius is the hypotenuse. The legs are shorter than the radius by 8 and 9 cm respectively. Use the Pythagorean Theorem, $(r - 9)^2 + (r - 8)^2 = r^2$. Simplifying: $r^2 - 34r + 145 = 0$ or $(r - 29)(r - 5) = 0$. This equation has two solutions r = 29 and r = 5. Only r = 29 makes sense in the context of the problem so the radius of the table has a length of 29cm.



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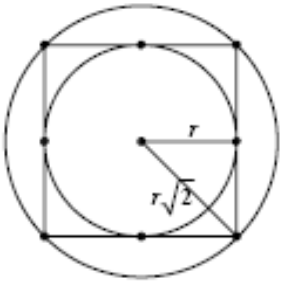
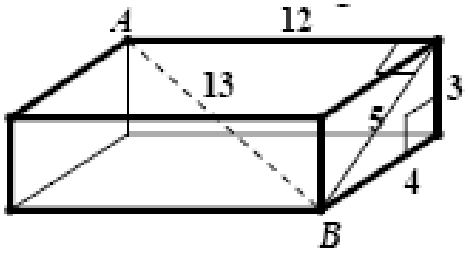
viii)



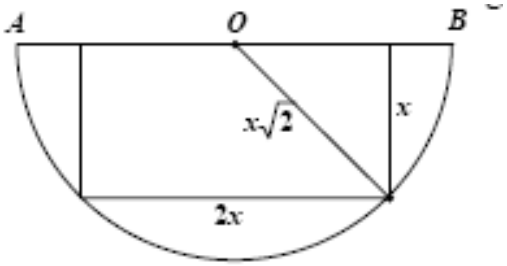

Draw the radius, r, of the small circle to the midpoint of a side of the square. Draw the radius of the large circle to a vertex of the square, forming a 45°-45°-90° right triangle. Therefore this radius has a measure of $r\sqrt{2}$. The ratio of the areas of the smaller circle to the larger circle is $\frac{\pi . r^2}{\pi\left(r\sqrt{2}\right)^2}\ \frac{\pi r^2}{\pi 2r^2}=\frac{1}{2}$.

ix)




Draw a face diagonal along one of the 3 cm by 4 cm faces. The face diagonal measures 5 cm. The face diagonal, the 12 cm edge, and AB are the sides of a right triangle. AB = 13 cm.

x)




Draw the radius to a vertex of the rectangle on the semicircle. Let the width of the rectangle be x units. The ratio of the area of the semicircle to the area of the rectangle is:

$\frac{\pi x^2}{2x^2}=\frac{\pi}{2}$.

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Several different aspects of measurement are assessed using various contexts involving shapes.