MATH 202 EXAM 3 Sample problems

① Mike bought a big white board measuring 3 yards wide, with an area of 5 square yards. Give the width and area in units related to inches.

1 yard = 3 feet = 3×12 inches → 3 yards = 3×3×12 inches

1 square-yard = (3×12)×(3×12) square inches → 5 sq-yards = 5×3×12×3×12 sq-inches

② 1 inch = 2.54cm. Tim wants to fill a container that has volume 80 cubic inches. If water flows into the container at 10 cubic centimeters per second, how long will it take to fill the container?

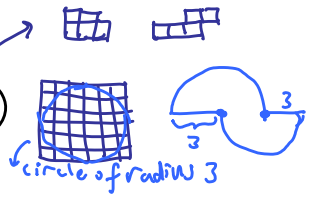
1 in = 2.54cm

1 sq-in = 2.54×2.54 = 6.4516 sq-cm

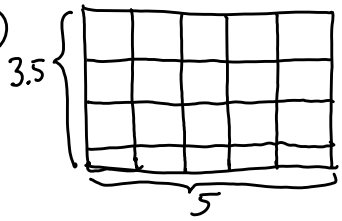
1 cubic inch = $(2.54)^3$ = 16.387044 cubic cm → 80 cubic inches = 80×16.387044 cm^3 = 1310.96512 cm^3

it takes $\frac{1310.96512}{10}$ seconds to fill the container

③ Draw two different regions (on a grid) having area
- (a) 5 units (2 pictures for this)
- (b) 9π units (2 pictures for this)



④



(a) Find the area by counting

(b) Show a corresponding product and explain why it gives the area using grouping definition of multiplication

Similar to a quiz question.

⑤ How many 3×2×1 rectangular blocks can you fit in a box with dimensions 5×8×4 ?

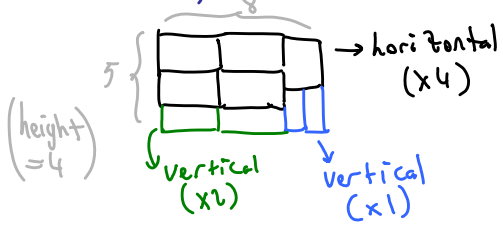
5×8×4 = 160

3×2×1 = 6

$\frac{160}{6}$ = 26.666...

We can't fit more than 26 boxes, but can we fit 26?

Yes, need to describe how: (there are other possible arrangements)



26 blocks with this arrangement

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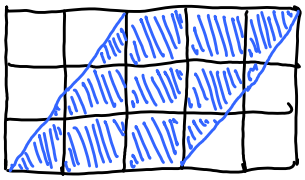
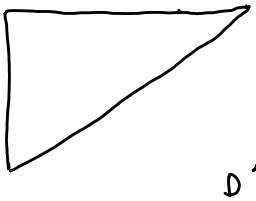
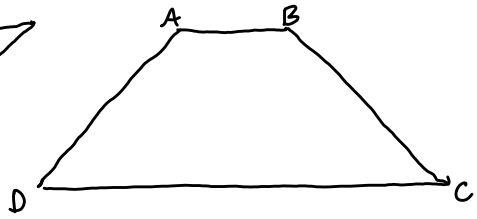
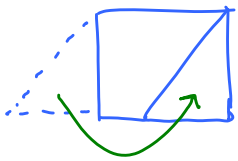
⑥ Cut and rearrange the following shapes to obtain rectangles of same area

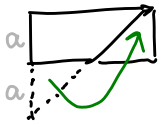


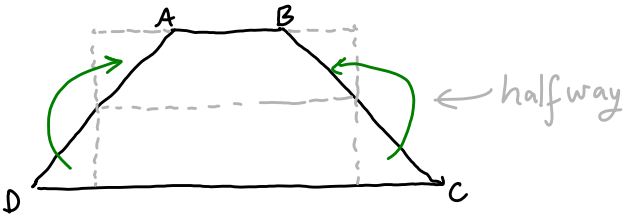




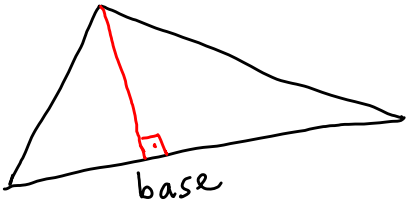
$AD \neq BC$

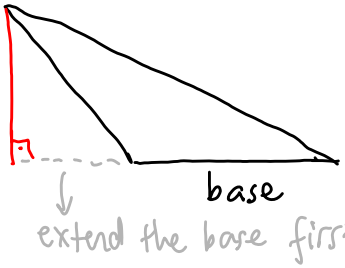


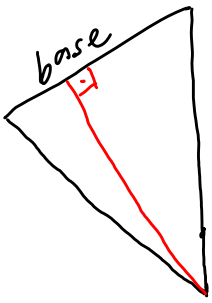




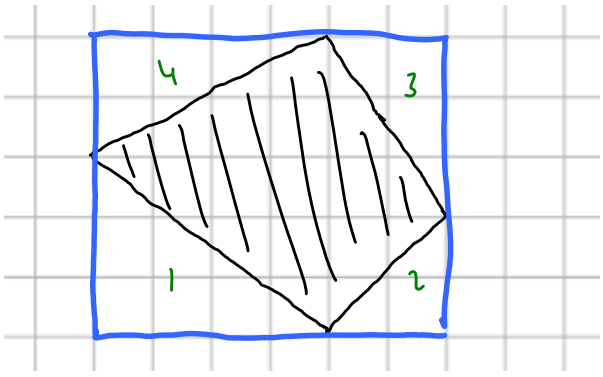
⑦ Draw heights for the following triangles corresponding to the indicated bases:

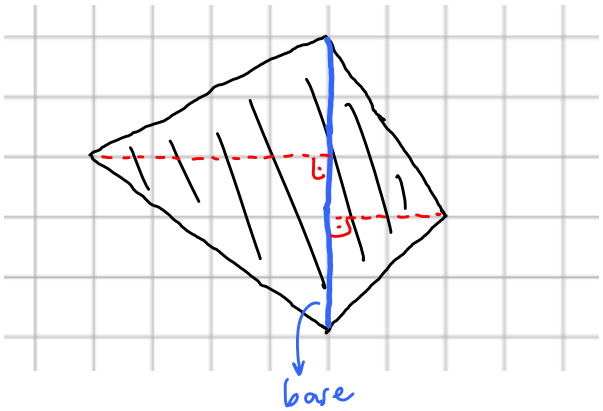






⑧ Compute the area of the following shape in two different methods. In one sentence explain each method.



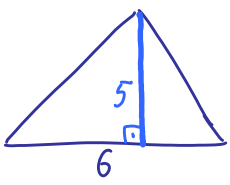


$$6 \times 5 - \left(\frac{4 \times 3}{2} + \frac{2 \times 2}{2} + \frac{2 \times 3}{2} + \frac{4 \times 2}{2} \right)$$

1 2 3 4

$$\frac{5 \times 4}{2} + \frac{5 \times 2}{2}$$

or we could do a vertical shearing:



$$\frac{6 \times 5}{2}$$

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(9) Another proof of Pythagorean thm:

Explain this proof in terms of moving, additivity and algebra.

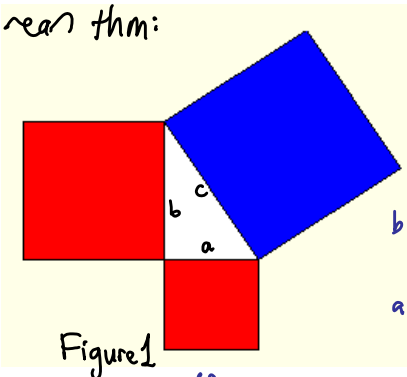


Figure 1

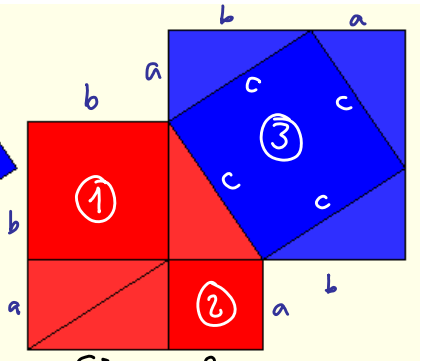


Figure 2

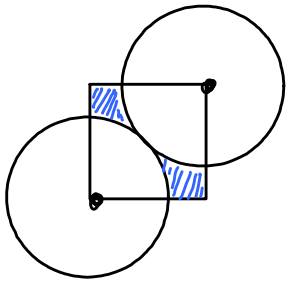
Compute area of figure 2 in two different ways:

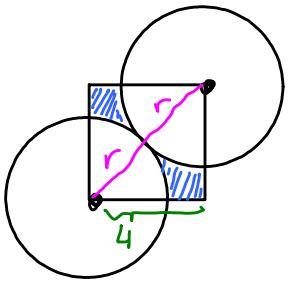
$$\underbrace{(a+b)(a+b)}_{\text{area of square}} + \underbrace{(a+b)(a+b)}_{\text{area of square}} - \underbrace{a\cdot b}_{\text{overlap}} = \underbrace{b^2}_{\text{square 1}} + \underbrace{a^2}_{\text{square 2}} + \underbrace{6\cdot\frac{a\cdot b}{2}}_{\text{6 triangles}} + \underbrace{c^2}_{\text{square 3}}$$

$$2a^2 + 2b^2 + 3ab = a^2 + b^2 + 3ab + c^2$$

$$a^2 + b^2 = c^2$$

(10) Find the area of the shaded region. Both circles have the same radius, and centers at the vertices of the square of side length 4cm.





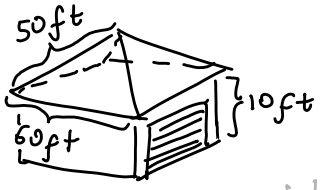
$$4^2 + 4^2 = (2r)^2$$

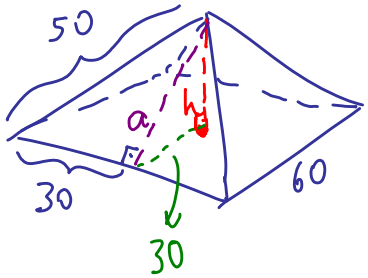
$$32 = 4r^2$$

$$8 = r^2 \longrightarrow r = \sqrt{8}$$

$$\text{Area} = \underbrace{4\times 4}_{\text{square}} - \underbrace{2\times\left(\frac{1}{4}\times\pi\cdot(\sqrt{8})^2\right)}_{\text{two quarter-circles}}$$

(11) Find the total height of the car garage in the figure.





$$a^2 + 30^2 = 50^2$$

$$a^2 = 250 - 90 = 160$$

$$a = \sqrt{160} = 40$$

right triangle because roof isosceles

$$30^2 + h^2 = a^2$$

$$30^2 + h^2 = 160$$

$$h^2 = 160 - 90 = 70$$

$$h = \sqrt{70} \approx 8.366$$

right triangle because height perpendicular to base

total height $= 10 + \sqrt{70}$ (doesn't simplify)