

1.7 Classwork: Unit conversion

1 inch = 2.54 centimeters	1 pound = 16 ounces	1 quart = 2 pints
1 meter = 39.37 inches	1 pound = 0.454 kilogram	1 gallon = 4 quarts
1 mile = 5280 feet	1 kilogram = 2.2 pounds	1 gallon = 3.785 liters
1 mile = 1760 yards	1 ton = 2000 pounds	1 liter = 0.264 gallon
1 mile = 1.609 kilometers	1 cup = 8 fluid ounces	1 liter = 1000 cubic centimeters
1 kilometer = 0.62 mile	1 pint = 2 cups	

1. Use the table above to answer this question, How many...

(a) centimeters in an inch

2.54

(c) gallons in 1 liter

0.264

(b) feet in a mile

5280

(d) pounds in a kilogram

2.2

2. Use your personal knowledge to answer, How many...

(a) years in a century

100 $\frac{\text{yrs}}{\text{century}}$

(b) hours in a day

24 $\frac{\text{hours}}{\text{day}}$

3. Multiply by the appropriate conversion factor (fraction) to calculate the equivalent measure. Show work, including units in numerator and denominator.

Example: Convert $T = 72$ hours to days.

$$T = 72 \text{ hours} \times \frac{1 \text{ day}}{24 \text{ hours}} = 3 \text{ days}$$

(a) Find the length in feet of a board with $L = 48$ inches.

$$L = 48 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 4 \text{ feet}$$

(b) Find the distance in miles of a race with $D = 10$ kilometers.

$$D = 10 \text{ km} \times \frac{0.62 \text{ mile}}{1 \text{ km}} = 6.2 \text{ miles}$$

(c) Find the volume in gallons of a tank with $V = 10$ liters.

$$V = 10 \text{ liters} \times \frac{0.264 \text{ gallons}}{1 \text{ liter}} = 2.64 \text{ gallons}$$

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1. Use the table above to answer this question, How many...

(a) ounces in a pound 16 (b) inches in a meter 39.37

2. Use your personal knowledge to answer, How many...

(a) inches in a foot 12 (b) minutes in an hour 60

3. Required notation: leading variable (capitalized), conversion ratio with units, answer with units.

Example: Find the distance in feet of $D = 4$ miles.

$$D = 4 \text{ miles} \times \frac{5280 \text{ feet}}{1 \text{ mile}} = 21,120 \text{ feet}$$

(a) Find the width in centimeters of a screen having $W = 20$ inches.

$$W = 20 \text{ inches} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} = 50.8 \text{ cm}$$

(b) Find number of minutes in a school day, $T = 6$ hours.

$$T = 6 \text{ hours} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 360 \text{ minutes}$$

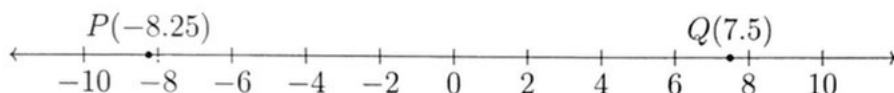
(c) Find the weight in kilograms of a person with weight $W = 120$ pounds.

$$W = 120 \text{ pounds} \times \frac{0.454 \text{ kg}}{1 \text{ pound}} = 54.48 \text{ kg}$$

(d) Find the length in feet of a New York City block whose length is $L = \frac{1}{20}$ miles.

$$L = \frac{1}{20} \text{ mile} \times \frac{5280 \text{ ft}}{1 \text{ mile}} = 264 \text{ feet}$$

4. The points $P(-8.25)$ and $Q(7.5)$ are shown on the number line. Find PQ .



$$PQ = 7.5 - (-8.25) = 15.75$$

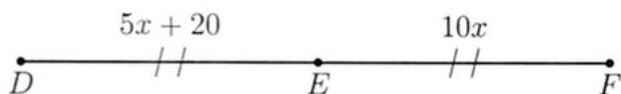
5. The perimeter of an equilateral triangle is 27 inches. Find the length of its sides.



$$P = 3s = 27$$

$$s = 9 \text{ inches}$$

6. Point E bisects \overline{DF} and $DE = 5x + 20$, $EF = 10x$. Find DF . (show check)



$$5x + 20 = 10x$$

$$20 = 5x$$

$$4 = x$$

check

$$DE = 5(4) + 20$$

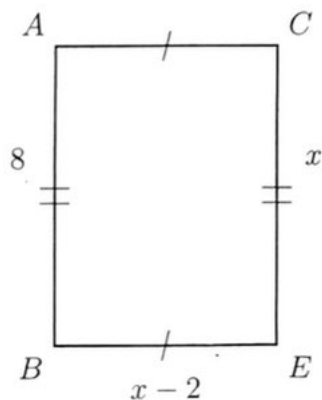
$$= 40$$

$$EF = 10(4)$$

$$= 40$$

$$40 = 40 \checkmark$$

7. Find the perimeter of rectangle $BECA$ given the dimensions as marked, $AB = 8$, $BE = x - 2$, $CE = x$.



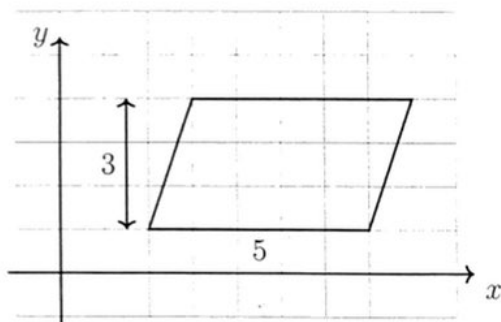
$$x = 8$$

$$P = 2(8) + 2(8 - 2)$$

$$= 16 + 12 = 28$$

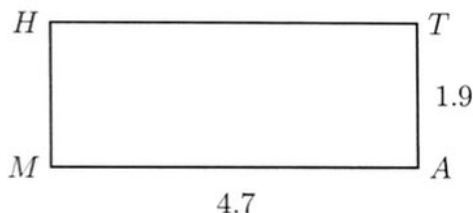
1.8 Classwork: Area of rectangles, triangles, parallelograms

1. Find the area of the parallelogram shown with a base $b = 5$ and height $h = 3$.



$$A = 3 \times 5 = 15$$

2. Given rectangle $MATH$ shown below with dimensions $MA = 4.7$ and $AT = 1.9$.



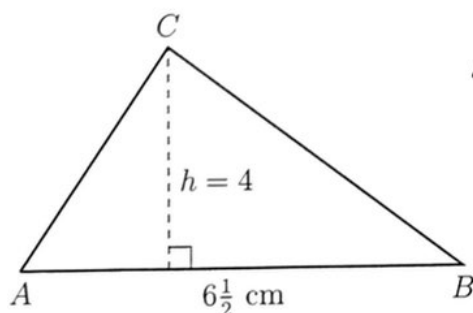
- (a) Find the area of the rectangle.

$$A = 4.7 \times 1.9 = 8.93$$

- (b) Find its perimeter.

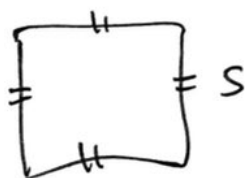
$$P = 2(4.7) + 2(1.9) = 13.2$$

3. Find the area of $\triangle ABC$. The altitude h of the triangle is 4 centimeters and the base $AB = 6\frac{1}{2}$ cm.



$$A = \frac{1}{2} (6\frac{1}{2})(4) = 13 \text{ cm}^2$$

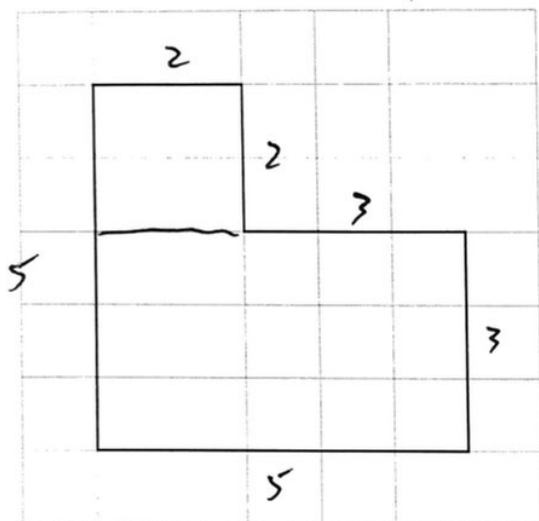
4. The area of a square is 100 square feet. Find the length of the side of the square.



$$A = S^2 = 100$$

$$S = 10 \text{ ft}$$

5. A compound shape is drawn below, combining a rectangle and a square. The grid is in centimeters. Find its perimeter and its area. (label the sides with their lengths first)



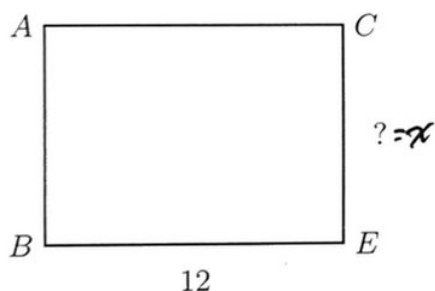
$$P = 5 + 5 + 2 + 2 + 3 + 3$$

$$= 20 \text{ cm}$$

$$A = 2 \cdot 2 + 3 \cdot 5$$

$$= 19 \text{ sq. cm}$$

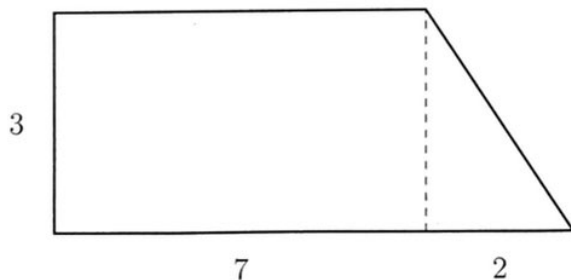
6. The rectangle $BECA$ has an area of 102, with length $BE = 12$. Find the width of the rectangle EC .



$$A = 12x = 102$$

$$= 8.5$$

7. The compound shape shown below is composed of a rectangle 3 inches by 7 inches, and a triangle with base 2 inches. Find the total area of the combined shape.

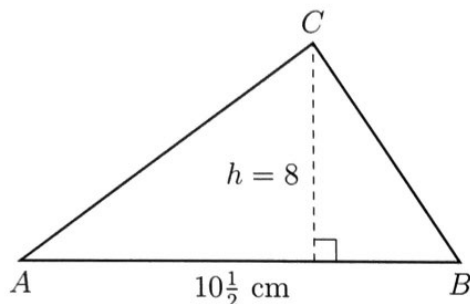


$$A = 3 \cdot 7 + \frac{1}{2} (2)(3)$$

$$= 24 \text{ inches}^2$$

1.8 Homework: Area of rectangles, triangles, parallelograms

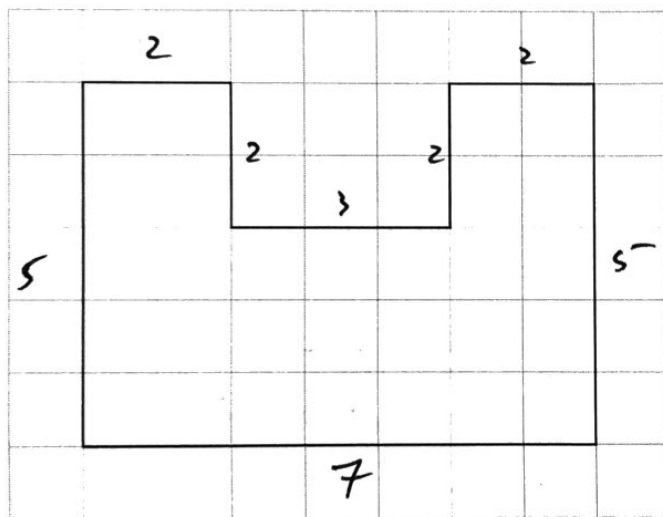
1. Find the area of $\triangle ABC$. The altitude h of the triangle is 8 centimeters and the base $AB = 10\frac{1}{2}$ cm. (diagram not to scale)



$$A = \frac{1}{2} (10\frac{1}{2}) (8)$$

$$= 42 \text{ cm}^2$$

2. Find the area A and perimeter P of the shape shown below. The grid is in centimeters.



$$A = 2 \cdot 2 + 2 \cdot 2 + 3 \cdot 7$$

$$= 4 + 4 + 21$$

$$= 29 \text{ cm}^2$$

$$P = 7 + 5 + 2 + 2 + 3 + 2 + 2 + 5$$

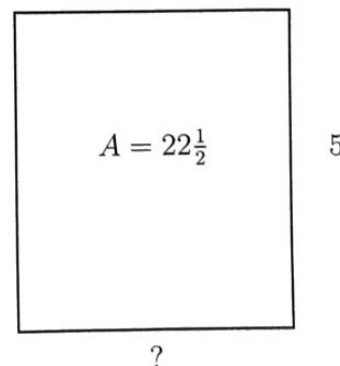
$$= 28 \text{ cm}$$

3. Find the length of the base of a rectangle with area $A = 22\frac{1}{2}$ and height $h = 5$, expressed as a fraction. Start with the form (use b or x):

$$A = b \times h = 22\frac{1}{2}$$

$$A = x \cdot 5 = 22\frac{1}{2}$$

$$x = \frac{22\frac{1}{2}}{5} = 4\frac{1}{2}$$



4. The perimeter of a square is 40 centimeters. Find the length of the side of the square.



$$P = 4s = 40$$

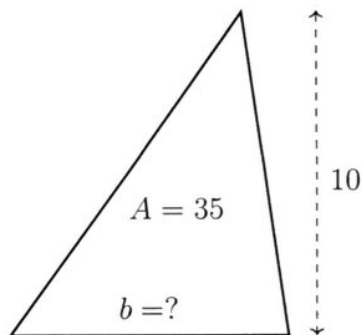
$$s = 10 \text{ cm}$$

5. Find the length of the base of a triangle with area $A = 35$ and height $h = 10$. Start with the form (use b or x):

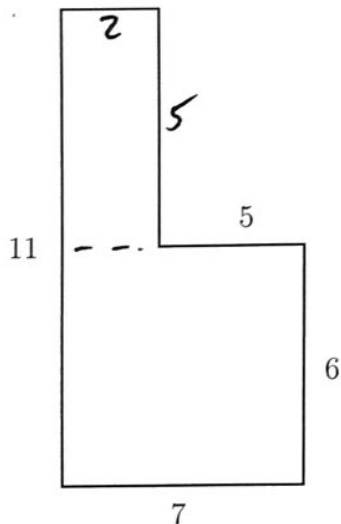
$$A = \frac{1}{2} \times b \times h = 35$$

$$A = \frac{1}{2} (10) x = 35$$

$$x = 7$$



6. Find the area and perimeter of the combined rectangular shape shown below. Mark the missing side lengths first. *(not drawn to scale)*



$$A = 6 \cdot 7 + 2 \cdot 5$$

$$= 42 + 10 = 52$$

$$P = 7 + 11 + 2 + 5 + 5 + 6$$

$$= 36$$

7. Rectangle $JKLM$ has area $A = 21$ and base $JK = 7$ but unknown height. Write an equation then solve. Start with this form (for the unknown, use h , x , or KL):

$$A = b \times h = 21$$

$$A = 7x = 21$$

$$x = 3$$

1.9 Rounding and circle area

1. Write these formulas and definitions in your notebook:

- The radius, r , is the distance from the center to the edge of a circle.
- The diameter, D , is the distance all of the way across a circle, two times the radius.
 $D = 2r$.
- The circumference, C , is the distance around the circle (its perimeter).

$$A = \pi r^2$$

$$C = 2\pi r$$

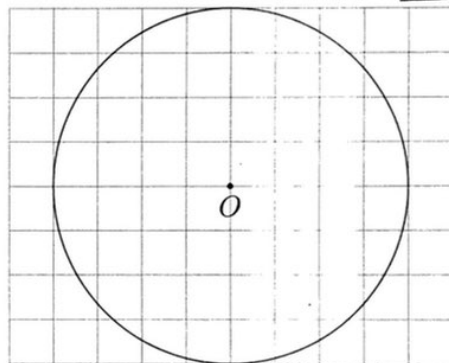
2. Given the circle centered at O with radius $r = 4$. Leave an exact answer, in terms of π .

(a) Find the circumference of circle O .

$$C = 2\pi 4 = 8\pi$$

(b) Find the area of the circle.

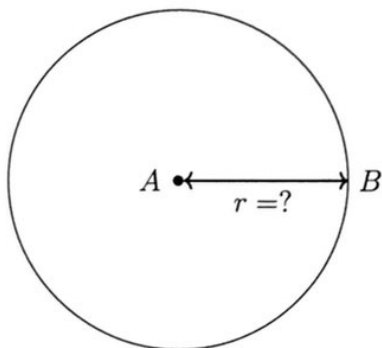
$$A = \pi 4^2 = 16\pi$$



3. Find the area A of a circle with radius 13 inches to the nearest square inch.

$$A = \pi 13^2 = 169\pi = 530.92915... \\ \approx 531 \text{ sq. inches}$$

4. Given circle O with area $A = 64\pi$ square centimeters. Find the radius, $AB = r$.



Start with the formula

$$A = \pi r^2 = 64\pi$$

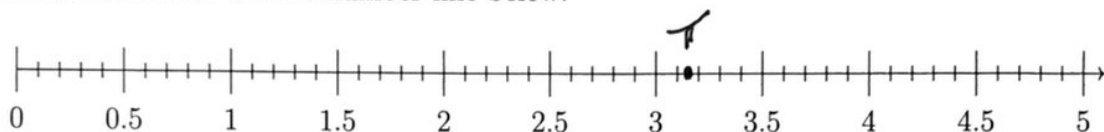
$$\frac{A}{\pi} = \frac{\pi r^2}{\pi} = \frac{64\pi}{\pi}$$

$$r^2 = 64$$

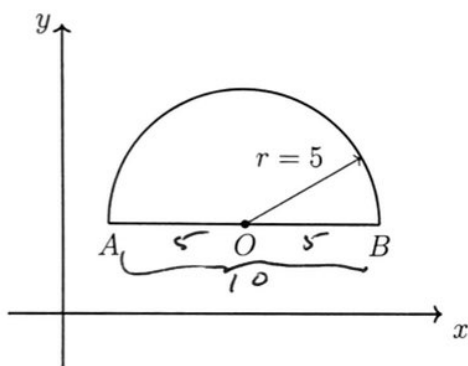
$$r = 8$$

$$\sqrt{64} = 8$$

5. In mathematics we commonly use the special, irrational number, $\pi = 3.14159265358\dots$. Mark and label π on the number line below.



6. A semicircle is half of a circle, as shown below. The given semicircle has a radius of $r = 5$. Round your answers to the nearest tenth.



- (a) Find the diameter, $D = AB$.

$$D = 2r = 10$$

- (b) Find the perimeter (the half circumference plus the diameter)

$$\frac{1}{2} C = \frac{1}{2} (2\pi r) = 5\pi$$

$$P = 5\pi + 10 = 25.707963\dots \approx 25.7$$

- (c) Find the area of the semicircle.

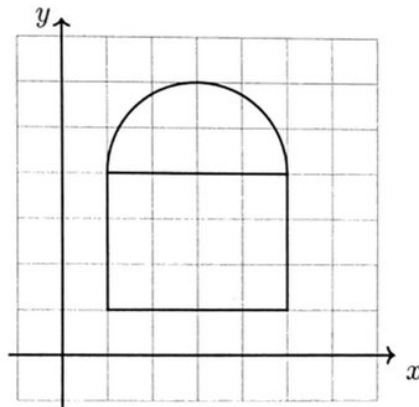
$$A_{s-c} = \frac{1}{2} \pi r^2 = \frac{25}{2} \pi = 39.2699\dots \approx 39.3$$

7. Find the area of the shape shown below composed of a rectangle and semicircular cap. Leave your answer as an exact value in terms of π .

$$A_R = 3 \times 4 = 12$$

$$A_c = \frac{1}{2} \pi (2^2) = 2\pi$$

$$A_{Total} = 2\pi + 12$$



1.9 Homework: Solving for missing parameters

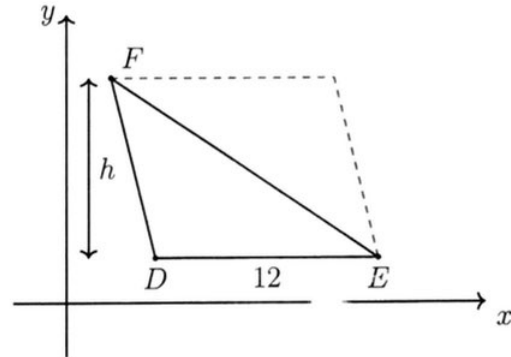
1. The $\triangle DEF$ has an area $A = 54$ and base $DE = 12$.

Find its height, starting with an equation.

$$A = \frac{1}{2}bh = 54$$

$$A = \frac{1}{2}(12)h = 54$$

$$h = 9$$



2. Given circle O with area $A = 49\pi$ square centimeters.

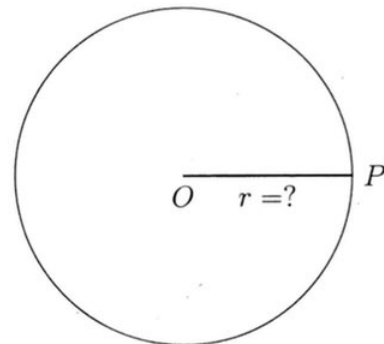
Find the radius of circle, OP . Start with the formula

$$A = \pi r^2 = 49\pi$$

$$\pi \quad \pi$$

$$r^2 = 49$$

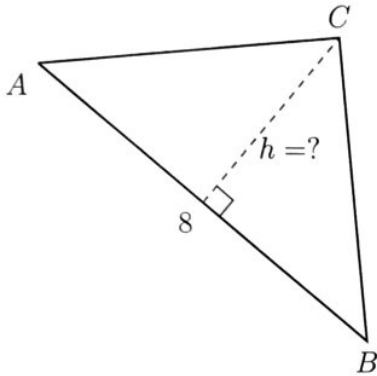
$$r = 7 \text{ cm}$$



3. Mark each statement true or false.

- (a) T (F) 3.14 is the exact value of π
- (b) (T) F 4π is the area of a circle with radius 2 in terms of π
- (c) (T) F $C = 10\pi \approx 31.4$ is an approximation
- (d) (T) F $3\sqrt{2}$ is an exact value
- (e) (T) F 0.707 is an approximation to the nearest thousandth for $\frac{1}{\sqrt{2}}$
- (f) T (F) Rounding 10.498 to the nearest whole number should round up because since 9 is more than 5, first you round to 10.5, then that rounds up to 11.

4. One side of the $\triangle ABC$, the base, has a length $AB = 8$ centimeters. The triangle's area is 44 square centimeters. Find the height of the triangle, shown as a dashed line in the diagram.



$$A = \frac{1}{2}(8)h = 44$$

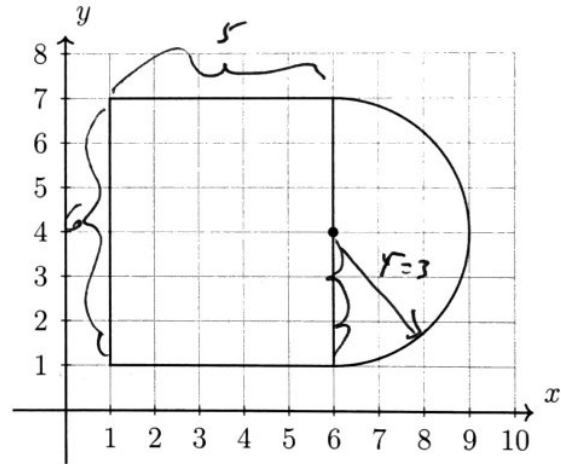
$$h = 11 \text{ cm}$$

5. Find the area of the shape shown below composed of a rectangle and a semi-circle.

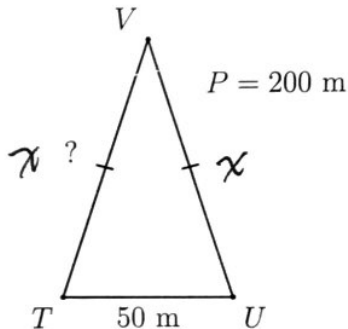
$$A_R = 5 \times 6 = 30$$

$$A_C = \frac{1}{2} \pi 3^2 = \frac{9}{2} \pi$$

$$A_{\text{Total}} = \frac{9}{2} \pi + 30$$



6. The given isosceles $\triangle TUV$ has a base of $TU = 50$ meters and a total perimeter of 200 meters. Find TU .



$$P = 2x + 50 = 200$$

$$2x = 150$$

$$x = 75 \text{ m}$$

1.10 Classwork: Precision and percent error

Write formula for percent error in your notebook

$$\epsilon = \left| \frac{v_A - v_E}{v_E} \right| \times 100\%$$

1. Round each value to the nearest thousandth.

(a) $e = 2.7182818... \approx 2.718$
(Euler's number)

(c) $\phi = 1.618033989... \approx 1.618$
(the golden ratio)

(b) $\pi \approx 3.1415926$
 ≈ 3.142

(d) $\sqrt{3} = 1.7320508... \approx 1.732$

2. Round each value to the nearest hundred thousand.

(a) $1,694,251 \approx 1,700,000$
(population of the Manhattan)

(b) $2,405,464 \approx 2,400,000$
(population of Queens)

3. Find the percent error for each approximation.

(a) $\pi \approx \frac{355}{113}$ (Zu's ratio)

$$\epsilon = \left| \frac{\left(\frac{355}{113} - \pi \right)}{\pi} \right| \times 100\%$$

$$= 0.0000849... \%$$

(c) $2^{10} = 1000$ (kilobyte)

$$\epsilon = \left| \frac{(1000 - 2^{10})}{2^{10}} \right| \times 100\%$$

$$= 2.34375 \%$$

$$\approx 2.34 \%$$

(d) 1 gallon \approx 4 liters

(use conversion table's value)

(b) 365 days \approx 52 weeks

$$\epsilon = \left| \frac{(52 \times 7 - 365)}{365} \right| \times 100\%$$

$$= 0.2739... \%$$

$$\approx 0.274 \%$$

$$\epsilon = \left| \frac{(4 - 3.785)}{3.785} \right| \times 100\%$$

$$= 5.6803... \%$$

$$\approx 5.68 \%$$

4. Convert each measure. Show the multiplication by the appropriate conversion factor (fraction), including units.

Example: Approximate the number of weeks in $T = 2$ years.

$$T = 2 \text{ years} \times \frac{52 \text{ weeks}}{1 \text{ year}} = 104 \text{ weeks}$$

- (a) Find the length in yards of a quarter-mile track.

$$\frac{1}{4} \text{ mile} \times \frac{1760 \text{ yards}}{1 \text{ mile}} = 440 \text{ yards}$$

- (b) Find the number of liters in a 15 gallon gas tank.

$$15 \text{ gallons} \times \frac{3.785 \text{ liters}}{1 \text{ gallon}} = 56.775 \text{ liters}$$

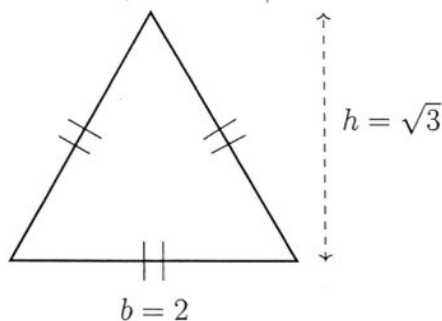
5. Find the number of hours in 4 weeks. (multiply by two conversion factors, weeks to days, then days to hours)

$$4 \text{ weeks} \times \frac{7 \text{ days}}{1 \text{ week}} \times \frac{24 \text{ hours}}{1 \text{ day}} = 672 \text{ hours}$$

6. Find the area of the equilateral triangle two ways and quantify the error.

- (a) Use the exact height of the triangle,
 $h = \sqrt{3}$.

$$A = \frac{1}{2} (2) \sqrt{3} = 1.732...$$



- (b) Assume the height is the same as the base, $h = 2$.

$$A_2 = \frac{1}{2} (2)(2) = 2$$

- (c) Calculate the percent error.

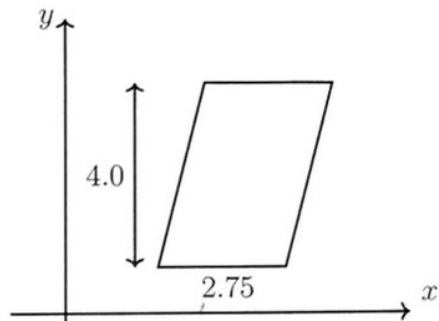
$$\mathcal{E} = \left| \frac{(2 - 1.732)}{1.732} \right| \times 100\% = 15.47\% \approx 15.5\%$$

1.10 Homework: Area situations

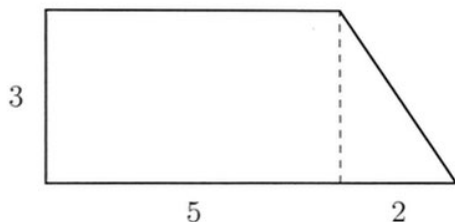
1. A parallelogram is shown on the x - y plane having a base $b = 2.75$ and height $h = 4.0$.

Find its area, showing the calculation.

$$A = 4 \times 2.75 \\ = 11$$



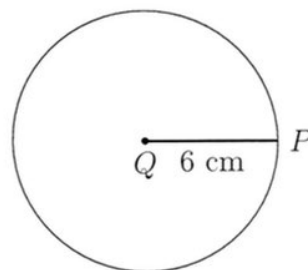
2. The compound shape shown below is composed of a square with side length 5 cm and a triangle with base 2 cm. Find the total area of the combined shape.



$$A = 3.5 + \frac{1}{2}(3)2 \\ = 18$$

3. Find the area of circle Q with radius $r = 6$ centimeters, rounded to the nearest tenth.

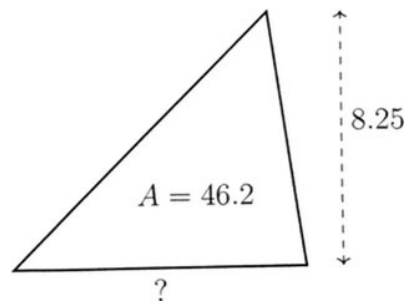
$$A = \pi 6^2 = 36\pi \\ = 113.0973... \\ \approx 113.1 \text{ cm}^2$$



4. Find the length of the base of a triangle with area $A = 46.2$ and height $h = 8.25$. Express your result as a decimal. Start with the form (use b or x):

$$A = \frac{1}{2} \times b \times h = 46.2$$

$$A = \frac{1}{2} (8.25) x = 46.2 \\ x = 46.2 \times 2 / 8.25 \\ = 11.2$$



5. Archimedes used polygons to approximate π . He calculated the area of the inscribed hexagon below as $A_{\text{hexagon}} \approx 2.5981$.

- (a) Find the area of the circle with $r = 1$.

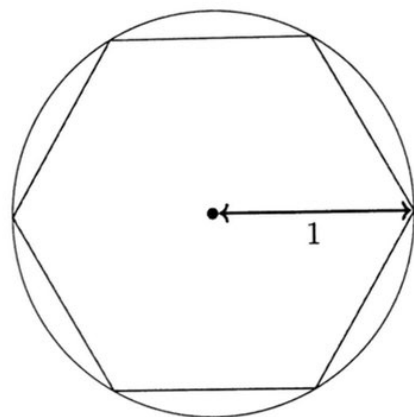
$$A = \pi r^2 = 3.141592\dots$$

- (b) Find the percent error of Archimede's approximation using a hexagon.

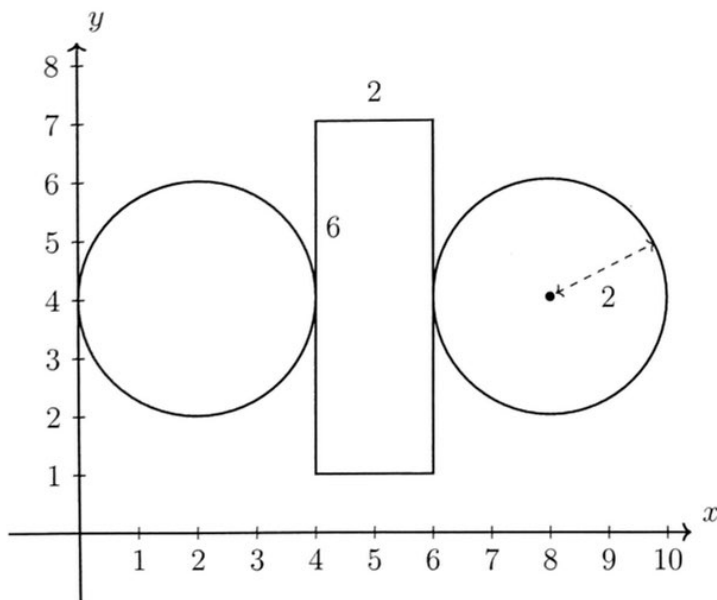
$$\varepsilon = \left| \frac{2.5981 - \pi}{\pi} \right| \times 100\%$$

$$= 17.2999\dots \%$$

$$\approx 17.3 \%$$



6. Find the area of the compound shape shown below composed of a rectangle measuring 2 by 6 and two circles, each with radius $r = 2$.



$$\begin{aligned} A &= 2(\pi r^2) + 2 \cdot 6 \\ &= 8\pi + 12 \\ &= 37.13274\dots \\ &\approx 37.1 \end{aligned}$$