Problem 1. A recipe that serves 6 calls for 2 Tbsp vegetable oil, 4 pints of stock, \( \frac{2}{3} \) lbs of peas, and 5 eggs. Note that 16 Tbsp = 1 cup. If the cafeteria needs to serve 1000, it must buy:

(a) How many gallons of vegetable oil?

\[
\frac{1000}{6} \cdot \frac{2 \ \text{Tbsp}}{16 \ \text{Tbsp}} \cdot \frac{1 \ \text{cup}}{16 \ \text{cups}} \cdot \frac{1 \ \text{gallon}}{1 \ \text{cup}} = \frac{2000}{1536} \ \text{gal} 
\]

(b) How many liters of stock?

\[
\frac{1000}{6} \cdot \frac{4 \ \text{pts}}{8 \ \text{pts}} \cdot \frac{1 \ \text{gal}}{3.79 \ \text{l}} \cdot \frac{3.79 \ \text{l}}{48} = \frac{315.8 \ \text{l}}{48} 
\]

(c) How many kilograms of peas?

\[
\frac{1000}{6} \cdot \frac{\frac{2}{3} \ \text{lbs}}{2.2 \ \text{lbs}} \cdot \frac{1 \ \text{kg}}{2.2 \ \text{l}} = \frac{50.5 \ \text{kg}}{48} 
\]

(d) How many dozens of eggs?

\[
\frac{1000}{6} \cdot \frac{5 \ \text{eggs}}{12 \ \text{eggs}} \cdot \frac{1 \ \text{dozen}}{1 \ \text{eggs}} = 69.4 \Rightarrow 70 \ \text{dozen eggs} 
\]

Problem 2. Standard copy paper is 8.5 inches by 11 inches.

(a) How many square millimeters (mm\(^2\)) is one sheet of copy paper?

\[
(8.5)(11) \ \text{in}^2 \times \left( \frac{2.54 \ \text{cm}}{1 \ \text{in}} \right)^2 \times \left( \frac{10 \ \text{mm}}{1 \ \text{cm}} \right)^2 = 60,322 \ \text{mm}^2 
\]

(b) One acre is 43,560 sq ft. How many pieces of copy paper will cover one acre?

\[
43,560 \ \text{sq ft} \times \left( \frac{12 \ \text{in}}{1 \ \text{ft}} \right)^2 \times \frac{1 \ \text{paper}}{(8.5)(11) \ \text{in}^2} = 67,087 \ \text{papers} 
\]
Problem 3. (a) How many km is 72,531 mm?

\[ 0.072531 \text{ km} \]

(b) How many km is 5.4 miles?

\[
5.4 \text{ mi} \times \frac{5280 \text{ ft.}}{1 \text{ mi}} \times \frac{12 \text{ in.}}{1 \text{ ft.}} \times \frac{2.54 \text{ cm}}{1 \text{ in.}} \times \frac{100,000 \text{ cm}}{1 \text{ km}} = 8.7 \text{ km}
\]

(c) How fast is 3 cm/sec in miles per hour?

\[
3 \text{ cm/sec} \times \frac{1 \text{ in.}}{2.54 \text{ cm}} \times \frac{1 \text{ ft.}}{12 \text{ in.}} \times \frac{1 \text{ mile}}{5280 \text{ ft.}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 0.0007 \text{ miles/hr}
\]

(d) The current price of gasoline in France is 1.58 Euros per liter. Now, $1 is 0.71 Euros. How much is gasoline in France in dollars per gallon?

\[
1.58 \text{ Euro/l} \times \frac{1 \text{ l}}{0.71 \text{ Euro}} \times \frac{3.79 \text{ l}}{1 \text{ gal}} = \$8.43/\text{gal}
\]

Problem 4. Jack reports that a pail weighs 4.7 lbs. Jill can weigh things in pounds to three decimal places. If Jill weighs the pail, what weight range could she report?

4.650 - 4.749

Problem 5. In \( \triangle ABC \), \( \angle BDC \) is a right angle, but do not assume that \( \angle ABC \) is a right angle.

(a) Find the area of \( \triangle ABC \).

\[
16^2 + \left( \frac{BD}{2} \right)^2 = 20^2
\]

\[
BD = \sqrt{20^2 - 16^2} = 12
\]

Area \( \triangle ABC \) = \( \frac{1}{2} \times 12 \times (9+16) = 150 \)

(b) Find the perimeter of \( \triangle ABC \).

\[
9^2 + \left( \frac{BD}{2} \right)^2 = (AB)^2 \implies 9^2 + 12^2 = (AB)^2 \implies AB = 15
\]

Perimeter \( \triangle ABC \) = 15 + 20 + 25 = 60

(c) Determine whether \( \angle ABC \) is a right angle. Justify.

Yes, since \( (AB)^2 + (20)^2 = (25)^2 \) (Pythagorean Thm.)

\[ 15^2 + 20^2 = 25^2 \]
Problem 6. Justify $A = \frac{1}{2}bh$ for $\triangle XYZ$, using rectangles and/or right triangles.

\[ 7(a+5) = 2(7a)(\frac{a}{2}) \]
\[ + 2 \text{ Area}(\triangle XYZ) \]

\[ \Rightarrow 7 \cdot 5 = 2 \text{ Area}(\triangle XYZ) \]
\[ \Rightarrow \text{ Area}(\triangle XYZ) = \frac{1}{2} (7)(5) \]

Problem 7. Find the area of the shaded region. (Leave $\pi$ in your answer.)

\[ \text{Area} = (12)(12) - \frac{1}{12} \pi (6)^2 + \pi (3)^2 \]
\[ = 144 - \frac{1}{2} \pi (6)^2 + \pi (3)^2 \]
\[ = 144 - 9\pi \]

Problem 8. The dots below are spaced 1 cm apart. Determine the area of the shaded figure. Show work.

\[ A = \square + \triangle + \triangle \]
\[ = (3)(4) + \frac{1}{2}(1)(3) + \frac{1}{2}(3)(3) \]
\[ = 18 \]

Problem 9. A construction company has dump trucks that hold 7 cubic yards. If the company digs a hole that is 12 feet deep, 17 feet wide, and 30 feet long, then how many dump trucks will they need to haul away the dirt dug from this hole?

\[ \text{Vol (hole)} = 12 \cdot 17 \cdot 30 \text{ ft}^3 \times \left( \frac{1 \text{ yd}}{3 \text{ ft}} \right)^3 = 226.7 \text{ yd}^3 \]

\[ \frac{226.7}{7} = 32.4 \Rightarrow 33 \text{ dump trucks} \]
Problem 10. A square with side length 6 cm is the base of a square pyramid, which has height 4 cm. Show work below, and use correct units.

(a) What is the slant height of the pyramid?

\[ S = 5 \text{ cm} \quad (3^2 + 4^2 = 5^2) \]

(b) Compute the surface area of the pyramid (including the base).

\[ 4 \cdot \frac{1}{2} (6)(5) + (6)^2 = 96 \text{ cm}^2 \]

(c) Compute the volume of the pyramid.

\[ \frac{1}{3} (36)(4) = 48 \text{ cm}^3 \]

(d) If a little cube with side length 5 mm is filled with water, how many such cubes will fill the pyramid?

Each cube vol = \( (\frac{1}{2} \text{ cm})^3 = \frac{1}{8} \text{ cm}^3 \)

\[ \text{# cubes} = (48)(8) = 384 \text{ cubes} \]

Problem 11. (BONUS) A cone will be made from the quarter-disc shown.

(a) Find the surface area of the cone.

\[ SA = \frac{1}{4} \pi (8)^2 = 16 \pi \]

(b) Find the radius \( r \) of the cone. (Hint: Use circumference.)

\[ 2\pi r = \frac{1}{4} (2\pi \cdot 8) \Rightarrow r = 2 \]

(c) Find the volume of the cone. (Hint: Find the height.)

\[ h = \sqrt{64 - 4} = \sqrt{60} \]

\[ V = \frac{1}{3} \pi r^2 h = \frac{1}{3} \pi (2^2)\sqrt{60} = \frac{4\pi \sqrt{60}}{3} \]

\[ = \frac{32\sqrt{15}}{3} \text{ cm}^3 \]