Skill 1: Rates/Ratios/Proportions

1) What is the ratio of 4 hours to 30 minutes?

$4 \text{ hours} \cdot \frac{60 \text{ min}}{1 \text{ hr}} = 240 \text{ min}$ $\quad \frac{240}{30} = \frac{8 \cdot 3 \cdot 10}{1 \cdot 3 \cdot 10} = \frac{8}{1}$

2) If 5 pounds of store brand hamburger costs \$18.75, and the select brand is on sale for \$7.10 for 2 pounds, which is the better buy? (Hint: find the price per pound to the nearest hundredth)

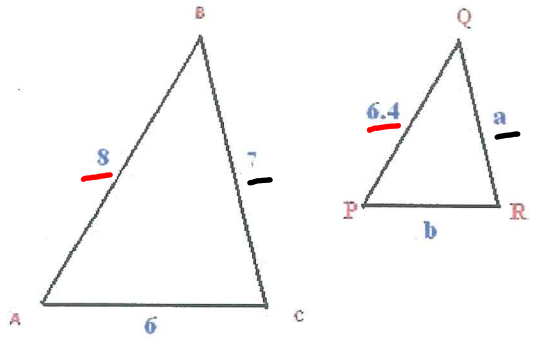
$\frac{\$18.75}{5 \text{ lb}} = \$3.75 \text{ per lb.}$

$\frac{\$7.10}{2 \text{ lb.}} = \$3.55 \text{ per lb.}$ better buy

$5\overline{)18.75}$ → 3.75, 15, 37, 35, 25

$2\overline{)7.10}$ → 3.55, 6, 11, 10, 10

3) Find the length of side a.



$\frac{a}{7} = \frac{6.4}{8}$

$8a = 7(6.4)$

$8a = 44.8$

$\frac{8a}{8} = \frac{44.8}{8}$

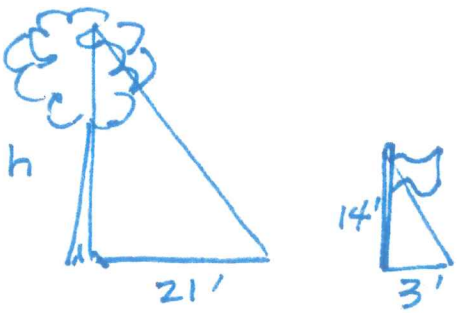
$a = 5.6$

$2\overline{)6.4}$ → 7, 44.8

$8\overline{)44.8}$ → 5.6, −40, 48, −48, 0

$a = 5.6$ units

4) A tall tree casts a shadow that is 21 feet long. If a flag pole nearby that is 14 feet tall casts a 3 foot shadow, how tall is the tree?



$\frac{h}{14} = \frac{21}{3}$

$\frac{3h}{3} = \frac{14(21)}{3} = \frac{14 \cdot 7 \cdot 3}{3}$

$h = 98$

$14 \times 7 = 98$

The tree is about 98 feet tall

% · whole = part
↑ as a decimal

Skill 2: Percent Problems

1) On a day when the class of 19 students had 5 members absent, what percent of the class took the quiz that day?

$\frac{19}{-5}$ $\frac{\text{part}}{\text{whole}} = \frac{14}{19} = 73.7\%$

19 × 3 = 57, +19 = 76 | 19 × 5 = 95, +19 = 114 | 19 × 7 = 133, 19 = 152

19 | 14.0000 → −133 → 70 → −57 → 130 → 114 → 160 → 152 → .7368

2) Charlie got a Black Friday special on a laptop computer for $370.00. If the tax rate is 7.4% what does he pay for the system?

7.4% = 0.074

$397.38

370 × .074 = 1480, 25900, 27.380 | 370.00 + 27.38 = 397.38 | or 1.074 × 370 = 75180, 32220, 397.380

3) The total school enrollment at Fort Collins High School was 1800 in 2013. In 2014 the student population was 1692. What was the percent change in enrollment?

Finish − start / start .100

1800 − 1692 = 108

$\frac{108}{1800} = .06 = 6\%$ decrease

18.00 | 1.08 → 0.06 → −18 → 108

4) Connie found a 25% off coupon for a TV that was $280.00 at Best Electronics. If the tax rate was 7.5%, what did she pay for the TV?

280 × .25 = 70.00 (2 decimal places)

$70.00 discount

280 − 70 = $210 New price

210 × .075 = 15.750 (3 decimal places) Tax

210.00 + 15.75 = 225.75

$225.75 with tax

5) In 2015 the Colorado Dept. of Transportation reported there were 68 fatalities on Colorado roads resulting from drivers under the influence of cannabis. This was 12.4% of all fatalities involving drugs. How many total deaths happened in our state due to "drugged drivers"?

% | part
124 | 68
x: whole

$\frac{.124x}{.124} = \frac{68}{.124}$

$x = 548$

.124 | 68.000 → 548 → 620 → −600 → 496 → −496 → 1040 → −992 → 48

548 fatalities in 2015

Skill 3: Measurements & Conversions

1 inch = 2.54 cm 1 quart = 0.95 L
1 lb. = 0.45 Kg 1 ounce = 28.35 g

K H D U D C m
meter
liter
grams

1) 9.72 L = 9720 mL 9.72

2) 28 cm = 0.28 m .28

3) 54 g = 0.054 Kg .54

4) 4 yds = 144 in $\frac{4\text{ yds}}{1}\cdot\frac{3\text{ ft}}{1\text{ yd}}\cdot\frac{12\text{ in}}{1\text{ ft}} = 12\cdot12$

5) 92 oz. = 5.75 lb $\frac{92\text{ oz}}{1}\cdot\frac{1\text{ lb}}{16\text{ oz}}$ 2|92, 2|46, 23 2|16, 2|8, 4 $\frac{2\cdot2\cdot23}{2\cdot2\cdot4} = 5\frac{3}{4}$

6) 864 cups = 54 gallons $864\text{c}\cdot\frac{1\text{ qt}}{4\text{ c}}\cdot\frac{1\text{ gal}}{4\text{ qt}} =$ $4\overline{)864}\ 216$ $4\overline{)216}\ 54$

7) 60 mph = 88 feet per second 60)5280 (88, 48, 48
$\frac{60\text{ miles}}{1\text{ hour}}\cdot\frac{5280\text{ ft}}{1\text{ mile}}\cdot\frac{1\text{ hour}}{60\text{ min}}\cdot\frac{1\text{ min}}{60\text{ sec}} = \frac{60\cdot60\cdot88}{60\cdot60} =$

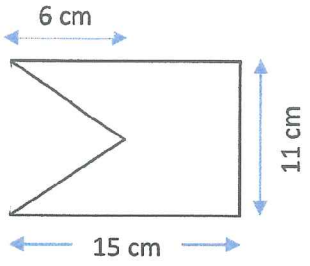
8) 25.4 m = 27.8 yds 25.4 m = 2540 cm $\frac{2540\text{ cm}}{1}\cdot\frac{1\text{ in.}}{2.54\text{ cm}}\cdot\frac{1\text{ ft}}{12\text{ in}}\cdot\frac{1\text{ yd}}{3\text{ ft}}$

9) 50 gal = 190 L $\frac{2.54\times1000}{2.54\times4\times3\times3} = \frac{250}{9} = 9\overline{)250}$ 27, 18, 70, 63 $50\text{ gal}\times\frac{4\text{ qts}}{1\text{ gal}}\times\frac{.95\text{ L}}{1\text{ qt}} = 200\times.95 = 190$ ×200, 190.00

10) 67.5 Kg = 150 lbs $67.5\text{ kg}\cdot\frac{1\text{ lb}}{0.45\text{ kg}} =$ .45)67.50 (150, −45, 225, 225, 0 5|225, 45!

Skill 4: Geometry

1) What is the area of this shape?



Area of rectangle - Area of triangle

$(15)(11) - \frac{1}{2}(11)(6)$

$15 \times 11 = 165$ (15, 150)

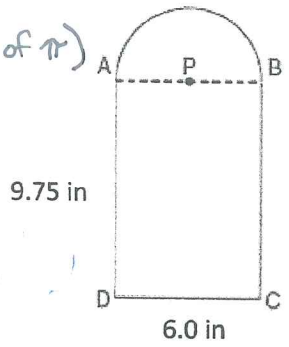
$\frac{1}{2} \cdot \frac{6}{1} = 3$

$3(11) = 33$

$156 - 33 =$

132 cm²

2) What is the perimeter of this shape? (leave in terms of π)



3 straight sides + $\frac{1}{2}$ circumference of circle

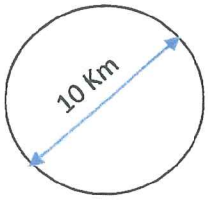
$9.75 + 6.0 + 9.75 = 25.50$

$\frac{1}{2}(\pi)(6)$ $(C = \pi d)$

3π

25.5 + 3π in

3) What is the circumference of this shape?
What is the area? (Use 3.14 for π)



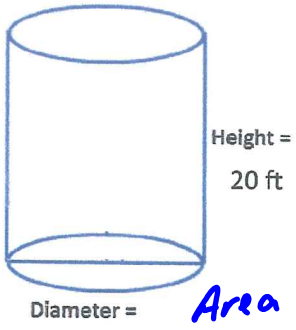
$C = \pi d$ $3.14(10) =$ **31.4 km**

$A = \pi r^2$ $3.14(5)^2 =$ **78.5 km²**

$3.14 \times 25 = 78.50$ (3.14, 1570, 6280)

4) What is the volume of this water tank?

(Hint: Use $\frac{22}{7}$ for π)



$V = \pi r^2 h$

$V = \frac{22}{7}\left(\frac{7}{1} \cdot 7\right)(20)$

$V = 22(140)$

V = 3080 ft³

$140 \times 22 = 3080$ (1280, 2800)

Area of base time height

Skill 5: Order of Operations & Exponents

P
E →
M D
A S

Simplify:

1) $72 \div 6^2(2) + (-7+10)$

$72 \div 36(2) + (3)$

$2(2) + 3$

$4 + 3$

(7)

2) $\dfrac{-6+\sqrt{5^2-4(2)(-3)}}{2(1)}$

$\dfrac{-6+\sqrt{25-(8)(-3)}}{2}$

$\dfrac{-6+\sqrt{25+24}}{2}$

$\dfrac{-6+\sqrt{49}}{2}$

$\dfrac{-6+7}{2}$

$\left(\dfrac{1}{2}\right)$

3) $\dfrac{3(4)^2-24\div 3(2)}{4(-2)}$

$\dfrac{3(16)-8(2)}{-8} = \dfrac{48-16}{-8} = \dfrac{32}{-8} = (-4)$

4) $(-7a^3b^3)(7a^6b^4)$

$-49\,a^{3+6}\,b^{3+4} = (-49a^9b^7)$

5) $\dfrac{12p^8q^9r^0}{(6p^3q^2r)^2}$

$\dfrac{12p^8q^9(1)}{36\,p^{3\cdot2}\,q^{2\cdot2}\,r^{1\cdot2}} = \dfrac{2\cdot2\cdot3\,p^{8-6}\,q^{9-4}\,r^{0-0}}{2\cdot2\cdot3\cdot3\,p^6\,q^4\,r^2} = \dfrac{1}{3}p^{8-6}q^{9-4}$

$= \left(\dfrac{p^2q^5}{3r^2}\right)$

Skill 6: Negative Exponents & Scientific Notation

Simplify:

1) $\dfrac{12m^5n^{-7}}{-4m^{-2}n^{-3}}$ $= \dfrac{12\,m^2m^5n^3}{-4\;\;n^{7-3}} = \dfrac{3\,m^7}{-1\,n^4}$ negative to top or out front $= \dfrac{-3m^7}{n^4}$

2) $\left(\dfrac{-2x^{-2}y^{-1}z^3}{6xy^{-2}}\right)^2$ distribute $= \dfrac{(-2)^2x^{-4}y^{-2}z^6}{6^2x^2y^{-4}} = \dfrac{4\;\;y^4z^6}{36\,x^2x^4y^2}$

$\dfrac{4\;\;y^4z^6}{36\,x^6y^2} = \dfrac{y^2z^6}{9x^6}$

3) $\dfrac{(-3x^4y^{-2})^{-2}}{(xyz)^{-3}}$ $= \dfrac{(-3)^{-2}x^{-8}y^{+4}}{x^{-3}y^{-3}z^{-3}} = \dfrac{x^3y^4y^3z^3}{(-3)^2x^{8-3}}$

$\dfrac{y^7z^3}{9x^5}$

4) $(5.3 \times 10^4)(4.1 \times 10^{-7})$ $= 5.3(4.1) \times 10^4 \cdot 10^{-7}$

21.73×10^{-3}

If the mantissa gets smaller make the exponent bigger.

2.173×10^{-2}

5) $\dfrac{(1.071 \times 10^{-4})}{(2.1 \times 10^{-6})}$ $0.51 \times 10^{-4-(-6)}$

$0.51 \cdot 10^2$

5.1×10^1

$2.1\overline{)1.071}$ → 51, -105, 21, 21, 0

5.3×4.1: 53, 2120

$21 \times 5 = 105$; $21 \times 6 = 126$; $21 \times 7 = 147$

Skill 7: Expressions and Equations

1) Evaluate the following expression when a = –3, and b = 2

$a^2 + 3ab - b^2$

$(-3)^2 + 3(-3)(2) - (2)^2$

$9 + -9(2) - 4$

$9 - 18 - 4$

$-9 - 4$

-13

2) Is 6 a solution to the following equation?

$\frac{3}{7}x = \frac{15}{7} + \frac{x}{14}$

$\frac{3}{7}\left(\frac{6}{1}\right) \stackrel{?}{=} \frac{15}{7} + \frac{6}{14}$

$\frac{18}{7} = \frac{15}{7} + \frac{3}{7}$

$\frac{18}{7} = \frac{18}{7}$

yes, 6 is a solution

Solve:

3) $10 = 8(3y - 4) - 13y + 20$

$24y - 32 - 13y + 20 = 10$

$11y - 12 = 10$

$+12 \quad +12$

$\frac{11y}{11} = \frac{22}{11}$

$y = 2$

4) $0.25t + 0.10(t - 3) = 0.05(22)$ - clear decimals !!

$100(.25t) + 100(.10)(t-3) = 100(.05)(22)$

$25t + 10(t-3) = 5(22)$

$25t + 10t - 30 = 110$

$+30 \quad +30$

$\frac{35t}{35} = \frac{140}{35}$

$t = 4$

$\frac{22}{5}$

110

5) $\frac{3(y+3)}{5} = (2y+6)5$

$3y + 9 = 10y + 30$

$-3y - 30 \quad -3y - 30$

$\frac{-21}{7} = \frac{7y}{7}$

$y = -3$

6) $\frac{5x+3}{4} + \frac{25}{12} = \frac{5x+2}{3}$ - clear fractions LCD is 12

$\frac{3 \cdot 4(5x+3)}{4} + \frac{12(25)}{12} = \frac{4 \cdot 3(5x+2)}{3}$

$15x + 9 + 25 = 20x + 8$

$-15x - 8 \quad -15x - 8$

$\frac{26}{5} = \frac{5x}{5}$

$x = \frac{26}{5}$ or $5\frac{1}{5}$

Skill 8: Linear Relationships

1) Find the slope between the points: (5,-9) and (-3,1)

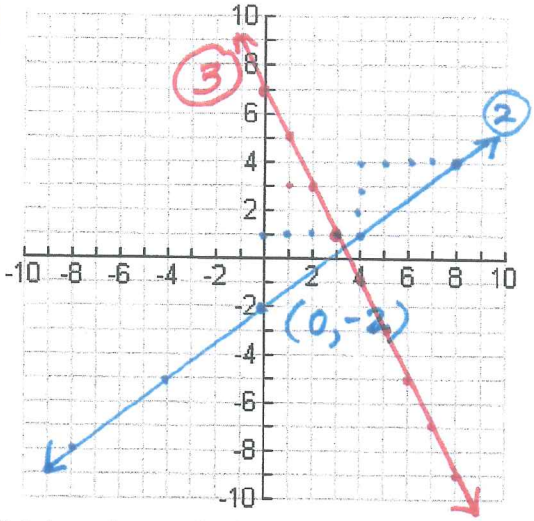
$\frac{-9-1}{5-(-3)} = \frac{-10}{8} = -\frac{5}{4}$

2) For the equation: $y = \frac{3}{4}x - 2$

a. What is the slope of this line? $\frac{3}{4}$

b. What is the y-intercept for this line? (0,-2)

c. Graph the line on the grid to the right.



3) Write the equation of the line 6x + 3y = 21 in slope-intercept form.

a. What is the slope of this line? -2 or $-\frac{2}{1}$

b. What is the y-intercept for this line? (0,7)

c. Graph the line on the same grid above.

$6x + 3y = 21$

$-6x \quad -6x$

$\frac{3y}{3} = \frac{-6x+21}{3}$

$y = -2x + 7$

4) Identify the type of line and slope for the following lines:

a. x = –2 vertical line; undefined slope

b. y = 3 horizontal line; slope is 0

5) A catering company offers a service where they rent their dining room, (which is in a beautiful location) and serve your guests dinner. They charge a fee of $250 to rent the dining room and they charge $45 for the food, service, and linens for each guest attending. If "g" represents the number of guests attending, and "C" represents the total cost, the linear model for this caterer's cost is: C = 45g + 250.

a. Estimate the cost to a client who will have 75 guests. $C = 45(75) + 250$ $3375 + 250$ $3625

b. Interpret the meaning of the slope in the context of this problem.

c. Interpret the meaning of the y-intercept in context.

The slope is the $45 charged per meal (person)

The y-intercept is the one-time charge of $250 to rent the room.

Skill 9: Writing Linear Equations

1) Write the equation of the line that has a slope of –2 and goes through the point (0, –4).

$y = -2x - 4$

2) Write the equation of the line that passes through the points (4,–3) and (–2, 2). Write your answer in slope-intercept form.

$\frac{2-(-3)}{-2-4} = \frac{5}{-6}$

$y = -\frac{5}{6}x + \frac{1}{3}$

$y-(-3) = -\frac{5}{6}(x-4)$

$y+3 = -\frac{5}{6}x + \frac{5}{3}\cdot\frac{4}{1}^{2} - 3\left(\frac{3}{3}\right)$

$-3 \quad -3$

$y = -\frac{5}{6}x + \frac{10}{3} - \frac{9}{3}$

3) Write the equation of a line with the following slope and point:

a. Slope = 0; (5,–4) $y = -4$

b. Slope is undefined; (2, 6) $x = 2$

4) In 2005, 110 students applied for the Math Department Scholarship. There were 125 applicants in 2010. Assume that 2005 is "year 0" for the Math Scholarship, and following years are the number of years after 2005.

a. Write an equation in slope-intercept form that models how many applicants there will be for the years after 2005.

b. Interpret the meaning of slope in the context of this problem.

c. Interpret the meaning of the y-intercept in this problem.

d. Estimate the number of students who will apply in 2016?

$2016 - 2005 = 11$

$(0, 110)$ $(5, 125)$

$\frac{125-110}{5-0} = \frac{15}{5} = 3$

$y = 3x + b$

$110 = 3(0) + b$

$110 = b$

(a) $y = 3x + 110$

(b) slope means 3 more students apply each year

(c) y-intercept is the # of students who applied at the beginning

(d) $y = 3(11) + 110$ in '16

$y = 143$ students

Skill 10: Polynomials

Simplify:

1) $3x^3 - 2x^2 + 6 - 4x^3 + 5x - 3x^2 - 1 - 9x$

$-x^3 - 5x^2 - 4x + 5$ or $-1(x^3 + 5x^2 + 4x - 5)$

2) $5y^2(-4y^3 + 10y^2 - 7y + 3)$

$-20y^5 + 50y^4 - 35y^3 + 15y^2$

3) $(3.1x^2 - 8.4x + 5.7y^2) + (-2.8x^2 + 6.6y - 0.9y^2)$

$0.3x^2 + 4.8y^2 - 8.4x + 6.6y$

$3.1 - 2.8 = 0.3$ $\quad$ $5.7 - 0.9 = 4.8$

4) $(7y^2 + 9y - 8) - (5y^2 - 8y + 2)$ $= 7y^2 + 9y - 8 - 5y^2 + 8y - 2$

$2y^2 + 17y - 10$

5) $(2x - 7)(8x + 4)$

$2x \cdot 8x : 16x^2$

$2x \cdot 4 : 8x$

$-7 \cdot 8x : -56x$

$-7 \cdot 4 = -28$

$16x^2 - 48x - 28$

6) $(h - 8)(6h^2 + 8h - 7)$

$h - 8$

$-48h^2 - 64h + 56$

$6h^3 + 8h^2 - 7h$

$6h^3 - 40h^2 - 71h + 56$

$6h^3 - 40h^2 - 71h + 56$

7) $(3x^2 + 4)(3x^2 - 4)$

$9x^4 - 12x^2 + 12x^2 - 16$

$9x^4 - 16$

8) $(-12a^3 + 24a^2 + 36a - 15) \div -3a$

$-3a \quad -3a \quad -3a \quad -3a$

$4a^2 - 8a - 12 + \frac{5}{a}$

Skill 11: Factoring

1) $-42r^4s - 63r^3s^2 + 28r^2s^3 - 7rs$

$-7rs(6r^3 + 9r^2s - 4rs^2 + 1)$

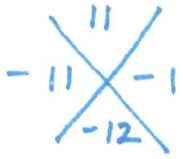
2) $15x^3 - 10x^2 \mid -9x + 6$

$5x^2(3x-2) - 3(3x-2)$

$(3x-2)(5x^2-3)$

3) $x^2 - 12x + 11$

multi: 11, 1 11 — add: -12 = -1 -11



$(x-11)(x-1)$

4) $-z^2 + 3z + 70$

$-1(z^2 - 3z - 70)$

$-1(z+7)(z-10)$

5) $2x^3 - 18x^2 + 40x$

$2x(x^2 - 9x + 20)$

$2x(x-5)(x-4)$

6) $n^2 - 36$

$(n+6)(n-6)$

7) $b^2 + 100$

prime

Skill 12: Solving Formulas

1) $B = \frac{1}{4}(x + y + z)$ Solve for z clear fractions!

$4 \cdot B = \frac{4}{1} \cdot \frac{1}{4}(x + y + z)$

$4B = x + y + z$

$-x \quad -y$

$4B - x - y = z$

$z = 4B - x - y$

2) $6x - 9y = 15$ Solve for y

$-6x \quad -6x$

$\frac{-9y}{-9} = \frac{-6x}{-9} + \frac{15}{-9}$

$y = \frac{2}{3}x - \frac{5}{3}$

3) $C = \frac{6d - 54}{3}$ Solve for d

$3 \cdot C = \frac{3(6d - 54)}{3}$

$3C = 6d - 54$

$+54 \quad +54$

$\frac{3C}{6} + \frac{54}{6} = \frac{6d}{6}$

$\frac{1}{2}C + 9 = d$

$d = \frac{1}{2}C + 9$

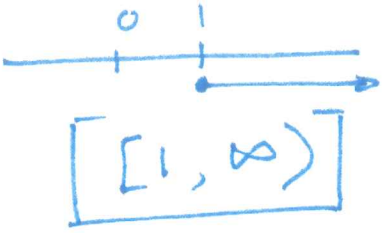
Distribute
Combine like terms
Gather variable terms

Skill 13: Solving Inequalities

Solve each inequality. Write your answer in Interval Notation.

1) $4x-1 \geq 5x-2x$

$4x-1 \geq 3x$
$-3x+1 \quad -3x+1$
$x \geq 1$

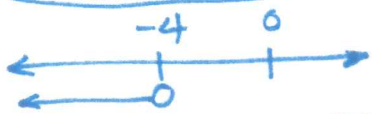


$[1, \infty)$

2) $-3(x+2)-6 > 2(x-3)+14$

$-3x-6-6 > 2x-6+14$
$+3x \qquad +3x$
$-12 > 5x+8$
$-8 \qquad -8$
$\frac{-20}{5} > \frac{5x}{5}$

$x < -4$



$(-\infty, -4)$

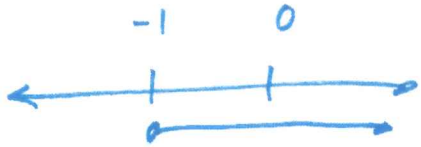
3) $-\frac{1}{2}x+\frac{3}{4} \leq \frac{13}{8}+\frac{3}{8}x$ clear fractions! LCD = 8

$\frac{8}{1}(-\frac{1}{2})x + 8(\frac{3}{4}) \leq 8(\frac{13}{8}) + 8(\frac{3}{8})x$

$-4x+6 \leq 13+3x$
$-3x \quad -6 \qquad -6 \quad -3x$

$\frac{-7x}{-7} \leq \frac{7}{-7}$

!!! $x \geq -1$



$[-1, \infty)$