Ratio

Proportions

Many trades, including automotive technology use ratios and proportions to help solve technical problems.

Vocabulary:

Ratio: Is a comparison, using division, of two quantities of the same kind, both expressed in the units.

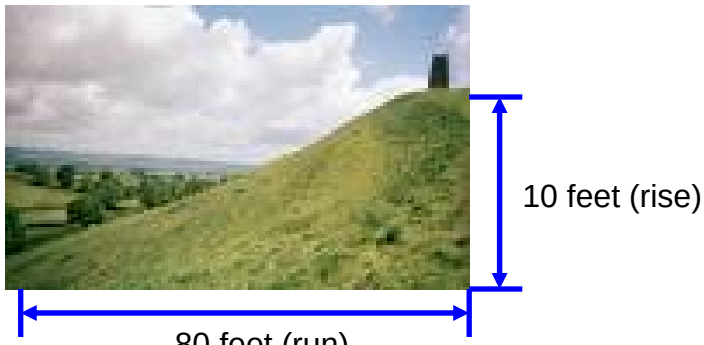
Proportions: An equation stating that 2 ratios are equal.

The ratio of two gears, one a 64 tooth *driving* gear, the other a *driven* gear with 16 teeth can be written as a ration using:

$$\text{Gear ratio} = \frac{\text{number of teeth on the driving gear}}{\text{number of teeth on the driven gear}}$$

This example would be written as: $\text{Gear ratio} = \frac{64}{16} = \frac{4}{1}$ or 4:1

Another way to show ration is through "rate of change or slope." For example, the steepness of a hill can be written as a ratio of the height (rise) to its horizontal extent (run).



$$\text{Steepness (slope)} = \frac{10}{80} = \frac{1}{8} \text{ or } 1{:}8$$

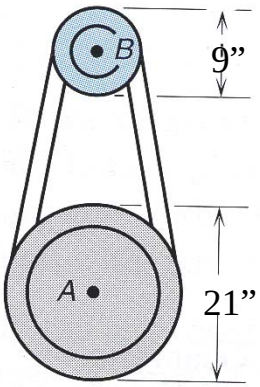
Remember:

Pretty **P**lease **M**y **D**ear **A**unt **S**ally
(From left to right; **P**arentheses; **P**ower; **M**ultiply; **D**ivide; **A**dd, **S**ubtract)

Pulleys are used to transfer power from one system to another (example: crankshaft to alternator). The ratio of the pulley diameter will determine relative pulley speed. Using the formula:

$$\text{Ratio} = \frac{\text{Diameter of Pulley A}}{\text{Diameter of Pulley B}}$$

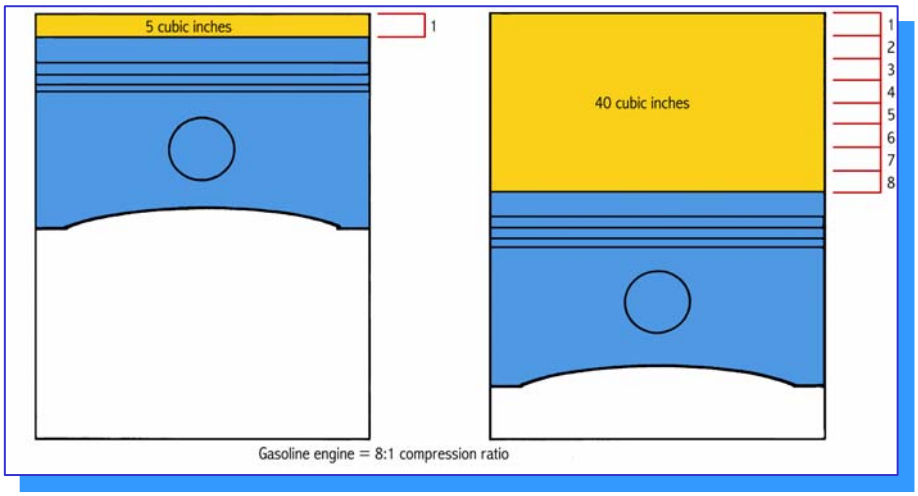
Same Units



$$\text{Ratio} = \frac{21}{9} = \frac{7}{3} = 7:3$$

Engine Compression Ratio (CR) is the difference when a cylinder (piston) is at the bottom of its stroke (Bottom Dead Center) and the air/fuel mixture is at its maximum *expanded volume* or at the top of its stroke (Top Dead Center) and the air/fuel mixture is at its maximum *compressed volume*.

$$CR = \frac{\text{Expanded Volume}}{\text{Compressed Volume}}$$

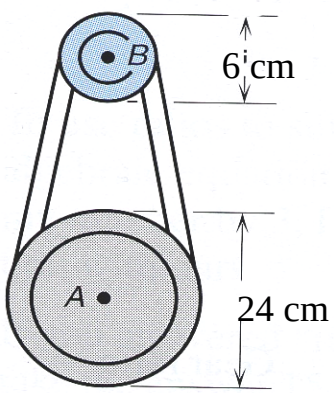


$$CR = \frac{40}{5} = \frac{8}{1} = 8:1$$

Compressed Volume
TDC

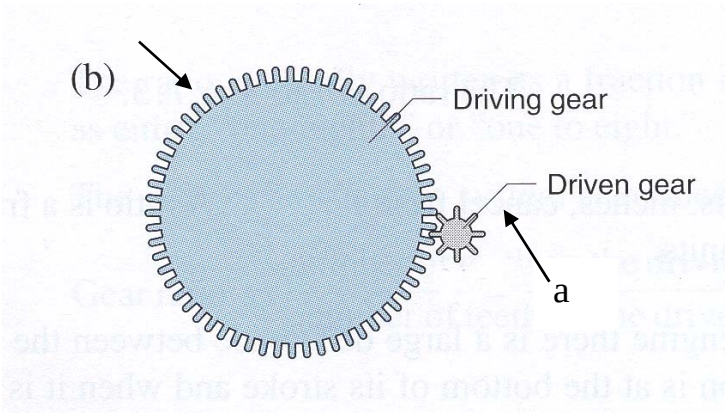
Expanded Volume
BTC

Example 1: Determine the ratio of this pulley set.



Example 2: Determine the ratio of this gear set.

$$\text{Gear ratio} = \frac{\text{number of teeth on the driving gear}}{\text{number of teeth on the driven gear}}$$



A = Driven gear (8 teeth)

b = Driving gear (60 teeth)

Example 3: Determine the CR of a gasoline engine that has an expanded cylinder volume of 47 in^3 and a compressed cylinder volume of 5.00 in^3.

Proportions, Example 4:

$$\frac{1}{3} = \frac{4}{12} \text{ say as: one is to three as four is to 12}$$

Let's look at the math…cross multiply (cross-products) 1 X 12 = 12 and 3 X 4 = 12 to determine if this is a true proportion. If the proportion is true statement

$$\frac{5}{8} = \frac{10}{16}$$

5 X 16 = 80 & 8 X 10 = 80
This is a true proportion!

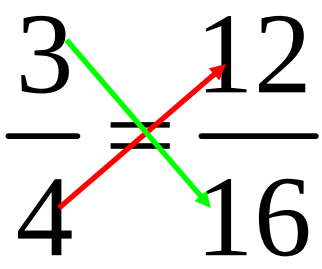
Example 5:

$$\frac{x}{4}=\frac{12}{16} \text{ solve for } x$$

$$x\times 16 = 4\times 12 \text{ or } 16x = 48$$

$$x=\frac{48}{16}$$

$$x = 3$$



4 X 12 = 48 & 3 X 16 = 48
This is a true proportion!

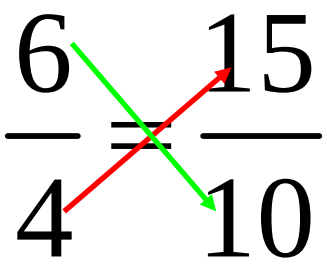
Example 6:

$$\frac{6}{x}=\frac{15}{10} \text{ solve for } x$$

$$x\times 15 = 6\times 10 \text{ or } 15x = 60$$

$$x=\frac{60}{15}$$

$$x = 4$$



4 X 15 = 60 & 6 X 10 = 60
This is a true proportion!

Example 7: The CR of a classic Datsun (Nissan) 280Z is 8.3:1. If the compressed volume of the cylinder is 36 cm^3, what is the expanded volume of the cylinder?

$$8.3=\frac{v}{36cm^3} \text{ or } \frac{83}{10}=\frac{v}{36}$$

8.3 X 10 = 83
This operation allows a fraction to be created to complete the calculation!

$$v=\frac{83\times 36}{10}=298.8 \text{ (round to } 300 \text{ } cm^3)$$

Example 8: A 10 ft bar of I-beam weights 208 lb. What is the weight of a 6 ft length?

Example 9: The headlights on a car are set so the light beam drops 2 in. for each 25 ft measured horizontally. If the headlights are mounted 30 in. above the ground, how far ahead of the car will they hit the ground?

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Worksheet – Ratio/Proportions

Name: _____ AM-1: _____ PM _____ Date: _____

Please show all your work!

1.

	Teeth on Driving Gear *A*	Teeth on Driven Gear *B*	Gear Ration, $\frac{A}{B}$
A	35	5	
B	12	7	
C		3	2:1
D	21		3.5:1

2.

	Diameter of Pulley *A*	Diameter of Pulley *B*	Pulley Ration, $\frac{A}{B}$
A	16”	6”	
B	15”	12”	
C	27 mm		4.5:1
D		10 cm	4:1

3.

	Rise	Run	Rate of Change (Pitch)
A	8 ft	6 ft	
B		24 ft	4:12
C	7 ft		3:12

4. $\frac{3}{2} = \frac{x}{8}$ solve for x

5. $\frac{y}{60} = \frac{5}{3}$ solve for y

6. The CR in a certain engine is 9.6:1. If the expanded volume of a cylinder is 48in^3, what is the compressed volume?

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Homework – Ratios/Proportions

Name: _____ AM-1: _____ PM _____ Date: _____

Please show all your work!

1.

	Teeth on Driving Gear *A*	Teeth on Driven Gear *B*	Gear Ration, $\frac{A}{B}$
A	15		1:3
B		18	1:2
C	30		3:5
D	27	18	

2.

	Diameter of Pulley *A*	Diameter of Pulley *B*	Pulley Ration, $\frac{A}{B}$
A	8.46 cm	11.28 cm	
B	20.14 cm		3.14:1
C		12.15 cm	1:2.25
D	4.45 cm		0.25:1

3.

	Rise	Run	Rate of Change (Pitch)
A	9 ft	15 ft	
B		20 ft	2.4:12
C	3 ft		1.8:12

4. $\frac{138}{23} = \frac{18}{x}$ solve for x

5. $\frac{x}{34.86} = \frac{1.2}{8.3}$ solve for x

6. In winter weather, fuel-line antifreeze must be added at a rate of one car per 8 gallons of fuel. How many cans must be added for an 18 gallon fuel tank?

7. The ideal air fuel ratio is 14.7:1 (14.7 parts air to I part air). If a certain vehicle 9 lb of fuel, how many lbs of air should it draw to achieve the ideal ratio? Round to the nearest pound.