

Exponent rules:

$$a^0 = 1 \text{ (One zero to rule them all)} \quad a^0 = b^0 = (4 \times 92)^0 = 1$$

$$a^m \cdot a^n = a^{m+n} \text{ (Helper exponents)} \quad a^b \cdot a^c = a^{b+c}$$

$$(a^m)^n = a^{m \cdot n} \text{ (Double team the a)} \quad \text{Andre the Giant} \quad (x^2)^4 = x^{2 \cdot 4} = x^8$$

$$\frac{a^m}{a^n} = a^{m-n} \text{ (m looks down on n (second class citizen))} \quad \frac{x^4}{x^3} = x^{4-3} = x^1$$

$$(ab)^n = a^n b^n \text{ (Distribution rule)} \quad (3x)^2 = 3^2 x^2 = 9x^2$$

$$a^{-1} = \frac{1}{a} \text{ (flip me over rule)} \quad \frac{1}{a^{-3}} = \frac{a^3}{1}$$

Example problems

Helper exponents

14. $10^5 \cdot 10^6 \cdot 10^7 =$ 10^{5+6+7}

A. 10^{15}

B. 10^{18}

C. 10^{21}

D. 10^{24}

E. 10^{30}

17. $(-3)^3 =$

A. 9

B. -9

C. 27

D. -27

E. None of the above

$$(-3)(-3)(-3) = (+9)(-3) = -27$$

25. If $2^n = 8$, what is the value of 3^{n+1} ?

A. 70

B. 81

C. 95

D. 102

E. None of the above

$$2^n = 8$$

$$2 \cdot 2 \cdot 2$$

$$2^n = 2^3$$

$$n = 3$$

$$3^4$$

$$(3 \cdot 3)(3 \cdot 3)$$

$$9 \cdot 9 = 81$$

Conversion memory aids (6th most asked on the AR)

Conversions: How many pounds are in 100 kg?

^{heavier}
 $1 \text{ kg} = 2.2 \text{ pounds}$

$$\begin{array}{r} 100 \cancel{\text{kg}} \mid 2.2 \text{ pounds} \\ \underline{1 \cancel{\text{kg}}} \\ 220 \text{ pounds} \end{array}$$

* $1 \text{ pound} = 16 \text{ ounces}$

$1 \text{ meter} = 1 \text{ yard} + (\text{approx})$

$1 \text{ meter} = 39 \text{ inches}$ 39.4

$1 \text{ yard} = 3 \text{ feet}$

$1 \text{ ft} = 12 \text{ inches}$

$1 \text{ in} = 2.54 \text{ centimeters}$

centipedes are smaller

$4 \text{ quarts} = 1 \text{ gallon}$

Example problems: Start with given, do conversions \rightarrow want

19. If $2.5 \text{ centimeters} = 1 \text{ inch}$, and $36 \text{ inches} = 1 \text{ yard}$, how many centimeters are in 1 yard?

- (A) 14
 (B) 25
 (C) 70
 (D) 80
 (E) 90

solution

$$\begin{array}{r} 1 \text{ yard} \mid 36 \text{ inches} \mid 2.5 \text{ cm} \\ \underline{1 \text{ yard}} \mid 1 \text{ inch} \end{array}$$

- (A) ☒ 3.9 kilograms
 (B) ☐ 4.1 kilograms
 (C) ☐ 17.6 kilograms
 (D) ☐ 18.7 kilograms
 (E) ☐ 19.38 kilograms

$160 \cancel{3} / 1 \text{ pound}$

Convert 8 pounds, 8 ounces to kilograms to the nearest tenth of a kilogram.

$$\begin{array}{r} 8.5 \text{ pounds} \mid 1 \text{ kg} \\ \underline{2.2 \text{ pounds}} \\ 2.2 \overline{) 8.5} \quad 22 \overline{) 85} \end{array}$$

17 millipedes more legs than centipedes Just Enough Rule

If there are 10 millimeters in 1 centimeter, how many millimeters are in 150 centimeters?

- (A) ☐ 1.5 mm
 (B) ☐ 15 mm
 (C) ☐ 150 mm
 (D) ☒ 1500 mm
 (E) ☐ 15,000 mm

$$\begin{array}{r} 150 \cancel{\text{cm}} \mid 10 \text{ mm} \\ \underline{1 \cancel{\text{cm}}} \\ 1500 \text{ mm} \end{array}$$

1500 mm

Percentages (Four types) (3rd, 4th, 11th, and 15th most asked on AR; few questions here and there on the MK)

- 1) Percentage / Part (discussed below)
- 2) Percentage / Percent (discussed below)
- 3) Percentage / Base
- 4) Percentage / Change

$$25\% = \frac{1}{4} \quad 50\% = \frac{1}{2}$$

$$256 \cdot 10\% = 25.6$$

$$256 \cdot 1\% = 2.56$$

Percents:

% * retail price = discount

10% means move decimal point one smaller

5% is half of 10%

1% means move decimal point two smaller

$$\text{Percent Change (error)} = \frac{\text{Increase (New - Old)} * 100\%}{\text{Decrease Old (NOO)}}$$

decimal

Example problems:

Percentage / Part:

11. How much money is saved by buying a car priced at \$12,000 with a single discount of 15% rather than buying the same car with discounts of 10% and 5%?

- (A) \$60
(B) \$120
(C) \$180
(D) \$360
(E) \$720

$$12,000 \cdot 10\% = 1,200$$

$$12,000 - 1,200 = 10,800$$

$$10,800 \cdot 5\% = 540$$

$$10,800 - 540 = 10,260$$

$$12,000 \cdot 15\% = 1,800$$

$$12,000 - 1,800 = 10,200$$

$$12,000 \cdot 10\% = 1,200$$

$$12,000 \cdot 5\% = 600$$

$$1,200 + 600 = 1,800$$

$$12,000 - 1,800 = 10,200$$

17. The school enrollment is 1700. Eighteen percent of the students study French, 25% study Spanish, 12% study Italian, 15% study German, and the rest study no foreign language. Assuming that each student may study only one foreign language, how many students do not study any foreign language?

- (A) 510
(B) 520
(C) 530
(D) 540
(E) 550

$$18\% + 25\% + 12\% + 15\% = 70\%$$

30% No study

$$1700 \cdot 30\% = 510$$

Percentage/Percent:

12. The price of an article has been reduced 25%. In order to restore the original price, the price must be increased by

- (A) 15.5%
(B) 20%
(C) 25%
(D) $33\frac{1}{3}\%$
(E) 40%

$$100\% \cdot 25\% = 25\%$$

$$100\% - 25\% = 75\%$$

$$\frac{75}{75} = 1$$

$$1 \cdot 100\% = 100\%$$

$$100\% + 33\frac{1}{3}\% = 133\frac{1}{3}\%$$

original price

$$100.00$$

$$- 25.00$$

$$75.00$$

$$75 \overline{) 100.00}$$

$$- 75$$

$$25.00$$

$$- 22.50$$

$$2.50$$

$$- 2.25$$

$$.25$$

30% → decimal \div by 100

1. Question

At West High School, 30% of athletes run cross country. At the school, 50% of the students are involved in athletic activities. What percentage of students run cross country?

$$100 \text{ students} \cdot \frac{50}{100} = 50 \cdot \frac{30}{100} =$$

$$\frac{1}{2}$$

$$\begin{array}{r} 50 \\ 03 \\ \hline 150 \\ 0 \end{array}$$

☒ 15%

☐ 10%

☐ 30%

☐ 25%

"Up and Up" Method for comparing fractions

$\frac{2}{7} < \frac{1}{3}$? $\frac{2}{7} < \frac{1}{3}$?
 $\frac{2}{7} < \frac{1}{3}$ True
 $6 < 7$ True

Example problems: AR

2. A car has a gasoline tank that holds 20 gallons. When the gauge reads $\frac{1}{4}$ full, how many gallons are needed to fill the tank?

(A) 16

(B) 15

(C) 10

(D) 5

(E) 4

$20 \cdot \frac{1}{4} = 5 \text{ gallons in tank}$
 $20 - 5 = 15$

17. A class of 198 recruits consists of three racial and ethnic groups. If $\frac{1}{3}$ are black and $\frac{1}{4}$ of the remainder are Hispanic, how many of the recruits in the class are white?

(A) 198

(B) 165

(C) 132

(D) 99

(E) 66

$200 / 3$
 $3 \overline{) 200}$
 $\underline{- 18}$
 20

$\approx \frac{66}{20} \approx 65$
 $3 \overline{) 200}$
 $\underline{- 18}$
 20

$200 - 65 = 135$ Black
 $135 - 34 = 101$ Hisp
 ≈ 101

Example problems: MK

$\approx 1 \frac{1}{2} + -$
 $1. \frac{14}{15} + \frac{3}{5} - \frac{1}{30} =$
 $\underline{= 30}$

a. $\frac{19}{15}$

b. $\frac{43}{30}$

c. $\frac{4}{3}$

d. $\frac{3}{2}$

e. 3

$\approx 1.5 \frac{3}{2}$
 $\frac{14 \cdot 2}{15 \cdot 2} + \frac{3 \cdot 6}{5 \cdot 6} - \frac{1}{30}$

$\frac{28}{30} + \frac{18}{30} - \frac{1}{30}$
 $\frac{28}{30} + \frac{18}{30} - \frac{1}{30}$

$\frac{28}{30} + \frac{18}{30} - \frac{1}{30}$
 $\frac{28}{30} + \frac{18}{30} - \frac{1}{30}$

$\frac{128}{18}$
 $\underline{46}$
 $\underline{- 1}$
 $\frac{45}{30} = \frac{3}{2}$

24. Arrange the following numbers from least to greatest value:

$$0.85, \frac{4}{5}, \frac{2}{3}, \frac{91}{100}$$

~~a. $0.85, \frac{4}{5}, \frac{2}{3}, \frac{91}{100}$~~

~~b. $\frac{4}{5}, 0.85, \frac{91}{100}, \frac{2}{3}$~~

$$\boxed{\text{c. } \frac{2}{3}, \frac{4}{5}, 0.85, \frac{91}{100}}$$

~~d. $0.85, \frac{91}{100}, \frac{4}{5}, \frac{2}{3}$~~

$$\text{e. } \frac{2}{3}, 0.85, \frac{4}{5}, \frac{91}{100}$$

$$0.\underline{8}5$$

$$0.\underline{9}1$$

$$\sqrt{2} \approx 1.4$$

$$\sqrt{3} \approx 1.7$$

$$\frac{4}{5} \overset{?}{>} \frac{2}{3}$$

$$12 \overset{?}{>} 10$$

$$0.8 < 0.85 \downarrow$$

$$\begin{array}{r} 8 \overline{) 4.0} \\ \underline{40} \\ 0 \end{array}$$