ASVAB Problem Set

Many of the ASVAB problems in the Arithmetic Reasoning section use variations of the same formula. One of the most commonly used formulas is

$$rate \times time = distance.$$

Some variations of this formula are

1. $rate \times time = amount,$
2. $rate \times amount = total.$

Note: Rates always have two units involved. For example, a rate can be miles per gallon, miles per hour, boxes per minute, bags per second, etc.

Example: A food packaging factory can pack 3 bags of chips every 2 seconds. How many bags of chips can the factory pack in two minutes?

Solution: The appropriate formula for this problem is $rate \times time = amount$. We can begin by stating the information we are given:

Rate: The rate is $r = \frac{3 \text{ bags}}{2 \text{ seconds}}$.

Time: The time is 2 minutes. Since the rate is given using seconds, we should convert time from minutes to seconds. Thus, we will use the time $t = 120$ seconds.

Amount: We want to find the number of bags.

Now we simply need to plug this information into the appropriate formula to obtain our final answer.

$$\begin{aligned} rate \times time &= amount \\ \frac{3 \text{ bags}}{2 \cancel{\text{ seconds}}} \times 120 \cancel{\text{ seconds}} &= \frac{3 \times 120}{2} bags \\ &= \frac{3 \times \cancel{2} \times 60}{\cancel{2}} bags \\ &= \frac{3 \times 60}{1} bags \\ &= 180\, bags. \end{aligned}$$

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ASVAB Problem Set

Example: Ryan drove 408 miles from Hesperia, CA to Lake Tahoe, CA. His truck gets 17 miles per gallon. If gas costs \$3.19 per gallon, how much does he spend on gas for a round trip?

Solution: We first need to find the number of gallons needed for the trip. Thereafter, we will find the cost for the trip.

We must use the formula $rate \times gallons = distance$ to find the number of gallons used on the trip.

Let's begin by stating the information we are given:

Rate: The rate that his truck burns fuel is $r = \frac{17 \text{ miles}}{1 \text{ gallon}}$.

Gallons: We want to find the number of gallons.

Distance: The number of miles for a one way trip is $d_1 = 408$ miles. However, we are interested in the number of miles for a round trip, so $d = d_1 \times 2 = 408 \times 2 = 816$ miles.

We can now substitute these values into the formula, then solve for the desired value.

$$rate \times gallons = distance$$

$$17 \frac{\text{miles}}{\text{gallon}} \times gallons = 816 \text{ miles}$$

In order to solve for the number of gallons, we need to cancel out any operations that are currently being done to the gallons variable in the formula.

We are currently multiplying the gallons variable by $17\frac{\text{miles}}{\text{gallon}}$. In order to cancel this operation, we must do the opposite operation. Thus, we will divide both sides of the equation by $17\frac{\text{miles}}{\text{gallon}}$.

$$\frac{\cancel{17\frac{\text{miles}}{\text{gallon}}} \times gallons}{\cancel{17\frac{\text{miles}}{\text{gallons}}}} = \frac{816 \text{ miles}}{17\frac{\text{miles}}{\text{gallons}}}$$

$$gallons = \frac{816}{17} \text{ gallons}$$

$$gallons = 48 \text{ gallons}$$

Now that we know the number of gallons used throughout the trip, we simply need to multiply the number of gallons used by the cost per gallon

$$48\,\cancel{gallons} \times \$3.19\,\frac{dollars}{\cancel{gallon}} = \$153.12$$

Thus, Ryan spent \$153.12 on gas for his trip. ■

ASVAB Problem Set

Example: A beverage company packages sodas in packs of 12. If the company has 135 cans of soda, how many cans will the company have left over if it fills as many packs of soda as possible?

Solution: To determine the number of cans left over after the company fills the maximum number of packs of sodas, we must divide the number total number of cans (135) by the number of cans in each pack (12). The answer to this problem is the remainder.

$$\frac{135}{12} \quad \text{is the same as} \quad \begin{array}{r} 11 \\ 12\overline{)135} \\ \underline{12} \\ 15 \\ \underline{12} \\ 3 \end{array}$$

We see that 135 divided by 12 is 11 with a remainder of 3. Thus, 3 cans are left over. ■

Example: Joann brought 100 cookies to work. There were 15 employees in her office, and there were 25 cookies left over at the end of the day. How many cookies did each employee eat on average?

Solution: To find the number of cookies each employee ate on average, we must divide the number of cookies eaten by the number of employees.

$$\frac{75 \text{ cookies}}{15 \text{ employees}} = 5 \quad \text{is the same as} \quad \begin{array}{r} 5 \\ 15\overline{)75} \\ \underline{75} \\ 0 \end{array}$$

Thus, on average each employee ate 5 cookies. ■

ASVAB Problem Set

Example: When 7.77 is divided by 0.021, what is the quotient?

Solution: We can find the solution to this problem by doing long division. Before we can do division, however, we need the divisor (the number we are dividing by) to be a whole number. We can obtain equivalent numbers as follows:

$$\frac{7.77}{0.021} \cdot \frac{1000}{1000} = \frac{7770}{21}$$

Note: We can simply count how many spaces the decimal in the divisor must move to the right for the divisor to become a whole number, then we can move the decimal in the dividend the same number of spaces to the right. $\frac{\text{dividend}}{\text{divisor}}$ = quotient.

$$\frac{7.77}{0.021} = \frac{7770}{21} = 370 \quad \text{is the same as} \quad \begin{array}{r} 370 \\ 21\overline{)7770} \\ \underline{63} \\ 147 \\ \underline{147} \\ 00 \end{array}$$

Thus, the quotient is 370. ■

Example: When 2.5 is divided by 0.4, what is the quotient?

Solution: We can find the solution to this problem by doing long division. Before we can do division, however, we need the divisor (the number we are dividing by) to be a whole number. Recall $\frac{\text{dividend}}{\text{divisor}} = \frac{2.5}{0.4}$. We can move the decimal in the divisor to the right until we obtain a whole number, as long as we move the decimal in the dividend the same number of places to the right. If we do this, we obtain

$$\frac{2.5}{0.4} = \frac{25}{4} = 6.25 \quad \text{which is the same as} \quad \begin{array}{r} 6.25 \\ 4\overline{)25.00} \\ \underline{24} \\ 1.0 \\ \underline{8} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

Thus, the quotient is 6.25. ■.

Example: Multiply $3x^4$ and $5x^2$.

Solution: We can multiply these numbers clearly if we begin by factoring each number, then use the commutative property of multiplication to rearrange the numbers as follows:

$$\begin{aligned} 3x^4 \times 5x^2 &= 3 \cdot x \cdot x \cdot x \cdot x \times 5 \cdot x \cdot x \\ &= 3 \cdot 5 \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \\ &= 15 \cdot x^6 \\ &= 15x^6 \end{aligned}$$

Thus, $3x^4 \times 5x^2 = 15x^6$. ■

Example: Multiply $(3x + 1)(2x - 2)$.

Solution: In this problem, we are multiplying two binomials. The common acronym used to describe the process is FOIL: First, Outer, Inner, Last. We begin by multiplying the first numbers in the parenthesis, then the outer numbers in the parenthesis, the inner numbers, then the last numbers.

The result is

$$\begin{aligned} (3x + 1)(2x - 2) &= 3x \cdot 2x + 3x \cdot -2 + 1 \cdot 2x + 1 \cdot -2 \\ &= 3 \cdot 2 \cdot x \cdot x + 3 \cdot -2 \cdot x + 1 \cdot 2 \cdot x + 1 \cdot -2 \\ &= 6 \cdot x^2 - 6 \cdot x + 2 \cdot x - 2 \\ &= 6x^2 - 4x - 2. \end{aligned}$$

Thus, the product is $(3x + 1)(2x - 2) = 6x^2 - 4x - 2$. ■

Example: For all a, $(2a - 2)(3a + 1) =$

Solution: In this problem, we are multiplying two binomials. The common acronym used to describe the process is FOIL: First, Outer, Inner, Last. We begin by multiplying the first numbers in the parenthesis, then the outer numbers in the parenthesis, the inner numbers, then the last numbers.

The result is

$$\begin{aligned} (2a - 2)(3a + 1) &= 2a \cdot 3a + 2a \cdot 1 + -2 \cdot 3a + -2 \cdot 1 \\ &= 6a^2 + 2a - 6a - 2 \\ &= 6a^2 - 4a - 2. \end{aligned}$$

Thus for all a, $(2a - 2)(3a + 1) = 6a^2 - 4a - 2$. ■

Example: Find the average of 5 and 9.

Solution: We find the average by adding the numbers in consideration together, then we divide the sum by the total number of numbers. Since we have two numbers, we will add 5 and 9, then divide by 2:

$$average = \frac{5+9}{2} = \frac{14}{2} = 7.$$

Thus the average of 5 and 9 is 7. $\blacksquare$

Example: Find the average of $\frac{1}{20}$ and $\frac{1}{30}$.

Solution: We find the average by adding the numbers in consideration together, then we divide the sum by the total number of numbers. Since we have two numbers, we will add $\frac{1}{20}$ and $\frac{1}{30}$, then divide by 2:

$$average = \frac{\frac{1}{20}+\frac{1}{30}}{2} = \frac{\frac{3}{60}+\frac{2}{60}}{2} = \frac{\frac{5}{60}}{2} = \frac{5}{60} \div 2 = \frac{5}{60} \times \frac{1}{2} = \frac{5}{120} = \frac{1}{24}.$$

Thus the average of $\frac{1}{20}$ and $\frac{1}{30}$ is $\frac{1}{24}$. $\blacksquare$

Example: A student takes four tests. If her grades are 94, 88, 76, and 98, what is her average test grade?

Solution: We find the average by adding the numbers in consideration together, then we divide the sum by the total number of numbers. Since we have four numbers, we will add 94, 88, 76, and 98, then divide by 4:

$$\frac{94+88+76+98}{4} = \frac{356}{4} = 89.$$

Thus, the student's average test grade is 89. $\blacksquare$