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# Word Problem Primer - *How to Solve Word Problems*

"How R U?"

You know that this means "How are you?". It is short-hand, abbreviation, "code"; it is a quicker way to write. Well, so is F=ma; you just don't know *the code* yet.

F = ma

*Formulas are just shorthand.*

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**Learn what the letters stand for.**

In order to read "the code" you have to know what the letters stand for. This table will tell you many of them.

There will be other letters, too. You will have to add them as you learn them.

**Variables Defined with Units**

| Variable | Quantity | Standard Units |
|---|---|---|
| a | acceleration | $m/s^2$ |
| D | distance | m (meters) |
| E | energy | J (joules) |
| F | force | N (newtons) |
| $F_w$ | force of weight | N (newtons) |
| g | acceleration due to gravity | $g = 9.8\ m/s^2$ |
| m | mass | kg (kilograms) |
| p | momentum | kgm/s |
| S | speed | m/s |
| T | time | sec, min, or hr |
| v | velocity | m/s |
| MA | mechanical advantage | no units |

F = ma

*F is force (in N)*
*m is mass (in kg)*
*a is acceleration (in $m/s^2$)*

The units are VERY important because word problems will not tell you what letters stand for, but the UNITS will..

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**Learn what you're supposed to do with the letters: math.**

Once you know what the letter mean, you have to know what math function to perform. This table will tell you.

**The Math Code**

| | | |
|---|---|---|
| m + a | is add | means m plus a |
| m - a | is sub | means m minus a |
| ma | is multi | means m times a |
| m/a | is div | means m divided by a |

F = ma

*Means Force equals the mass <u>times</u> the acceleration.*

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**Learn how to move the numbers around in the formulas. (There is a formula chart on the back.)**

Often you will have to solve for a different letter in the formula. You will have to know how to use math to do this.

**To Move Letters in Formulas**

| | |
|---|---|
| If m + a | then subtract by m or a |
| If m - a | then add by a |
| If ma | then divide by m or a |
| If m/a | then multiply by a |

***Make sure what ever you do to one side of an equation do to the other side, too or the equation is no longer equal!***

If F = ma

*Then to get "a", divide by "m" on both sides:*

$$\frac{F}{m} = \frac{ma}{m}$$

m's cancel on right side

So, $\mathbf{a = \frac{F}{m}}$

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**Use a five-step process to solve word problems.**

**5 Steps to Solve Word Problems**

| | |
|---|---|
| Step 1 | Assign letters (variables) to the numbers given |
| Step 2 | Find a formula that uses those variables |
| Step 3 | Solve for the letter you are trying to find |
| Step 4 | Put the numbers in for the variables (letters) |
| Step 5 | Calculate an answer (don't forget units) |

**We will do a few examples on the back of this paper.**

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Δ means "change of " ("delta"). So ΔS is "delta S" and means "change of speed". ΔT is change of time.

## Formula Chart

(Add other formulas here)

| | | | | |
|---|---|---|---|---|
| $S = \Delta D/\Delta T$<br>$A = \Delta S/\Delta T$<br>$\Delta T = T_2 - T_1$<br>$\Delta D = D_2 - D_1$<br>$S_{average} = D_{total}/T_{total}$ | $F_{net} = ma$<br>$F_{net} = F_{pos} - F_{neg}$<br>$F_w = mg$<br>$p = mv$<br>$m_L v_L = m_R v_R$ | $MA = F_{out}/F_{in}$<br>$MA = D_E/D_R$<br>$Arm_{in}(F_{in}) = Arm_{out}(F_{out})$ | | |

### Use the units to match the variables on the left with the quantities on the right

| | |
|---|---|
| 1. a = _____ | 35 joules |
| 2. S or v = _____ | 20 meters/sec |
| 3. m = _____ | 5 meters |
| 4. D = _____ | 43 newtons |
| 5. F = _____ | 6 |
| 6. p = _____ | 3 $m/s^2$ |
| 7. T = _____ | 60 kgm/s |
| 8. E = _____ | 76 sec |
| 9. MA = _____ | 9 kilograms |

### What do these variables mean?

1. E _____
2. a _____
3. S _____
4. D _____
5. F _____
6. p _____
7. T _____
8. MA _____
9. v _____
10. m _____

What is Δ and what does it mean?

What is ΔD and what does it mean?

A car starts 3 meters away and ends up 14 meters away. What is ΔD for the car?

A car leaves at 2:00 p.m. and arrives at 4:30 p.m. Find ΔT.

### Fill in the math functions

ma = m _____ a

S/T = S _____ T

$T_2 - T_1 = T_2$ _____ $T_1$

mv = m _____ v

F/m = F _____ m

$T_1 + T_2 = T_1$ _____ $T_2$

$D_{total}/T_{total} = D_{total}$ _____ $T_{total}$

### How do you break these up?

| | |
|---|---|
| $S = \Delta D/\Delta T$ | To move ΔT you would have to: _____ |
| $T = T_2 - T_1$ | To move $T_1$ you would have to: _____ |
| $F = ma$ | To move m you would have to: _____ |
| $A = \Delta S/\Delta T$ | To move ΔT you would have to: _____ |
| $p = mv$ | To move v you would have to: _____ |
| $D = D_2 - D_1$ | To move $D_1$ you would have to: _____ |
| $S_{average} = D_{total}/T_{total}$ | To move $T_{total}$ you would have to: _____ |

Equation: $\Delta T = T_2 - T_1$; solve for $T_2$.

Equation: F = ma; solve for a.

Equation: $S = \Delta D/\Delta T$; solve for ΔD.

Equation: $A = \Delta S/\Delta T$; solve for ΔT.

### A car travels 40 meters in 10 seconds. Calculate the car's speed.

Step 1: variables

Step 2: formula

Step 3: Solve for final variable

Step 4: Put in numbers

Step 5: Calculate answer

### A car starts at rest and accelerates to 50 m/s in 5 seconds. Calculate acceleration.

Step 1:

Step 2:

Step 3:

Step 4:

Step 5:

### A car travels at 60 mph for 10 hours. Calculate the distance it travels.

Step 1:

Step 2:

Step 3:

Step 4:

Step 5:

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To learn to solve word problems from this page you can do either one of two things:

1) You can read the problem and try to solve it by yourself then check the answer.

OR

2) You can cover up the answers and uncover each step as the page progresses.

**Problem 1:**
A 25 kg box is pulled by a 125 newton force.
What acceleration will it have?

Step 1: assign letters (variables) to the numbers given and to what you are looking for:

m = 25 kg  F = 125 N  a = ?

Step 2: Find an equation that fits these variables:

F = ma (Newton's second law) - means m multiplied by a

Step 3: Solve for the variable you are looking for:

(Note: If the equation is already solved for what you are looking for [like the F in F = ma] you can skip this step.)

Since ma is multiplication, then to get a by itself, divide by a on both sides:

$\frac{F}{m} = \frac{ma}{m}$ and the m's cancel on the right side

So: $a = \frac{F}{m}$ which means a = F ÷ m

Steps 4 and 5: Put the numbers in and calculate an answer:

$a = \frac{F}{m} = \frac{125\ N}{25\ kg} = \boxed{5\ m/s^2}$ - remember that acceleration is in $m/s^2$ (look on the letter chart).

**Problem 2:**
A plane stops from 250 m/sec in 10 seconds. What was its acceleration?

Step 1: assign variables to the numbers given and to what you are looking for:

$S_1 = 250$ m/s  $S_2 = 0$ m/s
$\Delta T$ (change of time) = 10 secs.
a = ?

Step 2: Find an equation that fits these variables:
Here we have 2 equations: $\Delta S = S_2 - S_1$ and $a = \frac{\Delta S}{\Delta T}$

Step 3: Solve for the variable you are looking for:
(For this problem we don't have to do this step.)

Steps 4 and 5: Put the numbers in and calculate an answer:
To calculate the acceleration, first we must get $\Delta S$.

So, $\Delta S = 0$ m/s – 250 m/s = -250 m/s
(the $\Delta S$ is negative because it stops from 250 m/s)

So, $a = \frac{\Delta S}{\Delta T} = \frac{-250\ m/s}{10\ s} =$ - 25 m/s2

**Problem 3:**
A lever has an input arm of 25 m and an output arm of 5 m.
How much force would it take to lift a 100N with this lever?

Step 1: $Arm_{in} = 25$ m  $Arm_{out} = 5$ m  $F_{out} = 100$ N  $F_{in} = ?$

Step 2: $Arm_{in}(F_{in}) = Arm_{out}(F_{out})$

Step 3: since $Arm_{in}(F_{in})$ means multiplication, divide both sides by $Arm_{in}$: $Arm_{in}(F_{in})/Arm_{in} = Arm_{out}(F_{out})/Arm_{in}$

$Arm_{in}$ cancels on the left giving: $F_{in} = Arm_{out}(F_{out})/Arm_{in}$

Step 4 and 5: $F_{in} = 5$ m(100 N)/25 m or 5m X 100N ÷ 25m (use a calculator!)

$\boxed{F_{in} = 20\ m}$

**Problem 4:**
A 40 kg boy throws a 2 kg ball to the left. The boy ends up going to the right a 2 m/s. How fast is the ball going?

Step 1: $m_{ball} = 2$ kg  $v_{ball} = ?$  $m_{boy} = 40$ kg  $v_{boy} = 2$ m/s

Step 2: $m_L v_L = m_R v_R$ (boy is $m_R$ and $v_R$, ball is $m_L$ and $v_L$)

Step 3: solve for $v_L$ (ball) $m_L v_L = m_R v_R$

divide both sides by $m_L$ $m_L v_L/m_L = m_R v_R/m_L$

$m_L$'s cancel on the left giving: $v_L = m_R v_R/m_L$

Step 4 and 5: $v_L = 40$kg (2m/s)/ 2kg = (80kgm/s) / 2 kg

kgs cancel out giving us: $\boxed{v_L = 40\ m/s}$

$\Delta$ means "change of " (name is "delta").
So $\Delta S$ is "delta S" and means change of speed.

**Formula Chart**

(Add other formulas here)

| | | | | |
|---|---|---|---|---|
| $S = \Delta D/\Delta T$<br>$A = \Delta S/\Delta T$<br>$\Delta T = T_2 - T_1$<br>$\Delta D = D_2 - D_1$<br>$S_{average} = D_{total}/T_{total}$ | $F_{net} = ma$<br>$F_{net} = F_{pos} - F_{neg}$<br>$F_w = mg$<br>$p = mv$<br>$m_L v_L = m_R v_R$ | $MA = F_{out}/F_{in}$<br>$MA = D_E/D_R$<br>$Arm_{in}(F_{in}) = Arm_{out}(F_{out})$ | | |