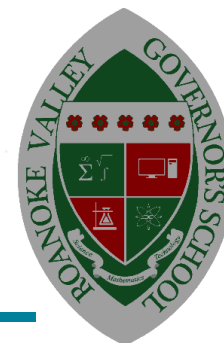


RVGS Physics 2026-27

Summer Assignment



ASSIGNMENT OVERVIEW

1. Class Introduction
2. Summer Assignment Details
3. Skills and Practice Problems
4. Practice Problems with Submission QR Code

1. Introduction

RVGS Physics is the introductory science course for all first-year students. Topics include motion, forces, momentum, work, and energy. Possible second semester units may also include waves, optics, fluids, electricity and magnetism. A focused approach allows students to develop a deep factual, conceptual, mathematical, and procedural knowledge of fundamental physics concepts. Labs and activities throughout the course reinforce skills in technology, statistics, data collection, and experimentation. The primary goals of the course are to improve problem-solving skills, correct basic preconceptions about physics, and build a "big picture" foundational model for future higher-level science courses.

2. Summer Assignment Details

Work for this assignment will be turned in at the beginning of the first class on Tuesday August 11th. Answers in part 4 are due by Sunday, July 26th at 9pm.

The following items will need to be submitted for full credit:

- Confirmation that you have received this document (**fill out the survey via the QR Code to the right ASAP**)
- Fully worked out solutions for all problems in parts 3 and 4
- Answers submitted online for problems found in part 4 via the QR code at the end of the assignment.

RVGS Physics Summer Assignment
Acknowledgement



We will check our emails periodically this summer. You are welcome to contact BOTH of us with any questions and we will do our best to answer them: mclarkston@rvgs.k12.va.us AND ConnorWade@rvgs.k12.va.us

Good luck, enjoy your summer, and we look forward to seeing you all August 11th.

Mr. Clarkston and Mr. Wade

3. Skills and Practice Problems

Directions: Look over the 4 skills in this section. Read over the information given and examine the worked-out examples. After the examples are practice problems with the correct final answers. Show all steps just like the examples for these problems. The written work is due the first day of class.

Skill 1: Unit Conversions

Goal: In Physics we use base units of meters for distance, seconds for time, and kilograms for mass. Often you will measure quantities that don't make sense to measure in meters, kilograms, or seconds and will need to be converted. Unit conversions present measurements in a way that can be easily analyzed.

Main Idea: When converting units, we are multiplying some value by 1. Multiplying a value by 1 doesn't change the actual value. For unit conversions the measured value doesn't change even though the physical value does.

Concept Example: You order 3 pizzas with 8 slices each. You can say you have 3 pizzas or 24 slices. Either way you still have the same physical quantity of pizza.

Steps to Convert Units:

1. List necessary conversion factors. Determine how many of one unit is equal to another unit.
2. Create a ratio from the conversion factors to multiply the measurement by. Since the values are equal this division would be equal to 1. The units in the ratio will need to be in the opposite position from the measurement.
3. Solve the problem. Multiply and divide the measurement and all the ratios. Cancel units as needed. You should end with just the desired unit in the end. If not, convert some more.

Let's look at all the steps with some examples.

Example #1:

Convert 2.5 km to m.

Step #1: List Conversion Factors

$$1 \text{ km} = 1000 \text{ m}$$

Step #2: Create Ratios

$$2.5 \text{ km} \left(\frac{1000 \text{ m}}{1 \text{ km}} \right)$$

*Notice km goes on the bottom. When we solve this problem, we will end up with km/km which will cancel....leaving only meters.

Step #3: Complete the conversion

$$\frac{2.5 \cancel{\text{km}} \times 1000 \text{ m}}{1 \cancel{\text{km}}} = 2500 \text{ m.}$$

*Notice the km units cancel since they are found in every quantity on the top and bottom.

Example #2:

Convert 12.8 cm/s to m/s.

*Notice this has two units. One for distance and one for time.

Step #1: List Conversion Factors

$$100 \text{ cm} = 1 \text{ m}$$

Step #2: Create Ratios

$$\frac{12.8 \text{ cm}}{1 \text{ s}} \left(\frac{1 \text{ m}}{100 \text{ cm}} \right)$$

Step #3: Complete the conversion

$$\frac{12.8 \cancel{\text{cm}} \times 1 \text{ m}}{1 \text{ s} \times 100 \cancel{\text{cm}}} = 0.128 \frac{\text{m}}{\text{s}}$$

Example #3:

Convert 25 m/s to km/hr.

Step #1: List Conversion Factors

$$1 \text{ km} = 1000 \text{ m}$$

$$1 \text{ hour} = 3600 \text{ seconds (60 seconds in a minute, 60 minutes in an hour, } 60 \times 60 = 3600 \text{ s)}$$

Step #2: Create Ratios

$$\frac{25 \text{ m}}{1 \text{ s}} \left(\frac{1 \text{ km}}{1000 \text{ m}} \right) \left(\frac{3600 \text{ s}}{1 \text{ hr}} \right)$$

*The order of the ratios does NOT matter when setting up. You can multiply in any order and get the same answer.

Step #3: Complete the conversion

$$\frac{25 \cancel{\text{m}} \times 1 \text{ km} \times 3600 \cancel{\text{s}}}{1 \cancel{\text{s}} \times 1000 \cancel{\text{m}} \times 1 \text{ hr}} = 90 \frac{\text{km}}{\text{hr}}$$

Unit Conversion Problems: Complete all steps for the following conversions on your own paper. The answer key is provided at the top of page 9 to verify accuracy and help find errors.

1. Convert 2.5 km to cm	2. Convert 2,500 cm to m	3. Convert 0.5 m to mm	4. Convert 0.25 km to m
5. Convert 4500 m/hr to km/s	6. Convert 60,000 cm/s to km/min	7. Convert 30 km/hr to m/s	8. Convert 38 m/s to km/hr

Skill 2: Analyzing Graphs

Goal: Graphs are a useful way to present measurements in science. They provide the observer with the opportunity to make **qualitative observations** (based on perception) and **quantitative analysis** (based on numerical calculations).

Main Idea: In physics we will use 2 kinds of quantitative analysis on graphs:

1. Slopes of Lines
2. Area of Graphs

These two analyses tell us additional information about the graph beyond what is pictured.

Steps for slope:

1. Determine two points on the graph. Often these will be determined by specific x-values that are given. Write down the coordinates for the two points to be used for analysis in (x, y) format.
2. Plug in the values into the mathematical slope equation: $slope = \frac{y_2 - y_1}{x_2 - x_1}$
3. Determine units

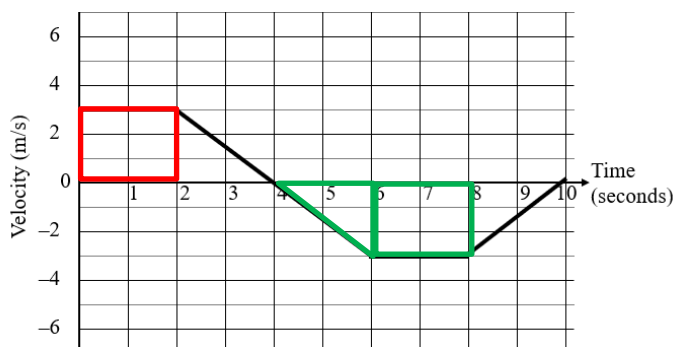
Steps for Area:

1. Map out the area to be solved for. This area will be determined by all 3 of the following:
 - a. The graphed line
 - b. The x-axis
 - c. One or two vertical lines that connect the x-axis to the graphed value.

This can be the y-axis or a reference vertical line at some y-value. Determine the shape of the area. You may need to divide the area into smaller shapes. All graphs in this course can be divided into some combination of triangles and rectangles.

2. Determine the area of each shape. $Area\ Rectangle = Base \times Height$ or $Area\ Triangle = \frac{1}{2} Base \times Height$. Keep track of negative values.
3. Add up the individual areas and perform unit analysis.

Let's look at all the steps with the following graph.



Slope Example #1: Determine the slope between seconds 8 and 10.

Step #1: Determine both points

Point 1: (8, -3)

Point 2: (10, 0)

Step #2: Slope Equation

$$slope = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - (-3)}{10 - 8} = \frac{3}{2} = 1.5$$

Step #3: Determine Units

$$Units = \frac{m}{s} = \left(\frac{m}{s}\right)\left(\frac{1}{s}\right) = \frac{m \times 1}{s \times s} = \frac{m}{s^2}$$

Slope = 1.5 m/s²

Area Example #1: Determine the area of the graph for the first 2 seconds.

Step #1: Map out Area

Use graph, x-axis, y-axis, and y line at x = 2 seconds up to the graphed value of 3. SHOWN BY THE RED BOX ON THE GRAPH ABOVE.

Step #2: Determine Shape Area

$$Area\ Rectangle = Base \times Height = 2\ s \times 3\ \frac{m}{s} = 6$$

Step #3: Determine Units

$$Units = s \left(\frac{m}{s}\right) = \frac{s \times m}{s} = m$$

Area = 6 m

Slope Example #2:

Determine the slope between seconds 2 and 6.

Step #1: Determine both points

Point 1: (2, 3)

Point 2: (6, -3)

Step #2: Slope Equation

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - 3}{6 - 2} = \frac{-6}{4} = -1.5$$

Step #3: Determine Units

$$\text{Units} = \frac{\frac{m}{s}}{s} = \left(\frac{m}{s}\right)\left(\frac{1}{s}\right) = \frac{m}{s^2}$$

Slope = -1.5 m/s²

Area Example #2:

Determine the area of the graph from 4 to 8 seconds.

Step #1: Map out Area

Use graph, x-axis, y-axis, and y lines at $x = 4 \text{ s}$ and $x = 8 \text{ s}$ to the graphed values. SHOWN BY THE GREEN BOX AND TRIANGLE ON THE GRAPH ABOVE.

Step #2: Determine Shape Area

$$\text{Area Rectangle} = \text{Base} \times \text{Height} = 2 \text{ s} \times -3 \frac{m}{s} = -6$$

$$\begin{aligned} \text{Area Triangle} &= \frac{1}{2} \text{Base} \times \text{Height} \\ &= \frac{1}{2} \times 2 \text{ s} \times -3 \frac{m}{s} = -3 \end{aligned}$$

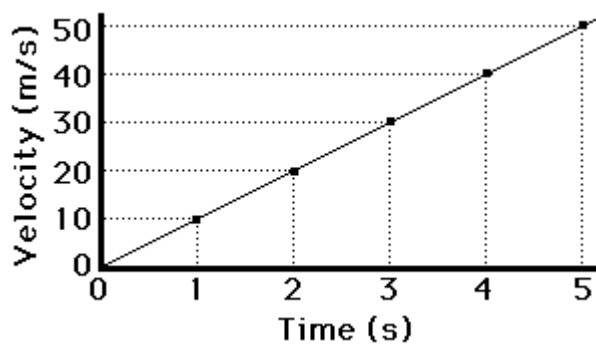
Step #3: Determine Units

$$\text{Units} = s \left(\frac{m}{s}\right) = \frac{s \times m}{s} = m$$

Area = -9 m

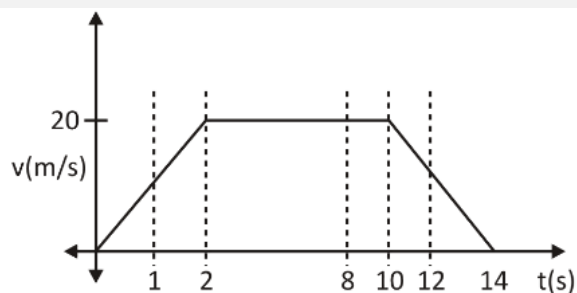
Analyzing Graphs Problems: Complete all steps for the following conversions on your own paper. The answer key is provided to at the top of page 9 verify accuracy and help find errors.

Graph #1



9. What is the slope of the line from 0 to 5 seconds?
10. What is the area under the graph from 0 to 5 seconds?

Graph #2



11. What is the slope of the graph from 0 to 2 seconds?
12. What is the slope of the graph from 10 to 14 seconds?
13. What is the area of the graph from 0 to 14 seconds?

Skill 3: Rearranging an Equation (Putting it in terms of...)

Goal: In science we like to create models of relationships between quantities. These always appear in the form of mathematical equations.

Main Idea: In Physics, we often need to examine a particular effect that one variable has on another, solve for an unknown, or create a prediction. The first step for any of them often requires that an equation be rearranged to isolate a particular quantity.

Steps to rearrange an equation:

1. Circle the variable that needs to be isolated.
2. Use appropriate math operations (also known as inverse operations) on both sides of the equation to remove other variables and constants until the desired variable is alone. Common math operations we use include:
 - a. Multiplication – if the variable is being divided by something (*example: $\frac{x}{A}$*)
 - b. Division – if the variable is being multiplied by something (*example: AX*)
 - c. Addition – if the variable has something being subtracted from it (*example: $X - A$*)
 - d. Subtraction – if the variable has something being added to it (*example: $X + A$*)
 - e. Square root – if the variable is squared (*example: X^2*)
 - f. Squaring – if the variable has a square root over it (*example: $\sqrt{X}$*)

PHYSICS NOTE: Often physics models will have the same quantity occurring at a different time. In those cases a subscript is often attached to a variable. The most common example is for an initial condition and is given by adding a subscript of zero. Examples are X_0 (initial position) and V_0 (initial velocity). It does not need any mathematical operation as it is just a note for the variable.

Let's look at all the steps with some examples.

Example #1:

Solve the equation $v = \frac{x}{t}$ in terms of x .

Step #1: Circle the variable to be isolated

$$v = \frac{x}{t}$$

Step #2: Use appropriate math operations

- $v = \frac{x}{t}$ * t needs to be moved from the right side. Since x is being divided by t we need to multiply both sides of the equation by t .
- $t \times v = \frac{x}{t} \times t$ * t cancels on the right side of the equation
- $x = tv$ *Our final equation written in terms of x .

Example #2:

Solve the equation $v = \frac{x}{t}$ in terms of t .

Step #1: Circle the variable to be isolated

$$v = \frac{x}{t}$$

Step #2: Use appropriate math operations

- $v = \frac{x}{t}$ * t needs to be moved to the numerator. Since x is being divided by t we need to multiply both sides of the equation by t .
- $t \times v = \frac{x}{t} \times t$ * t cancels on the right side of the equation
- $tv = x$ * t is being multiplied by v so we need to divide by v .
- $\frac{tv}{v} = \frac{x}{v}$ * $\frac{v}{v} = 1$ so it gets removed from the left side of the equation
- $t = \frac{x}{v}$ *Our final equation written in terms of t .

Example #3:

Solve the equation $v^2 = v_0^2 + 2ax$ in terms of v_0 .

Step #1: Circle the variable to be isolated

$$v^2 = \textcircled{v_0^2} + 2ax$$

Step #2: Use appropriate math operations

- $v^2 = v_0^2 + 2ax$ * $2ax$ needs to be subtracted from the right side.
- $v^2 - 2ax = v_0^2 + \cancel{2ax} - \cancel{2ax}$ * $2ax - 2ax$ equals 0 on the right side.
- $v^2 - 2ax = v_0^2$ * v_0 is being squared so we need to square root both sides to remove it.
- $\sqrt{v^2 - 2ax} = \sqrt{v_0^2}$ *The square on the v_0 is removed since $\sqrt{v_0^2} = v_0$
- $v_0 = \sqrt{v^2 - 2ax}$ *our final equation written in terms of v_0 .

Rearranging Equations Practice: Complete all steps for the following conversions on your own paper. The answer key is provided at the top of page 9 to verify accuracy and help find errors.

Equation #1: $v = v_0 + at$	Equation #2: $a = \frac{v^2}{r}$
14. Solve the equation for a . 15. Solve the equation for v_0	16. Solve the equation for r 17. Solve the equation for v

Skill 4: Proportional Reasoning

Goal: Most fields of science will want to establish a relationship between quantities. This is how models (equations) are made.

Main Idea: In Physics we like to predict how changing one variable will affect another.

Steps to solve proportional reasoning:

1. Put the equation in terms of the variable being investigated.
2. Write a new version of the equation with the changed quantity. This is often called prime.

PHYSICS NOTE: Prime means a quantity has been transformed. It is signified by an apostrophe on the appropriate variable (for example x')

3. Perform mathematical operations on the changed quantity until the variables from the original situation are present. The goal is to rearrange the equation to isolate the original relationship.
4. Substitute the original situation into the prime equation to determine the quantity's change.

Let's look at all the steps with some examples.

Example #1:

Given the equation $v = \frac{x}{t}$ what would happen to v if t were three times larger.

Step #1: Rearrange the equation

$$v = \frac{x}{t}$$

*This one is already in terms of the examined variable. Otherwise, we would use our rearranging skills.

Step #2: Prime equation

$$v' = \frac{x}{3t}$$

*The equation is rewritten with prime on the examined variable. The change from t to $3t$ is also included.

Step #3: Find the original terms

$$v' = \frac{1}{3} \left(\frac{x}{t} \right)$$

*Notice inside the red quantities in the parenthesis are equal to our original v .

Step #4: Substitute the original equation into the prime equation

$$v' = \frac{1}{3} (v)$$

*This means that the new (prime) velocity is 1/3 the original velocity.

Example #2:

Given the equation $v^2 = 2ax$ what would happen to v if a was 4x larger.

Step #1: Rearrange the equation (this one was an example in skill #3)

$$v^2 = 2ax$$

*We needed to square root both sides of the equation to remove the square from v .

$$v = \sqrt{2ax}$$

Step #2: Prime equation

$$v' = \sqrt{2(4a)x}$$

*The equation is rewritten with prime on the examined variable. The change from a to $4a$ is also included.

Step #3: Find the original terms

$$v' = 2\sqrt{2ax}$$

*By taking the square root of 4 we can place the 2 outside of the square root. Everything in the square root was the original equation's terms.

Step #4: Substitute the original equation into the prime equation

$$v' = 2v$$

*This means that the new (prime) velocity is 2 times the original velocity.

Proportional Reasoning Practice: Complete all steps for the following conversions on your own paper. The answer key is provided at the top of page 9 to verify accuracy and help find errors.

Equation #1:	Equation #2:
$W = Fd$	$K = \frac{1}{2}mv^2$
18. What would happen to W if F was tripled? 19. What would happen to F if d was halved? 20. What would happen to d if W was three times smaller?	21. What would happen to K if m was 5 times smaller? 22. What would happen to m if v was 4 times larger? 23. What would happen to v if K was 4 times larger?

Key for Practice Problems

Unit Conversions: 1. 250,000 cm, 2. 25 m, 3. 500 mm, 4. 250 meters, 5. 0.00125 km/s, 6. 36 km/min, 7. 8.33 m/s, 8. 136.8 km/hr

Graph Analysis: 9. 10 m/s², 10. 125 m, 11. 10 m/s², 12. -5 m/s², 13. 220 meters.

Rearranging Equations: 14. $a = \frac{(v-v_0)}{t}$, 15. $v_0 = v - at$, 16. $r = \frac{v^2}{a}$, 17. $v = \sqrt{ra}$

Proportional Reasoning: 18. $W' = 3W$ (W' is 3 times larger), 19. $F' = 2F$, 20. $d' = \frac{d}{3}$, 21. $K' = \frac{K}{5}$,

22. $m' = \frac{m}{16}$, 23. $v' = 2v$

4. Answer Submission

Directions: Use the QR code to submit final answers to the questions in this section. Full work of the solution still needs to be done on paper and turned in at the beginning of the first class.

RVGS Physics Summer Assignment
Answer Submission

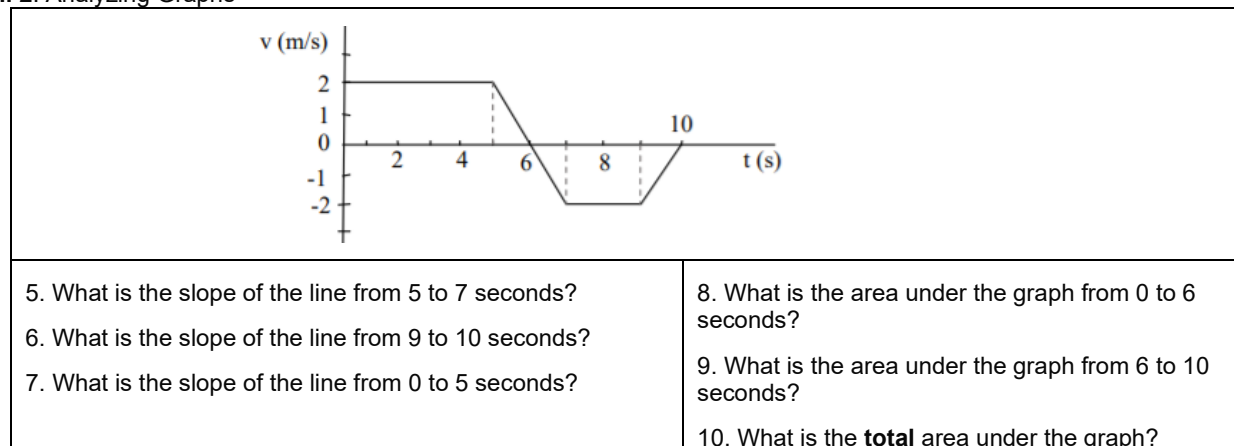


The form will close on July 26th at 9:00PM.

Skill 1: Unit Conversions – Show all work for the following unit conversions

1. Convert 12 cm to m	2. 3355 mm to km	3. 400 cm/min to km/hr	4. 75 km/hr to m/s
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Skill 2: Analyzing Graphs



Skill 3: Rearranging an Equation – Show all steps to rearrange the following equations to solve for the given variable.

Equation #1: $\frac{1}{2}mv^2 = mgy$	Equation #2: $x = vt + \frac{1}{2}at^2$
11. Solve the equation for y .	13. Solve the equation for a
12. Solve the equation for v	14. Solve the equation for v

Skill 4: Proportional Reasoning – Determine the effect of making the given change on a chosen variable. Show all steps on your paper to be turned in.

Equation: $F = \frac{m_1 m_2}{r^2}$
15. What would happen to m_1 if F was tripled? 16. What would happen to F if r was halved? 17. What would happen to r if m_1 was 9 times larger?