Adult Basic Education

Science

Physics 2104A

Kinematics and Dynamics

Study Guide

Prerequisite: Physics 1104 or Science 1206

Credit Value: 1

Text: *Physics: Concepts and Connections*. Nowikow et al.; Irwin, 2002
Science 10. Ritter et al.; Nelson, 2001

Physics Concentration

Physics 1104
Physics 2104A
Physics 2104B
Physics 2104C
Physics 3104A
Physics 3104B
Physics 3104C

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To the Student

I. Introduction to Physics 2104A

Physics is a fundamental science which studies phenomena as diverse as black holes in the galaxies and fundamental subatomic particles like quarks and gluons. Physicists play a vital role in the development of new technologies. An understanding of physics is essential to understanding the pumping action of your heart, the circuits in a computer and the stresses on bridges, buildings and roads. An understanding of physics is essential for anyone interested in studying any science, or engineering discipline.

Physics requires a good understanding of mathematics, so you will find that studying physics will further develop your math skills. Don't be intimidated by the material. Learning physics is a bit like learning to skate. You can watch someone skate and it looks effortless, but wait until you are on the ice for the first time. To become an expert skater requires practice and falling a few times. To become good at physics also requires practice and making mistakes. Don't get discouraged if you do a problem incorrectly, that is part of the learning experience. In studying physics, you ***will*** learn from your mistakes. Don't be intimidated by this first course, it will become easier to learn Physics as you go along.

This particular course uses two texts. Your instructor may also direct you to other resources. In addition to your texts, you will need a scientific calculator and graph or quad paper. You will have labs to complete and lab reports to submit. If you are having trouble with a unit, ask your instructor for help, for extra problems or for alternate resources that you could use. Check your answers as you go. Numerical problems have solutions at the back of the *Physics: Concepts and Connections* text. You will have to ask your instructor for answers to the *Science 10* problems as they are not provided in the text.

II. Use of Science Study Guides

Before beginning this course, ensure you have the text and any other resources needed *(see the information in the Introduction to this course for specifics)*.

As you work through the Study Guide, you will see that it is divided according to the Units listed in the Table of Contents. When you open a unit it will have the following components:

Reading for this Unit:
Here you will find the chapters, sections and pages of the text you will use to cover the material for this unit. Skim the sections of the textbook, look at the titles of the sections, scan the figures and read any material in the margins. Once you have this overview of the unit, you are ready to begin. Do not be intimidated by the content. You will work through the text, section by section, gaining knowledge and understanding of the material as you go.

References and Notes	**Work to Submit**
This left hand column guides you through the material to read from the text. Read any highlighted notes that follow the reading instructions. The symbols ▶▶ direct you to the questions that you should complete when finished a reading assignment..	You come across three (3) headings in this right hand column. **Writing:** This section comprises your notes for the unit. Here you will find either written questions or references to specific questions or problems from your text. You may want to write out each question followed by the answer. This material should be checked by your instructor before moving on to the next unit. Mathematical problems should have their solutions checked as you go. **Laboratory:** This section indicates if there is a Lab that should be completed for the unit. Let the instructor know in advance that you will be ready for the lab. A lab report should be submitted for each Lab. Your instructor will provide guidelines as to how s/he wants the report written. **Assignment:** This section indicates if there is an assignment that should be completed for the Unit. The information in the "References and Notes" column will indicate how you obtain the assignment. These assignments frequently relate the science content to technology, society and the environment.

III. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam *(entire course)*	50%
	100%

The overall pass mark for the course is 50%.

Unit 1 - Position - Time Graphs

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Physics: Concepts and Connections:*
Chapter 1: Section 1.1: pages 5-6
Section 1.2: pages 6-11
Section 1.3: pages 12-13
Section 1.4: pages 14-19
Section 1.5: pages 19-23
Section 1.6: pages 23-25

References and Notes	Work to Submit
	Writing:
Read pages 5 to 6 of Section 1.1 ▶▶	1.1 Define mechanics.
Read pages 6 to 7 of Section 1.2 ▶▶	1.2 Define and give examples of: (a) scalars (b) vectors (c) distance (d) displacement (e) position (f) average speed (g) average velocity (h) instantaneous speed (i) instantaneous velocity
Read pages 8 to 9 of Section 1.2 ▶▶	1.3 What are the S.I. units used for: distance; displacement; time; speed; velocity.
Read pages 10 to 11 of Section 1.2 ▶▶	1.4 How do you represent vector quantities symbolically? Give an example.

Unit 1 - Position - Time Graphs

References and Notes	Work to Submit
	1.5 How is the magnitude of a vector quantity represented?
Review Examples 2 and 3 on page 10. ▶▶	1.6 Complete Question 4 on page 11.
Read page 12 of Section 1.3 up to Example 5 ▶▶	1.7 What is the standard reference system?
Review Examples 5 and 6 on page 12 ▶▶	1.8 Complete Problem 23 on page 31. You will need a ruler to do this.
Measure the vectors in problem 23, find their values in cm, use 1cm=50m to solve. Also find the direction of the vector from the compass.	
Review significant digit rules on page 13. Appendix E on page 797 has extra information.	1.9 Complete Problems 2-5 on page 13.
Read pages 14 to 15 of Section 1.4 ▶▶	1.10 What are the 3 things you can do with a graph?
	1.11 Complete Question 2 on page 15.
Read pages 15 to 17 of Section 1.5 up to Example 7 ▶▶	1.12 What information comes from reading the graph?
	1.13 What information does the slope of a position-time graph yield?

Unit 1 - Position - Time Graphs

References and Notes	Work to Submit
Study Example 7 on pages 17 and 18 ▶▶	1.14 What information comes from a negative slope for velocity?
Complete reading Section 1.5 ▶▶	1.15 Complete Question 28 on page 32.
	1.16 What are the formulas for area of a (i) triangle, (ii) rectangle and (iii) trapezoid?
Remember velocity has direction.	1.17 Complete Questions 29 and 30 on page 32.
Read pages 19 to 23 of Section 1.6 ▶▶	1.18 What information do you get from reading the curved line graph of position-time?
You need a ruler to draw tangents. Study Figure 1.19 on page21 to determine how to study tangents.	1.19 How do you calculate the slope for points on curved-line graphs?
	1.20 What is instantaneous velocity and how is it determined?
	1.21 What is acceleration?
	1.22 Why is the process of slowing down called acceleration?
	1.23 What is velocity when a tangent to a position-time graph is zero?
You will need graph or quad paper for this.	1.24 Complete Question 38 on page 34.
Read pages 23 to 25 of Section 1.7 ▶▶	1.25 How is average velocity obtained from a curved position-time graph?

Unit 1 - Position - Time Graphs

References and Notes	Work to Submit
$v_{avg}=\Delta d/\Delta t$ * remember signs. In question 43, the values obtained for average velocity and averages of the instantaneous velocities should be similar.	1.26 What is the standard kinematic equation for change in displacement ($\Delta \vec{d}$) in terms of initial and final velocities? 1.27 Complete Questions 42 and 43 on page 35.

Unit 2 -Velocity -Time Graphs

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Physics: Concepts and Connections:*
Chapter 2: Section 2.3: pages 53 - 56
Section 2.4: pages 56 - 64
Lab 2.2: page 77

References and Notes	Work to Submit
Read pages 53 to 55 Section 2.3 ▶▶ *Don't be intimidated by this section. Just read it through once. You will not need to derive equations just use them - that is difficult enough for now!* *Appendix E on page 798 has some helpful math equations and techniques. If you are having a problem rearranging the equations, ask your Science or Math instructor for help.*	**Writing:** 2.1 What is the meaning of each of the following variables? (a) v_1 (b) v_2 (c) a (d) Δt 2.2 When are the five fundamental equations applicable in kinematics?

Unit 2 -Velocity -Time Graphs

References and Notes	Work to Submit
Read pages 56 to 59 of Section 2.4 and study Examples 7-10 ▶▶	2.3 Complete Questions 1 to 3 on page 64.
When solving these problems have all your formulas on a sheet next to you for reference.	
Study Examples 12 to 15 on pages 59 to 63 ▶▶	2.4 Complete Questions 54 to 55 on page 74.
Inform your instructor you are ready for Lab #1.	**Laboratory:** Complete and submit to your instructor: Core Lab #1: Acceleration Due to Gravity: page 77.
Appendix B on pages 784-786 will provide guidelines for writing your lab report. Check with your instructor as to the way <u>your</u> instructor wants reports submitted.	

Unit 3 - Vectors and Relative Motion

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Science 10*
Chapter 11: Section 11.1: pages 414 - 416
Section 11.3: pages 420 - 423
Section 11.5: pages 426 - 428
Concepts and Connections
Chapter 3: Section 3.1: pages 79 - 84
Section 3.4: pages 95 - 103

References and Notes	Work to Submit
Read pages 414 to 416 of Section 11.1 of ***Science 10*** ▶▶	3.1 What is a reference point? 3.2 What is a vector and how is it different from a scalar quantity?
Read pages 420 to 423 of Section 11.3 ▶▶	3.3 Write the rules for drawing a single vector. 3.4 Complete Question 8 on page 417. 3.5 What is the head to tail rule for adding vectors? 3.6 How is the final sum for vector addition determined? 3.7 Summarize the scale diagram method for vector addition.

Unit 3 - Vectors and Relative Motion

References and Notes	Work to Submit
	3.8 Summarize the algebraic method for vector addition.
Study Sample Problems 1 to 3 of Section 11.5 ▶▶	3.9 Complete Questions 5 and 7 on page 423.
Read pages 426 to 428 of Section 11.5 Review the procedure for adding two-dimensional vectors using scale diagrams and Sample problem 1. ▶▶	3.10 Complete Questions 3 and 5 on page 429.
Read pages 95 to 96 of Section 3.4 in Physics: Concepts and Connections up to Example 7 ▶▶	3.11 What is meant by relative motion?
	3.12 What is the most common stationary reference frame?
	3.13 Explain what is meant by each variable in the equation: $\vec{v}_{og} = \vec{v}_{om} + \vec{v}_{mg}$
Review the 3 cases in Example 7. ▶▶	3.14 Complete Problems 35 and 36 on page 116.

Unit 4 - Introduction to Dynamics

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: *Physics: Concepts and Connections:*

Chapter 4:	Section 4.1:	pages 125-129
	Section 4.2:	pages 129 -131
	Section 4.3:	pages 131 - 137
	Section 4.4:	pages 138 - 142
	Section 4.5:	pages 142 - 145
	Lab 4.1:	page156

References and Notes

Dynamics involves understanding the cause of motion.

Read pages 125 to 129 of Section 4.1

*As difficult as it appears to understand, you must remember that an object can move at **constant** speed in a straight line without an applied force. It is just that in our world, we generally have to overcome forces like friction to keep moving.*

Work to Submit

Writing:

4.1 What are three states of motion for an object?

4.2 State Newton's First Law.

4.3 State Newton's Second Law.

4.4 State Newton's Third Law.

4.5 What is inertia? (Use the glossary).

4.6 What is a measure of inertia? State its S.I. unit.

4.7 What effect does the action of a force have on motion?

Unit 4 - Introduction to Dynamics

References and Notes	Work to Submit
Read pages 129 to 131 of Section 4.2 ▶▶	4.8 Write the equation for Newton's second law, identify what each variable (letter) represents and what the S.I. unit for each variable is .
	4.9 Why is force a vector quantity?
	4.10 What is meant by net force? What does that mean?
	4.11 Complete Questions 16, 19, and 22 on page 150.
Read pages 131 to 133 of Section 4.3 up to Example 1 ▶▶	4.12 What is a FBD?
	4.13 How is $\vec{F}_{net}$ determined?
Read Appendix A ▶▶	4.14 List five (5) types of forces.
Use the forces from the Appendix to help answer #33.	4.15 Complete Question 33 on page 151.
Study Example 1 and 2 on pages 133 to 134 ▶▶	4.16 Complete Question 35 on page 151and Question 37 on page 152.
Study Example 3 on page 135 ▶▶	4.17 Complete Questions 38 and 42 on pages 152-153.

Unit 4 - Introduction to Dynamics

References and Notes	Work to Submit
Read pages 142 to 145 of Section 4.5 ⏭⏭	4.18 Explain why a person standing on ice and pushing on a wall moves away from the wall. 4.19 Why would a person standing on a floor in a carpeted room and pushing on a wall not experience movement? 4.20 Complete Questions 53 to 54 on page 154.
Inform your instructor you are now ready for this lab.	**Laboratory:** Complete and submit to your instructor: Core Lab #2: Lab 4.1 - Newton's Second Law.

Appendix A

Some Types of Forces			
Force	**Symbol**	**Definition**	**Direction**
Friction	F_f	The contact force that acts to oppose sliding motion between surfaces.	Parallel to the surface and opposite to the direction of sliding.
Normal	F_n	The contact force exerted by a surface on an object	Perpendicular to and away from the surface.
Tension	F_T	The pull exerted by a string, rope or cable when attached to a body and pulled taut.	Away from the object and parallel to the string, rope or cable at the point of attachment.
Weight	F_g	A field force due to gravitational attraction between two objects, generally Earth and an object.	Straight down toward the center of the Earth
Spring	F_{spring}	A restoring force; that is the push or pull a spring exerts on an object.	Opposite the displacement of the object at the end of the spring.