Physics 2051 General Physics I – Fall 2021 Syllabus

Section:	**101**	**102**
Class times:	MWF 9:40 – 10:35, Th 10:30 – 11:50 a.m.	MWF 10:45 – 11:40 a.m., Th 1:30 – 2:50 PM
Classroom:	Walter 245	Walter 245
Laboratory:	Clippinger 036 – see your schedule for your lab time	
TopHat:	JoinCode: 518386	JoinCode: 026023
Instructor:	Dr. David Ingram	Dr. Alexander Neiman
Office:	Edwards 106	Lindley S207
E-mail:	ingram@ohio.edu	neimana@ohio.edu
Office Hours:	Via Zoom and by appointment	Via Zoom and by appointment

Course Websites: LON-CAPA (access with OU ID and password): https://loncapa.phy.ohio.edu
Changes to the syllabus will be announced in class and will be found in the most up to date syllabus version at https://loncapa.phy.ohio.edu. We do not use Blackboard.

Course Description: Classical physics with calculus and vectors: measurement; kinematics in 1, 2 and 3 dimensions; Newton's laws of motion; conservation of energy; conservation of momentum, rotational dynamics and angular momentum, static equilibrium, elasticity, simple harmonic motion, the first and second laws of thermodynamics, entropy, and the kinetic theory of gases.

Outcome Goals:

- Students will develop a broad knowledge of the physical principles that describe the world around us.
- Students will learn how algebra, trigonometry, geometry and calculus are used to represent the world mathematically and how they are used to solve physics problems involving mechanics and dynamics.
- Students will write multiple drafts of a technical report on one laboratory experiment, be able to reliably record data in laboratory notebooks, and be able to present data in graphical and tabular form, appropriately annotated with labels, legend, titles and units.
- Students will develop critical thinking and analysis skills by problem solving and experiments.
- Students will develop an understanding of how scientific theories are limited by assumptions.

Statement on Discrimination, Sexual Harassment and Bias: The University endeavors to maintain an employment and educational environment that is free from discrimination and harassment. This includes discrimination and harassment on the basis of race, color, religion, age, ethnicity, national origin, national ancestry, sex, pregnancy, gender, gender identity or expression, sexual orientation, military service or veteran status, mental or physical disability, or genetic information. Faculty have a mandatory reporting responsibility to share information regarding sexual misconduct or information about a crime that may have occurred at Ohio University with the Office of University Equity and Civil Rights Compliance (ECRC). The ECRC office houses the university Title IX Coordinator, who can be reached by email at titleix@ohio.edu or by phone at 740-593-9140. In addition, students may contact the Survivor Advocacy Program (SAP) for confidential support. The SAP office is located in Lindley Hall 038. The SAP 24/7 Hotline is 740-597-7233. The SAP email is survivor.advocacy@ohio.edu .

Attendance and Access: The instructor recommends that all students attend class. Students are responsible for all material covered in class whether they attend or not. Students are responsible for being aware of schedule changes announced in class. There is also an important participation component of the grade, discussed in the next section that will be affected by lack of attendance.

It is very important to **come to class prepared** by going through the textbook, taking notes at home as your read, and working through the homework. There are no makeups for missed in-class activities, this is allowed for in the grading, see next section.

Any student who suspects they may need an accommodation based on the impact of a disability should

contact the class instructor privately to discuss their specific needs and provide written documentation from the Office of Student Accessibility Services. If the student is not yet registered as a student with a disability, they should contact the Office of Student Accessibility Services.

A University Excuse (see O.U. Handbook) is required for any makeups on exams. If in doubt about a make-up please ask, I am usually more generous than the O.U. Handbook.

Prerequisite: MATH 2301. The course registration system will allow you to sign up if you are taking MATH 2301 as a co-requisite but be advised that there is a note on the course description that warns that you should only do this if you have taken and passed a Calculus course in High School. If you have never seen calculus before, this course will be ***much*** more challenging than if you have at least some experience with calculus (see the "Statement regarding mathematical knowledge assumed" on page 7).

How to succeed in this class.
Success in physics classes and other subjects where math is used extensively depends on practice through solving problems. To this end there are homework problems, reading assignment questions, and in-class questions and exercises. Do not take shortcuts (cheating) by using Chegg and other sources of solutions to problems. By all means work in groups, we will put you in groups for in-class exercises and in labs. Working together on problems is a great way to learn the material but make sure you can solve any problem do discuss in a group by yourself. When you come to the exams that is what you are going to have to do.

Where to find the content for this class?
Come to class and we will be doing in-class exercises and quizzes around key parts of the content. This is where we can help you solve problems. You will work in groups and we can see what you are doing and hopefully mistakes as they happen.
Read the textbook sections before coming to class and do the textbook reading assignments. They are there to give you practice.
University Physics Volume 1, https://openstax.org/details/books/university-physics-volume-1,
University Physics Volume 2, https://openstax.org/details/books/university-physics-volume-2
These are available online at no cost to you. You can view the material online or you can download the pdf files. We are not covering all the material in these two volumes. See later in this syllabus for the topics we plan to cover. Even within chapters covered, there are sections and example problems that will be skipped, and some emphasized more—these details are covered in Reading Guides for each segment of the book that are available on the LON-CAPA site with all other textbook reading materials.
There are also videos that you can view of the materials that are typically presented in class. Sometimes there is more in the videos that we can get to in class. In the same area of LON-CAPA as the videos are more practice questions, you can use this to practice for the exam and to boost your grade on the TopHat in-class questions if you have missed some classes, which you should try not to do. A set of the slides we typically use is also posted in the same area as the videos.

LON-CAPA: Many problems such as the Textbook Reading Assignments, and the Homework Assignment Problem Sets, other problems, and additional information about the course can be found on the Learning On-Line Computer Assisted Personalized Assignment (LON-CAPA) system https://loncapa.phy.ohio.edu. Use your OU ID and password to log in and select the course. When a problem is completed successfully, you are provided with a **receipt number**. Please record this number in your homework notes if you are concerned the system is not giving you credit or you are of a nervous disposition. This is your proof that you completed the work. We cannot investigate discrepancies in records without this receipt number.

Homework Assignments on LON-CAPA: There is a weekly assignment of problems like those on exams. These assignments will make up 15% of your grade. If your combined score for the assignments is above 90%, you will receive the full 15% towards your final grade. If it is below 90%, we will calculate your score considering 90% as full credit. The assignments for each week will be in sub-folders of the week's

folder together with the reading assignments. I don't want you spending lots of time getting that last point on a homework assignment. Please ask if you need help. If you enter more than four incorrect answers to a question, please ask for help.

Pre-class reading assignments and TopHat: In-class questions will be posed throughout the classes and responses will be collected using the TopHat Personal Response System: (https://www.ohio.edu/oit/tophat/). You can use your cell phone, smart phone, laptops, or etc. via a variety of means (e.g. through phone texting only, web browser, app,etc…) The OIT weblink above in this paragraph, along with instructions given in class and by email will tell you how to get registered with the TopHat system for your section: the process uses a unique id for each class section called the JoinCode—the JoinCode is listed at the top of this syllabus and also will be given out in class. You will need to create an account at app.tophat.com (find Ohio University and log in with your Ohio ID). Most students prefer to use the TopHat app on their smartphones. Further instructions will be provided in class if you are unable to get setup before the first day or days of class. TopHat questions will be graded with 1 pt for a correct response and 0.5 pts for an incorrect response.
The Textbook Reading Assignments section, and the TopHat Questions section will together be worth 15% of the final grade score. To get that 15% students have get 75% of the available points from the textbook reading assignments and the TopHat questions. Any points the student has from the questions Class Notes and Section Materials posted on LON-CAPA will be added to the total points scored as extra credit, but you cannot get more than the 15% toward your final grade. This should be an easy 15% to get and is to encourage participation in the course. Not getting this 15% will likely drop your grade by one letter. The questions in the Class Notes and Section Materials posted on LON-CAPA will be open until the last day of classes and can be used by you to help prepare for the exams.

General Assignment observations:

- It is probably possible to Google all of the questions on the homework and get recipes that will give you the answer. It might also be possible to guess the answer by randomly multiplying or dividing variables. While these methods may be tempting, you are cheating yourself if you use them as anything but a last resort. Solving physics problems is almost universally found to be a humbling experience. This is a normal part of the process. The struggle you go through in trying to solve the problems on your own is a key part of the experience. You *must* go through that learning process yourself to do well on exams (which make up 55% of the grade for this class). If you get help from a friend or a TA or the instructor (or if you help a friend), be sure that you get them to help you to learn the method and principles needed to solve the problem, and not just give the answer: you need to understand solutions not memorize facts for this course.

- You are strongly encouraged to write down on paper in a notebook the solutions to all the homework problems with diagrams and full algebraic rearrangement, as you will be encouraged to do in class. If you do the problems on your calculator, you will have no idea how you did the homework problems when it comes time to study for the exams. It also gives you physical memory of the solution and practice for the communication with the graders that is required to do well on exams.

- **HELP!!!** If you are having technical difficulties try https://loncapa.phy.ohio.edu/help, if that does not help, please e-mail your instructor. Include a brief description of the problem and any error messages you have seen. We will ask whether you have tried submitting the answer on a university computer (such as one of the machines at Alden Library). LON-CAPA occasionally experiences outages. If these come a crucial moment, we may consider an extension.

Laboratory: You are required to register for a laboratory for this class. A passing grade on the laboratory of at least 70% is required in order to pass the course. A missed lab without a valid university excuse counts as zero and cannot be made up. Only labs for which you have a valid university excuse can be made up. Where possible, labs should be made up during the week in which they were due to be taken. Students

waiting until the last weeks of the semester to make up labs missed in the first part of the semester will be denied make up privileges even if the original excuse for the missing lab was valid. **If a student misses more than 3 labs without a valid University excuse, then the lab will be failed which means the student will also fail the entire course.** The laboratory counts 15% towards the final grade. The average grade on the laboratory is ~90%. There is a small correlation between the laboratory grade and your overall grade for the course. However, like the homework, it is there to help you learn the material and to teach you how to obtain data in an experiment, keep a lab notebook and prepare a technical report.

Midterm exams: There will be four midterm exams as noted in the course schedule below. Three exams will be worth 10% toward your final grade. One exam, the one with the lowest score will count 5% toward your final grade.

Final Exam: The final exam will be a two-hour exam. The final exam will count for 20% of the final grade.

General Rules for Exams:

- **No books, notes or formulas stored in electronic or written form may be consulted during the exams.** Students are expected to remember basic definitions and relations. The instructor will provide a formula sheet for exams. The sheet will contain some of the more complex formulas but will not contain definitions or laws in word form.
- Anyone who misses an exam will be given a makeup if they have a valid university-approved excuse. Please let the instructor know about the absence or exam conflict as early as possible.
- **Calculators and electronic devices:** You are allowed a dedicated calculator for exams. All other electronic devices are forbidden. This includes music players, electronic dictionaries, tablets, cell phones, etc. Simple scientific calculators can be purchased for as little as $10. Make sure that the calculator will handle scientific notation and trigonometric functions. Calculators from the TI-80 series will be allowed.

Grading: Summarizing, your grade will be determined as follows:

Homework	15%
Laboratories	15%
On-line content grading + TopHat	15%
Exams	55%
TOTAL	100%

The numerical scores for each category will be weighted, as given above, to compute a total score out of 100%. Letter grades will be assigned using the following standards as a guide:
A– to A ≥90%; (Excellent)
B– to B+ 80 to 89%; (Good)
C– to C+ 70 to 79%; (Acceptable)
D– to D+ 60 to 70%; (Passing but minimally acceptable: students are advised to retake the course)
F < 60%. (Need to retake the course)
These percentage bands may be adjusted down if the exams are deemed to be unusually difficult but will never be moved up. The numerical scores from the parts, with the weightings shown, are used to calculate the final letter grade.

Advising: In order to assist you in identifying obstacles to improve your grade and overall learning experience, **you will be required** to attend an advising session with your instructor and/or personnel in your college **if your Midterm 1 score is 65% or below**. After exams are returned, you are to approach your instructor in order to make arrangements for this advising session.

PHYSICS 2051– General Physics I Tentative Schedule

(Subject to changes announced in LON-CAPA)

Text: Openstax University Physics Volume 1 and University Physics Volume 2 – see links above. The following list of chapters/topics will be covered in approximately the order indicated. Students are expected to keep up with the reading assignments, including videos so they are ready for online group sessions.

Date	Sections	Content
Week1		
Aug 23	1-1 to 1-7	Introduction, measurement, SI units, unit conversion
25	2-1 to 2-3	Vectors and their components, vector addition
26	3-1 to 3-4, 3-6	Motion along a straight line: position, displacement, velocity, acceleration
27	3-1 to 3-4, 3-6	Motion along a straight line: position, displacement, velocity, acceleration
Week2		
Aug 30	3-1 to 3-4, 3-6	Motion along a straight line: position, displacement, velocity, acceleration
Sep 1	3-4 to 3-5	Motion along a straight line: free fall
2	3-5	Motion along a straight line: free fall (group activity)
3	4-1 to 4-3	Motion in two and three dimensions: motion vectors, projectile motion
Week3		
Sep 6		No classes Labor Day
8	4-3	Projectile motion
9	4-4 to 4-5	Circular motion and 1D and 2D relative motion
10	4-1 to 4-5	Review 2-D motion
Week4		
Sep 13	5-1 to 5-7	Newton's laws
15	5-1 to 5-7	Newton's laws
16	**Midterm 1 Kinematics**	
17	6-1 to 6-2	Application of Newton's laws
Week5		
Sep 20	6-1 to 6-2	Application of Newton's laws
22	6-3	Uniform circular motion, centripetal acceleration and force
23	7-1 to 7-2	Work and Kinetic Energy
24	7-3 to 7-6	Work-Kinetic Energy theorem; Power
Week 6		
Sep 27	8-1 to 8-2	Work and Potential Energy; conservative forces
29	8-3 to 8-4	Conservation of mechanical energy
30	**Midterm 2 Newton's Laws**	
Oct 1	Fall Break no classes	
Week7		
Oct 4	8-4 to 8-5	Potential energy curves, non-conservative forces, work, and energy
6	9-1-9-3	Linear momentum; collisions and impulse; conservation of linear momentum
7	9-1 to 9-6	KE and momentum in (in-)elastic collisions; Center of Mass, 2D Collisions
8	9-7	Momentum in 2-D Collisions and Rocket Motion
Week8		
Oct 11	10-1 to 10-3	Rotational variables & angular acceleration; relation to linear variables
13	10-4 to 10-6	Angular kinetic energy; moment of inertia; torque
14	10-7 to 10-8	Newton's 2nd law for rotation; work and rotational kinetic energy
15	11-1 to 11-5	Rolling as translation and rotation combined.

Week9

Oct	18	11-1 to 11-5	Rolling as translation and rotation combined.
	20	11-6 to 11-8	Conservation of angular momentum and rigid body rotation
	21	**Midterm 3 @ Class time (Momentum and Energy)**	
	22	12-1 to 12-4	Static equilibrium examples, Elasticity

Week10

Oct	25	12-1 to 12-4	Static equilibrium examples, Elasticity
	27	13-1 to 13-8	Newton's Law of gravitation
	28	13-1 to 13-8	Newton's Law of gravitation
	29	14-1 to 14-3	Fluids, Density, and Pressure, Fluids at Rest, Measuring Pressure

Week11

Nov	1	14-1 to 14-3	Pascal's Principle; Buoyancy and Archimedes' Principle
	3	14-4 to 14-7	Continuity Equation, Bernoulli's Equation
	4	**Midterm 4 Rotational Motion**	
	5	15-1 to 15-2	Simple Harmonic Motion (SHM), Energy in SHM

Week12

Nov	8	15-4 to 15-5	Pendulums, Circular Motion, and Damped SHM
	10	15-5 to 15-6	Damped SHM, Forced Oscillations and Resonance
	11	Veterans' Day	
	12	Vol. 2 1-1 to 1-3	Temperature and thermal expansion

Week 13

Nov	15	1-4 to 1-6	Specific heat, latent heat, heat transfer
	17	2-1 to 2-4	Kinetic Theory of Gases, P, V, and rms speed
	18	3-1 to 3-3	Work, heat, and internal energy; The First Law of Thermodynamics
	19	3-4 to 3-6	Thermodynamic process, heat capacities, and adiabatic processes
Nov	22	3-4 to 3-6	Thermodynamic process, heat capacities, and adiabatic processes

Thanksgiving November 25

Week14

Nov	29	4-1 to 4-4	Heat engines, refrigerators, and the Second Law of Thermodynamics
Dec	1	4-1 to 4-4	Heat engines, refrigerators, and the Second Law of Thermodynamics
	2	4-5 to 4-7	The Carnot cycle, entropy
	3		Review for final – bring your questions!

Finals Week
Combined Sections Final Exam Thursday, December 9, at 2:30 p.m. rooms Walter 135 and 145

Cheating: Students suspected of cheating will be warned and may be asked to take a retest or may be asked to resubmit the work in the case of laboratory reports. This is not an indication that cheating has actually occurred but is a preventative measure to reduce the chances of cheating in suspicious circumstances. Students caught cheating may be given an F for the course. If the student does not agree with this action, the student may file a grievance through established University channels. The instructor may also initiate a review by The Office of Community Standards and Student Responsibility. This action could result in suspension of the student or other punitive actions. The value of a degree from Ohio University is largely determined by the strength of the reputation of all of us. Academic dishonesty cannot be tolerated and reflects on the reputation of all of us and on the ability of graduating seniors to obtain jobs.

Statement regarding mathematical knowledge assumed.
Calculus is used throughout 2051 and 2052. The basics of differentiation and integration will be reviewed

during the introduction of one-dimensional motion in PHYS 2051. For PHYS 2051, you are expected to be fluent in the following topics:

- Basic arithmetic and logical operations
- Algebra of single and multiple variable equations
- Graphical representation of equations
- Solution of simultaneous equations with 2 or 3 variables
- Trigonometric functions, their definitions, properties and associated identities
- Logarithmic and exponential function properties

The following topics will be reviewed as they arise:

- Differentiation and integration of simple functions, e.g. x, x^2, $x^{-1/2}$, x^{-1}, $\log x$, $\sin x$. (High School Calculus)

In addition, you will be taught the properties of vectors including, vector addition and subtraction and vector multiplication, both dot (scalar) and cross (vector) products. You will also be shown how to perform simple line integrals.

There are many resources online that will help those who need some math revision.

Covid/Coronavirus

Because information on this topic changes and probably will change during the semester please check on this link for the latest: https://www.ohio.edu/coronavirus.

As of this version of the syllabus we are all required to wear masks indoors.

Physics 2051 Laboratory Schedule – Fall 2021

Week of:		Experiment
Aug	**23**	**NO LABS THIS WEEK ---- First week of classes**
Aug	**30**	**Vector treatment of concurrent forces**
Sept	**6**	**NO LABS THIS WEEK ---- Labor Day Week**
Sept	**13**	**Measurement and Error**
Sept	**20**	**Determination of acceleration due to gravity and Newton's 2nd Law**
Sept	**27**	**Friction**
Oct	**4**	**Centripetal Force ---- Technical Report** 1st draft due in lab. week of October 11 2nd draft due in lab and online week of October 25 Final version due in lab and online week of November 15
Oct	**11**	**Impulse and Momentum**
Oct	**18**	**Ballistic Pendulum**
Oct	**25**	**Experimental Determination of the Moments of Inertia of Solid Bodies**
Nov	**1**	**Laws of Equilibrium for Non-concurrent Forces**
Nov	**8**	**NO LABS THIS WEEK ---- Veterans Day (Thursday)**
Nov	**15**	**Simple Harmonic Motion**
Nov	**22**	**NO LABS THIS WEEK ---- Thanksgiving**
Nov	**29**	**The Ideal Gas Laws**

1. The Experiment writeups must be downloaded through LON-CAPA and read before coming to lab. Bring a copy with you to lab or have it available through you own electronic device.
2. The lab reports are to be **written up as described in the lab manual** and given to your lab instructor at the end of the lab or within 24 hours of the end of your lab. Your TA needs to sign your lab report before you leave the lab. Small green or black Vernon Royal Composition books with Quadrule ruling are to be used. They may be purchased at the bookstore.
3. **The technical report is described in the section in the lab manual on technical reports**. It includes an abstract, theory, experimental details, data, results (tables or graphs), conclusions, and bibliography in that order.
4. In writing the **technical report**, give particular attention to: English (e.g. spelling, grammar, proper word usage, and use of precise and detailed statements); handling of equations, tables, and graphs; organization; neatness. Make sure that your theory is complete, relevant, and discusses the physical phenomena and equations using complete sentences and not point form. The Conclusions section indicates what you learned about the physical phenomena observed and discusses values obtained, the source of errors, and suggestions for improving the equipment and experimental technique so as to reduce random and systematic errors. This is the most crucial section and will require considerable attention and thought.
5. **Missed labs** and/or lab reports count as 0%. If more than two labs and/or reports are missed with or without a University sanctioned excuse (and not made up in the case of a University excuse) the student will fail the entire course. **You are responsible for reading and following the Physics Department Laboratory Makeup Policy** posted on the door of the laboratory.
6. For each school day (Monday-Friday) a report is late, without excuse, 10% will be subtracted from the report grade. A 70% lab grade is required to pass the lab.
7. In the case of academic dishonesty (copying, plagiarism, etc. including use of material from a previous semester, your lab partner and the lab manual), the grade on the lab report may result in a zero. If this happens on the technical report, you may fail the lab and hence the entire course since your total lab grade may now fall below 70% as the technical report is worth 30% of the total lab grade. All lab reports are to be your own work even though the data may have been taken by you and your lab partner.

****Bring your calculator, pen, memory stick, and a ruler to lab and read the lab before you come.**

Grading Standards

Physics 2051 is the first of a two-semester sequence in General Physics for students of science and engineering. This sequence presents a unified view of physics by analyzing the basic principles, their implications and their limitations. One reason why scientists and engineers take physics is because your departments know that we test your ability to cope with unfamiliar situations and recognize that the questions we present to you are readily answered (i) with a knowledge of basic science, (ii) the capacity to interpret illustrations, graphs and tables, (iii) the ability to read carefully and process unfamiliar scientific information. Solving physics problems is not just about what you know but also about how you think. Memorization is a useful asset in physics, as in many other subjects, but it is not sufficient. The set of all physics problems is effectively infinite, so there is no way to simply memorize every possible variation of every physics problem. A corollary is that there is no way for us to do an example of every possible type of problem. Instead, you will need to learn the basic principles and know how to apply them to a new situation. We think it useful to share with you what we expect student in each letter grade to be capable of doing.

An A student will be able to solve correctly problems involving the motion of particles subject to Newton's laws of motion, in straight lines and in circular paths. They will provide all the steps necessary for the solution and they will explain them, citing the relevant physical principles. They will be able to solve problems involving vectors in two and three dimensions, including the three-dimensional properties of vectors such as torque and angular momentum. They will be able to solve problems involving the use of the principle of conservation of energy in mechanical systems. They will also be able to solve problems involving both conservation of linear momentum, in one or two dimensions, and conservation of angular momentum. They will be able to apply the principles of particle dynamics to systems of particles and in particular rigid bodies. They will be able to solve problems involving simple harmonic oscillators such as the simple pendulum, a mass connected to a spring, a mass connected to two or more springs, the physical pendulum. They will also solve problems in stationary and moving ideal fluids; thermal properties of matter; heat transfer; zeroth, first and second laws of thermodynamics; kinetic theory of gases; equipartition theorem. They will probably complete nearly all of the homework (>95%). They will have learned how to write lab reports in a lab notebook and written a very good technical report for one experiment.

A B student will be able to apply correctly the principles of conservation of energy and momentum to mechanical systems. They will be able to solve most problems correctly involving the motion of particles in straight lines but probably have difficulties with rotational motion problems. They will give well-structured solutions to problems but may not completely finish them. They will be able to solve problems involving vectors in two and three dimensions including linear momentum. They will have learned how to write lab reports in a lab notebook and written a very good technical report for one experiment.

A C student will be able to solve some problems correctly involving the motion of particles in straight lines and to solve most problems involving vectors in two dimensions. They will be able to apply the principles of conservation of energy and momentum to mechanical systems but will make mistakes in their solutions. They will give some structure to solutions of problems but will not complete all steps. They will complete most of the homework (>90%). They will have learned how to write lab reports in a lab notebook and written an acceptable or good lab technical report for one experiment.

A D student will get some parts to many problems correct but find it difficult to complete correctly any of the problems on exams. Parts of problems that are correct will not be explained; diagrams will be missing, as will statements regarding the physical principles used. They will usually get more than 50% of the multiple-choice questions on exams correctly. They will probably complete less than 70% of the homework. They will have learned how to write lab reports in a lab notebook and written an acceptable technical report for one experiment.To get an **F** in this course, a student will either have failed the laboratory or have had severe difficulties with the course material such as failing to grasp the concept of vectors, inability to handle the mathematics required to solve the problems and giving little or no explanation of solutions to problems.