Welcome!

Start Your Semester Off Right
Join us for a FREE
Pre-Semester Prep Workshop Series

These interactive workshops will review all foundational material leading up to the specified course so you are better equipped to hit the ground running.

**Synchronous in-person in the ESS suite & virtual via Zoom**

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RSVP is preferred but not required

[ess.unm.edu/events > January](ess.unm.edu/events > January)

or [through our web-app • succESS](through our web-app • succESS)

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Physics 1 Prep
(for PHYS 1310)

Presented by:
Bryan & Paul Tice
Drop-In Tutoring for Engineering & Computing

Get help in your core STEM courses, engineering & computing specific classes, software, and coding languages.

ESS suite (CEC 2080) & online via the Penji App (with Zoom)

Tutoring schedule & more info at ess.unm.edu/services/tutoring/
or through our app - succESS
Semester-Long Engagement Opportunities

Many are open to pre- and full majors and have no citizenship or GPA requirements.

MENTORING

- **BE a mentor**
  ...to our incoming students in their transition into the University of New Mexico, the university setting, and Albuquerque.

- **HAVE a mentor**
  ...who is a STEM Professional working in the field to build your network and receive guidance and support.

*This program is open to UNM STEM Majors. Priority is given to Freshmen and Sophomores, but all levels are encouraged to apply.*

INTERNSHIPS

Getting real-world experiences leads to your satisfaction with your undergraduate journey. Gain valuable hands-on experience while making professional connections.

*These programs are only open to School of Engineering Students.*

RESEARCH

- **EPICS @UNM**
  ...to give back to the community, earn credit, and gain research experience all at the same time!

- **Student Research Experience Program**
  ...to get hands-on research experience to understand how your courses fit in to real-world applications.

*These programs are only open to School of Engineering Students.*

For more information, or to apply, visit:
https://ess.unm.edu/programs/current-students
A tool for engineering your success.

Put your learning into your own hands.

[success.unm.edu](http://success.unm.edu) Includes 1-click RSVP

Spring 2023 Events

- **Pre-Semester Prep Series**
  - Physics 1, Chem 1, Trig/pre-Calc through Calc 3

- **Semester Long Programs**
  - Mentoring, Internships, Research

- **Presentation Prep Series**
  - What is a Conference?
  - Designing Effective Presentations
  - Data Visualization
  - Delivering Presentations

- **1st & 2nd Year Student Events**
  - Building Community - Weekly focused Study Groups
  - How to make the most of your learning
  - Twitch streaming event
  - Study Skills
  - Manage Your Time
  - Shadow Day
  - CAD Basics
  - Coffee Hour with Faculty
  - How to be more assertive
  - UROC - Attendance Participation

- **Spatial Visualization Series**
  - Recap of sessions 1-3 from the Fall semester
  - Two-Axis Rotations and Inclined Planes & Curved Surfaces
  - Reflection Symmetry & Write a Rule

- **Career and Professional Development Events**
  - Landing an internship
  - So, What’s Next? Start-Ups, Patents, and Publications
  - STEM Mixer & Find Your Pack
  - Interviewing Basics
  - Building Connections & Networking
  - Resumes and Cover Letters
  - Industry site visits

- **Lab Safety Series**
  - Hazard Communication & Hazard Evaluation
  - Hierarchy of Controls & Basics of PPE
  - Chemical Waste Management

  WIN a gift card. GAIN experience.
  BUILD your skill set. ENHANCE your resume.

And more! For more details, visit: ess.unm.edu/events OR through our web-app - essESS.
Outline

• Units
• Graphs
• Motion
• Geometry/Trigonometry in physics
• How to approach word problems
Units
A standard of measurement of physical quantities
What are physical quantities?
What are NON-physical quantities?
What are SI units?
<table>
<thead>
<tr>
<th>Base Quantity</th>
<th>Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Meter</td>
<td>m</td>
</tr>
<tr>
<td>Mass</td>
<td>Kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>Time</td>
<td>Second</td>
<td>s</td>
</tr>
<tr>
<td>Electric Current</td>
<td>Ampere</td>
<td>A</td>
</tr>
<tr>
<td>Temperature</td>
<td>Kelvin</td>
<td>K</td>
</tr>
<tr>
<td>Amount of Substance</td>
<td>Mole</td>
<td>mol</td>
</tr>
<tr>
<td>Luminous Intensity</td>
<td>candela</td>
<td>cd</td>
</tr>
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Helpful Website: National Institute of Standards and Technology
https://physics.nist.gov/cuu/Units/units.html

Fundamental Base SI Units
Velocity = +25 m/s

Density = kg/m$^3$
Scalar and Vector quantities

Scalar:
- Volume
- Time
- Temperature
- Speed

Vector:
- Weight
- Thrust
- Magnetic field
- Velocity
What does 2500 m equal to in km?
What is $10 \frac{g}{cm^3}$ equal to in $\frac{kg}{m^3}$?
Is density scalar or vector?
Is Time (seconds) fundamental or derived?
Is Area ($m^2$) "fundamental or derived?"

Problem 5: Fundamental vs derived
(Independent variable) causes a change in (Dependent Variable) and it isn't possible that (Dependent Variable) could cause a change in (Independent Variable)
How to read a graph

Slope = \frac{Y_2 - Y_1}{X_2 - X_1}

Distance (m)

Time (min)
On a Velocity vs. Time graph, any time the line crosses the “x” axis, the object is changing direction.
Variable Speed
Average and instantaneous speed
Geometry & Trig in Physics
Basic Trigonometric Functions

SOH: \( \sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \)

CAH: \( \cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} \)

TOA: \( \tan \theta = \frac{\text{Opposite}}{\text{Adjacent}} \)
\[
\sin(\theta) = \frac{\text{Opposite}}{\text{Hypotenuse}} \quad \cos(\theta) = \frac{\text{Adjacent}}{\text{Hypotenuse}} \quad \tan(\theta) = \frac{\text{Opposite}}{\text{Adjacent}}
\]
Pythagorean Theorem

\[ a^2 + b^2 = c^2 \]
\[
\sin(\theta) = \cos(90^\circ - \theta)
\]

\[(\cos(\theta), \sin(\theta))\]

Pythagoras Theorem for physical quantities

$\sqrt{\frac{5^3}{2}}$

$\left(\frac{1}{2}, \frac{3}{2}\right)$

https://youtu.be/LE6dmczMc68
Special Triangles

45-45-90 Triangle

30-60-90 Triangle

3-4-5 Triangle

5-12-13 Triangle
Determine the Magnitude and direction
Determine the Magnitude and direction of the 5 km journey.
Determine the Magnitude and direction
Trigonometry of inclined planes

Forces

Diagram showing forces and angles on an inclined plane.
A **Force** is a push or a pull that causes an object with mass to move faster (accelerate), or slower (decelerate), change direction, or deform.
Forces are vector quantities because they have a magnitude and direction.
Types of Forces:

- Applied Force
- Pull (Tension)
- Push (Compression)
- Normal Force (Perpendicular to the Surface)
- Drag Force (Resistance to motion in Air or Water)
- Friction (Always moves opposite to motion)
- Spring Force
- Weight (mass * acceleration)
Sir Isaac Newton and Newton’s Second Axiom

**Force** = **Mass** * **Acceleration**

\[ N = kg \times \left( \frac{m}{s^2} \right) \]

\[ \sum \vec{F} = m\vec{a} \]
A uniform ladder 5 m long weighing 200 N is leaning against a smooth vertical wall with its base 3 m from the wall. The coefficient of static friction between the bottom of the ladder and the ground is 0.4. How far, measured along the ladder, can a 600 N man climb before the ladder starts to slip?
As you go along… Formula Sheet

Quadratic Formula

\[ a x^2 + bx + c = 0 \]
\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

Geometry
Circumference = \(2\pi R\), area = \(\pi R^2\)
Sphere: area = \(4\pi R^2\), volume = \(4\pi R^3 / 3\)

Trigonometry

\[
\sin \alpha = \frac{A}{C}, \quad \cos \alpha = \frac{B}{C}
\]
\[
\tan \alpha = \frac{A}{B}
\]

Rotational Motion & Gravity

\[
v = \omega r = \frac{2\pi r}{T}, \quad \omega = \frac{2\pi}{T}, f = \frac{1}{T}
\]
\[
\alpha = \frac{\omega_f - \omega_0}{t} = \frac{a}{r}
\]
\[
L = I\omega = mvr \sin \theta, \quad (\theta = \text{angle between } v \text{ and } r)
\]
\[
KE = \frac{L^2}{2I} = \frac{1}{2} I\omega^2
\]
\[
\tau = rF \sin \theta, \quad I\alpha = \tau, \quad I_{\text{point}} = mR^2
\]
\[
I_{\text{cyl. shell}} = mR^2, \quad I_{\text{sphere}} = \frac{2}{5} mR^2, \quad I_{\text{solid cyl.}} = \frac{1}{2} mR^2
\]

Gases, liquids and solids

\[
p \cdot V = nRT
\]

Polar Coordinates
A bus traveled on a level road for 6 hours at an average speed 20 miles per hour faster than it traveled on a winding road. The time spent on the winding road was 3 hours. Find the average speed on the level road if the entire trip was 462 miles.

Step 1: Identify variables/physical quantities.
Step 2: Draw a picture
A rectangular field is to be fenced off next to a straight wall, with fencing on three sides, with the wall making the fourth side. Exactly 150 feet of fencing is to be used. Express the area of the field as a function of its width.

**Given:**

\[ p = 150 \text{ ft} \quad (3 \text{ sides}) \]
\[ x = \text{width} \]
\[ y = \text{length} \]
Step 4: Identify the unknowns

Three coffees and two muffins cost a total of 7 dollars. Two coffees and four muffins cost 8 dollars. What is the individual price for a single coffee and a single muffin?

Let $x =$ cost of a single coffee
Let $y =$ cost of a single muffin
Step 5: Begin strategizing for the answer based on the given information
What is the average velocity of the car if it travels 60 km in 1.5 hours?
Displacement: \( = x_2 - x_1 = 60 \text{ km} \)
Time = 1.5 hours

Average Velocity = Displacement / Time
A plane lands at a speed of 68 m/s and slows down at a rate of $4\text{m/s}^2$. How much runway is needed to stop the plane?
Word Problem 2: Write all the given quantities

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<thead>
<tr>
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<th>Initial</th>
<th>Final</th>
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<tr>
<td>( x )</td>
<td>0 m</td>
<td></td>
</tr>
<tr>
<td>( t )</td>
<td>0 s</td>
<td></td>
</tr>
<tr>
<td>( v )</td>
<td>68 m/s</td>
<td></td>
</tr>
<tr>
<td>( a )</td>
<td>4 m/s²</td>
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Initial quantities:
- Initial position: 0 m
- Initial time: 0 s
- Initial velocity: 68 m/s
- Initial acceleration: 4 m/s²

Final quantities:
- Final position: 0 m
- Final time: 0 s
- Final velocity: 0 m/s
- Final acceleration: 4 m/s²
Word Problem 2
A plane lands at a speed of 68 m/s and slows down at a rate of 4 m/s$^2$. How much runway is needed to stop the plane?

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$x_1 = 0 \text{m}$
A plane lands at a speed of 68 m/s and slows down at a rate of 4m/s². How much runway is needed to stop the plane?

\[ x_{\text{initial}} = 0 \text{ m} \quad \quad x_{\text{final}} = 578 \text{ m} \]

\[ t_{\text{initial}} = 0 \text{ s} \quad \quad t_{\text{final}} = 17 \text{ s} \]

\[ v_{\text{initial}} = 68 \frac{\text{m}}{\text{s}} \quad \quad v_{\text{final}} = 0 \frac{\text{m}}{\text{s}} \]

\[ a_{\text{initial}} = 4 \frac{\text{m}}{\text{s}^2} \quad \quad a_{\text{final}} = 4 \frac{\text{m}}{\text{s}^2} \]

\[ x_1 = 0 \text{ m} \quad \quad x_2 \]

Word Problem 2: Write all the given quantities.
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Give feedback.
Win a gift certificate!

goto.unm.edu/ess-feedback

Don’t forget to follow up on social media.

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