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

- College Algebra Review (Pre-Calc/Trig Prep)  Monday, August 15, 2022  10 AM - 12 PM
- Pre-Calc/Trig Review (Calc 1 Prep)  Tuesday, August 16, 2022  10 AM - 12 PM
- Calc 1 Review (Calc 2 Prep)  Wednesday, August 17, 2022  10 AM - 12 PM
- Calc 2 Review (Calc 3 Prep)  Thursday, August 18, 2022  10 AM - 12 PM
- Physics 1 Prep  Friday, August 19, 2022  10 AM - 12 PM
- Chem 1 Prep  Friday, August 19, 2022  1 - 3 PM

Attend these sessions & give feedback for access to a general knowledge exam.

RSVP is preferred but not required

ess.unm.edu/events > August

or through our app - sucEss

Welcome!

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.

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.

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

This APP allows you to keep up to date on all we have to offer.

Put your learning into your own hands.

success.unm.edu

Now with a log-in option!
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?

**Scalar**
- Volume
- Time
- Temperature
- Speed

**Vector**
- Weight
- Thrust
- Magnetic field
- Velocity
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>
</tbody>
</table>

Helpful Website: National Institute of Standards and Technology
[https://physics.nist.gov/cuu/Units/units.html](https://physics.nist.gov/cuu/Units/units.html)
Velocity = +25 m/s
Density = kg/m$^3$
Scalar and Vector quantities

Scalar:
- Volume
- Time
- Temperature
- Speed

Vector:
- Weight
- Thrust
- Magnetic field
- Velocity

Scalar and Vector quantities
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?

Problem 4: Fundamental vs derived
Is Area ($m^2$) "fundamental or derived?"

Problem 5: Fundamental vs derived
Graphs
(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

Hypotenuse

Adjacent

Opposite

SOH

\[ \sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \]

CAH

\[ \cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} \]

TOA

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

**SOH CAH TOA Rule**
Pythagorean Theorem

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

The Unit Circle

Pythagoras Theorem for physical quantities

https://youtu.be/LE6dmczhMc68
Special Triangles

45-45-90 Triangle

$$x \quad x\sqrt{2}$$

$$x^\circ \quad 45^\circ$$

30-60-90 Triangle

$$x \quad 2x$$

$$x^\circ \quad 60^\circ$$

3-4-5 Triangle

3 4 5

5-12-13 Triangle

5 12 13
Determine the Magnitude and direction
Determine the Magnitude and direction
Determine the Magnitude and direction
Trigonometry of inclined planes

Forces
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)
\[ F = ma \]

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

\[ ax^2 + bx + c = 0 \]

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

**Geometry**

- Circle: circumference = \(2\pi R\), area = \(\pi R^2\)
- Sphere: area = \(4\pi R^2\), volume = \(\frac{4}{3}\pi R^3\)

**Trigonometry**

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

\[ \tan \alpha = \frac{A}{B} \]

\[ \frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C} \]

\[ A^2 + B^2 - 2AB \cos \gamma = C^2 \]

**Rotational Motion & Gravity**

\[ PE = -G \frac{Mm}{r}, \quad \Delta PE = mgh \text{ (small } h), \quad F = G \frac{Mm}{r^2} = mg \]

\[ a = \frac{v^2}{r}, \quad GM = \frac{R^3}{T^2} \]

\[ v = \omega r = \frac{2\pi r}{T}, \quad \omega = \frac{2\pi f}{T}, \quad f = 1/T \]

\[ \alpha = \frac{\omega f - \omega_0}{t} = \frac{a}{r} \]

\[ L = I \omega = mvr \sin \theta, \quad (\theta = \text{angle between } v \text{ and } r) \]

\[ KE = \frac{L^2}{2I} = \frac{1}{2} I \omega^2 \]

\[ \tau = rF \sin \theta, \quad I \alpha = \tau, \quad I_{\text{point}} = mR^2 \]

\[ I_{\text{cyl.shell}} = mR^2, \quad I_{\text{sphere}} = \frac{2}{5} mR^2, \quad I_{\text{solid cyl.}} = \frac{1}{2} mR^2 \]

**Gases, liquids and solids**

- **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.

<table>
<thead>
<tr>
<th>categories</th>
<th>rate</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>level road</td>
<td>$x + 20$</td>
<td>6 hr</td>
</tr>
<tr>
<td>winding rd.</td>
<td>$x$</td>
<td>3 hr</td>
</tr>
</tbody>
</table>

The relationship between distance, rate, and time is given by the equation $d = rt$. 

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:**

\[ p = 150 \text{ ft} \quad (3 \text{ sides}) \]

\[ x = \text{width} \]

\[ y = \text{length} \]
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?
<table>
<thead>
<tr>
<th>$x_{\text{initial}}$</th>
<th>0 m</th>
<th>$x_{\text{final}}$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_{\text{initial}}$</td>
<td>0 s</td>
<td>$t_{\text{final}}$</td>
<td></td>
</tr>
<tr>
<td>$v_{\text{initial}}$</td>
<td>$68 \frac{m}{s}$</td>
<td>$v_{\text{final}}$</td>
<td>0 $\frac{m}{s}$</td>
</tr>
<tr>
<td>$a_{\text{initial}}$</td>
<td>$4 \frac{m}{s^2}$</td>
<td>$a_{\text{final}}$</td>
<td>$4 \frac{m}{s^2}$</td>
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Word Problem 2: Write all the given quantities.
Word Problem 1
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?

### Word Problem 2: Write all the given quantities

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Initial</th>
<th>Final</th>
</tr>
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<tbody>
<tr>
<td>$x$</td>
<td>0 m</td>
<td>$x$</td>
</tr>
<tr>
<td>$t$</td>
<td>0 s</td>
<td>$t$</td>
</tr>
<tr>
<td>$v$</td>
<td>68 m/s</td>
<td>$v$</td>
</tr>
<tr>
<td>$a$</td>
<td>4 m/s$^2$</td>
<td>$a$</td>
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$x_1 = 0$ m

$x_2 = \text{runway length}$
A plane lands at a speed of 68 m/s and slows down at a rate of 4 m/s². How much runway is needed to stop the plane?

<table>
<thead>
<tr>
<th>x&lt;sub&gt;initial&lt;/sub&gt;</th>
<th>0 m</th>
<th>x&lt;sub&gt;final&lt;/sub&gt;</th>
<th>578 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>t&lt;sub&gt;initial&lt;/sub&gt;</td>
<td>0 s</td>
<td>t&lt;sub&gt;final&lt;/sub&gt;</td>
<td>17 s</td>
</tr>
<tr>
<td>v&lt;sub&gt;initial&lt;/sub&gt;</td>
<td>68 m/s</td>
<td>v&lt;sub&gt;final&lt;/sub&gt;</td>
<td>0 m/s</td>
</tr>
<tr>
<td>a&lt;sub&gt;initial&lt;/sub&gt;</td>
<td>4 m/s²</td>
<td>a&lt;sub&gt;final&lt;/sub&gt;</td>
<td>4 m/s²</td>
</tr>
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Word Problem 2: Write all the given quantities:

- x<sub>1</sub> = 0 m
- x<sub>2</sub>
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