PHYSICS I

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Introduction

Physics I, class code PHY 116 at college of Staten Island is the first part of two semester algebra-based introductory physics course. This course is overlapping of many topics in laws of classical mechanics, fluid dynamics, thermodynamics, wave motion and sound. The important laws of physics in these areas and problem solving are emphasized. Problem solving is an integral part of the course, all contents are designed to think critically, analytically, and logically. Conceptual understanding is reinforced using interactive computer-based techniques, demonstrations, problems solving strategies, and laboratory experiences. In this document, all the class materials including lectures, worksheets, homework and group work assignments, quizzes, and conceptual questions are presented as Open Education Resources (OER).

Course learning objectives (CLO) are mentioned below.

At the end of this course, students will be able to:

CLO 1: Describe physics concepts verbally, graphically, and mathematically by identifying and defining physical quantities to explain major laws of Physics and its applications by using mathematical models for quantitative reasoning and describing physical reality.

CLO 2: Apply knowledge of linear motion, rotational motion, forces, energy, momentum, circular motion, sound waves, fluid mechanics and thermodynamics to explain natural physical processes and related technological advances including critical analytical skills to evaluate physical phenomena and their effects

CLO3: Demonstrate the understanding of algebraic mathematics along with physical principles to effectively solve problems encountered in everyday life, applicable to biological activity and health care, and further study in science, and professional world.

CLO 4: Design and demonstrate experiments and acquire data in order to explore physical principles, effectively, communicate results, and critically evaluate related scientific studies and use basic level programing including detail data analysis technics.

The course is structured to teach in different modalities: In -person, hybrid synchronous or totally asynchronous.

Asynchronous lectures: Lecture slides are prepared and presented asynchronously. The goal is to use assigned class time 55 minutes effectively. Asynchronous lectures are required to watch during the assigned time interval or at student's own pace. The lectures will provide the key content knowledge to be conveyed in this course. Students should take notes and complete the related lecture summary assignment while watching it and submit to learning management system (LMS) on time.

Asynchronous/synchronous problem solving: The goal of this component is to use learnt concepts in E-lectures to problem solving or real-world applications. This component of the course is very important. Class time one hour is assigned for students, they watch recorded problem solving or attend the session to work together. Students should understand the working problems and rewrite them and submit them to LMS on time.

Synchronous Group work: In this work, students get problems set to work as a group. They are assigned to submit individually or as a group in different semesters. All members of the group should attend, work equally, agree on the final product, and understand all the work. This will help students to contribute equally to all aspects of learning, communicating, organizing, and collaboration.

Lecture materials:

The goal of this part of the course is to provide the key content knowledge of the crucial concepts that will be used during the rest of the class structure. E-lecturing is assigned to complete 55 minutes period of the class. Learners are supposed to complete a given following task while watching the recorded lectures and submit it before they participate or complete the problem-solving session. E-lecture gives freedom to learn the material within an individual schedule. Learners can expose themselves to the subject matter by exploring crucial concepts that are needed to apply for problem-solving. E-lecturing allows them to revisit and review class material as much as needed.

YouTube link for lectures: https://www.youtube.com/playlist?list=PLv_BVWnieP42nOEYvFF_GuDaA2VN5rnmb

PHY 116 Lecture Notes-This should be completed before starting the worksheet. This is graded for following the given structure and the completeness.

Date: _____

Student Name: _____ Last 4 digits of Student ID#: _____

Take your notebook handwrite above information. Then, start to watch the ***Lecture*** video and answer to each part [a], [b], [c], [d], and [e] below at the same time. Your answers should be **handwritten with more than 20 words long** including important concepts that were discussed. This can be used as a short note for your worksheet, groupwork and quizzes.

[a] between 0:00 and 15:00 minutes of the video? **(20 points)**
[b] between 15:01 and 25:00 minutes of the video? **(20 points)**
[c] between 25:01 minutes and the end of the video? **(20 points)**
[d] Write all fundamental formulas and constants discussed in the lecture. These can be used to solve problems and should be the formulas on the formula sheet only. **(20 points)**
[e] Summarize the most important or interesting thing you learn towards your education or day today life from this lecture? **(20 points)**

Figure 1: Lecture notes task: Learners will complete this simple task in their notebooks by watching the E-lectures.

Contents are divided into four-unit modules in learning management system (LMS). Each E-lecture describes the subject matter with crucial concepts and derives or introduces mathematical formulas that will be used for problem-solving. The learners get an opportunity to revisit the lecture or refer to the open educational physics textbook for more information on materials. A small task for each lecture as shown in Figure 1 is given to complete as lecture notes. This assignment must be completed while watching the E-lectures. Students have to hand-write the answers in their notebooks by following the model and submit it to LMS before the problem-solving session.

Unit 1:

Lecture 1: Physics and Measurements: Introduction to Science, Measurement, Significant, Uncertainty, Estimation, SI and other units, unit conversion, and dimensional analysis.

Lecture 2: Kinematics: Distance, displacement, speed, velocity, acceleration, instantaneous velocity, and acceleration, graphical representation, motion diagram, vectors, scalars, and vector addition, coordinate system, free fall, and constant acceleration problems.

Lecture 3: Two-dimensional Kinematics: Detail information about vector addition and subtraction in graphical and analytical methods, projectile motion, kinematics on two-dimension problems.

Unit 2:

Lecture 4: Dynamics: The laws of motion, force, mass, weight, Inertial frames, Newton's laws of motion and applications, free body diagram, gravity, tension, spring, and friction forces, friction, drag forces, elasticity.

Lecture 5: Uniform Circular Motion and Gravitation: Uniform circular motion, non-uniform circular motion, Newton's law of gravitation, bank and unbanked roads, satellites motion, Kepler laws.

Lecture 6: Work and Energy: Work done, energy, translational kinetic energy, gravitational potential energy, spring potential energy, work-energy principle, conservative and non-conservative forces and workdone, power, conservation of energy.

Unit 3:

Lecture 7: Linear momentum & Collision: Linear momentum, impulse, conservation of momentum, elastic, and inelastic collision, 1D and 2D collision, Center of Mass, rocket propulsion.

Lecture 8: Static Equilibrium & Torque: Equilibrium conditions, the center of gravity, stability, torques, torques of body joints and muscles.

Lecture 9: Rotational motion and Angular momentum: Angular position, velocity and acceleration, moment of inertia, rotation of rigid object about a fixed axis, rolling objects, rotational kinetic energy, angular momentum, energy conservation and angular momentum conservation.

Unit 4:

Lecture 10: Heat and temperature: Temperature, zeroth law of thermodynamics, thermal equilibrium, specific heat, latent heat, thermal expansion, heat transfer, conduction, convection and radiation, ideal gas laws, kinetic theory.

Lecture 11: Fluid Mechanics: pressure & variation, blood pressure, barometer, Buoyant forces and Archimedes' principle, Flow rate and velocity, Bernoulli's equations, laminar flow.

Lecture 12: Oscillations and Waves: Wave motion, sound waves, harmonic oscillations, pendulum, spring, damp motion, traveling waves, reflection, and transmission, sinusoidal, Sound: Intensity, quality, and interference of sound waves, energy transfer, intensity, resonance, speed of sound, speed of light, Doppler effect of sound.

Problem solving strategies and Worksheets:

This component is assigned 1 hour and 55 minutes of the class period to use the learned concepts in E-lectures toward problem-solving and real-world applications. This component of the course is very important for students to learn how to apply what they learn and develop problem-solving strategies by working with a given set of problems. At the end of the class, completed work is supposed to be submitted for a completion grade. The technique was investigated under mandatory attendance policy and choice-based attendance policy in two

separate semesters to check the progress and effectiveness. The problem-solving recitation session allows learners to build a bridge between what they heard and learned in E-lecture to real-life problem-solving and applications by making sense of the content and its relevance.

YouTube link for problem solving:
https://www.youtube.com/playlist?list=PLv_BVWnieP42nOEYvFF_GuDaA2VN5rnmb

There is a worksheet for each lecture. In these recordings, problems are discussed in detail with detailed answer discussions that help students to think about critically to new problems and variations.

Homework Assignments:

After completion of the worksheet or problem-solving strategies, students must complete the homework assignment for each lecture individually. They will get about a week to submit after the worksheet discussion. Homework questions are very similar to worksheet questions. Since we are not using expensive published homework systems, I grade homework submissions digitally through Blackboard. This was tested by adding grading and ungraded categories. Questions are kept updating and testing in a different way to get maximum learning output from students.

PHY 116 homework # X: Lecture X

Please work with your group, learn from each other, revisit the concepts and requirements together, connect physics to all disciplines and make a great friendship. Always bring any questions to the office hours.

- All should be *handwritten* in your notebook, then scan and submit it as a *single pdf file* to the blackboard.
- Please *don't print or save* the assignment, it will be always available and updated on the blackboard.
- All answers should be *handwritten clearly, spaced, explained, and ordered* starting from question one.
- Use only the *fundamental formulas and concepts* you learn from this class; *no random variables or formulas* are allowed.
- Use ChatGPT as a learning tool only, don't write generated answers without your effort and understanding.
- If you *do not follow the requirements*, you will receive *no credit* for the assignment, check the grading rubric.
- Use *significant rules* throughout the assignment and *use units for all answers*.
- To start: *handwrite* the following statement, *names*, IDs, start date, lab section, and *attendance* on it:

"On my honor, I attest that I will follow the letters and spirit of all of this assignment's rules."

Date:_____

Student Name: _____ Last 4 digits of the ID #: _____

Use the last digit of of your ID numbers and add them all:_____. This is **A**.

Add 10 to **A**:_____. This is **B**.

Add 100 to **B**:_____. This is **C**.

Write the value of **A, B,** and **C** to one decimal place. You may refer to some or all these numbers later in this assignment.

A=_____ **B**=_____ **C**=

Figure 2: First page for all homework assignments that shows class requirements for students to follow.

Homework assignments are implemented with several different methods to minimize academic dishonesty issues. Homework assignments are integrated with Students' last four digits of the ID as shown in Figure 2. The ID-integrated questions will provide personalized questions for each student. This makes it not possible to share homework answers between students because every student gets a different answer. Therefore, this method forces students to work individually. Also, at the top of the paper student must write the honor statement by hand by providing a psychological effect on students' minds to think that they should do it individually, follow assignments requirements, and feel about their own work and learning. Video recordings of the homework requirements and the way of completing the assignments are posted on the blackboard which shows a step-by-step process. All requirements are noted on the top of each assignment as in Figure 2 and restate them with penalties on the rubric to force students to follow the rules and learn better through the designed process of personalized learning. This page is displayed in each homework assignment.

PHY 116 HW1 – Lecture 01: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. Find the area of a rectangle of length **B**/10.0 cm and width **C**/20.0 cm? Remember to use correct units and significant for the final answer. How many significant are in your final answer? **(20 points)**
2. What is the correct way of writing the length of your arm in cm if you use ruler to measure it. Remember to write accurate measurements with correct decimal and uncertainty. If you have a ruler, you can measure it or else you are volunteering to hypothetical measurement. **(20 points)**
3. Convert **B** mph (miles per hour) to SI unit? If you drive at this speed, do you exceed the speed limit of 35.0 m/s? **(15 points)**
4. A certain physical quantity, P is calculated using formula P=**AB**(**B-C**)^2, what will be the SI unit and the value of P? Consider your **A** in kg and **B** and **C** are in $\frac{m}{s^2}$. **(20 points)**

Do for practice and earn (25 points) for completion:

5. Take the value of **C** and multiply that by 100000. Write your final answer in scientific notion. How many significant are in your final answer?
6. Take the value of **C** and divide that by 100000. Write your final answer in scientific notion. How many significant are in your final answer?
7. What is the final correct answer for **B**/5.00+**C**/20.00+**C***0.0005?
8. What is the final correct answer for **A**+5.112?
9. What is the final correct answer for **A** x 5.112?
10. What is the final correct answer for **B**-0.105 x 2.2465?
11. A certain physical quantity, X is calculated using formula X=**B/C**. What will be the SI unit and the value of X to correct significant and accuracy? Consider your **B** in kg and **C** in m/s.
12. Do you think $x = v + at^2$ is dimensionally correct if x is measured in m, v is measured in m/s and a is measured in m/s^2 and t is measured in s? Explain why?

PHY 116 HW2 – Lecture 02: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. John drops the ball from the tower, and it takes **B**/10 s to land on the ground.
   a. Calculate the height of the tower? **(20 points)**
   b. Calculate velocity of the ball before it crashes into the ground? **(20 points)**
   c. What will be the answers to a and b if John throws the ball downward with velocity **B**/10 m/s? **(15 points)**
   d. Plot the rough graph of displacement, velocity, and acceleration as a function of time **(20 points)**

Do for practice and earn (25 points) for completion:

2. a. A car travels with a velocity of **B** m/s. Suddenly the car begins to slow down with an acceleration magnitude is **A**/2 m/s^2. What is the velocity of the car when the displacement of the cart is **C**/5 m?

   b. At a particular instant a free-falling object has a velocity of **A** m/s. Exactly 2 s later its velocity will be? What is the distance it travels?

   c. A stone is dropped from the top of a tall building. After **C**/100 s of free fall, what is the displacement of the stone and what is the velocity of the stone?

   d. If a train travels at a speed of **C** km/h, you walk in the same direction with speed of **A** km/h inside the train. What is the speed of you with respect to your friend sitting on the ground?

PHY 116 HW3 – Lecture 03: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. A basketball is launched with an initial speed of **A** m/s and with an angle of 60.0 degrees from the ground. It follows the parabolic trajectory, and the ball enters the basket in **B**/50 s after it is launched. Ignore air resistance!
   a. Draw a cartoon, label your chosen origin and X and Y coordinates (**10 points**)
   b. What is the horizontal distance from you to basket? **(10 points)**
   c. What height of the basket should be located to catch the ball? **(15 points)**
   d. According to your calculated basketball height, can it be a real basketball problem? If not explain why? Real basketball height will be approximately 2-4 feet. **(20 points)**
   e. What will happen to horizontal and vertical directional velocities with time? **(10 points)**
   f. What will happen to horizontal and vertical directional accelerations during the motion? **(10 points)**

Do for practice and earn (25 points) for completion:

2. A rural mail carrier leaves the post office and walks **B** m in a northerly direction. She then walks in a direction 60.0° north of west for **A** m.

   a. Which quadrant **B** and **A** vectors belong to?
   b. What is her displacement from the post office?
   c. Sketch graphical representation of vector addition?

3. Balls P and Q are identical. From the top of a **C**/10 m tall building, ball P is launched with a velocity of 15.0 m/s at an angle of 30° above the horizontal direction, ball Q is launched with a velocity of 15.0 m/s in horizontal direction. Ignore any effects of air resistance.

a. Draw a cartoon for P and Q balls and choose the origin and label X and Y coordinates.
b. What can you say about the horizontal velocities of both balls?
c. What can you say about the vertical velocities of both balls?
d. Find the resultant velocity of both balls just before they hit the ground?
e. Are they the same? Explain why?

PHY 116 HW4 – Lecture 04: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. **B**/50 kg block sits on a 30^0 frictional incline. You push the block with constant velocity upward with the force of **B** N.
   a. Draw the Free body diagram (FBD) of the block **(10 points)**
   b. What is the acceleration of the box? **(10 points)**
   c. Write Newton 2^{nd} law for both object for chosen X and Y coordinates? **(10points)**
   d. Calculate the normal force of the object? **(10 points)**
   e. Calculate the force of the gravity of the object? **(10 points)**
   f. Calculate the friction force? **(10 points)**
   g. Calculate the coefficient of kinetic friction **(15 points)**

Do for practice and earn (25 points) for completion:

2. **B** kg person stands on a scale and observes scale reading (read the mass in kg) in following scenarios, $g=9.80 m/s^2$.
   a. If an elevator accelerates at 0.2g downward, what is the scale reading in elevator?
   b. If an elevator goes down as free fall, what will be the scale reading?

3. A cat of mass **B/5** kg fell from a very tall building. If the drag coefficient **C**=0.60, density of air 1.2 kg/m^3, and the effective area of the cat is 0.052 m^2
   a. Calculate the force of gravity of the cat?
   b. Calculate the terminal velocity when drag force is equal to gravitational force?

4. A **B**/2 kg block sits on a 60^0 frictional incline with kinetic friction coefficient 0.35. It is attached to string that is thread over a pulley mounted at the top of the incline. **A** kg block hangs from the string.
   a. Draw the FBD for both objects?
   b. Write Newton 2^{nd} law for both object for chosen X and Y coordinates?
   c. Calculate the friction force?
   d. Calculate the friction force?
   e. Calculate the acceleration of the system?
   f. Calculate the tension force?

5. a. Calculate the change in length of the upper leg bone (the femur) when a man supports **B** kg of his mass on it, assuming the bone to be equivalent to a uniform rod with cross sectional area 1.5×10^{-3} m^2, length 0.50 m long, and Young's module of the bone is $9.0 \times 10^9 N/m^2$.

b. The area of the upper face of rectangular block is **A**/100 m^2 and lower face is fixed. The height of the box is 2.0cm. A shear force applied to the top face and produce a displacement of 0.015mm, Find the shearing force by taking shear module of the box as $4.5x10^{10}$ N/m**.**
c. Calculate the fractional decrease in volume ($\Delta V/V_0$) for seawater at **A** km depth. Bulk module of sea water is $2.2x10^9$ N/m^2, density of seawater 1030 kg/m^3.

PHY 116 HW5 – Lecture 05: Please follow the instructions given above about the requirements, rules, and submissions.

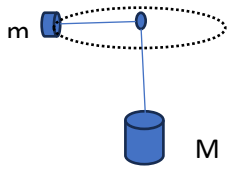
Show all work with all effort. This will be graded with detailed feedback (75 points):

1. Take $G=6.67 \times 10^{-11}\ N \cdot m^2/kg^2$; Mass of the one planet is $\boldsymbol{B} \times 10^{24}$kg and other planet is **C** x 10^{24} kg and distance between two planets is **A** x 10^8 m.
   a. Find the gravitation force between two planets? **(15 points)**
   b. Determine the speed of the Space Telescope orbiting at a height of **C** km above the first planet surface. Take the radius of the first planet as $\boldsymbol{B} \times 10^6$m. **(25 points)**
2.
   a. Draw the FBD for Loop the loop motorcycle stunk on top, bottom, left and right, why the motorcycle not free fall from top? **(15 points)**
   b. Draw the FBD for the person on earth on north pole and equator, discuss how gravitational acceleration of two places? **(20 points)**

Do for practice and earn (25 points) for completion:

3. If the car is traveling on banked curved road with keeping radius **A** m on the road,
   a. Draw the FBD
   b. Write Newton's 2nd law for the car for chosen X and Y coordinates.
   c. Find the optimum angle of the road to maintain the speed of the car as **B**/10 m/s without slipping?
4. The roller coaster with mass **B** kg will follow the **A** m diameter track as shown, what minimum speed must it have at the top of the loop to remain in contact with the loop?

5. A mas m=**A**/2 kg slides in a circle of radius 20 cm of a frictionless table. It is attached to the cylinder of mass M= **A** kg by a cord that goes through the hole in the table as shown. What speed should need mass m to slide while keeping the cylinder at the same position?

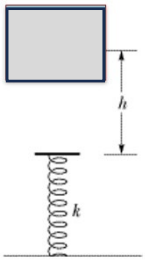


PHY 116 HW6 – Lecture 06: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. The block of mass M= **A** kg drops from h= 100.0 cm height to the spring attach to the ground. The spring of spring constant k=**C**+1000 N/m compreses the distance y.

a.



a. Choose PE=0 position and initial and final postions for your convenience to solve the problem for y below. **(10 points)**

b. Write algeberic equations (using given symbols,M,h,k,g) for intial and final postions energies? **(15 points)**

c. Use enegy conservation to write algebaric equation for y? **(15 points)**

d. Calculate y? **(15 points)**

e. Now the same block is projected up on the plane of 30^0 incline with velocity **A** m/s, from an initial position of incline distance *d* =100.0 cm from the end of the same relaxed spring. What will be the spring compress distance when object hit the spring, compress, and rest.? Remember to follow the a to d procedure above for this problem. **(20 points)**

Do for practice and earn (25 points) for completion:

2. The box is dropped on a frictionless incline ramp a distance d before hitting the spring on the bottom of the ramp. Use θ=30, d=**B**/10 m, k=**C** N/m, mass of the box=**A** kg.
   a. Take the spring totally compressed x distance, then write an equation to find x. Then plug the values and solve x?
   b. If there is a friction between the box and incline, What is the frictional force? Use kinetic friction coeficient as 0.5.
   c. Find the loss of energy due to friction when box reach d+x distance.
   d. What is the x with having friction?

3.
   a. Car 1 has mass **B** kg and car 2 has mass **A** kg, but they both have the same kinetic energy. How do their speeds compare, you can find the ratio?
   b. **A** kg crate initially at rest is being lowered down a frictionless **B**/10 m ramp using a rope with tension **B** N in 30 degrees ramp.
      i. Calculate the work done from gravity?
      ii. Calculate the work done by the rope?
      iii. Calculate the work done by normal force?
      iv. Calculate the network done?

PHY 116 HW7 – Lecture 07: Please follow the instructions given above about the requirements, rules, and submissions.

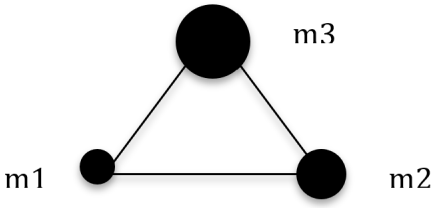
Show all work with all effort. This will be graded with detailed feedback (75 points):

1. A block of mass *m* = **B**/10 kg, moving on a frictionless surface with a velocity of v_i= **A** m/s in +X direction, collides with a block of mass *M* =**B**/2 at rest. After the collision, the m block recoils with a velocity of v_f=**A**/5 m/s.

   a. Draw the cartoon of the balls before and after the collisions. **(5points)**
   b. Write initial momentum of the system by using symbols only? **(10points)**
   c. Write final momentum of the system by using symbols only? **(10points)**
   d. Use momentum conservation and solve for unknown v by using symbols? **(10points)**
   e. Calculate V? **(10points)**
   f. Show whether the collision is elastic or inelastic by doing calculations? **(15points)**
   g. Calculate the impulse of one object? **(15points)**

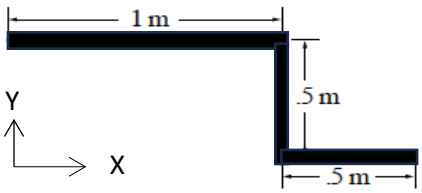
Do for practice and earn (25 points) for completion:

2. Three-point particles of masses m_1=**D**/10kg, m_2=**B**/10kg and m_3=**C**/10kg are located an equilateral triangle of edge length a=**D** cm. Where is the center of mass of the system from the origin where mass m_2 is located?



   a. Choose origin as the position of m2 and write X, Y coordinates for three masses?
   b. Calculate X and Y coordinates of center of mass of the system.
   c. Calculate the resultant center of mass of the system.
   d. Calculate r cm?

3. A uniform bar of mass 4 kg is bent in the shape of an asymmetric' Z' as shown in the figure. Locate the center of mass of the bar from x=0 and y=0 position as marked?



4. Blocks X and Y are moving toward each other. The X has a mass of **B** kg and a velocity of ***B***/3 m/s in +X direction, while Y has a mass of **B**/2 kg and a velocity of ***A*** m/s in -X direction. After the collision ball X is moving with velocity **B**/4 m/s in +X direction.

   a. What will be the velocity of ball Y after the collision?
   b. Is it an elastic or inelastic collision? Explain and prove your answer?
   c. Calculate impulse on ball A?

PHY 116 HW8– Lecture 08: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

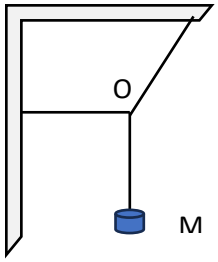
1. If you lift an object of mass **A** kg by bending your right elbow. Take the length from elbow to the object as **B** cm and mass of your body part is **B**/10 kg and acting at the center of elbow to object distance. Draw the free body diagram including biceps muscle force as F_b, elbow reaction force as F_e, weight of the object as F_o and weight of the body parts as F_p. Take the distance between F_b and F_e as 4.2 cm.
   a. Which forces do the counterclockwise (CCW) torque and which forces do clockwise (CW) torque if you choose elbow as the pivot point? **(10points)**
   b. Find CCW torque by using given symbols? **(10points)**
   c. Find CW torque by using given symbols? **(10points)**
   d. Which equilibrium condition you can use to find F_b? Calculate F_b**(10points)**
   e. Which equilibrium condition you can use to find F_e? Calculate F_e? **(10points)**
   f. Calculate F_b if you use back to lift the object. Use your upper body mass as **C**/5 kg. Take distance from back pivot point to body mass acting point as **B** cm and object mass acting point as twice of that. Additionally, distance between Fb and pivot point is 8.5 cm. **(25points)**

Do for practice and earn (25 points) for completion:

4. A uniform board with a weight of **C** N and a length of 2.0m rests horizontally on two supports as shown. One support is on the left end of the board, while the other support is 1.5 m from left end.

   a. Draw free body diagram for the board with all the forces?
   b. Find two support forces by using equilibrium conditions? Explain which equilibrium condition you use and how?
   c. If you have only one support to balance the uniform board. If you use block of mass 3.0kg on top of the right end of the board as shown. What will be the balance distance to the pivot from left side of the board?

5. A block of mass M= **A** kg is suspended from a rope tied to two other ropes at point O as shown below. One rope is horizontally attached to a wall and the other is fastened to the ceiling. The angle between ceiling and the rope is 60°. Assuming the mass of the ropes and the knot are negligible, Calculate the tensions in each of the ropes by labeling them as T_1, T_2 and T_3? Explain how you use equilibrium condition here?

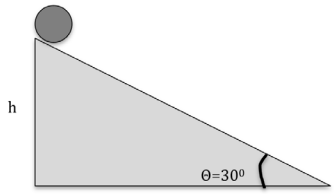


PHY 116 HW9 – Lecture 09: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. If inertia for solid sphere at its center axis is $I_s = \frac{2}{5} M_s R_s^2$ (M_s is the mass of the sphere, R_s is the radius of the sphere) and uniform rod at its center axis $I_r = \frac{1}{12} M_r L^2$ (M_r is the mass of the rod and L is the length of the rod) Take the distance from center of the left sphere to center of the right sphere as L, which is the length of the rod.
   a. Find the total moment of inertia formula, I at the axis of the system given below (center of the system). **(25 points)**
   b. Calculate I by using L= **C** m, R_s=**A** cm, M_s=**B**/10 kg and M_r=**C**/10 kg? **(25 points)**

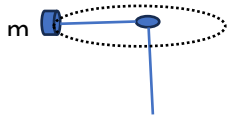
   c. The solid sphere of mass M_s and radius R_s is rolling down an inclined plane of angle 30^0 as follows starting from the rest at height h= **A** m. Write the conservation of energy by choosing initial as the top and final as before it hits the ground to calculate the velocity of the sphere before hits the ground. You can use M_s and radius R_s from above to calculate v. **(25 points)**



Do for practice and earn (25 points) for completion:

2. You and your friend ride a merry-go round. You sit **B** cm distance from the center your friend sits **B**/2 cm from the center. If the angular speed of the system is constant, what can you say about following for you and your friend?
   a. Who is close to the center?
   b. Which one has the larger linear speed? Explain why
   c. How about angular speed? Are they the same or different why?
   d. Who has larger radial acceleration?
   e. How about tangential acceleration?
   f. If the ride starts with zero angular speed and runs with constant angular acceleration of **D** rad/s^2 for **B**/10 s, calculate final angular displacement and linear displacement you and your friend travel?

3. A small mass *m* attached to the end of a string revolves in a circle on a frictionless tabletop. The other end of the string passes through a hole in the table. Initially, the mass revolves with a speed v_1 = **A** m/s in a circle of radius R_1 = **C**/100 m. The string is then pulled slowly through the hole so that the radius is reduced to R_2 = **B**/100 m. What is the speed, v_2, of the mass now?



PHY 116 HW10 – Lecture 10: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. a. **B** kg of water at 100°C is poured into a bucket that contains **A** kg of ice at 0°C. Find the equilibrium temperature (neglect the influence of the bucket)? **(40 points)**
   b. What is the rate of heat transfer by radiation if a hot tea pot in 100 ºC sits outside in temperature **B**/5 ºC. Take the surface area of the pot as **B**/10 m^2. The emissivity of pot is **A**/20 in the infrared, where the radiation takes place. Stephan Boltzmann constant 5.67×10^{-8} $W/m^2 \cdot K^4$**(35 points)**

Do for practice and earn (25 points) for completion:

2.

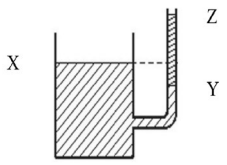
   a. Take **B** ºC, then convert it to Fahrenheit and Kelvin.
   b. Find the amount of heat needed to change the temperature of **B** g of ice from -**A** ºC to **B** ºC. The specific heat of water is 4186 J/kg ºC, Latent heat of fusion is 3.33 $x10^5$ J / kg, laten heat of vaporization 2.25 x 10^6 J/ kg.
   c. A patient of mass **B** kg is spiking a fever of 105 Fahrenheit. The patient is immersed in ice bath 0°C ice to reduce the fever immediately back down to 98.6 Fahrenheit. How much ice must melt (bath stays at 0°C water) for this temperature reduction to be achieved? Latent heat of fusion is 3.33 $x10^5$ J / kg. and Specific heat of body is 3500 J/kg ºC.
   d. A Styrofoam ice box has a total area of **C**/100 m^2 and walls with an average thickness of 2.50 cm. The box contains beverages at 0ºC. The inside of the box is kept cold by melting ice. How much ice melts in one day if the ice box is kept in the trunk of a car at 35.0ºC? Thermal conductivity of ice 0.010 J/s m ºC, Latent heat of fusion is 3.33 $x10^5$ J / kg.
   e. Suppose that a house has inside dimensions **B**/10 m × **A** m × 3.00 m, and that all air is replaced in 20.0 min. Calculate the heat transfer per unit time in watts needed to warm the incoming cold air by **B**/10 ºC, thus replacing the heat transferred by convection alone. Take density of air is 1.26 kg/m^3 and the specific heat of air is 1000 J/kg ºC.

PHY 116 HW11– Lecture 11: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. a. The barometer is a device to measure atmospheric pressure. If you plan to make a barometer by using a special liquid that has density **C** kg/m^3, what will be expected device height? Take atmospheric pressure $1.01x10^5 N/m^2$ **(25points)**

   b. If your volume is **B** liters, what is the buoyant force acting on you if you are inside the water. Take density of water as 1000 kg/m^3. **(25 points)**
   c. A container has a vertical tube, connected to it at its side, as shown in the figure. A liquid of density C+500 kg/ m^3reaches level X in the container and level Y in the tube. Level X being 8.0 cm higher than level Y. The tube has unknown oil to a **A** cm high, between levels Y and Z, Calculate the density of the unknown liquid. **(25 points)**



Do for practice and earn (25 points) for completion:

2.
   a. You are walking out on a frozen lake, and you begin to hear the ice cracking beneath you. As the best strategy for getting off the ice safely, you decide to spread your body and crawl. If your mass is **B** kg and your body area is **A**/10 m^2, calculate the pressure you apply to the frozen lake?
   b. When you visit the doctor's office, a nurse calls out your blood pressure as "**B/C**." in systolic blood pressure where is upper bound **B** and **C** is lower bound. What will be this value in Pascals, and do you have unhealthy blood pressure?
   c. A nurse needs to inject liquid medicine into your body by exerting a **A**/5 newtons force onto a hypodermic syringe. If the barrel of the syringe is 5.0 millimeters in diameter and the syringe's needle is 0.25 millimeters in diameter, how many newtons of force does the medicine come out from the needle into your body?
   d. A garden hose has two cross-sectional obstructed openings with a cross sectional area of X opening is **A**/10 m^2 and Y opening is **A**/100 m^2. What will be the ratio of speed of water coming outside in these two openings (X to Y)? What principles did you use here?

PHY 116 HW12– Lecture 12: Please follow the instructions given above about the requirements, rules, and submissions.

Show all work with all effort. This will be graded with detailed feedback (75 points):

1. You are riding a roller coaster. Your mother who is standing on the ground yells out behind at a frequency of **A** x200 Hz, but it sounds to you like **C** Hz. Take v_{snd}=343 m/s.
   a. What is the true frequency of your mom? **(10 points)**
   b. What is the frequency you hear? **(10 points)**
   c. Explain which of 4 categories belong to this problem? **(10 points)**
   d. Which one is source which one is observer? **(10 points)**
   e. Calculate the speed of your ride? **(20 points)**
   f. Now you yell at **A** x 200 Hz, what will be the frequency your mom will hear if you move toward your mom? **(15 points)**

Do for practice and earn (25 points) for completion:

2. a. Sound waves belong to which wave category?
   b. Write a simple harmonic oscillation acceleration equation by taking angular frequency as **A** rad/s.
   d. There are two simple pendula with the same mass but with length **A** m and **B** m, compare their periods?

   e. There are two spring pendula with the same mass but with spring constant 500+**C** N/m and 1000+**C** N/m, compare their periods?

   f. Sound of **C** decibels has how much intensity in watts per square meter? $I_0 = 1.0 \times 10^{-12}$ W/m^2 . Is that enough to damage your hearing?

3. Draw and find the frequencies of first 2 harmonics for following tubes
   a. A tube open at both ends (tube length is **C** m)
   b. A tube open at one end (tube length is **B** m)
   c. Which one has the higher frequency?

Groupwork Assignments:

Redesigning individual student learning activities into group learning activities will benefit various ways of education by building each other's support, connection, and communication. Unloading individual homework and loading in-class group work during a synchronous classroom setting will benefit all levels of individual learning effectively. Assigning most of the classwork to be completed during class time has potential benefits since Students are more likely to be engaged and focused effectively individually and grouply by sharing and communicating ideas together within the class. Therefore, I create group work for personalized classrooms by integrating students' college IDs and a set of specific rules to follow for best learning, imposing a list of roles as below. Each group member has a role and the following ground rules related to justice, equity, and diversity inclusion (JDEI) are imposed to facilitate the group work effectively.

List of roles:

1: Distribute the roles and ask all to write them on the top.

2: Take attendance and ask all to note on their work. Ask them to introduce themselves to the first session.

3: Explaining the assignments rules and requirements. Be responsible for explaining them.

4: In charge of the ground rules related to justice, equity, diversity inclusion (JEDI) below.

5: Listen to instructor carefully and manage given time and distribute among members.

6: Help everyone to submit a single PDF file to BB for all assignments.

JEDI (justice, equity, and diversity inclusion) ground rules:

- One person should speak at a time
- Provide reasons when you make statements
- Raise a hand or signal when you have something to say
- Listen carefully to what other people are saying
- Respect other people and their ideas
- Should not interrupt others
- Should not speak too long and give the opportunity to others
- Should not bias in gender, color, major, body shape, college, and all other diversities and demographics

Figure 3: Group work assignment roles and JEDI ground rules to follow.

There are 4-6 students in the group, we met each week during 55 class time to do group work through Zoom breakout rooms and group settings through LMS system. This follows the same process as homework, but problems are using all students' IDs. The first page of each groupwork represents what students need to follow and write before starting problem solving. This structure needed to be practiced as a group since all quizzes are followed by the same structure but using individual IDs.

Group work # X- Lecture XXX

Please work with your group, learn from each other, revisit the concepts and requirements together, connect physics to all disciplines and make a great friendship. Always bring any questions to the office hours or during group work sessions. Although you work in a group, individual work should be submitted to BB with self-grading in red color.

- All should be *handwritten* in your notebook, then scan and submit it as a *single pdf file* to the blackboard.
- Please *don't print or save* the assignment, it will be always available and updated on the blackboard.
- All answers should be *handwritten clearly, spaced, explained, and ordered* starting from question one.
- Use only the *fundamental formulas and concepts* you learn from this class; *no random variables or formulas* are allowed.
- Use ChatGPT or AI as a learning tool if you wish to, don't write generated answers without your effort and understanding.
- If you *do not follow the requirements*, you will receive *no credit* for the assignment, check the grading rubric.
- Use *significant rules* throughout the assignment and *use units for all answers*.
- To start: *handwrite* the following statement, *names*, IDs, date, Group #, roles and *attendance* on it:

"On our honor, we attest that we will follow the letters and spirit of all of this assignment's rules."

Date:_____Group Number:_____

Students' Names:	Last 4 digits of the ID #:	Attendance:	Roles:
1._____	_____	_____	_____
2._____	_____	_____	_____
3._____	_____	_____	_____
4._____	_____	_____	_____
5._____	_____	_____	_____
6._____	_____	_____	_____

Use the last digit of all of your ID numbers and add them all:_____. This is **A**.

Add 10 to **A**:_____. This is **B**.

Add 100 to **B**:_____. This is **C**.

Write the value of **A, B,** and **C** to one decimal place. You may refer to some or all these numbers later in this assignment.

A=_____ **B**=_____ **C**=

Figure 4: First page for all groupwork assignments that shows class requirements for students to follow.

PHY 116 GW1 – Lecture 01: Please follow the instructions given above about the requirements, rules, and submissions.

1.

a. Find the area of a rectangle of length $\frac{\boldsymbol{B}}{10}$ cm and width $\frac{\boldsymbol{C}}{10}$ cm? Remember to use correct units and significant for the final answer. How many significant are in your final answer? **(10 points)**

b. What is the correct way of writing the length of your arm in cm if you use ruler to measure it. Remember to write accurate measurements with correct decimals, uncertainty, and units. If you have a ruler, you can measure it or else you use it as hypothetical measurement. **(10 points)**

c. Convert **B** mph (miles per hour) to SI unit? If you drive at this speed, do you exceed the speed limit of 35.0 m/s? **(10points)**

d. A certain physical quantity, P is calculated using formula P=**AB**(**B-C**)^2. What will be the SI unit and the value of P? Consider your **A** in kg and **B** and **C** are in $\frac{m}{s^2}$. **(10 points)**

e. Take the value of **C** and multiply that by 100000. Write your final answer in scientific notation. How many significant are in your final answer? **(10 points)**

f. Take the value of **C** and divide that by 100000. Write your final answer in scientific notation. How many significant are in your final answer? **(10 points)**

g. What is the final correct answer for $\frac{\boldsymbol{B}}{5.00}+\frac{\boldsymbol{C}}{10.0}+$**A**x0.0005? **(10 points)**

h.Do you think $x = vt + at^2$ is dimensionally correct if x is measured in m, v is measured in m/s and a is measured in m/s^2 and t is measured in s? Explain why? **(10 points)**

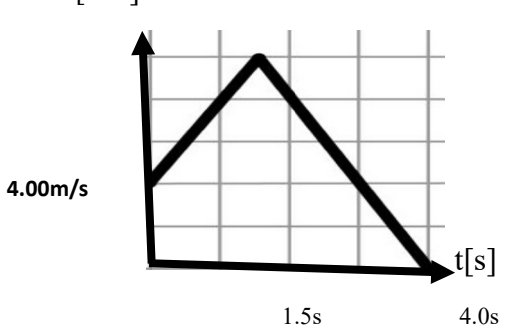
i. Discuss with your group how to write the correct answer for doing one example for each arithmetic separately: subtract, addition, multiplication, and division. Then write the number of significances in each answer. **(20 points)**

PHY 116 GW2 – Lecture 02: Please follow the instructions given above about the requirements, rules, and submissions.

1. You drop a ball from a tower, and it takes $\frac{\boldsymbol{B}}{10}$ s to reach the ground. Always draw a cartoon and choose initial and final positions of the path of the ball, label origin and X and Y coordinates as necessary for each part of the question. Neglect your height and air resistance for all calculations.

a. What is the acceleration of the ball, what is the direction? (**10 points)**
b. What is the velocity of the ball at the starting point? (**10 points)**
c. Calculate the total displacement of the ball before hitting the ground? What is the height of the tower? (**10 points)**
d. Calculate the velocity when the ball reaches the ground, what is the direction (**10 points)**
e. Plot the rough graph of displacement, velocity, and acceleration as a function of time. (**10 points)**
f. Calculate the velocity when the ball reaches ground if you throw the ball downward with a velocity $\frac{\boldsymbol{A}}{10}$ m/s from the same tower? (**10 points)**
g. At a particular instant a free-falling object has a velocity of $\frac{\boldsymbol{B}}{10}$ m/s. Exactly 2 s later its velocity will be? (**5 points)** If the object starts at rest, exactly 2 s later its velocity will be? (**5 points)**

h. By analyzing the following plot.



i. Explain velocity as a function of time? What is velocity at 1.5 s (**10 points)**
ii. Explain displacement as a function of time and sketch it? (**10 points)**
iii. Explain acceleration as a function of time and sketch it? What is the acceleration in first 1.5 s and next 2.5 s (**10 points)**

PHY 116 GW3 – Lecture 03: Please follow the instructions given above about the requirements, rules, and submissions.

1. A football is launched with an initial speed of **A** m/s and with an angle of 30.0 degrees from + X, the ground. It follows the parabolic trajectory, and the ball enters the goal in **B**/50 s after it is launched. Ignore air resistance and height of the player.
   a. Draw a cartoon, label your chosen origin and X and Y coordinates (**10 points**)
   b. What are the initial velocity components in X and Y directions? Are they changing with time? (**10 points)**
   c. What are the accelerations components in X and Y directions? Are they changing with time? (**10 points)**
   d. Calculate the time needed to reach the maximum height? Is it greater or less than the **B**/50 s? What does it mean to you about ball reaching the goal post (**10 points)**
   e. Calculate the maximum height possible in this projectile? (**10 points)**
   f. Calculate the vertical displacement of the ball when it hits the goal? Hence what is the vertical height to the goal post from the ground. (**10 points)**
   g. College football goal post from cross bar is 3m -14m. Explain whether your numbers belong to real goal post or not? (**10 points)**
   h. What is the horizontal displacement that the ball travels? Hence what is the range of the ball? (**10 points)**
   i. If the ball did not reach the goal, discuss your suggestion for the player to succeed in this launching. (**10 points)**
   j. Explain when you add vectors and when you subtract vectors. Then explain when you use Pythagorean theorem to add vectors. Then, explain when you need component method to add vectors. Discuss all these situations with your group by taking examples. (**10 points)**

PHY 116 GW4 – Lecture 04: Please follow the instructions given above about the requirements, rules, and submissions.

1. A block of mass, M_1=1.0 kg sits on a 30^0 frictional incline with kinetic friction coefficient of 0.20. It is attached to string that is thread over a pulley mounted at the top of the incline. A block of mass M_2= **A**/10 kg hangs from the string.

a. Draw a Free Body Diagram for each object by drawing the cartoon of the problem and label forces as F_G, F_f, F_T, F_N to show force of gravity, force of friction, force of tension and force of normal respectively. You should use subscript 1 and 2 to show all labeling of mass M_1 and M_2 respectively. **(10 points)**
b. Write Newton 2nd law for both object for chosen X and Y coordinates? **(10 points)**
c. Calculate the force of gravity for M_1 and write it as F_{G1} **(10 points)**
d. Calculate the force of gravity for M_2 and write it as F_{G2} **(10 points)**
e. Calculate the force of normal for M_1 and write it as F_{N1} **(10 points)**
f. Calculate the force of friction for M_1 and write it as F_f **(10 points)**
g. Calculate the acceleration "*a*" of blocks by using formulas written in part b? **(10 points)**
h. Calculate the tension force F_T of the wires connecting two blocks? **(10 points)**
i. Now, repeat the question for M_1 on frictionless incline by keeping all other aspects the same? **(10 points)**
j. Now, repeat the question for M_1 on frictionless horizontal plane, by keeping all other aspects the same? **(10points)**

PHY 116 GW5-Lecture 05: Please follow the instructions given above about the requirements, rules, and submissions.

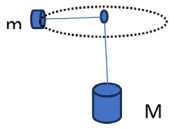
1. i. Take G=$6.67 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$; Mass of the one planet is $\boldsymbol{B} \times 10^{24}$kg and other planet is **C** x 10^{24} kg and distance between two planets is **A** x 10^8 m.

a. Find the gravitation force between two planets? **(15 points)**
b. Determine the speed of the Space Telescope orbiting at a height of **C** km above the first planet surface. Take the radius of the first planet as $\boldsymbol{B} \times 10^6$m. **(15 points)**

ii. Draw the FBD to Loop the loop motorcycle on top, bottom, left and right, why the motorcycle not free fall from top? **(15 points)**

iii. Draw the FBD for the person on earth on north pole and equator, discuss how gravitational acceleration of two places works? **(15 points)**

iv. A mas m = $\frac{\boldsymbol{A}}{10}$ kg slides in a circle of radius 25.0 cm of a frictionless table. It is attached to the cylinder of mass M = $\frac{\boldsymbol{B}}{10}$ kg by a cord that goes through the hole in the table as shown.



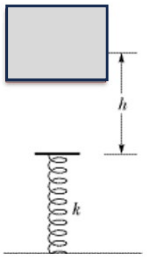
a. What speed should mass m need to slide while keeping the cylinder at the same **points)**
b. Then calculate the period and frequency of the revolving. **(10 points)**

PHY 116 GW6-Lecture 06: Please follow the instructions given above about the requirements, rules, and submissions.

1. i. Car 1 has mass **B** kg and car 2 has mass twice of the car 1, but they both have the same kinetic energy. How do their speeds compare, calculate the speed ratio $\frac{v_1}{v_2}$? **(10 points)**

ii. Object 1 has mass **B** kg and object 2 has mass twice of the object 1, but they both have the same potential energy. How do their locations compare, calculate the height ratio $\frac{h_1}{h_2}$? **(10 points)**

iii. An object of mass M= **A** kg is dropped from h= 5.0 m height to the spring attach to the ground. The spring of spring constant k=**C**+1200 N/m compreses the distance y.



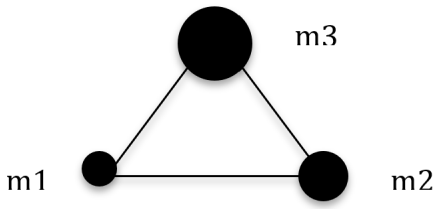
a. Choose PE=0 position and initial and final postions for your convenience to solve the problem for y below. **(10 points)**
b. Write algeberic equations (using given symbols,M,h,k,g) for intial and final postions energies? **(10 points)**
c. Use enegy conservation to write algebaric equation for y? **(10points)**
d. Calculate y? **(10 points)**
e. Calculate the velocity of the object when it touches the spring? **(10 points)**
f. Did you use the same PE=0 point for part e or different? Discuss any different way you can choose to solve part e easily? **(10 points)**
g. Calculate the work done by the object M? **(10 points)**
h. Calculate the work done by the spring or the spring potential energy? **(10 points)**

PHY 116 GW7-Lecture 07: Please follow the instructions given above about the requirements, rules, and submissions.

1. A block of mass $M_1 = \frac{A}{10}$ kg, moving on a frictionless surface with a velocity of $v_{1i}=\frac{A}{5}$ m/s in +X direction, collides with a block of mass $M_2=\frac{B}{10}$ kg moving with $v_{2i}=\frac{A}{2}$ m/s in -X direction. After the collision, the M_1 block recoils with a velocity of $v_{1f}=\frac{A}{3}$ m/s and M_2 will moving with v_{2f} (direction is to be decided after calculation below)

a. Draw the carton of the blocks, velocity, directions and X and Y coordinates. **(10Points)**
b. Write algebraic formula for initial momentum of the system by using given symbols for velocities and masses? **(10Points)**
c. Write algebraic formula for final momentum of the system by using given symbols for velocities and masses? **(10Points)**
d. Use momentum conservation to write algebraic formula for unknown v_{2f} by using given symbols for velocities and masses? **(10Points)**
e. Calculate V? is it moving +X direction **(10 Points)**
f. Show whether the collision is elastic or inelastic by performing calculation? **(10 Points)**
g. Calculate the impulse of one object? What is it direction **(10 Points)**
h. What is the impulse of the other object? What is it direction **(10 Points)**

2. Three-point particles of masses $m_1=\frac{A}{10}$kg, $m_2=\frac{B}{10}$kg and $m_3=\frac{C}{10}$kg is located an equilateral triangle of edge length a=**C** cm.



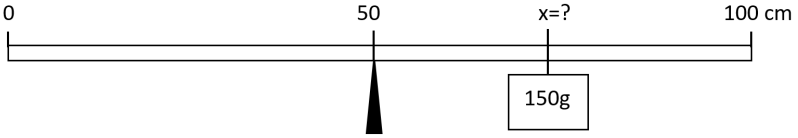
   a. Choose origin as the position of m2 and write x, y coordinates for three masses? **(10 Points)**
   b. Find X and Y coordinates of center of mass. **(5 Points)**
   c. Calculate the resultant center of mass. **(5 Points)**

PHY 116 GW8-Lecture 08: Please follow the instructions given above about the requirements, rules and submissions.

1. A uniform board with a weight of **A** N and a length of 1.0m rests horizontally on two supports as shown. One support is on the left end of the board, while the other support is 0.75 m from left end.

   d. Draw free body diagram for the board with all the forces? Label the forces and explain what they are. **(5 Points)**
   e. calculate the left supported force, by explaining which equilibrium condition you use and where you choose the pivot point and which forces do CCW rotation and CW rotation. **(10 Points)**
   f. Calculate right supported force, by explaining which equilibrium condition you use **(10 Points)**

2. Consider the beam of 100 cm long and mass of **C**g. It's center of mass is located at 40 cm. The system is balanced by using fluctrum at 50 cm and moving 150g on the beam to x location.



   a. Draw free body diagram for the board with all the forces? Label the forces and explain what they are. **(10 Points)**
   b. Which forces do CCW rotation around fulcrum? Express CCW rotation by using notations and given numbers. **(10 Points)**
   c. Which forces do CW rotation around fulcrum? Express CW rotation by using notations and given numbers. **(10 Points)**
   d. Now calculate the location of the 150 g. What equilibrium condition do you use here? **(10 Points)**
   e. Next calculate the reaction force at the fulcrum. What equilibrium condition do you use here? **(10 Points)**

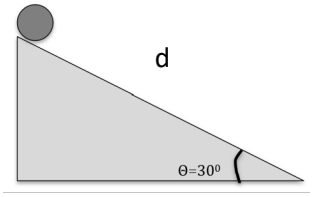
PHY 116 GW9-Lecture 09: Please follow the instructions given above about the requirements, rules and submissions.

1.

a. Inertia of solid sphere at its center axis is $I_s = \frac{2}{5}MR_s^2$ (R_s is the radius of the sphere) and inertia of hollow sphere at its center axis is $I_h = \frac{2}{3}MR_h^2$ (R_h is the radius of the sphere). Both spheres have the same mass M and $R_s = 2R_h$. If both spheres are rotating around their own axis and have the same rotational kinetic energy, find the angular speed ratio $\frac{\omega_h}{\omega_s}$ **(20 points)**

b. If you roll solid and hollow spheres of the same mass and the radius from the incline height, which one reaches bottom the first, explain why? **(20points)**

c. The solid sphere of mass M and radius R_s is rolling down an inclined plane of angle 30^0 as follows starting from the rest at d= 2.5 m incline distance. Write the conservation of energy by choosing initial as the top and final as before it hits the ground to calculate the velocity of the sphere before hits the ground. You can use M=**C** g and radius $R_s = \frac{A}{10}$ cm to calculate v. **(20 points)**



d. If you bring your straight arms closer to body while you are spinning, what will happen to your spinning speed, explain why? **(20 points)**

e. You and your friend ride a merry-go round. You sit **C** cm distance from the center your friend sits **C**/2 cm from the center. If the angular speed of the system is constant, what can you say about linear velocity and angular velocity for you and your friend? Calculate the ratios $\frac{v_F}{v_Y}$ and $\frac{\omega_F}{\omega_Y}$ **(20 points)**

PHY 116 GW10-Lecture 10: Please follow the instructions given above about the requirements, rules, and submissions.

1.

a. **C** kg of water at 50°C is poured into a bucket that contains **B** kg of ice at 0°C. Find the equilibrium temperature (neglect the influence of the bucket)? **(20 points)**

b. Find the amount of heat needed to change the temperature of **B** kg of ice from -**A** ºC to **B** ºC. the specific heat of water is 4186 J/kg ºC, the specific heat of ice 2093 J/kg ºC, latent heat of fusion is 3.33 x10^5 J / kg, latent heat of vaporization 2.25 x 10^6 J/ kg. **(20 points)**

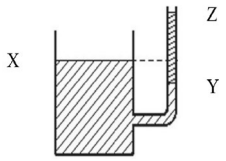
c. A patient of mass **B** kg is spiking a fever of 105 Fahrenheit. The patient is immersed in ice bath 0°C ice to reduce the fever immediately back down to 98.6 Fahrenheit. How much ice must melt (bath stays at 0°C water) for this temperature reduction to be achieved? Specific heat of body is 3500 J/kg ºC. **(20 points)**

d. A Styrofoam ice box has a total area of 0.980 m^2 and walls with an average thickness of 1.50 cm. The box contains beverages at 0ºC. The inside of the box is kept cold by melting ice. How much ice melts within 12 hours if the ice box is kept in the trunk of a car at 35.0ºC. Use heat transfer only by conduction. Thermal conductivity of ice 0.010 J/s m ºC. **(20 points)**

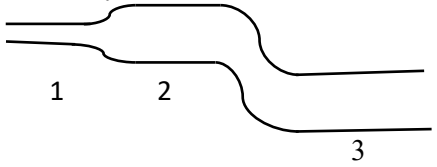
e. What is the rate of heat transfer by radiation to the environment from an unclothed person standing in a dark room of ambient temperature 20.0ºC. The person has a normal skin temperature of 33.0ºC and a surface area of 2.0m^2. The emissivity of skin is 0.97 in the infrared, and Stephan Boltzmann constant 5.67 × 10^{-8} W/m^2·K^4**(20 points)**

PHY 116 GW11-Lecture 11: Please follow the instructions given above about the requirements, rules, and submissions.

1.
   a. The barometer is a device to measure atmospheric pressure. If you plan to create a barometer by using a special liquid that has density 100**C** kg/m^3, what will be expected device height? Take atmospheric pressure 1.01x10^{5}N/m^2 **(20points)**
   b. If your body volume is **B** liters, what is the buoyant force acting on you if you are inside the sea water. Consider 1 liter=0.001 m^3, density of sea water as 1027 kg/m^3. **(20 points)**
   c. A container has a vertical tube, connected to it at its side, as shown in the figure. A liquid of density **C**+500 kg/m^{3}reaches level X in the container and level Y in the tube. Level X being 8.0 cm higher than level Y. The right tube has unknown oil to a **A** cm between levels Y and Z, Calculate the density of the unknown liquid? Both tubes are open to atmosphere on the top opening. **(20 points)**



   d. A nurse needs to inject liquid medicine into your body by exerting a **A**/5 newtons force onto a hypodermic syringe. If the barrel of the syringe is 20.0 mm^2 and the syringe's needle is 1.0 mm^2 in cross sectional areas, how many newtons of force does the medicine come out from the needle into your body? **(20points)**
   e. Fluid is flowing from left to right through the pipe shown in the drawing. Points 1 and 2 are at the same height, but the cross-sectional areas of the pipe are different at the two locations. Points 3 and 4 are at the same heights, but the cross-sectional areas are different. Rank the velocities at four locations? Rank the pressures at the three locations? Use mathematical symbols as >, < and = for ranking. **(20points)**



PHY 116 GW12-Lecture 12: Please follow the instructions given above about the requirements, rules, and submissions.

1. You are riding a roller coaster. Your mother who is standing on the ground yells out behind at a frequency of 10**C** Hz, but it sounds to you like 750 Hz. Take v_{snd}=343 m/s.
   a. What is the true frequency? (frequency you hear when you are at rest)? **(10 points)**
   b. What is the frequency you hear when you are riding the roller coaster? **(10 points)**
   c. Explain the category of this problem (we discuss 4 of them)? **(10 points)**
   d. Which one is source which one is observer? **(10 points)**
   e. Set up the formula that suits this problem clearly mentioning why?
   f. Calculate the speed of your ride? **(10 points)**
   g. Now you yell at 15**C** Hz when reach towards mom, what will be the frequency your mom will hear? Explain all steps above and use the velocity calculated in part f **(10 points)**
2.
   a. There are two simple pendula. Pendulum 1 has length **A** m and pendulum 2 has length **B** m, compare their periods, and calculate period ratio as $\frac{T_1}{T_2}$? **(10 points)**
   b. There are two spring pendula with the same mass. Pendulum 1 has spring constant 10**C** N/m and pendulum 2 has spring constant 5**C** N/m, compare their periods, and calculate period ratio as $\frac{T_1}{T_2}$? **(10 points)**

c. Draw and find the frequencies of first harmonics for following tubes. **(10 points)**
   i. A tube opens at both ends (tube length is **C** cm)
   ii. A tube opens at one end (tube length is 1.5**C** cm)
   iii. Which one has the higher frequency? Explain by calculating and explaining wavelength and frequency of the tubes.

Unit wise Quizzes:

Unit quizzes are assigned to do at the end of each unit. The problems of the unit quizzes are like the worksheet and homework/ group work problems and are also integrated with the last 4 digits of the student's ID to vary the problem and individualize the conclusion. Quizzes are done synchronously and proctored via a video conference system. The following are the quizzes for one of the semesters as samples to show here. They are updating each semester to balance academic integrity. Figure is provided as first page for all quizzes with formula sheet.

PHY 116 QuizX – Lecture XXX-XXX

This is a test; you should do it individually. You will receive zero if I found you work with someone else or plagiarize in any other way. You can use only my class materials and complete it during class time.

- It is very important that your *internet connection is stable* to take the quiz.
- If you are not sure how to follow requirements, *please read below and watch the quiz guide* on the blackboard.
- All should be *handwritten* in your notebook, then scan and submit it as a *single pdf file* to the blackboard.
- Please *don't print or save* the assignment, The test will be available on the blackboard when you are ready to take.
- All *work should be shown* and *handwritten clearly, spaced, explained, and ordered* starting from question one.
- Starting the work to each question by writing the *fundamental formulas and concepts* you learn from this class; *no random variables or formulas* are allowed.
- If you *do not follow the requirements*, you will receive *no credit*, please check the grading rubric for more information.
- Don't use ChatGPT or AI, *don't write generated answers* for this exam, it should be your own work.
- Use *significant rules* throughout the assignment and *use units for all answers*.
- To start: *handwrite* the following statement, *sign*, and *date* on it:

"On my honor, I attest that I will follow the letter and spirit of all of this assignment's rules."

Date: _____ Signature: _____

Student Name: _____ Last 4 digits of Student ID#: _____

Use the last four digits of your ID number and add them all:_____. This is **A**.

Add 10 to **A**:_____. This is **B**.

Add 100 to **B**:_____. This is **C**.

Write the value of **A, B,** and **C** to one decimal place. You may refer to some or all these numbers later in this assignment.

A=_____ **B**=_____ **C**=_____

Figure 5: First page for all quizzes that shows class requirements for students to follow.

PHY 116 Quiz1-Lecture 1-3: Please follow the instructions given above about the requirements, rules, and submissions.

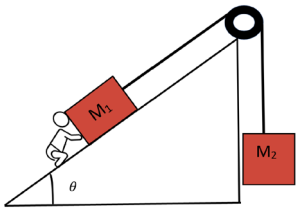
1. Suppose that you are standing on the ground holding a ball. Neglect your height and air resistance for all calculations.
   a. Now you decide to throw the ball with velocity of **A** m/s straight up. Draw a cartoon of the ball motion, choose the origin and label X and Y coordinates. (**5 points)**
   b. How long will it take to reach the maximum height? (**10 points)**
   c. Calculate the maximum height the ball reaches. (**10 points)**
   d. What will be the velocity when it reaches the ground? Explain or show work how you get this. (**10 points)**
   e. If you decide to drop the same ball from a tower of height **B** m, what will be the velocity when it reaches the ground? (**10 points)**

2. You project a basketball with an initial speed of 20.0 m/s and with an angle of **B** degrees from the ground. It follows the parabolic trajectory, and the ball enters the basket in $\frac{A}{5}$ s after it is launched. Ignore air resistance and your height!

   a. Draw a cartoon, label your chosen origin, and label X and Y coordinates (**5 points**)
   b. Calculate initial velocity on X and Y directions? (**5 points**)
   c. What will be the acceleration on X and Y directions? (**5 points**)
   d. Calculate the maximum height of the ball possible? **(10 points)**
   e. Calculate the time to reach the maximum possible height? Is it greater or less than the $\frac{A}{5}$ s? **(5 points)**
   f. Explain whether the ball reach the basket before reach the maximum height or not or exacly?**(5 points)**
   g. What is the horizontal distance from you to the basket? **(5 points)**
   h. What height should be the basket located in your problem to catch the ball? **(10 points)**
   i. According to your calculated height, is it a real basketball problem, usual basket is located around 2-4 m above the ground? If not explain why? **(5 points)**

PHY 116 Quiz2-Lecture 4-6: Please follow the instructions given above about the requirements, rules, and submissions.

1. Use $M_1=\frac{A}{10}$ kg and $M_2=\frac{B}{10}$ kg and assume there is a no friction in incline ($\theta=20^0$) and no friction between M_2 and vertical plane. Very light weighted wires with tension force F_T, pull on M_1 blocks parallel to the surface of the ramp up and the M_2 block move downward. If the system moves with acceleration "*a*" by applying force of 10.0 N by a child as shown.

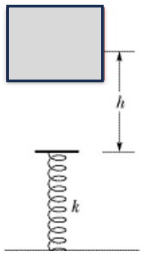


a. Draw a Free Body Diagram for each object on diagram (you should draw the diagram on your paper) and label forces as F_G, F_T, F_N, F_A to show force of gravity, force of tension, force of normal, and applied force respectively. You should use notation F_{G1} and F_{N1} for M_1 and F_{G2} for M_2. Draw X and Y coordinates on your diagram for both objects. **(10 points)**

b. For each object writes $\sum F = ma$ by using above drawn X and Y directions. (You should use given symbols and notations, plugging numbers will receive zero credits here). **(10 Points)**

c. Calculate the force of gravity for M_1 and write it as F_{G1} **(5 points)**
d. Calculate and the force of gravity for M_2 write it as F_{G2} **(5 points)**
e. Calculate the force of normal for M_1 write it as F_{N1} **(5 points)**
f. Use Linear formulas in part **b**. to calculate acceleration "*a*" of blocks? **(10 points)**
g. Is your M_2 accelerate up or down, explain by using calculated acceleration direction above? **(5 points)**
h. Calculate the tension force F_T of the wires connecting two blocks? **(5 points)**

2. The block of mass M= $\frac{B}{10}$kg drops from h= **C** cm height to the spring attach to the ground. The spring of spring constant k compreses totally to a distance y=5.0 cm verically.



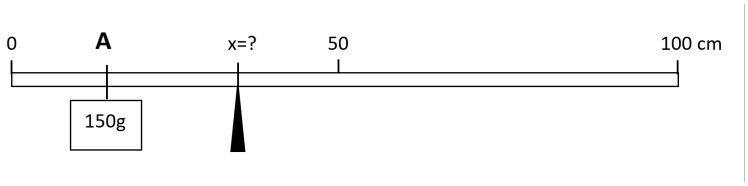
a. Choose and label PE=0 position and initial and final postions for your convenience to solve the problem for k below. **(5 points)**
b. Write algeberic equations (using given symbols,M,h,k,y,g) for intial and final energies? **(10 points)**
c. Use enegy conservation to write algebaric equation for k? **(10 points)**
d. Calculate k? **(5 points)**
e. The same spring is attached horizontally to a wall, you decide to push the object from d=C cm distance horizontally from the spring towards it. The spring totally compressed x=5.0 cm horizontally. What will be the velocity v you push the object? Make sure to draw the cartoon, label PE=0, label initial and final positions, write energies in both positions, write algebraic formula for v and calculate v. **(15 points)**

PHY 116 Quiz3-Lecture 7-9: Please follow the instructions given above about the requirements, rules, and submissions.

1. A solid ball of mass M = 1.5 kg is moving forward (+X) on a frictionless surface with a velocity of $v_{1i} = \frac{B}{5}$ m/s, collides with another ball of mass m= 0.5 kg, moving with $v_{2i} = \frac{B}{10}$ m/s in backward (-X) direction. After the collision, both masses move in forward (+X) direction. If mass m ball moves with a velocity of $v_{2f} = \frac{B}{4}$ m/s and mass M is moving with v_{1f}.

a. Express initial momentum of the system in terms of M, m, v_{1i} and v_{2i}? plugging numbers has no points **(5 points)**
b. Express final momentum of the system in terms of M, m, v_{1f} and v_{2f}? plugging numbers has no points **(5 points)**
c. Use momentum conservation to find v_{1f} in terms of M, m, v_{2f}, and v_{2i}? Plugging numbers has no points **(10 points)**
d. Calculate v_{1f} velocity vector? **(5points)**
e. Show whether the collision is elastic or inelastic by performing calculations? **(10points)**
f. Calculate the impulse of mass m object? **(10points)**
g. The solid ball of mass M =1.5 kg and radius R $= \frac{B}{10}$ cm is falling with rolling vertically. The ball starts at rest from vertical height h= 5.0 m. The ball reaches the ground with velocity, v. Write initial and final energies by choosing initial as where the ball starts, final as before it hits the ground and the PE=0 point at your convenience. Write conservation of energy to calculate the v. The center axis moment of inertia of the solid ball is $I_s = \frac{2}{5}MR^2$. **(10 points)**

2. Consider a uniform beam of 100.0 cm long and mass of 98.0g. The system is balanced by using fluctrum (pivot) at x cm place and mass 150.0g is located at **A** cm as shown, **A** is your number for **A** letter.



a. Draw the FBD on the beam and label forces by using your own labeling and explain what are they? **(10points)**
b. Which of your forces do CCW rotation around pivot point? **(5points)** Express CCW torque in terms of given symbols, numbers in your drawing and the given figure? **(5points)**
c. Which forces do CW rotation around pivot? **(5points)** Express CW torque in terms of given symbols, numbers in your drawing and the given figure? **(5points)**
d. Calculate x? **(10points)**
e. Calculate reaction force at pivot point by explaining the equilibrium condition you use? **(5points)**

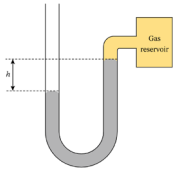
PHY 116 Quiz4-Lecture 10-12: Please follow the instructions given above about the requirements, rules, and submissions.

1.

a. Calculate the amount of heat needed to change the temperature of **C** g of ice at 0 ^{o}C to 50 ^{o}C water. Specific heat of water is 4186 J/kg ^{o}C, specific heat of ice is 2093 J/kg ^{o}C, and latent heat of fusion is 3.33 x10^5 J/kg and latent heat of vaporization is 2.25 x10^6 J/kg? **(15 points)**
b. You drop the aluminum bar of mass **C**g at 100 ^{0}C to the insulated beaker that contains 0.2 kg of ice at 0 ^{o}C. Assuming that there is no heat transfer to the outside or to beaker material, calculate the equilibrium temperature of the system. Specific heat of Aluminum 903 J/ kg ^{o}C, specific heat of water is 4186 J/kg ^{o}C, specific heat of ice is 2093 J/kg ^{o}C, latent heat of fusion is 3.33 x10^5 J/kg and latent heat of vaporization is 2.25 x10^6 J/kg? **(15 points)**

2.

a. If you sink the aluminum (density 2.7 g/cm^3) sphere of mass **C** g inside water, what is the buoyant force acting on the sphere. Take density of water as 1.0g/cm^3. **(15 points)**
b. If the left tube is open to the atmosphere, calculate the gas pressure in the right chamber by taking h= **A** cm, the liquid mercury is shown on shaded area and it density is 13.6 g/cm^3. **(15 points)**



3. Draw and calculate the frequencies of the first harmonics for the following two tubes (**a** and **b)** by taking the speed of sound as 340 m/s.

a. A tube opens at both ends (tube length is **C** cm) **(10 points)**
b. A tube opens at one end (tube length is **C** cm) **(10 points)**
c. A firetruck is coming towards you at a speed **B** m/s while you are standing onthe sidewalk. The firetruck produces sound at 1760 Hz and the speed of sound is 340 m/s. Calculate the frequency you hear? **(10 points)**
d. If the firetruck is at rest and producing sound 1760 Hz while you are walking toward the firetruck at speed of 5.0 m/s on the sidewalk. Calculate the frequency you hear? Take the sound speed as 340 m/s **(10 points)**

Sample Concepts Questions from Slido or LMS:

I develop my own conceptual questions that measure students' understanding of the materials. They keep updating each semester to balance academic integrity and provide students to work and think conceptually how to navigate the materials and what they really need to learn to apply for problem solving. Following are the sample questions for one previous semester.

Lecture 1:

1. What is the least count of an instrument?
    a. The same as uncertainty
    b. Estimation of the measurement
    c. The smallest division
    d. Always the same value for all instruments
2. Chose incorrect answer about uncertainty
    a. It is usually least count divide by 2
    b. It is estimation of the measurement
    c. Always should have the same accuracy as the measurement
    d. Always write as a positive value
3. How many significances in 30.26
    a. 1
    b. 2
    c. 3
    d. 4
4. How many significances in 30.00
    a. 1
    b. 2
    c. 3
    d. 4
5. How many significances in 0.026
    a. 1
    b. 2
    c. 3
    d. 4
6. How many significances in 30260000
    a. 3
    b. 4
    c. 6
    d. 8
7. What is answer for 2.00 x 3.5
    a. 7.00
    b. 7.0
    c. 7.000
8. What is the answer for 152.00+35.5
    a. 187.5
    b. 188
    c. 187.50
    d. 187

9. Choose the answer which is not in SI units?
    a. m
    b. s
    c. m/s
    d. g
10. If the physical parameter P is calculated by using $P=A^3/BC$ formula if A is measured in units of kg, B is measured in m, and C is measured in s, what will be the units of P?
    a. kg^3/ms
    b. kg^2/ms
    c. kg^3
    d. kg/ms
11. Is $x=vt+at^2$ dimensionally correct formula?
    a. Yes, both side units are m
    b. No, each side has deferent units
12. What is the final answer for 32.5+(2.000 x 50.00)
    a. 132.50
    b. 132.5
    c. 133
    d. 132.5000
13. What is the correct reading of the ruler?
    a. 12.50 cm with uncertainty 0.05 cm
    b. 12.5 cm with uncertainty 0.05 cm
    c. 12.50 cm with uncertainty 0.01 cm
    d. 12 cm with uncertainty 0.05 cm
14. If you find the area of a square of length 1.25 cm, it will be
    a. 1.56 cm^2
    b. 1.56 cm^3
    c. 1.56 cm
    d. 1.5625 cm^2
15. If you calculate the density of material that has mass 20.0 g and volume 8.00 cm^3, it will be
    a. 2.5 g/cm^3
    b. 2.50 g/cm^3
    c. 2.500 g/cm^3
    d. 2.50 g/cm

Lecture 2:

1. How many kinematics formulas do we discuss?
    a. 2
    b. 3
    c. 4
    d. 5
2. What can you say about acceleration of kinematics problems?
    a. Zero
    b. Any value
    c. Constant
    d. changing with time

3. What can you say about the acceleration of free fall motion?
    a. Changing with time
    b. 9.80 m/s^2 in -Y direction
    c. 9.80 m/s^2 in +Y direction
    d. Zero
4. What can you say about the velocity of the ball dropping from some height?
    a. increasing linearly in -Y direction
    b. decreasing linearly in -Y direction
    c. Constant
    d. zero
5. What can you say about the velocity of the ball thrown upward from the ground?
    a. decreasing linearly in +Y direction and then increase linearly in -Y direction
    b. Increasing linearly in +Y direction then decrease linearly in -Y direction
    c. constant
    d. zero
6. What can you say about the displacement of the ball dropped from some height?
    a. increasing linearly in -Y direction
    b. increasing parabolically in -Y direction
    c. increasing linearly in +Y direction
    d. Constant
7. What can you say about the displacement of the ball thrown upward from the ground?
    a. decrease parabolically in +Y direction and then increase parabolically in -Y direction
    b. increasing parabolically in +Y direction and then decrease parabolically in -Y direction
    c. Always increasing
    d. Constant
8. What will be the velocity at maximum height?
    a. Non-zero constant
    b. zero
    c. Can't calculate
9. At a particular instant a free-falling object has a speed of 30 m/s. Exactly 1 s later its speed will be
    a. 30 m/s
    b. 35 m/s
    c. Around 40 m/s
    d. Above 60 m/s
10. What is the distance fallen after 4 s for a freely falling object starting from rest?
    a. Around 4m
    b. Around 16m
    c. Around 32m
    d. Around 80m
11. You toss a coin up with an initial speed of 5.00m/s. In the absence of air resistance, how high does the coin go above from its point of release?
    a. Can't calculate
    b. Around 1.25 m
    c. Around 0.25 m
    d. Zero

12. You throw a ball upward with an initial speed of 10 m/s. Assuming that there is no air resistance, what is its speed when it returns to you?
    a. zero
    b. 20 m/s in -Y direction
    c. 10 m/s in -Y direction
    d. 10 m/s in +Y direction
13. You and your friend are at the top of a cliff. Both throw a ball with the same initial speed. You decide to throw straight down and your friend straight up. What can you say about the velocities of balls when they hit the ground?
    a. Your ball has greater velocity
    b. Your friend ball has grater velocity
    c. Both balls reach the same velocity
14. Does free fall motion depend on the mass of the object?
    a. yes
    b. no
15. Can we use kinematics formula when there is air resistance?
    a. yes
    b. no

Lecture 3:

1. Vector is defined as physical quantity that has
    a. Magnitude only
    b. Direction only
    c. both magnitude and direction.
    d. Always a positive sign value
2.
2. Which one of following is not a vector?
    a. Velocity
    b. displacement
    c. mass
    d. acceleration
3. If there is a vector of magnitude B in the 1st quadrant with an angle of A with respect to +X axis, what will be its Y component?
    a. BCos(A)
    b. BSin(A)
    c. BTan(A)
    d. Zero
4. If there is a vector of magnitude B in the 1st quadrant with an angle of A with respect to +Y axis, what will be its Y component?
    a. BCos(A)
    b. BSin(A)
    c. BTan(A)
    d. Zero

5. If there are two vectors of magnitude B are separated by 90 degrees, what will be the

magnitude of the resultant vector?

a. 1.414B
b. 2B
c. B
d. Zero

6. If there are two vectors of the same magnitude are separated from 90 degrees, what will be the resultant vector direction with respect to one of the above vectors?
   a. 60 degrees
   b. 45 degrees
   c. 30 degrees
   d. zero
7. Projectile motion can be always described by using vertical and horizontal directional kinematics formulas, what can you say acceleration components of this kind of motion?
   a. Both are the same, ax=ay=-9.80 m/s^2
   b. Both are changing with time
   c. ax=0 and ay=-9.80 m/s^2
   d. Both ax=ay=0 m/s^2
8. Projectile motion can be always described by using vertical and horizontal directional kinematics formulas, what can you say velocity components of this kind of motion?
   a. Both stay the same
   b. Vx keeps changing with time
   c. Vy stays constant with time
   d. Vx stays constant and Vy is changing with time linearly
9. Which component of the velocity will be zero at maximum height position?
   a. Vx
   b. Vy
   c. Both
   d. None
10. What kinematics formula can be used to calculate the range of the projectile motion?
    a. $x_f=x_i+v_{ix}t+\frac{1}{2}a_xt^2$ with $a_x=0$
    b. $y_f=y_i+v_{iy}t+\frac{1}{2}a_yt^2$ with a_y=-9.80 m/s^2
    c. v=d/t
    d. None of the above
11. To reach maximum range what angle you should project the ball?
    a. 75 degrees
    b. 60 degrees
    c. 45 degrees
    d. 0
12. Which angle of following will reach the maximum height of the flight?
    a. 30 degrees
    b. 45 degrees
    c. 60 degrees
    d. 75 degrees

13. What will happen to the maximum range when you project the ball with air resistance?
    a. range will decrease

   b. range will increase
   c. no change
14. If you project the ball horizontally from the cliff, what will be initial velocity in y direction?
   a. Can't tell
   b. 9.80 m/s
   c. Zero
15. The 60km/h crosswind blows the 80km/h airplane off course at 100 km/h. What is the angle of resultant vector which is 100 km/h with rest to +X axis?
   a. 45 degrees
   b. less than 45 degrees
   c. greater than 45 degrees
   d. 90 degrees

Lecture 4:

1. What do you know about the force?
   a. Scaler quantity of unit of N
   b. Vector quantity of unit of N
   c. Vector quantity of no units
   d. None of the above is correct
2. Choose the example of contact force?
   a. Gravitational attraction between masses
   b. Magnetic attraction between magnets
   c. Electrical attraction between charges
   d. dragging a object by applying a force
3. If you apply 10.0N to the object of mass 2.0 kg, what is the acceleration of the object?
   a. 20.0 m/s^2
   b. 5.0 m/s^2
   c. 0.2 m/s^2
   d. zero
4. What is the difference between mass and weight?
   a. mass and weight are the same
   b. mass and weight have no connection
   c. mass x gravitational acceleration is the weight
   d. None of the above
5. What is the direction of force of gravity?
   a. straight up
   b. keep changing
   c. straight down
   d. no direction
6. What is the direction of normal force?
   a. Always straight up
   b. Always straight down
   c. Always perpendicular upward direction to the surface of contact
   d. Always parallel to the surface of contact
7. Is the normal force always equal to the force of gravity?
   a. No

   b. Yes
8. Do you have a direct formula to calculate the normal force of the object?
   a. Yes, direct formula is given in the formula sheet
   b. No, I must write Newtons laws in each direction to find it.

9. If you bring an object from Earth to Moon, what quantity will change as we discussed?
   a. Mass
   b. Weight
   c. Size
   d. Shape
10. What direction will be the frictional force directed?
   a. Always perpendicular upward direction to the surface of contact
   b. Always parallel downward direction to the surface of contact
   c. Always parallel to the surface of contact but pointed to opposite direction of the motion of the object
   d. Always parallel to the surface of contact but pointed to the direction of the motion of the object
11. Which one is greater from kinetic and static friction coefficients?
   a. Always kinetic
   b. Always Static
   c. Both the same
12. Friction coefficient is dependent on
   a. Surface area of rubbing objects
   b. Materials of objects
   c. Mass of the objects
   d. Volume of the objects
13. Drag force is dependent on
   a. Media density, area of the object, and relative speed
   b. object density, mass of the object, and relative speed
   c. Only area of the object
14. There are two objects in the same shape and size but one of them has greater mass. Which one reaches the ground first? (consider drag force scenario)
   a. Both reach at the same time
   b. greater mass reaches the first
   c. lighter mass reaches the first
15. How do you define FBD?
   a. Vector diagram of all vectors
   b. Drawing of all forces at center of the object or the system
   c. Drawing of all forces and accelerations of the object

Lecture 5:

1. What is the uniform circular motion?
   a. Any motion of the object in circular path

   b. Circular motion of the object by keeping constant tangential velocity
   c. Circular motion of the object by keeping nonzero constant tangential acceleration
   d. Circular motion of the object by keeping constant centripetal force
2. Centripetal force depends on
   a. Mass of the rotating object only
   b. Mass, and velocity of the rotating object and radius of circular path
   c. Velocity of the rotating object only
   d. radius of circular path only
3. Is the centripetal force part of the FBD?
   a. No, it goes to right side of the F=ma formula
   b. Yes, it will count to net force of the left side of F=ma formula
   c. No, it is not a force or an acceleration
4. If you rotate the same object with the same tangential velocity in two different radius, centripetal force will
   a. will remain constant
   b. will increase with greater radius
   c. will decrease with greater radius
   d. Can't determine
5. You are taking turns on the frictionless bank or flat roads, which one is easier to take turn without slipping?
   a. Flat roads
   b. Bank Roads
6. What kind of motion loop the loop motorcycle stunt does?
   a. Uniform circular motion
   b. Non-uniform circular motion
   c. Changing radius during the motion
7. Gravitation force between two objects increase
   a. by increasing the distance between them
   b. by bringing them to another planets
   c. by increasing mass of them
8. What can you say about gravitation acceleration value g and universal gravitational constant G?
   a. they are the same
   b. they are different quantities but are related each other
   c. both are changing parameters
9. What can you say about the g value?
   a. Always 9.80 everywhere in the universe
   b. Always 9.80 everywhere in the Earth
   c. keep changing with altitude and closer to north, south and equator
10. How can you define Weightlessness?
   a. complete absence of the sensation of weight
   b. moving with some forces
   c. moving with constant acceleration

11. Satellite can have one speed if the satellite is remaining in an orbit with a fixed radius, why is that?
   a. Satellite speed only can be changed by changing the radius, other all are constant
   b. Satellite speed only depended on the radius
   c. Satellite speed depends on the mass of the satellite
12. The wheel of a car wheel is rotated at 10 revolutions per second on a tire-balancing machine. What is the

period of rotation?
   a. 10 s
   b. 0.1s
   c. 6 s

13. The wheel of a car has a radius of 0.25m and it rotates at 10 revolutions per second on a tire-balancing machine. What is the speed at which the outer edge of the wheel is moving?
   a. 15.7 m/s
   b. 0.05 m/s
   c. can't calculate
14. If the masses of two planets are each somehow doubled, the force of gravity between them
   a. doubles.
   b. quadruples.
   c. reduces by half.
   d. reduces by one-quarter.
15. If the mass of one planet is somehow doubled, the force of gravity between it and a neighboring planet
   a. doubles.
   b. quadruples
   c. reduces by half.
   d. reduces by one-quarter.

Lecture 6:

1. How do you identify work done in Physics?
   a. Push the object by applying a force
   b. Pull the object by Appling a force
   c. a measurable change in a system caused by a force.
   d. None of the above
2. Units of work done
   a. N
   b. kgm/s
   c. Nm
   d. Jm
3. How do you calculate the work done if you apply the force of F and the object moves d distance?
   a. times F and d together
   b. times F, d and cosine angle between F and d together
   c. time F, d and sine angle between F and d together
   d. None of the above
4. Can work done be negative?
   a. Yes, if F and d are in opposite directions
   b. No, it is always positive
   c. Yes, if F and d are in the same direction
5. What is the work done from centripetal force?
   a. Non-zero
   b. Always zero
   c. Sometime zero
6. Kinetic energy depends on
   a. Mass only

b. Velocity only
c. it is ½ x mass x velocity squared.
d. it is ½ x mass x velocity

7. Can kinetic energy be negative?
   a. Yes
   b. Never
   c. Sometime
8. Can you describe any energy as a vector quantity?
   a. Yes
   b. No
   c. Sometime
9. How do you calculate the gravitational potential energy of an object of mass m at height h with respect to the ground?
   a. -mgh
   b. mgh
   c. zero
10. Can gravitation potential energy be negative?
    a. Yes, if the object is sitting underneath from the reference point where you choose potential energy zero.
    b. No, it is always positive and independent of the reference point.
11. The gravitational potential energy of mass m object is mgh, what is the correct choice of h?
    a. horizontal distance from reference point
    b. vertical distance from reference point
    c. incline distance from reference point
    d. It is always the height and positive
12. Spring potential energy is dependent on
    a. Mass only
    b. Spring constant only
    c. it is ½ x spring constant x compressed or stretched distance squared.
    d. it is ½ x spring constant x velocity squared.
13. Energy conservation can be written as total initial energy equal total final energy
    a. As always
    b. Only with conservative forces
    c. only with non-conservative forces
14. What is an example of non-conservative forces?
    a. Force of gravity
    b. Spring force
    c. Friction force
    d. Electric force

15. When you walk and run on the staircase, what will change?
    a. The same work done but power different
    b. Both work done and power are different
    c. the same power but work done is different

Lecture 7:

1. Proper of moving matter called as momentum, how do you calculate the momentum of an object in motion?
    a. times mass and acceleration
    b. times mass and velocity
    c. times mass and speed
    d. time mass and force
2. Momentum is a vector, what direction will it be?
    a. the same as impulse
    b. the same direction as velocity
    c. different direction from velocity
    d. opposite direction from velocity
3. What is the unit of momentum?
    a. kg/ms
    b. N/s
    c. Ns
    d. kgm/s^2
4. What is the correct definition of the impulse?
    a. change of momentum
    b. force per unit time
    c. total momentum
5. What can you say about the impulse of two objects collide with each other?
    a. both objects have the same impulse
    b. they have deferent impulse
    c. object in greater mass has larger impulse
6. How do you understand whether the collision is elastic or inelastic?
    a. momentum is conserved only in elastic Collison
    b. momentum is conserved in both Collisions
    c. Kinetic energy is conserved only elastic Collison
    d. Kinetic energy is conserved in both collision
7. The center of mass point is sitting always middle of the object?
    a. True
    b. False
8. Center of mass point
    a. only doing translation motion
    b. doing both rotational and translational motion
    c. only doing rotational motion
9. Center of mass point is located
    a. closer to the lighter side of the system
    b. closer to the heavier side of the system
    c. closer to the midpoint of the object
10. A small beanbag and a bouncy rubber ball are dropped from the same height above the floor. They both have the same mass. Which one will impart the greater impulse to the floor when it hits?
    a. the beanbag
    b. the rubber ball
    c. both the same
11. A box slides with initial velocity 10 m/s on a frictionless surface and collides with an identical box. The boxes stick together after the collision. What is the final velocity?
    a. 10 m/s

b. 20 m/s
c. 0 m/s
d. 5 m/s

12. Car A is moving with velocity v toward identical car B that is at rest. When they collide, both cars couple together. What is the velocity of the coupled cars?
    a. v
    b. v/2
    c. v/4
    d. 2v
13. You have three choices to ride in three frictionless slides to the ground at the same height. Each slide has different steep paths, and bends. What is incorrect in the following?
    a. Take different times to reach the ground
    b. Reach the same velocity at the ground
    c. Travel different distances
    d. Take the same time to reach the ground
14. When the force that produces an impulse act for twice as much time, the impulse is
    a. not changed.
    b. doubled.
    c. quadrupled.
    d. halved.
15. A small car and a large truck collide head-on and stick together. Which one has the larger momentum change?
    a. the car
    b. the truck
    c. they both have the same momentum change

Lecture 8:

1. What are the conditions needed to be an object at equilibrium?
    a. forces along each coordinate axis add to zero.
    b. no torque around any axis
    c. no torque around any axis and forces along each coordinate axis add to zero
    d. If the object stays at rest
2. Torque is a twist or turn that tends to produce a rotation, how do you calculate it?
    a. times apply force, distance to pivot point and sine angle between them
    b. times apply force, distance to pivot point and cosine angle between them
    c. times apply force and distance to pivot point
3. Torque is a
    a. Scaler quantity
    b. vector quantity and direction express as counterclockwise (CCW) or clockwise (CW) and direction is to the force direction
    c. vector quantity and direction is to the direction of distance to pivot point
4. What will be the unit of torque?
    a. N
    b. Nm
    c. N/m

d. kg/m

5. Child A and B are riding a uniform board seesaw. Child A has a mass of 50 kg and sits 2.0 m from the pivot point. At what distance from the pivot must child B, of mass 25 kg, sit to balance the seesaw?
    a. 3.0 m
    b. 4.0 m
    c. 5.0 m
    d. 6.0 m
6. Which of the following can be used to increase the torque
    a. Apply force perpendicular to the distance between force and pivot point
    b. Apply force parallel to the distance between force and pivot point
    c. Apply force with some angle to the distance between force and pivot point
7. If you are tight the nut, which direction you should apply the torque
    a. Counterclockwise (CCW)
    b. Clockwise (CW)
    c. Left
    d. Right
8. If you ride a seesaw by sitting on the left side of the seesaw, what direction you apply the torque on pivot point?
    a. Counterclockwise (CCW)
    b. Clockwise (CW)
    c. No torque
9. If you lift a shopping bag of 10.0 kg by hand by bending your elbow, what is the torque you create on the elbow joint? Take the distance from the elbow to the object as 30.0 cm.
    a. 300 Nm
    b. around 30.0 Nm
    c. around 3000 Nm
    d. Unable to calculate
10. If you lift a shopping bag of 250 g by hand by bending your elbow, what is the torque you create on the elbow joint? Take the distance from the elbow to the object as 30.0 cm.
    a. Around 0.75 Nm
    b. Around 750 Nm
    c. Around 7.50 Nm

11. Which of the following cannot be used to increase the torque?
    a. Increase the apply force
    b. Apply the force away from pivot point
    c. Apply force 90 degrees apart from distance to pivot point
    d. Apply force parallel to the distance from pivot point
12. Which of the following creates zero torque?
    a. Apply force at pivot point
    b. Apply force in 1m distance
    c. Apply 1N in 1 m distance
    d. Apply force perpendicular to the distance to pivot
13. By conventionally what torque is positive?
    a. Clockwise (CW)

b. Counterclockwise (CCW)

14. If you (mass 50 kg) and your friend (30kg) ride a seesaw of mass 60kg. What is the reaction force at rotational point (pivot point)?
    a. 588 N
    b. 196 N
    c. 60 N
    d. 20 N
    e. 80 N
15. Pivot point is located
    a. Where the axis of rotation happens
    b. Where the center of the object
    c. Where the force is acting
    d. Where the mass acting point

Lecture 9:

1. You and your friend are riding a merry-go-round, and you feel you are moving faster than your friend. What is the conclusion of this ride?
    a. Both you and your friend are at the same distance from the center of the merry-go-round
    b. you are sitting closer to the center of the merry-go-round than your friend
    c. you are sitting far away from the center of the merry-go-round than your friend
    d. You both have the same linear speed
    e. You both have the same angular speed
    f. You both have the same period and frequency
2. Rotational (angular) speed is
    a. the number of rotations or revolutions per unit time
    b. time to complete one rotation or a revolution
    c. measured in unit of m/s
3. What is the relation between rotational and tangential speed of rotation?
    a. They are the same
    b. tangential speed= radial distance x rotational speed
    c. rotational speed= radial distance x tangential speed
    d. Different quantities but have the same units
4. You sit on the outer rim of a merry-go-round, and your friend sits midway between the center and the rim. Who has the larger linear (tangential) velocity?
    a. you
    b. your friend
    c. the same for both
5. A ladybug sits halfway between the rotational axis and the outer edge of the turntable. The bug has a tangential speed of 5.0 cm/s, what will be the tangential speeds of her friend who sits at the outer edge?
    a. 5.0 cm/s
    b. 2.5 cm/s
    c. 10.0 cm/s
    d. 15.0 cm/s
6. A ladybug sits halfway between the rotational axis and the outer edge of the turntable. When the turntable has a rotational speed of 20 RPM and the bug has a tangential speed of 5.0 cm/s, what do you think about the angular speed of her friend.

a. 20 RPM
b. 10 RPM
c. 5 RPM
d. 40 RPM

7. The rotational inertia of an object depends on
   a. the total mass of the object
   b. mass distribution around the rotational axis
   c. the location of the center of mass
   d. environment of the rotation
8. What is unit of moment of inertia?
   a. kgm
   b. kgm^2
   c. Nm
   d. kg/m
9. What is the parallel-axis theorem?
   a. can be used to calculate moment of inertia about any axis by knowing moment of inertia about center of mass axis of an object
   b. can be used to calculate moment of inertia about any perpendicular axis by knowing moment of inertia about center of mass axis of an object
   c. can be used to calculate moment of inertia about any axis parallel to an axis that goes through the center of mass of an object
10. Angular kinematic formulas can be used for
    a. Constant linear acceleration problems
    b. Constant angular acceleration problems
    c. Changing linear acceleration problems
    d. Constant angular acceleration problems
11. Same radius two balls are given to you, one is solid and the other one is hollow. Which one has greater moment of inertia?
    a. solid ball
    b. hollow ball
    c. the same for both

12. Same radius two balls are given to you, one is solid and other one is hollow. If you drop them which one land the ground first, why?
    a. Solid ball, more resistance to the motion
    b. hollow ball, more resistance to the motion
    c. Solid ball, less resistance to the motion
    d. both reach the same time
13. Suppose by pulling the weights inward, the rotational inertia of the man reduces to half its value. By what factor would his angular velocity change?
    a. Double
    b. Three times
    c. Half
    d. One-quarter
14. Rotational kinetic energy of an object defines as
    a. 1/2 x mass x angular speed
    b. 1/2 x moment of inertia x angular speed squared

c. 1/2 x moment of inertia x angular speed
d. None of the above

Lecture 10:

1. The freezing point of water is
   a. -10°C or 32°F
   b. 0°C or 52°F
   c. 0°C or 32°F
   d. -10°C or 0°F
2. The boiling point of water is
   a. 100°C or 212°F
   b. 212°C or 100°F
   c. 100°C or 100°F
3. Linear expansion occurs when an object is heated, what is expanse of copper wire of length 10.0 cm after heated 10 Celsius up (take linear expansion confident as $1.7x10^{-5}$).
   a. 0.1700 cm
   b. 0.0017 cm
   c. 1.7000 cm
   d. 17.000 cm
4. Heat energy moves from
   a. cooler to hot
   b. hot to cooler
   c. not move
   d. both directions
5. What is 1 calorie?
   a. the amount of temperature necessary to boil 1 g of water: 1 cal = 4.18 J
   b. the amount of water necessary to add into 1 g of water to raise the temperature from 1 Celsius degree: 1 cal = 4.18 J
   c. the amount of heat necessary to raise the temperature of 1 g of water by 1 Celsius degree: 1 cal = 4.18 J
   d. None of the above
6. SI units of heat energy
   a. Joules
   b. Calories
   c. Food calories
   d. Celsius
7. The amount of heat required to change the temperature of a material is proportional
   a. to mass only
   b. to temperature change only
   c. to the mass and to the temperature change
   d. to density only
8. Which one of the following temperatures is approximately equal to "room temperature?"
   a. 50 °C
   b. 0 K
   c. 293 K
9. Two drinking glasses are stuck, one inside the other. How would you get them unstuck?
   a. put hot water in the inner one
   b. run hot water over the outer one

c. run cold water over them both
d. break the glasses

10. Two balls, made of different materials, have the same mass and temperature. The same amount of heat is added to them, but the final temperature of the two spheres is different. Which one of the following statements best explains the reason?
    a. The specific heat capacities of the two spheres are different.
    b. The densities of the two spheres are different.
    c. The volumes of the two spheres are different.
    d. The latent heats of vaporization of the two spheres are different

11. A 20.0 kg child is spiking a fever of 40ºC. The child is immersed in an ice bath of 0 ºC ice to reduce the temperature to 37 ºC. How much ice must be melted to achieve this? (Lf: 3.33×10^5 J/kg, and body-specific heat: 3500J/kg ºC)
    a. 0.10 Kg
    b. 6.0 kg
    c. 0.63 kg
    d. 60.0 kg
12. Heat energy transfer without a change in temperature is
    a. Latent heat
    b. specific heat
    c. total heat
    d. temperature
13. How much energy is needed to convert 0 Celsius 2.0 kg ice into 0 Celsius water? latent heat of fusion=3.33×10^5 J / kg
    a. 3.33 J
    b. 6.66×10^5 J
    c. 3.33×10^5 J
    d. 6.66×10^5 J/kg
14. Which of following is not the heat transfer methods?
    a. Radiation
    b. Conduction
    c. Convection
    d. Evaporation
15. What is the unit of specific heat capacity?
    a. J/kg
    b. J
    c. J/kg ^{0}C
16. What is the unit of latent heat?
    a. J/kg ^{0}C
    b. J/kg
    c. J

Lecture 11:

1. Fluid is
    a. Liquid
    b. Gas
    c. Both liquid and gas

d. Plasma

2. Density of the object is
   a. ratio of mass to volume
   b. ratio of volume to mass
   c. ratio of mass to specific heat
3. Specific gravity of a substance is
   a. the ratio of water to its density
   b. the ratio of its density to that of water.
   c. Property that has unit of Joule
4. Pressure is defined as
   a. the force per unit area, it is Bernoulli's Principle and unit is Pascal
   b. the force per unit area, Pascal's Principle and unit is Pascal
   c. the force per unit mass, Pascal's Principle and unit is pascal
5. The atmosphere pressure at a depth h below with respect to standard atmospheric pressure
   a. density of air x g x h
   b. density of object x g x h
   c. density of water x g x h
   d. -density of air x g x h
6. When you stand on one foot instead of two, the pressure you exert on the floor is
   a. less
   b. the same
   c. more
   d. None of the above
7. Atmospheric pressure is at sea level is normally
   a. 1 atm = 1.01×10^5 Pa = 1 N/m^2= 760 torr = 14.7 psi
   b. 1 atm = 1.01×10^5 Pa = 1.01×10^5 N/m^2= 760 torr = 14.7 psi
   c. 0 atm = 0 Pa = 0 torr = 0 psi
8. Water pressure provided by a water tower is greater if the tower
   a. is taller
   b. holds more water
   c. Both a and b
   d. None of the above
9. You are walking out on a frozen lake and you begin to hear the ice cracking beneath you. What is your best strategy for getting off the ice safely?
   a. Stand still and don't move a muscle
   b. Jump up and down to lessen your contact time with the ice
   c. Lie down flat on the ice and crawl toward shore
   d. Shuffle your feet (without lifting them) to move towards shore
10. The atmosphere pressure at a height h above with respect to standard atmospheric pressure
    a. -density of air x g x h
    b. density of air x g x h
    c. density of water x g x h
    d. g x h
11. Why don't barometers use water instead of mercury?
    a. Water cannot be used because it does not exert pressure.
    b. Water cannot be used because it sticks to the glass.
    c. Water can be used but the barometer will be too tall.

d. None of the above.

12. Find the most explained expression about Buoyant force, Archimedes' principle, and Displacement rule:
    a. Buoyant force is the weight of the object
    b. A submerged object always displaces a volume of fluid equal to its own volume. If you calculate weight of displaced fluid, that is the buoyant force acting upward in the object
    c. Buoyant force is the upward force acting on the object, but cannot be calculated
    d. Archimedes' principal explains the buoyant force on the object submerged in a liquid only.
13. When the weight of submerged object is greater than the buoyant force.
    a. Sink
    b. float
    c. neither sink or float
14. On which of these blocks submerged in water is the buoyant force greatest? (Density rank is lead > Uranium > aluminum)
    a. 1 kg of lead
    b. 1 kg of aluminum
    c. 1 kg of uranium
    d. All the same
15. Two solid blocks of identical size are submerged in water. One block is lead and the other is aluminum. Upon which is the buoyant force greater?
    a. On the lead block
    b. On the aluminum block
    c. Same on both blocks
16. Bernoulli's principle states
    a. that where the velocity of a fluid is high, the pressure is low and where the velocity is low, the pressure is high
    b. that where the velocity of a fluid is high, the pressure is high and where the velocity is low, the pressure is low
    c. that where the velocity of a fluid is high, the cross-sectional area is high and where the velocity is low, the cross-sectional area is low

Lecture 12:

1. The pendulum makes 2 revolutions in 1 second. What is it frequency and period?
    a. Frequency is 1/2 Hz. Period is 2 second.
    b. Frequency is 2 Hz. Period is 1 second.
    c. Frequency is 2 Hz. Period is 1/2 second.
2. A spring can be stretched a distance of 5.0 cm with an applied force of 1 N. What is the spring constant k?
    a. 0.2 N/m
    b. 20 N/m
    c. 5.0 N/m
    d. 20 N
3. There is a simple pendulum of mass M. If the mass is doubled, what will happen to the period?
    a. period will increase because period depend on mass
    b. period will not change because period is independent of mass
    c. period will decrease because period depend on mass
    d. period will increase because period depend on mass

e. period will not change, because period is independent of mass
f. period will decrease, period depend on mass

4. Two pendula have different lengths: one has a length L and the other has a length 4L. How do their periods compare?
   a. period of 4L is four times that of L
   b. period of 4L is two times that of L
   c. period of 4L is the same as that of L
   d. period of 4L is one-half that of L
5. A wave with a wavelength of 10 meters and time between crests of 0.5 second is traveling in water. What is the wave speed?
   a. 0.1 m/s
   b. 2 m/s
   c. 5 m/s
   d. 20 m/s
6. The vibrations along a transverse wave move in a direction
   a. long the wave
   b. perpendicular to the wave
   c. Both a and b
   d. Neither a nor b
7. You hear thunder 2 seconds after you see a lightning flash. How far away is the lightning? (Speed of the sound is 330 m/s)
   a. 340 m/s
   b. 660 m/s
   c. More than 660 m/s
   d. There's no way to tell
8. Do sound waves travel faster in water or in ice?
   a. water, because sound travel faster in liquid than solid
   b. ice, because sound travel faster in solid than liquid
   c. same speed in both
9. Do you expect an echo to return to you more quickly or less quickly on a hot day, as compared to a cold day?
   a. more quickly on a hot day, because sound travel faster in higher temperatures
   b. equal times on both days
   c. more quickly on a cold day, because sound travel faster in lower temperatures
10. Sound level is measured in decibels (dB). Human ears can be damaged by over 120 dB. If you are in an auto racing place that makes the sound of intensity 20 W/m^2, does it damage your ears? (dB value = 10 $\log(I/I_o)$ and $I_o = 1.0 \times 10^{-12}$ W/m^2.)
    a. Yes, it is over 120dB
    b. No, it is less than 120 dB
11. You have a long pipe and a short pipe. Which one has the higher frequency?
    a. the long pipe because frequency is higher in longer pipe
    b. the short pipe because frequency is higher in shorter pipe
    c. both have the same frequency
12. You blow into an open pipe and produce a tone. What happens to the frequency of the tone if you close the end of the pipe and blow into it again?
    a. you hear the same frequency

b. you hear a higher frequency, because frequency is higher one end closed tube
c. you hear a lower frequency, because frequency is lower one end closed tube

13. The Doppler effect occurs for
    a. sound only
    b. light only
    c. Both sound and light
14. You are moving toward the fire truck that makes sounds at rest. This problem can be named to one of the four categories we learnt, which category and what will happen to the frequency that observer hears due to this relative motion?
    a. Observer is moving away from the source, and frequency will decrease
    b. Observer is moving toward the source, and frequency will increase
    c. Source is moving toward the observer, and frequency will increase
    d. Source is moving toward the observer, and frequency will decrease