**Prqactice Exam 1 Phys 1210**

 **\_\_\_\_\_\_\_\_\_\_**

 **your name**

The exam consists of 6 problems. Each problem is of equal value.

You can skip one of problems.

Tips for better exam grades:

 Read all problems right away and ask questions as early as possible.

 Make sure that you give at least a basic relevant equation or figure for each sub- problem.

 Make use of the entire exam time. When you are done with solving the problems and there is some time left, read your answers over again and search for incomplete or wrong parts.

Show your work for full credit. The answer ‘42’ only earns you any credit IF ‘42’ is the right answer. We reserve points for ‘steps in between’, figures, units, etc. If all you give us is a numeric answer that may account only for a C grade for the problem in some cases.

 No credit given for illegible handwriting or flawed logic in an argument.

 All multiple choice questions may have more than one correct answer. For full credit, you need to mark all correct answers ***and*** mark no incorrect answer.

1. **Kinematics, conceptual and numerical**

Three runners run around a track of length 400[m]. They all start at the same time at the same location. Runner A runs in the opposite direction of runner B and runner C. A is the fastest, she runs at a constant speed of 8 [m/s]. B runs at a constant speed of 6.5 [m/s], and C at a constant speed of 4.8 [m/s].

1. When do A and B first meet?
2. When does B first overtake C? How far have they run by this time?
3. When do all three runners meet? How far has each runner run by this time?
4. **Kinematics, conceptual and numerical**
5. Consider a vertical throw for which the object can land at a lower level than where it started. Assume that air resistance is negligible

Hint: *Use /g/ = 10 [m/s2]*

Draw the vy-t diagram. Derive the y-t and ay-t diagrams by building the graphical derivative and graphical integral of the vy-t diagram.

*Hint: Make sure to draw the time scales of each diagram such that a vertical line through all three diagrams connects points of equal time.*



1. If the maximum height is 20[m] above the launching height, what is the magnitude of the launch velocity?
2. If the launch velocity is 20[m/s], what will the velocity be at half the distance between launching height and the highest point? At which two times will the object be at this height?
3. **Projectile Motion, conceptual and numerical**

Consider a projectile motion without air drag where the projectile lands at a lower height as where it had started, lower by 40[m].

*Hint: Use /g/ = 10 [m/s2] and take downward as negative.*

1. Which statements about ***this*** two-dimensional (x-y) projectile motion are correct?
2. Acceleration is constant

Explain:

1. Acceleration is zero at the highest point

Explain:

1. Acceleration has only a x-component

Explain:

1. The highest point occurs at xmax/2.

Explain:

1. At some point on the trajectory, before landing, the velocity vector is zero

Explain:

1. When one doubles the magnitude of the v0 vector of the projectile, leaving 0 the same, the projectile will go more than four times as far in x.

Explain:

1. The average velocity of two points on the trajectory, which are of equal height, is vx.

Explain:

1. Just before landing, the magnitude of the velocity is larger than at the start.

Explain:

1. Consider such a projectile that is launched at 45° with v0 = 20[m/s]. What is the value of xmax? What are the magnitude and direction of the velocity vector at that time?
2. **Kinematics and Vectors**

An object of mass 0.5 [kg] is moving in the horizontal x-y plane. You find a formula that determines the velocity as function of time: $v\left(t\right)=2 \left[\frac{m}{s}\right]\hat{i}- 1.2\left[\frac{m}{s^{2}}\right]\hat{j}∙t+0.6\left[\frac{m}{s^{3}}\right]\hat{i}∙t^{2} $.

1. Find the ***position*** vector (magnitude and orientation) for t = 2[s].
2. Find the acceleration vector (magnitude and orientation) for t=2[s] and t = 4[s].
3. Sketch the position, velocity, and acceleration functions between t =2[s] and t= 4[s].
4. **Dynamics – use Newton Law analysis**

Consider the modified Atwood Machine where one mass, A, rests on a table (s= 0.4). The mass of A is 4[kg]. The string and the pulley are massless and the pulley is frictionless on its axle. Air drag can be neglected. Hint: *Use /g/ = 10 [m/s2]*

1. What is the minimum value of mass B so that the system will start to move?
2. What is the tension in the string for that situation?
3. **Dynamics – use Newton Law analysis**

Three blocks are connected by weightless ropes. They are pulled by a force F over a rough, horizontal surface, where they experience friction. Each object has the same kinetic coefficient of friction: 0.2. The force has a magnitude of 200[N] and pulls horizontally on the first block. The first block has mass 2[kg], the second 4[kg], and the third 2[kg].

1. What is the acceleration of the system, if any?
2. What is the tension in each rope?
3. If the force suddenly disappears when the boxes have moved by 2[m] how does the motion change?

**Master Equations – Physics 1210**

One-dimensional motion with constant acceleration:

  $x= x\_{0}+v\_{0x}t+\frac{1}{2}a\_{x}t^{2}$ find the other forms of master equation 1 by

1. building the derivative of the equation
2. solving the new equation for t and substituting it back into the master equation, and
3. using the equation for average velocity times time

Two-dimensional motion with constant acceleration:

$x= v\_{0}cosα t$

$y=v\_{0}sinα t- \frac{1}{2} a\_{y} t^{2}$find the related velocities by building the derivatives of the equations

Newton’s Laws

$Σ\vec{F}=0, Σ\vec{F}=m \vec{a}, \vec{F}\_{A\rightarrow B}=-\vec{F}\_{B\rightarrow A}$find the related component equations by replacing all relevant properties by their component values

The quadratic equation and its solution:

 $a∙x^{2}+ b∙x+c=0 , then x= \frac{-b \pm \sqrt{b^{2}-4ac}}{2a}$

Table with some values for trig functions:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Degrees: | 30 | 45 | 60 | 330 |  |
| sin | 0.5 | 0.707 | 0.866 | -0.5 |  |
| cos | 0.866 | 0.707 | 0.5 | 0.866 |  |
| tan | 0.577 | 1 | 1.732 | -0.577 |  |