EXAM I Physics 218 2014

Name.....Section Number.....

USEFUL INFORMATION

$$If \quad f(x) = kx^n \qquad \frac{df}{dx} = nkx^{n-1}$$

$$If \quad f(x) = kx^n \qquad \int f(x)dx = \frac{1}{n+1}kx^{n+1} + C$$

For the **SPECIAL CASE:**
CONSTANT ACCELERATION IN ONE DIMENSION

$$x(t) = \frac{1}{2}a_c t^2 + v(0)t + x(0).$$

Please Note: The symbol g stands for the magnitude of the acceleration vector due to gravity and, as such, it is a positive quantity.

Do Not Spend Too Much Time on Algebra!

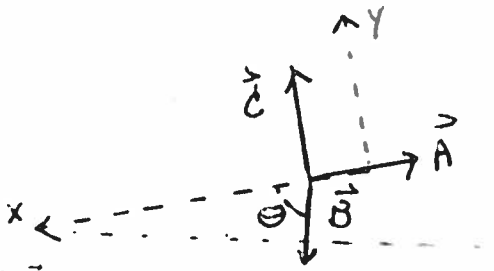
1.

2.

3.

4.

1. (20 Points) There are three vectors, $\vec{A}$, $\vec{B}$, and $\vec{C}$. The sum of the three vectors is defined to be $\vec{R}$. The directions of the three vecors is shown below.



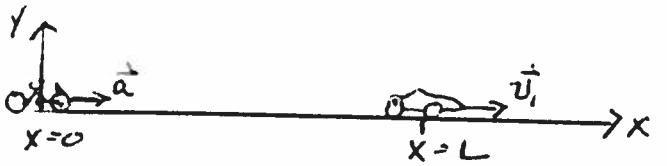
The magnitude of $\vec{B}$ is B, a known quantity. The magnitude of the vector $\vec{A}$ is a known constant, k, times the magnitude of the vector $\vec{C}$. The magitude of $\vec{C}$ is unknown. If it is required that the y component of $\vec{R}$ be zero, find the x component of $\vec{R}$. (The angle θ is known.)

Law or Definition

Application

Result

2. (30 Points) A car is observed to be at $x = L$ at time $t = 0$. It is travelling to the right along the x axis with known constant velocity of magnitude v_1. A motorcycle starts at rest at the origin at $t = 0$ with acceleration $\alpha + \beta t$ where α and β are known constants. Obtain one equation which could be solved for T, the time when the motorcycle catches the car. Solve the equation for the special case where $L = 0$ and $\alpha = 0$.



Law or Definition

Application

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3. (20 Points) The velocity vector for some object is given by

$$\vec{v} = (c_1 t^3 + c_2 t)\vec{i} + (c_3 t^2 + c_4 t)\vec{j}.$$

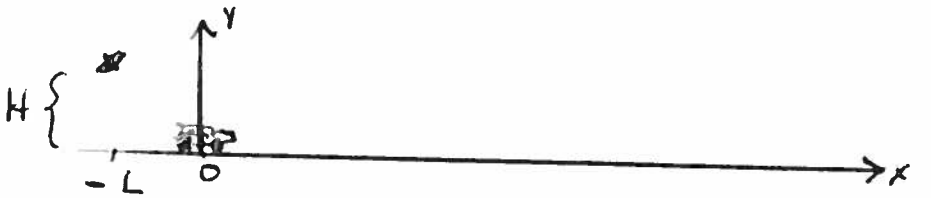
If the object started at $t = 1$ at the point $x = 4$ and $y = 2$, find the acceleration, $\vec{a}(t)$ and the position, $\vec{r}(t)$.

Law or Definition

Application

Result

4. (30 Points) A terrorist is driving a truck filled with oil along the x axis. It starts at the origin at $t = 0$ with initial velocity v_1 and constant acceleration a_1. A drone is launched from the point $x = -L$ and $y = H$ at $t = 0$. It has an initial velocity of magnitude v_m aimed at the angle θ above the x axis. The drone is programmed to have a horizontal acceleration such that $a_x = \beta + \alpha t$. The acceleration also has the usual vertical component due to gravity. Obtain an equation relating the variables which could be solved to find the necessary conditions in order for the drone to hit the truck. Solve for the necessary value of α if $\beta = 0$, $L = 0$, $v_m = 0$ and $a_1 = 0$.



Law or Definition

Application

Result