EXAM I Physics 218 2015

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

$$v(t) = a_c t + v(0)$$

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

$$v^2(t_2) - v^2(t_1) = 2a_c\Big[x(t_2) - x(t_1)\Big]$$

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.

1. (33 Points) A small object is dropped from rest a height H above the ground. At the same instant a drone is launched vertically upwards, from a point $2H$ above the earth, with an initial velocity of magnitude v_1. It has an acceleration, including the effects of gravity, towards the earth of magnitude βt where β is a constant and $t = 0$ is the instant the object is released. It is required that the object and the drone hit the ground at the same time. Obtain an equation that **could** be solved for β if all other parameters were given.

Law or Definition

Application

Result

2. (33 Points) You are to program a robot so that it starts at the point $x = 0, y = H$ and goes into a hole at $x = C, y = D$. The robot will have an initial velocity of magnitude W directed at an angle θ_1 with the horizontal and an acceleration of magnitude $\alpha + \beta t$ **always** directed at an angle θ_2 with the vertical. Here α and β are constants. Obtain the equations that relate all the parameters in order to accomplish the task.

Law or Definition

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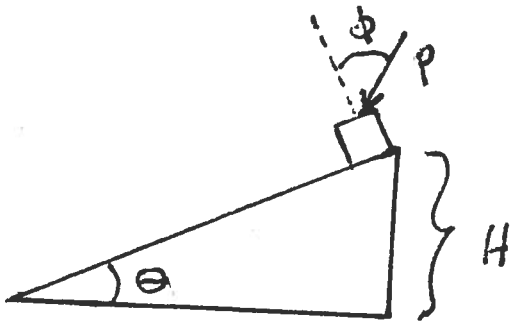
3. (34 Points) A block of mass m is placed at rest on an inclined plane as shown. The coefficient of friction between the block and the plane is μ. A constant force of magnitude P is applied to the block. The force is directed at the angle ϕ as shown, where the dotted line is perpendicular to the plane. How fast will the block be moving when it reaches the bottom of the plane?



Law or Definition

Application

Result