

2011

EXAM I Physics 218

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

USEFUL INFORMATION

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

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

For the **SPECIAL CASE:**

CONSTANT ACCELERATION IN ONE DIMENSION

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

Do Not Spend Too Much Time on Algebra!

1.

2.

3.

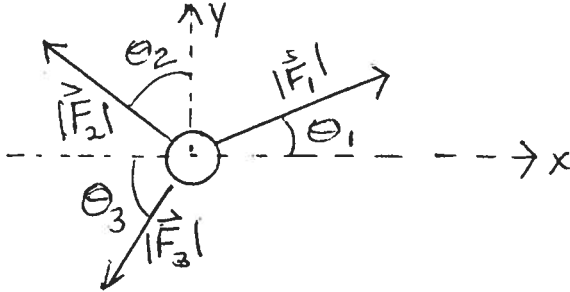


1a. (32 points) You are driving at a constant, known velocity, v_1 , along a straight road. Your computer controlled car begins to accelerate with $a = c_1 - c_2t$ where you can enter the constants c_1 and c_2 as input and where t is the time, starting when the acceleration begins. You see a cliff a distance D from your car at $t = 0$. For a given c_2 what value of c_1 must you enter in order to just stop at the edge of the cliff? (No algebra please. Stop when you have a sufficient number of equations to determine the unknowns.)

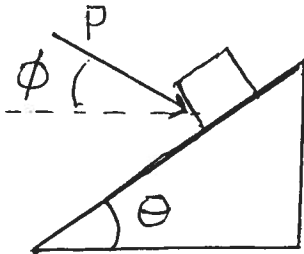
1b. (2 points) For the case when $c_2 = 0$ solve the equations from part a. for c_1 .

2. (33 points)

- a. In a physics lab experiment a ring is subjected to three forces as shown. Find the components of each force in the given coordinate system and determine how the magnitudes and directions of the three forces must be related in order for the ring to be in equilibrium.



- b. A block of mass m is placed at rest on an inclined plane as shown below. The plane is frictionless and makes the angle θ with the horizontal as shown. If another force of magnitude P is applied to the block at the known angle ϕ as shown, draw the free body diagram for the block and determine what the value of P must be if the block is to remain at rest.



3. (33 points) A terrorist fires a cannon at you from a distance D away. The bullet has an initial velocity of magnitude v_b and the cannon is pointed at the angle θ as shown. You hope to intercept the bullet by firing a rocket at it the instant the cannon goes off. Your rocket starts at rest and is to be aimed at the angle ϕ . It is so powerful that it goes in a straight line, its acceleration having a magnitude that increases with time according to $c_1 t$, always directed at the original angle ϕ . (In other words neglect gravity for the rocket.) Obtain the equations that could be solved on a computer that determine the relationship between all the variables in order to hit the bullet.

