Game 2005 assignment 2 document

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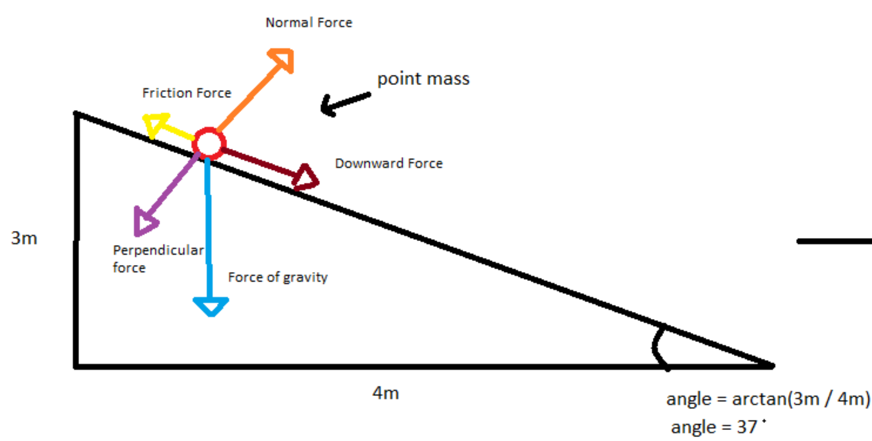

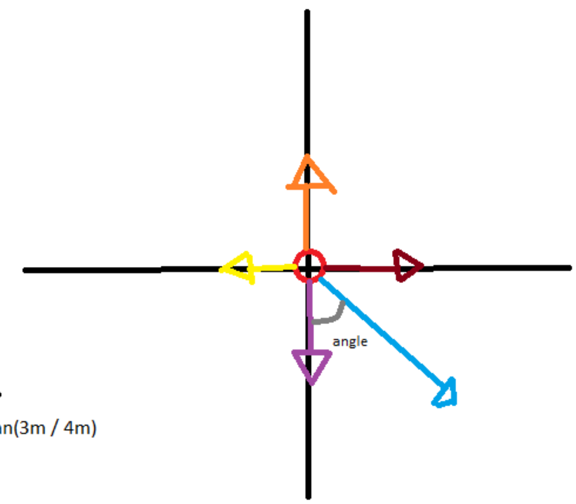

Above is the free body diagram of a point mass on a slope, specifically the slop given in the problem.

To break down the forces:
Force of Gravity = mass * gravity
Perpendicular force = Force of gravity * cos(angle)
DownWard force = Force of gravity * sin(angle)
Normal Force = Perpendicular Force
Friction Force (Induced Force) = coefficient of friction * Downward Force

If the mass of the object is 12.8 kg and the angle is 37 degrees while gravity is 9.8 m/s^2 then,

Force of Gravity = 12.8 kg * 9.8 m/s^2 = 125.44 N
Perpendicular Force = 125.44 N * cos(37) = 100.18 N
DownWard Force = 125.44 N * sin(37) = 75.49 N
Normal Force = 100.18N
Friction Force = 75.49 N * 0 (frictionless currently) = 0 N

Now, not all the forces are in the same direction, the ones we care about are the main directional forces seen in the right hand diagram, the downward force, the perpendicular force, the Normal force and the force of friction.

$F_{net\ y} = F_{perpendicular} + F_{Normal} = -100.18\ N + 100.18\ N = 0\ N$
$F_{net\ x} = F_{Downward} + F_{friction} = 75.49\ N - 0\ N = 75.49\ N$

These values are relative to the slope of the ramp.

F = m * a

$A_X = F_X / m = 75.49\ N / 12.8kg = 5.9\ m/s^2$

The acceleration would be $5.9 m/s^2$ in the slopes direction.

Now if we add in friction to the mix, the calculations for the $F_{net\ y}$ will not change so we only need to redo out $F_{net\ x}$ calculations. Our coefficient of friction will be 0.42

$F_{net\ x} = F_{downward} + F_{friction} = 75.49\ N + (-75.49\ N * 0.42) = 75.49\ N - 31.70\ N = 43.79\ N$

Now we can use this new net force to calculate out new acceleration

$A_x = F_x / m = 43.79\ N / 12.8\ kg = 3.42\ m/s^2$

Which gives us a new acceleration of $3.42\ m/s^2$

Now we wonder when the object will stop, if friction is constant then the acceleration is constant. The distance is travels is the hypotenuse of the triangle.

$D = sqr(x^2 + y^2) = sqr(4m^2 + 3m^2) = sqr(16\ m^2 + 9\ m^2) = sqr(25\ m^2) = 5m$

Now we can assume the starting velocity is zero as it starts at rest so we can use our kinematics formulas for this.

$D = V_i * t + ½ * a * t^2 = 0 + 1 / 2 * 3.42\ m/s^2 * t^2 = 1.71\ m/s^2 * t^2$

$T = sqr(5m / 1.71\ m/s^2) = sqr\ (2.92\ s^2) = 1.70s$

That means it would take 1.70s for the mass to get to the bottom.