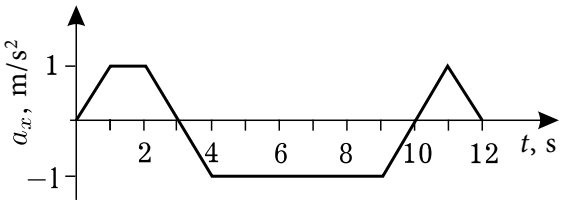
Homework #3. 2D Kinematics & Dynamics

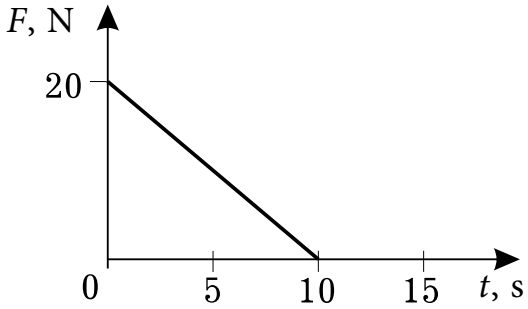
Attempt ALL problems by Wednesday night (11:59pm, Oct. 21, 2020).
The hard deadline is Sunday night (**11:59pm, Oct. 25, 2020**)

1. A grenade exploded on the surface a sloped hill that makes an angle θ with respect to the horizon. The grenade's fragments fly away in a radially symmetric manner with the initial velocity V_0. At what time after the explosion will the last fragment land on the hill?

2. A particle moves within the (x, y)-plane. Its x-velocity is variable, whereas its y-velocity is constant and equal to 3 m/s. The time dependance of the particle's acceleration is given on the graph below. Assume that v_{0x} =0 and find the particle's maximum speed.



3. A 10kg block is at rest on a horizontal surface. The coefficient of friction between the block and the surface is 0.1. At t = 0, a horizontal force is applied to the block. The graph below shows the time dependance of the force. Find the velocity of the block at t = 5 s, 10 s, 15 s. Assume acceleration of gravity g = 10 m/s^2.

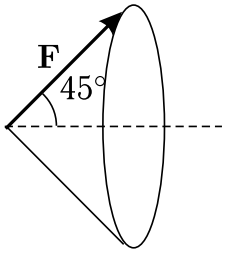


4. A particle of mass m moves in 3D according to

$$x(t) = A\cos\omega t, \qquad y(t) = A\sin\omega t, \qquad z(t) = 2A\omega t$$

Find the net force acting on the particle and the pathlength covered by the particle over the time t. Assume that ω and A are given.

5. A particle of mass m is originally at rest. At t = 0, it becomes a subject to a force of constant magnitude (F) whose vector uniformly rotates around a cone with an angle of 45° (see figure). The period of this rotation is T. Find the displacement of the particle at t = T/2.



6. A block of mass 1 kg slides down a frictionless wedge of the same mass (see figure). The angle of wedge is 45°, and the coefficient of friction between the wedge and the floor is 0.1. What minimum horizontal force applied to the wedge will keep it at rest?