MECH230 - Fall 2024
Recommended Problems - Set 01

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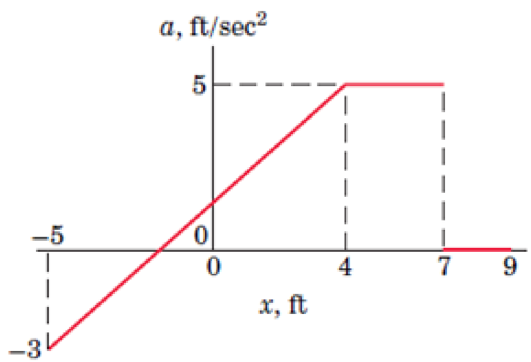
August 26, 2024

The problems are taken from J. L. Meriam, L. G. Kraige, and J. N. Bolton (MKB), Engineering Mechanics: Dynamics, Ninth Edition, Wiley, New York, 2018.

1. [MKB 2/24]

2/24 A particle moving along a straight line has an acceleration which varies according to position as shown. If the velocity of the particle at the position $x = -5$ ft is $v = 4$ ft/sec, determine the velocity when $x = 9$ ft.



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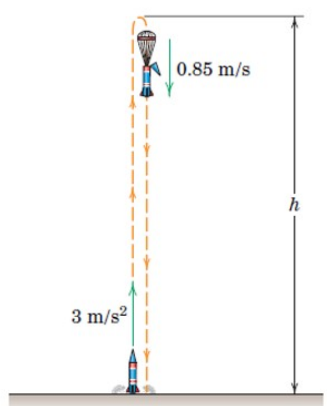
2. [MKB 2/25] Take the unit vector $\mathbf{E}_y$ to be pointed vertically upwards and take the origin to be located at the initial position of the rocket. In this case, the position vector of the rocket would be $\mathbf{r} = r\mathbf{E}_y$. You are given the acceleration in m s^{-2} to be

$$a = \begin{cases} 3 & 0 \leq t < 8 \\ -9.81 & 8 \leq t < t_{top} \\ 0 & t_{top} < t \leq t_{end} \end{cases}$$

where t_{top} is the time at which the rocket reaches the apex of the trajectory and t_{end} is the time at which the rocket comes backs to its initial location.

2/25 A model rocket is launched from rest with a constant upward acceleration of 3 m/s^2 under the action of a small thruster. The thruster shuts off after 8 seconds, and the rocket continues upward until it reaches its apex. At apex, a small chute opens which ensures that the rocket falls at a constant speed of 0.85 m/s until it impacts the ground. Determine the maximum height h attained by the rocket and the total flight time. Neglect aerodynamic drag during ascent, and assume that the mass of the rocket and the acceleration of gravity are both constant.



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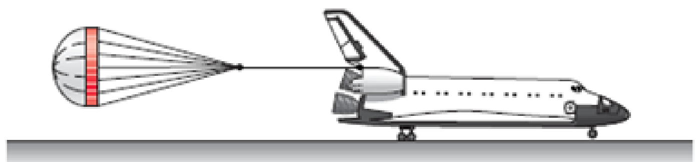
Note that this problem seems to assume that the velocity at the apex changes very quickly from 0 m/s to 0.85 m/s downwards, so we will neglect this transition.

3. [MKB 2/28] Take the unit vector $\mathbf{E}_x$ to point along the horizontal. You may take the origin to coincide with the location of the plane when the parachute deploys (ie. when $v = 200$ mi/hr). Be careful to convert mi to ft and hr to sec.

2/28 **The 230,000-lb space-shuttle orbiter touches down at about 220 mi/hr. At 200 mi/hr its drag parachute deploys. At 35 mi/hr, the chute is jettisoned from the orbiter. If the deceleration in feet per second squared during the time that the chute is deployed is $-0.0003v^2$ (speed v in feet per second), determine the corresponding distance traveled by the orbiter. Assume no braking from its wheel brakes.**



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