

1. {1,5,9,10}

Reminder: Midterm 1 will take place on Thursday, 2/18, from 8:10 to 9:25 in our usual classroom. The exam will cover the first four chapters of Kleppner and Kolenkow. You will not need a calculator.

1 - Center of mass of a non-uniform rod* - KK 4.1 The mass per unit length of a non-uniform rod of length l is given by $\lambda = A \cos(\pi x/2l)$, where x is the position along the rod, $0 \leq x \leq l$.

- (a) What is the mass M of the rod?
- (b) What is the coordinate X of the center of mass?

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2 - Acrobat and monkey - KK 4.5 A circus acrobat of mass M leaps straight up with initial velocity v_0 from a trampoline. As he rises up, he takes a trained monkey of mass m off a perch at a height h above the trampoline. What is the maximum height attained by the pair?

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3 - Rocket sled - KK 4.9 A rocket sled moves along a horizontal plane, and is retarded by a friction force $f_{\text{friction}} = \mu W$, where μ is constant and W is the weight of the sled. The sled's initial mass is M , and its rocket engine expels mass at constant rate $dM/dt \equiv \gamma$; the expelled mass has constant speed v_0 relative to the rocket. The rocket starts from rest and the engine stops when half the sled's total mass is gone. Find an expression for the maximum speed.

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4 - Rolling freight car with sand - KK 4.10 A freight car of mass M contains a mass of sand m . At $t = 0$ a constant horizontal force R is applied in the direction of rolling and at the same time a port in the bottom is opened to let the sand flow out at constant rate dm/dt . Find the speed of the freight car when all the sand is gone. Assume the freight car is at rest at $t = 0$.

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