

Phys 261—Math worksheet for Hwk #6

- (a) Find the center of mass of a uniform semicircle of radius R . (In mathspeak, the semicircle is the locus of points (x, y) such that $x^2 + y^2 \leq R^2$ and $y \geq 0$.) Obviously $x_{cm} = 0$; we seek y_{cm} .
- (b) The boxcar of KK problem 3.9 turned out to have a velocity

$$v(t) = \frac{Ft}{M + bt}$$

Find its position $x(t)$ (where we start from $x(0) = 0$).

- (c) The leaky boxcar (KK 3.9) turned out to have a velocity of the form

$$v(t) = -a \log(1 - \beta t)$$

(where $a = F/b$ etc., but never mind that, just use the parameters “ a ” and “ β ”.) Find the position $x(t)$, again starting from $x(0) = 0$.

- (d) Compute the indefinite integral $\int x \cos(bx)$ using integration by parts.
- (e) Compute the same indefinite integral in part (d), starting from the result for $\int \sin(bx)$ and taking a derivative with respect to the parameter.