

Solution to Problem 12.25:

$$a = \frac{5}{\left(3s^{\frac{1}{3}} + s^{\frac{5}{2}}\right)} = f(s);$$

$$\because a = \frac{dv}{dt}, \text{ and } v = \frac{ds}{dt}; \quad \Rightarrow \quad \frac{a}{v} = \frac{\frac{dv}{dt}}{\frac{ds}{dt}} = \frac{dv}{ds} \quad \Rightarrow \quad ads = vdv,$$

$$\Rightarrow \int ads = \int vdv \quad \Rightarrow \quad I = \int_1^2 \frac{5}{\left(3s^{\frac{1}{3}} + s^{\frac{5}{2}}\right)} ds = \int_0^v vdv = \frac{1}{2}v^2$$

The integral $I = \int_1^2 \frac{5}{\left(3s^{\frac{1}{3}} + s^{\frac{5}{2}}\right)} ds$ can be calculated by Simpson's $\frac{1}{3}$ rule as below:

Simpson's $\frac{1}{3}$ rule for integral with even number of subintervals:

$$I = \frac{1}{3}h[f_0 + 4f_1 + 2f_2 + \dots + 4f_{n-1} + f_n]$$

We can divide interval between $s=1$ and $s=2$ into 10 subintervals, which means $h=0.1m$, $n=10$;

s	$f(s)$	Coefficient	Coefficient* $f(s)$
1.00	1.25	1	1.25
1.10	1.14524	4	4.580957956
1.20	1.04923	2	2.098452389
1.30	0.96134	4	3.845358805
1.40	0.88103	2	1.762061722
1.50	0.80778	4	3.231112413
1.60	0.74107	2	1.482141614
1.70	0.68041	4	2.721625886
1.80	0.62529	2	1.250588191
1.90	0.57526	4	2.301038257
2.00	0.52985	1	0.529850876
summation			25.05318811

$$\text{So } I = \frac{1}{3} * h * (25.05318811) = \frac{1}{2}v^2 \Rightarrow v = \sqrt{0.1 * (25.05318811) * \frac{2}{3}} = 1.29236 \text{ m/sec}$$