The Fundamental theorem + u-subst.

$$\frac{1}{2}\int_0^4 2\sqrt{2x+1}\,dx = \frac{1}{2}\int_1^9 u^{1/2}\,du \qquad \frac{1}{2}\cdot\frac{2}{3}$$

$u = 2x+1$

$du = 2\,dx$

$u = 2(0)+1 = 1$

$u = 2(4)+1 = 9$

$$= \left[\frac{1}{3}u^{3/2}\right]_1^9$$

$$= \frac{1}{3}(9)^{3/2} - \frac{1}{3}(1)^{3/2}$$

$$= 9 - \frac{1}{3} = \boxed{\frac{26}{3}}$$

Ex. $\frac{1}{2}\int_0^1 \frac{2x}{x^2+1}\,dx = \frac{1}{2}\int_1^2 \frac{du}{u}$ $\left\{\int \frac{1}{u}\,du\right.$

$u = x^2+1$

$du = 2x\,dx$

$$= \left[\frac{1}{2}\ln u\right]_1^2$$

$$= \frac{1}{2}\ln 2 - \cancel{\frac{1}{2}\ln 1}^{\,0}$$

$$\frac{1}{2}\int_0^{\sqrt{\pi}} 2x \cdot \sin(x^2)\,dx = \frac{1}{2}\int_0^{\pi} \sin u\,du$$

$u = x^2$

$du = 2x\,dx$

$$= \left[\frac{-1}{2}\cos u\right]_0^{\pi}$$

$$= -\frac{1}{2}\cos\pi - -\frac{1}{2}\cos 0$$

$$= \frac{1}{2} + \frac{1}{2} = \boxed{1}$$

Math 8

$$\frac{d}{d\boxed{x}}\left(x\text{^}3\right)\Big|_{\boxed{x}=\boxed{-2}}$$

$$\frac{d}{dx}\left[x^3\right]\Big|_{x=-2} = 12$$

Ex $\int_0^{\pi} \sin x^2 \, dx \doteq [\ ?\ ]$

Particle Motion in 1-dimension

displacement function: $s(t)$ or $x(t)$

velocity function: $v(t) = \frac{ds}{dt} = s'(t)$

acceleration function: $a(t) = \frac{dv}{dt} = v'(t)$

Ex. The velocity of a particle is $v(t) = t^2 - 9$, $t \geq 0$. At time $t = 2$ secs, the particle is at $x = 5$.

(a) Find the position of the particle when $t = 6$ secs.

(b) Is the particle's speed increasing or decreasing when $t = 6$ secs?

(c) Find its distance travelled for the first 6 secs.

(a) $s(t) = \int (t^2 - 9)\,dt = \frac{1}{3}t^3 - 9t + C$

$s(2) = \frac{1}{3}(2)^3 - 9(2) + C = 5$

$C = \frac{46}{3}$

$s(6) = \frac{1}{3}(6)^3 - 9(6) + \frac{46}{3}$

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