Use Part 1 of the Fundamental Theorem of Calculus to find the derivative of the function.[1]

$$R(y) = \int_y^2 t^3 \sin(t)\ \mathrm{d}t$$

Let's remind ourselves of the Fundamental Theorem of Calculus, Part 1:

> **The Fundamental Theorem of Calculus, Part 1** If f is continuous on $[a, b]$, then the function g defined by
>
> $$g(x) = \int_a^x f(t)\ \mathrm{d}t \qquad a \leq x \leq b$$
>
> is continuous on $[a, b]$ and differentiable on (a, b) and $g'(x) = f(x)$.

First, we'll use properties of the definite integral to make the integral match the form in the Fundamental Theorem.

$$\int_y^2 t^3 \sin(t)\ \mathrm{d}t = -\int_2^y t^3 \sin(t)\ \mathrm{d}t$$

so we have

$$R(y) = -\int_2^y t^3 \sin(t)\ \mathrm{d}t$$

The minus sign is just a constant factor, so

$$\begin{aligned} \frac{\mathrm{d}}{\mathrm{d}y}\left[R(y)\right] &= -1 \cdot \frac{\mathrm{d}}{\mathrm{d}y}\left[\int_2^y t^3 \sin(t)\ \mathrm{d}t\right] \\ R'(y) &= -1 \cdot y^3 \sin(y) \end{aligned}$$

Thus,

$$R'(y) = -y^3 \sin(y)$$

[1] Stewart, *Calculus, Early Transcendentals*, p. 399, #12.