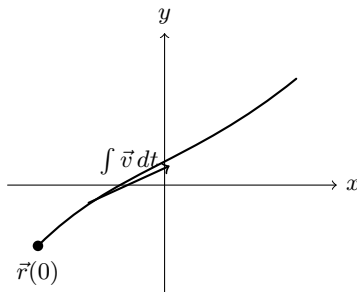


Question 3

A curve has velocity $\vec{r}'(t) = \langle 2t, 3t^2, e^{-t} \rangle$ and passes through $P = (1, -2, 4)$ at $t = 0$. Find $\vec{r}(t)$ and the net displacement from $t = 0$ to $t = 2$.

Question 3 – Solution

Strategy Integrate each velocity component and use the initial condition to determine the constant vector.



Antiderivative $\vec{r}(t) = \langle t^2, t^3, -e^{-t} \rangle + \vec{C}$. Since $\vec{r}(0) = \langle 0, 0, -1 \rangle + \vec{C} = P$, $\vec{C} = \langle 1, -2, 5 \rangle$. Therefore

$$\boxed{\vec{r}(t) = \langle t^2 + 1, t^3 - 2, 5 - e^{-t} \rangle}.$$

Displacement $\vec{r}(2) - \vec{r}(0) = \int_0^2 \vec{r}'(t) dt = \boxed{\langle 4, 8, 1 - e^{-2} \rangle}$.

Verification Differentiation recovers the given velocity and substitution gives P .