

Answers ②

③ $\vec{r}(t) = \langle x(t), y(t), z(t) \rangle = \langle 3t + 2\sqrt{t}, t^3 - t, t^3 + t \rangle$

$$\begin{cases} 5 = 3 + 2\sqrt{t} \\ 0 = t^3 - t \\ 2 = t^3 + t \end{cases} \text{ solve for } t.$$

$$5 = 3 + 2\sqrt{t}$$

$$2 = 2\sqrt{t}$$

$t=1$ Candidate.

check $|3-1|=0 \checkmark$

$|3+1|=2 \checkmark$

$$\vec{r}(1) = \langle 5, 0, 2 \rangle$$

$$\vec{r}'(t) = \langle t^{-1/2}, 3t^2 - 1, 3t^2 + 1 \rangle$$

$$\vec{r}'(t) = \langle 1, 2, 4 \rangle$$

Parametric equations

$$x = x_0 + ta$$

$$y = y_0 + tb$$

$$z = z_0 + tc$$

$$x = 5 + t$$

$$y = 2t$$

$$z = 2 + 4t$$

$$(x_0, y_0, z_0) = (5, 0, 2)$$

$$(a, b, c) = (1, 2, 4)$$

④ $\vec{r}'(t) = 6\mathbf{i} + 12\sqrt{t}\mathbf{j} + 12t\mathbf{k}$

$$|\vec{r}'(t)| = \sqrt{6^2 + (12\sqrt{t})^2 + (12t)^2}$$

$$= \sqrt{36 + 144t + 144t^2} = \sqrt{(12t+6)^2} = 12t+6$$

$$L = \int_0^1 (12t+6) dt = 6t^2 + 6t \Big|_0^1 = \boxed{12}$$

⑤ $(x-1) + 3(y-3) - 2(z-5) = 0$

$$x-1 + 3y-9 - 2z+10 = 0$$

$$\boxed{x + 3y - 2z = 0}$$