1. Find the derivative of the vector function \( \vec{r}(t) = \langle \cos(t), \frac{4}{t}, t^3 \rangle \)

2. Find the derivative of the vector function \( \vec{r}(t) = \langle \frac{3e^t}{2}, \ln(3t), t^2 + \frac{3}{t^2} \rangle \)

3. A space curve \( C \) is described by the vector function \( \vec{r}(t) = \langle t^2, \frac{t}{2}, t^2 \rangle \). Find \( \vec{T}(1) \), the unit tangent vector to \( C \) at the point corresponding to \( t = 1 \).

4. A space curve \( C \) is described by the vector function \( \vec{r}(t) = \langle 3 \ln(t), 2\sqrt{t}, t \rangle \). Find \( \vec{T}(1) \), the unit tangent vector to \( C \) at the point corresponding to \( t = 1 \).

5. A space curve \( C \) is described by the vector function \( \vec{r}(t) = \langle \cos(t), 4 \sin(t), 2t \rangle \). Find \( \vec{T}\left(-\frac{\pi}{2}\right) \), the unit tangent vector to \( C \) at the point corresponding to \( t = -\frac{\pi}{2} \).

6. Express the indefinite integral \( \int \langle 2 \sin(t), 2t^3, \sqrt{t} \rangle \, dt \) as a vector of elementary functions. Use the constant vector \( \langle C_1, C_2, C_3 \rangle \) to denote arbitrary constants of integration.

7. Express the indefinite integral \( \int \langle t^2 + t, e^{2t}, 3e^t \rangle \, dt \) as a vector of elementary functions. Use the constant vector \( \langle C_1, C_2, C_3 \rangle \) to denote arbitrary constants of integration.

8. Find \( \vec{r}(t) \) given \( \vec{r}'(t) = \langle \sin(t), e^t, -2t^2 \rangle \) and \( \vec{r}(0) = \langle -1, -2, 3 \rangle \)

9. Find \( \vec{r}(t) \) given \( \vec{r}'(t) = \langle \frac{t}{t^2 + 1}, t^2 - t, -2(t^3 + 2t) \rangle \) and \( \vec{r}(0) = \langle -2, -2, 3 \rangle \)

10. Find \( \vec{r}(t) \) given \( \vec{r}'(t) = \langle \sin(t), 0, -2 \cos(t) \rangle \) and \( \vec{r}(\pi) = \langle 2, -1, 3 \rangle \)
1. \(-\sin(t), -\frac{4}{t^2}, 3t^2\)

2. \(\left(\frac{3e^t}{2}, \frac{1}{t}, 2t - \frac{6}{t^3}\right)\)

3. \(\left(\frac{4}{\sqrt{33}}, \frac{1}{\sqrt{33}}, \frac{4}{\sqrt{33}}\right)\)

4. \(\left(\frac{3}{\sqrt{11}}, \frac{1}{\sqrt{11}}, \frac{1}{\sqrt{11}}\right)\)

5. \(\left(\frac{1}{\sqrt{5}}, 0, \frac{2}{\sqrt{5}}\right)\)

6. \((-2\cos(t), \frac{t^4}{2}, \frac{2t^2}{3}) + (C_1, C_2, C_3)\)

7. \(\left(\frac{t^3}{3} + \frac{t^2}{2}, \frac{e^{2t}}{2}, 3e^t\right) + (C_1, C_2, C_3)\)

8. \(-\cos(t), e^t - 3, 3 - \frac{2t^3}{3}\)

9. \(\left(\frac{\ln(t^2 + 1)}{2} - 2, \frac{t^3}{3} - \frac{t^2}{2} - 2, 3 - 2 \left(\frac{t^4}{4} + t^2\right)\right)\)

10. \(1 - \cos(t), -1, 3 - 2\sin(t)\)