

Simplify your final answers. Show organized work. Defend all answers.

1) Find an integral that represents the work done by the force $\vec{F} = \langle z, x, y \rangle$ on a particle that moves on the helix parameterized by $\vec{r}(t) = \langle t, \sin t, \cos t \rangle$ from $t = \frac{-\pi}{2}$ to $t = \frac{\pi}{2}$, and then **evaluate the integral**. (10 points)

2) Find the mass of a wire with density $\delta = \frac{y+1}{\sqrt{1+4x^2}}$ grams per cm if it is located on the path $y = x^2$ from the point $(-1,1)$ to the point $(2,4)$. (10 points)

3) Sketch the surface corresponding to $y^2 = z^2 + x^2$. Label the axes. (5 points)

4) Find the values of x for which the vectors $\langle 1, x, 12 \rangle$ and $\langle 4x, x, -1 \rangle$ are perpendicular. (6 points)

5a) Find all the second partial derivatives of $f(x, y) = \ln(x + y^2)$. (6 points)

5b) What is $\nabla f(3, 1)$? (4 points)

6) Find the equation of the plane that contains the points $P = (1, -1, 2)$, $Q = (-2, 0, 3)$, and $R = (1, -1, 4)$. Write your final answer in standard form. (10 points)

7) You may use work from one part below to answer questions in other parts. (15 points)

7a) Find the flux of $\vec{a} = \langle 1, 0, -1 \rangle$ through the parallelogram spanned by $\vec{b} = 2\hat{i} - \hat{j} - 2\hat{k}$ and $\vec{c} = \langle 1, 1, 1 \rangle$. (Use g/sec for units.)

7b) Find the area of the parallelogram spanned by $\vec{b} = 2\hat{i} - \hat{j} - 2\hat{k}$ and $\vec{c} = \langle 1, 1, 1 \rangle$. (Use m^2 .)

7c) Find the component of $\vec{a} = \langle 1, 0, -1 \rangle$ on $\vec{b} = 2\hat{i} - \hat{j} - 2\hat{k}$.

8) $\vec{r}(t) = \langle 2+t, t^2, t \rangle$, and $\vec{w}(t)$ has $\vec{w}'(1) = \langle 1, 1, 1 \rangle$ and $\vec{w}''(1) = \langle 1, 0, 1 \rangle$ in the following problems.

8a) Find and simplify $\left. \frac{d(\vec{w}' \cdot \vec{r})}{dt} \right|_{t=1}$. (5 points)

8b) Find the curvature κ of $\vec{w}(t)$ when $t = 1$. (5 points)

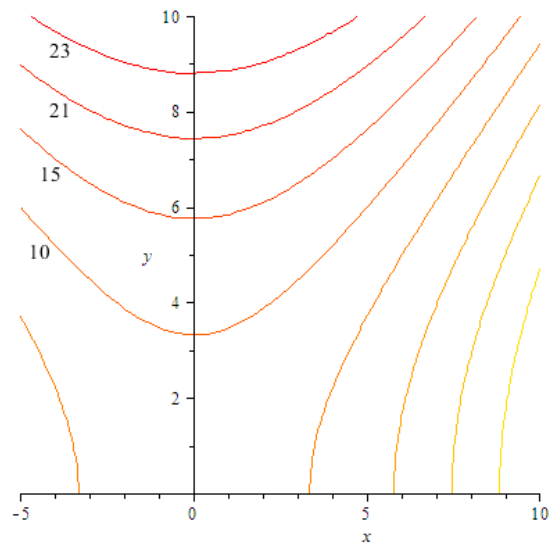
9) Evaluate $\int_C (x^2 y) dx + 2e^x y dy$ if C is the piecewise linear curve that moves on a line from (0, 0) to (0, 3) and then on a line from (0, 3) to (1, 3). (10 points)

10) Write “scalar”, “vector”, or “undefined.” (4 points)

10a) $3\vec{a} - 2(\vec{b} \times 4\vec{c})$ _____

10b) $3\vec{a} \cdot \vec{b} - 2(\vec{b} + 4\vec{c})$ _____

11) Use the contour plot of $f(x, y)$ to estimate $f_x(2, 6)$. Draw an appropriate segment. (5 points)



12) Find a position function for the circle in the plane $z = 5$ with center (3, 2, 5) and radius 4 that is oriented by the right hand rule with respect to the positive z – axis. (5 points)