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1 /12	2 /14	3 /7	4 /6	5 /12	6 /12	7 /12	T /75

MATH 2415 (Fall 2016) Exam I, Sep 30th

No books or notes! **NO CALCULATORS!** Show all work and give **complete explanations**. Don't spend too much time on any one problem. This 90 minute exam is worth 75 points.

(1) [12 pts]
(a) Find a parametrization of the line that goes through the point $(-2, 2, 4)$ and that is perpendicular to the plane $2x - y + 5z = 12$.

(b) Calculate the vector projection of $\mathbf{a} = 3\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ onto $\mathbf{b} = \mathbf{i} + \mathbf{j} - 2\mathbf{k}$.

(2) [14 pts] Let $P = (3, -1, 1)$, $Q = (4, 0, 2)$, and $R = (6, 3, 1)$ be three points in space.

(a) Find a parametrization of the form $\mathbf{r}(s, t) = \mathbf{p} + s\mathbf{u} + t\mathbf{v}$ for the plane containing P, Q, and R.

(b) Find an equation of the form $Ax + By + Cz + D = 0$ for the same plane as in (a).

(3) [7 pts] Find two unit vectors that are both perpendicular to $\mathbf{i} + \mathbf{j}$ and perpendicular to each other.

(4) [6 pts] Let $f(x, y) = \sqrt{x^2 + 9y^2}$. Sketch the level curves $f(x, y) = k$ for $k = 1, 2, 3$.

(5) [12 pts]
(a) Plot the point with spherical coordinates $(\rho, \theta, \phi) = (6, \frac{\pi}{3}, \frac{\pi}{4})$, and find its rectangular coordinates.

(b) The equation $z = r$ is given in cylindrical coordinates. Convert this equation to spherical coordinates.

(6) [12 pts] Make a labelled sketch of the traces (slices) of the surface

$$4x^2 - y^2 + z^2 = 0$$

in the planes $x = 0$, $z = 0$, and $y = k$ for $k = 0$, ± 1, ± 2. Then make a labelled sketch of the surface.

(7) [12 pts] Let C be the curve parametrized by

$$x = t, \qquad y = \frac{t^2}{2}, \qquad z = \frac{t^3}{6}.$$

Find the length of C from the origin to the point $(6, 18, 36)$.

Please sign the following honor statement:

On my honor, I pledge that I have neither given nor received any aid on this exam.

Signature: _____