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MATH 253 Honors FINAL EXAM Fall 1999

Sections 201-202 P. Yasskin

Multiple Choice: (7 points each)

1. Consider the line through the point $P = (4,4,4)$ which is perpendicular to the plane $x + 2y + 3z = 7$. Its tangent vector is

a. $(3,2,1)$
b. $(1,2,3)$
c. $(7,6,5)$
d. $(5,6,7)$
e. $(4,4,4)$

2. Find the plane tangent to the hyperbolic paraboloid $x - yz = 0$ at the point $P = (6,3,2)$. Which of the following points does **not** lie on this plane?

a. $(-6,0,0)$
b. $(0,3,0)$
c. $(0,0,2)$
d. $(1,-1,-1)$
e. $(-1,1,1)$

3. Duke Skywater is flying the Millenium Eagle through a polaron field. His galactic coordinates are $(2300,4200,1600)$ measured in lightseconds and his velocity is $\vec{v} = (.2,.3,.4)$ measured in lightseconds per second. He measures the strength of the polaron field is $p = 274$ milliwookies and its gradient is $\vec{\nabla}p = (3,2,2)$ milliwookies per lightsecond. Assuming a linear approximation for the polaron field and that his velocity is constant, how many seconds will Duke need to wait until the polaron field has grown to 286 milliwookies?

a. 2
b. 3
c. 4
d. 6
e. 12

4. Consider the surface S parametrized by $\vec{R}(u,v) = (u+v, u-v, uv)$ for $0 \le u \le 2$ and $0 \le v \le 4$. Compute $\iint_S \vec{F} \bullet d\vec{S}$ where $\vec{F} = (y, x, y)$.

a. -32
b. -16
c. 16
d. 32
e. 64

5. Consider the surface S parametrized by $\vec{R}(u,v) = (u+v, u-v, uv)$. Find the plane tangent to this surface at the point $P = \vec{R}(1,2) = (3,-1,2)$. Which of the following points does **not** lie on this plane?

a. $(3,0,0)$
b. $(0,4,0)$
c. $(0,0,-2)$
d. $(1,1,0)$
e. $(0,6,1)$

6. Compute $\oint (-x^2y^2\,dx + 2xy^3\,dy)$ over the complete boundary of the semicircular area $0 \le y \le \sqrt{4-x^2}$ traversed counterclockwise.

a. 0
b. 16
c. $\dfrac{4}{5}$
d. $\dfrac{80}{5}$
e. $\dfrac{128}{5}$

7. Compute $\iint_S \dfrac{x^3z^2}{3}\,dy\,dz + \dfrac{y^3z^2}{3}\,dz\,dx + \dfrac{z^5}{5}\,dx\,dy$ over the complete surface of the sphere $x^2+y^2+z^2 = 4$ with outward normal.

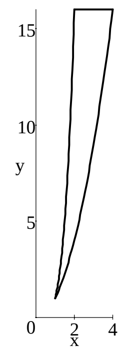
a. $\dfrac{512\pi}{21}$
b. $\dfrac{32\pi^2}{5}$
c. $\dfrac{128\pi}{5}$
d. $\dfrac{16\pi}{3}$
e. $\dfrac{256\pi}{15}$

8. (15 points) Find the point in the first octant on the surface $z = \frac{32}{x^4 y^2}$ which is closest to the origin.

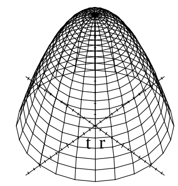
9. (10 points) Compute $\iint_R x\,dA$

over the region R in the first quadrant bounded by the curves

$y = x^2$, $y = x^4$ and $y = 16$.



10. (15 points) Find the mass and center of mass of the solid below the paraboloid $z = 4 - x^2 - y^2$ above the xy-plane, if the density is $\delta = x^2 + y^2$. (11 points for setting up the integrals and the final formula.)



11. (15 points) Find the area and centroid of the **right** leaf of the rose

$$r = 2\cos^2\theta.$$

(12 points for setting up the integrals and the final formula.)