Math 335 HW 2 NAME: KEY
Due Wednesday 9/10 5:15pm

Practice Problems *(Do not turn in.)*
Sec 9.1 #17, 33, 37, 41
Sec 9.2 #1, 5
Sec 9.3 #17
Sec 9.4 #13, 23, 33, 39, 41, 49

Print out this assignment and write all work directly on this worksheet. Do not attach extra pages. Show all work. Your answers must be clear and legible. All pages must be stapled. Homework may be submitted within 24 hours of the due date with an automatic 2 point deduction. After Thursday 5:00pm, no late homework will be accepted for any reason.

1.) *[4 points]* Compute the first and second partial derivatives of $f(x, y) = 5x^2y^4 - e^{3y} + 24x$.

$$f_x = \boxed{10xy^4 + 24}$$

$$f_y = \boxed{20x^2y^3 - 3e^{3y}}$$

$$f_{xx} = \boxed{10y^4}$$

$$f_{yy} = \boxed{60x^2y^2 - 9e^{3y}}$$

$$f_{xy} = f_{yx} = \boxed{40xy^3}$$

2.) Butterfree flies along a curve given by

$$\vec{r}(t) = cos3ti - 2tj + sin3tk.$$

a.) *[4 points]* Calculate the unit tangent and normal vectors. (Your textbook refers to these and the "tangential and normal components of the acceleration.")

$$\vec{v}(t) = \langle -3\sin 3t, -2, 3\cos 3t \rangle$$

$$|\vec{v}| = \sqrt{(-3\sin 3t)^2 + (-2)^2 + (3\cos 3t)^2}$$

$$= \sqrt{9\sin^2 3t + 4 + 9\cos^2 3t}$$

$$= \sqrt{9+4} = \sqrt{13}$$

$$\vec{T} = \frac{\vec{v}}{|\vec{v}|} = \boxed{\left\langle -\frac{3}{\sqrt{13}}\sin 3t, -\frac{2}{\sqrt{13}}, \frac{3}{\sqrt{13}}\cos 3t \right\rangle}$$

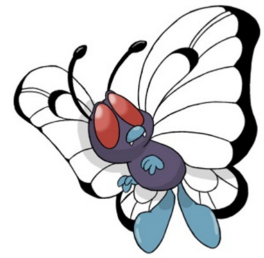
$$T' = \left\langle -\frac{9}{\sqrt{13}}\cos 3t, 0, -\frac{9}{\sqrt{13}}\sin 3t \right\rangle$$

$$|T'| = \sqrt{\frac{81}{13}\cos^2 3t + 0 + \frac{81}{13}\sin^2 3t} = \frac{9}{\sqrt{13}}$$

$$\vec{N} = \frac{T'}{|T'|} = \boxed{\langle -\cos 3t, 0, -\sin 3t \rangle}$$

#2 continued...

b.) *[4 points]* Calculate the curvature of Butterfree's path.



$$K = \frac{|T'|}{|\vec{v}|} = \frac{9/\sqrt{13}}{\sqrt{13}} = \boxed{\frac{9}{13}}$$

Note the curvature is constant along this path.

c.) *[4 points]* Calculate the distance Butterfree has travelled over the interval $0 \leq t \leq 2$.

$$L = \int_0^2 |\vec{v}|\, dt = \int_0^2 \sqrt{13}\, dt$$

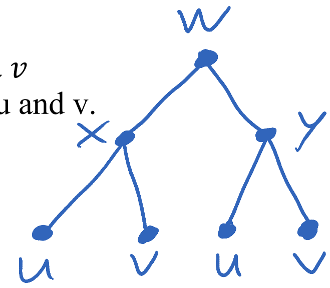
$$= \sqrt{13}\, t \Big|_0^2$$

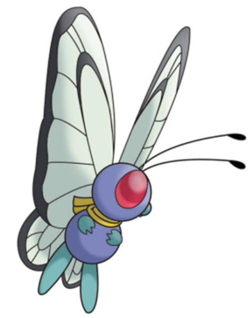
$$= \boxed{2\sqrt{13}}$$

3.) *[4 points]* Use the Chain Rule to find $\frac{\partial w}{\partial u}$ and $\frac{\partial w}{\partial v}$ for

$$w = x^4 - x\sin y, \quad x = u + 2v, \quad y = u\ln v$$

Your final answer should be in terms of only the variables u and v.





$$\frac{\partial w}{\partial u} = \frac{\partial w}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial w}{\partial y}\frac{\partial y}{\partial u}$$

$$= (4x^3 - \sin y)(1) + (-x\cos y)(\ln v)$$

$$= \boxed{4(u+2v)^3 - \sin(u\ln v) - (u+2v)\cos(u\ln v)\ln v}$$

$$\frac{\partial w}{\partial v} = \frac{\partial w}{\partial x}\frac{\partial x}{\partial v} + \frac{\partial w}{\partial y}\frac{\partial y}{\partial v}$$

$$= (4x^3 - \sin y)(2) + (-x\cos y)\left(\frac{u}{v}\right)$$

$$= \boxed{8(u+2v)^3 - 2\sin(u\ln v) - (u+2v)\cos(u\ln v)\frac{u}{v}}$$