

Chapter 12 Checkpoint

Directions:

- You will have 2 hours to complete as many of the following questions as you can. When you begin the checkpoint, please write down the current time at the top of your cover page, and leave a space to write the time you finish. When you finish please immediately write the time.
- You may use your notes, the book, and any materials posted on the course website. Also, feel free to ask me clarifying questions or about typos. You may not use any other resource. In particular, you may not use any other resource on the internet, you may not use a computer to assist you with graphing or computations (unless the problem explicitly states otherwise) and you may not discuss the problems with anyone else.
- Each problem corresponds to a standard and specifically asks about that standard. You may complete as many or as few of the problems as you wish.
- If you have a question about any of the problems, or think there is an error please email me immediately. Also, if something occurs during your allotted time or some other special circumstance arises, please email me immediately.
- Write your own personal growth mindset statement. This really does help you do better on the checkpoint. If you have trouble thinking of a growth mindset statement you can use this one:

I am a problem solver and my mind grows everyday. I improve with lots of practice. I learn from my mistakes. Learning is my superpower.

Chapter 12: I can calculate, use, and interpret vector calculus

- ☐ VC.1 I can identify, evaluate, sketch and interpret vector fields in the plane and in space.
- ☐ VC.2 I can define and interpret line integrals of vector fields along oriented curves. I can use parametrizations to evaluate line integrals of vector fields along oriented curves.
- ☐ VC.3 I can use the Fundamental Theorem of Calculus for Line Integrals to evaluate line integrals of gradient fields.
- ☐ VC.4 ** I can define, evaluate, and interpret the divergence of vector fields. I can define, evaluate, and interpret the curl of vector fields.
- ☐ VC.5 ** I can use Green's Theorem to evaluate circulations of smooth vector fields along simple closed curves in the plane.
- ☐ VC.6 ** I can define, evaluate, and interpret flux integrals of vector fields across parametrized surfaces.
- ☐ VC.7 ** I can use Stokes' Theorem to evaluate circulations of smooth vector fields along simple closed curves in space.
- ☐ VC.8 ** I can use The Divergence Theorem to evaluate flux of continuous vector fields through closed surfaces in space.

VC.5 Let $\mathbf{F}(x, y) = \langle e^{-x^2}, x \rangle$. Use Green's theorem to compute

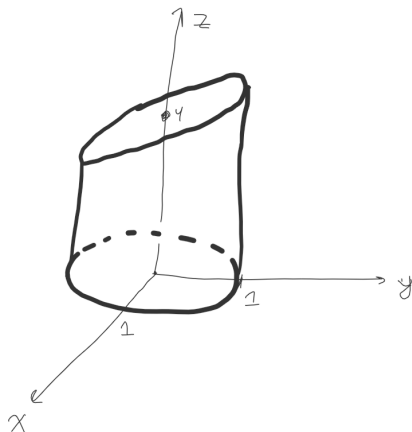
$$\int_C \mathbf{F} \cdot d\mathbf{r},$$

where C is the boundary of the square with vertices $(0, 0)$, $(1, 0)$, $(1, 1)$ and $(0, 1)$, oriented in the anticlockwise direction.

VC.6 Compute the flux integral $\iint_S F \cdot dS$ where $F = (x, y, z)$ and S is the triangle defined by the three points $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$ with orientation given by normals pointing towards the origin.

VC.7 Let S be the part of the cylindrical shell $x^2 + y^2 = 1$ between the planes $z = 0$ and $z = y + 4$ oriented so that its normal vectors point away from the z -axis.

- (a) On the drawing of S below (or your own drawing), clearly indicate ∂S , the boundary of S , and indicate which direction gives the positive orientation.



- (b) Use Stokes' Theorem to compute $\int_{\partial S} \vec{F} \cdot d\vec{r}$ for some vector field $\vec{F} = \langle P, Q, R \rangle$ with $\text{curl } \vec{F} = \langle \sqrt{5}x, \sqrt{5}y, 0 \rangle$ and the first order derivatives of P, Q, R are continuous.

VC.8 Use the divergence theorem to evaluate the flux integral $\iint_S F \cdot dS$ where $F = \langle x, 2y, 3z \rangle$ and S is the cube with vertices $(\pm 1, \pm 1, \pm 1)$ given the positive orientation.