Chapter 9 Checkpoint, version 3

Directions:

- You will have 30 minutes per question to complete whichever question you want. 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 many 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 9: I can use and interpret multivariable and vector functions.

☐ F.1 I can identify, evaluate and interpret functions of two variables using formulas, tables, graphs, and contour maps.

☐ F.2 I can compute dot products of vectors as well as use dot products to find lengths, angles, and projections. I can compute cross products of vectors and interpret them geometrically.

☐ F.3 I can find equations of lines and planes in space in various forms. I can determine the intersections, angles between, and distance between lines and planes.

☐ F.4 I can draw curves in space and define vector-valued functions for space curves.

☐ F.5 I can evaluate and interpret derivatives and integrals of vector-valued functions.

☐ F.6 ** I can find arc length of space curves.

F.1 (a) For the surface defined by $z = 3 + \sqrt{x^2 + y^2}$

i. sketch the contour plot, including at least four labeled level curves;

ii. sketch the surface in 3D on a labeled xyz-axes.

(b) For the surface defined by $x^2 + y^2 + z^2 = 2$

i. sketch the contour plot, including at least four labeled level curves;

ii. sketch the surface in 3D on a labeled xyz-axes.

F.2 Consider the vectors $\mathbf{u} = \langle 5, 0, 1\rangle$ and $\mathbf{v} = \langle 2, 2, 1\rangle$.

(a) What is the angle between $\mathbf{u}$ and $\mathbf{v}$?

(b) What is the area of the parallelogram determined by $\mathbf{u}$ and $\mathbf{v}$?

(c) Compute the projection of $\mathbf{u}$ onto $\mathbf{v}$.

F.4 (a) On an xy-axis sketch the graph of the parametric equation

$$\mathbf{r}(t) = \langle \sin(t), t\rangle, \quad -\infty \leq t \leq \infty$$

(b) In a complete English sentence describe the path in space given by

$$\mathbf{r}(t) = \langle 3t - 1, 4 - 5t, 2t\rangle, \quad 0 \leq t \leq 1$$

F.5 The velocity of an trick airplane is given by

$$v(t) = \langle 2t, 1 - t, t^2\rangle.$$

(a) If the airplane is at position $(2, 3, 0)$ at time $t = 0$, where is the airplane at time $t = 3$?

(b) At what time is the plane accelerating the least?

F.6 Set up but DO NOT EVALUATE and integral to compute the arc length of the portion of the curve $r(t) = \langle t, \sqrt(t), e^{2t}\rangle$ between $y = 1$ and $y = 4$.