

Math 120 - Fall 2021

Final Exam

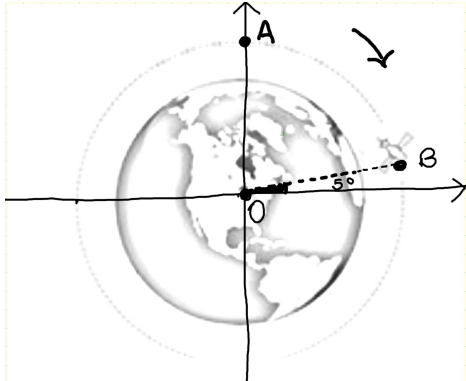
NAME (First,Last) :

UW email:

Student ID

- You have 2 hrs and 30 min to complete this exam.
- Please use the same name that appears in Canvas.
- Make sure your writing is clear and dark enough.
- Unless stated otherwise, you **MUST** show work for credit.
- Your work needs to be neat and legible.
- Unless the problem gives you different instructions, you can give exact answers or round off your answers to 2 decimal places.
- The only calculator allowed is the TI 30X IIS. You are allowed an 8x11 sheet of notes, written both sides.
- Box your final answer, when appropriate.
- Raise your hand if you have a question.

1. A satellite is circling Earth, moving in the direction indicated by the arrow (see picture below) . At 6 PM on 12/10/2021 it passes by point A, and 40 minutes later the satellite is at B. The angle the line OB forms with the horizontal is 5° .



- (a) How many minutes does it take the satellite to complete a full revolution ?
- (b) The satellite is orbiting at a distance of 7000 miles from the center of the earth. Impose a coordinate system with the origin at the center of the earth, like in the picture above, and find the coordinates of the satellite at time t minutes after 6 PM on 12/10/2021.

2. An infectious disease is spreading in SmallTown in 2019. The number of people testing positive on any given day can be modeled by a sinusoidal function. On February 15, 2019 (the 46th day of the year) there was a peak (highest number) of 52 positive tests; after that the daily number of positive tests kept decreasing and reached a minimum (lowest number) of 10 on April 4, 2019 (the 94th day of the year).

(a) Write a formula for the function $f(t)$ that gives you the number of people testing positive on day t of the year .

(b) According to this sinusoidal model, how many people tested positive on December 31st, 2019 (the 365th day of the year)? (Round to the closest integer).

(c) For how many days in 2019 was the daily number of positive tests at least 15 ? (Round to the closest integer).

3. At 8:00 AM one day Steve starts walking from the point $(-3,4)$ on the line $y = -\frac{4}{3}x$ in the SE direction (i. e. towards the origin). He walks at a constant speed of 2.5 mph. At 10:00 AM Elsie is at $(0, -10)$ and starts walking North along the y axis at a constant speed of 2 mph. Let $t=0$ correspond to 8:00 am. One unit in the coordinate system corresponds to one mile.

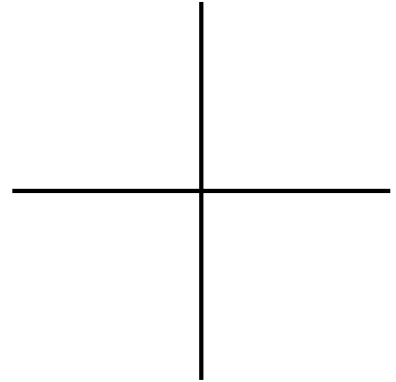
(a) Find the parametric equations for Steve.

(b) Find the parametric equations for Elsie.

(c) When are Steve and Elsie closest to each other ? (Assume they keep walking forever). Give your answer as a time of day in the normal HH:MM AM/PM way, for example, 7:30 AM.

4. Consider the function $f(x) = x^2 - 8x + 15$ defined on $-\infty < x < \infty$

- (a) The x intercepts of this functions are at $x=3$ and $x=5$. Draw the graph of $y = f(x)$. Mark and show the value of all x and y intercepts and of the vertex.



- (b) Restrict f to the domain $x \leq 0$ and compute $f^{-1}(x)$, the inverse of f .

- (c) What are the domain and range of $f^{-1}(x)$?

Domain:

Range:

5. The number of oak trees in Oakville doubles every 30 years; the number of Maples in Nomapletown decreases 10% every 5 years. Last year the number of oak trees in Oakville was the same as the number of maple trees in Nomapletown. In how many years (from this year) will the number of Maples in Nomapletown be half of the number of oaks in Oakville?