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**Instructions:**

1. Read every problem CAREFULLY!
2. You are allowed a 8.5x11 inch sheet of handwritten notes, front and back. No other notes or books are allowed.
3. You may use a TI-30x IIS Calculator. No other calculators are allowed.
4. All answers should be EXACT. Decimal approximations will not be given full credit.
5. You **must** show your work! If it is not clear how you got from point A to point B, you will lose points.
6. You **must** write your name and section on EVERY page.

Good Luck!

1a	/10
1b	/10
1c	/10
2a	/10
2b	/10
2c	/10
3a	/10
3b	/10
4a	/10
4b	/10
5a	/ 5
5b	/ 5
5c	/ 5
5d	/ 5
5e	/ 5
T	/125

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1. Compute the derivatives of the following functions.

(a)  $f(x) = (\arcsin x)5^x$

(b)  $f(x) = \ln(\tan x) + x^{3/2}$ , when  $0 < x < \pi/2$ .

(c)  $f(x) = (x^2 + 4)^{\sqrt[3]{x^3-1}}$

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2. Consider the plane curve  $C$  given by

$$y^2 + 7x^2y - 3x^3 = -99.$$

(a) Compute the tangent line to  $C$  at  $P = (2, -3)$ .

(b) Use the tangent line to approximate the  $y$ -value of a point  $Q$  near  $P$  where the  $x$ -coordinate of  $Q$  is equal to 2.1.

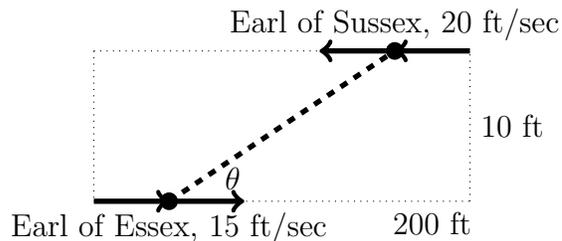
(c) Use concavity to determine whether the approximation in (b) is an overestimate or an underestimate. Explain your answer.

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3. The Earl of Sussex and the Earl of Essex are jousting each other. They start at opposite corners of a  $200 \times 10$  ft<sup>2</sup> rectangle and travel straight along the long edges. The Earl of Essex travels at a constant speed of 15 ft/sec and the Earl of Sussex travels at a constant speed of 20 ft/sec.

Assume that the earls and their horses have 0 length and width.



- (a) After 2 seconds, how fast is the distance between the two earls decreasing?
- (b) Let  $\theta$  be the angle between the Earl of Essex's lance and his path. If the lance is pointed directly at his competitor, what is the rate of change of  $\theta$  at  $t = 2$  seconds.

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4. Consider a particle moving along the following parametric curve for  $-\infty < t < \infty$

$$x(t) = 4t^2 + 3t, \quad y(t) = -t^2 + 2.$$

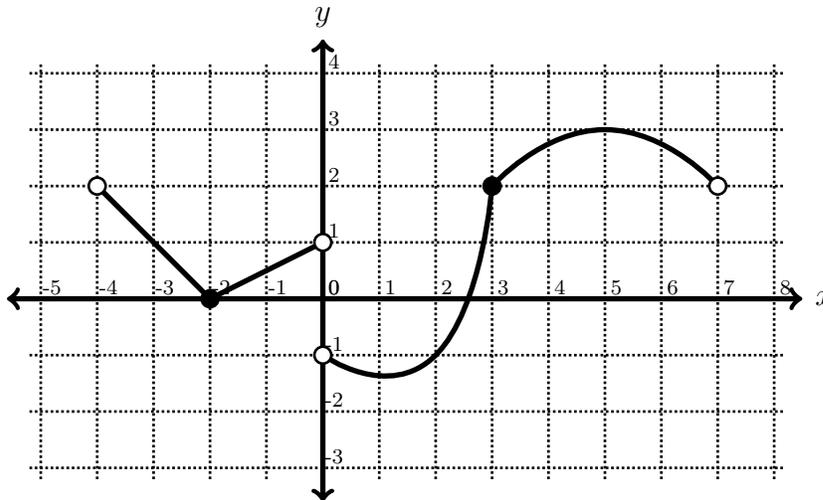
(a) Compute the speed of the particle when  $t = 2$ .

(b) Find all tangent lines to the curve that pass **through**  $(-5, 2)$ .

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5. Consider the graph of  $f'(x)$  for  $-4 < x < 7$ . (Note that this is a graph of the **derivative** of  $f(x)$ !)



In all of the problems below, you may give an approximation if you are not sure of the exact coordinate. There is **no** partial credit on this problem.

- (a) What are the critical points of  $f(x)$ ? (If there aren't any, state that.)
- (b) What are the local maximums? (If there aren't any, state that.)
- (c) State the intervals on which  $f(x)$  is decreasing. (If there aren't any, state that.)
- (d) What are the inflection points of  $f(x)$ ? (If there aren't any, state that.)
- (e) State the intervals on which  $f(x)$  is concave up. (If there aren't any, state that.)