

### Instructions

- Print your name, student ID number and section number on this page.
- Print your name on each page of the exam as you check to see that your copy of the exam has 6 pages.
- You may use one sheet (two-sided) of notes and a scientific calculator. Other notes, books or a calculator with graphing or symbolic functions are not allowed. If you need more space to solve a problem, use the back of the page preceding that problem, and clearly indicate that you have done so.
- Read each question carefully. Work the problems in an order that will maximize your score. Good Luck!

Problem	Total Points	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

1 (20 points) You do not need to simplify the expressions you obtain.

(a) (5 points) Find  $f'(x)$  if  $f(x) = (3x^2 + x + 1)^7$ .

Answer:

(b) (5 points) Find  $f'(x)$  if  $f(x) = \frac{x \sin(x)}{1+x^2}$ .

Answer:

(c) (5 points) Find  $f'(x)$  if  $f(x) = e^e e^x + x^e x^x$ .

Answer:

(d) (5 points) Find  $f^{(10)}(x)$  if  $f(x) = \sin(2x + 7) + (x^3 + 2x^2 + 1)^2$ .

Answer:

2 (20 points) Find the equation of the line tangent to the graph of  $y^3 + xy^2 - 5x^3 = 5$  at the point  $(2, 3)$ .

3 (20 points) An object moves in a plane with coordinates given as functions of time by  $x(t) = t^3 - 6t^2 + 1$  and  $y(t) = \arctan(e^t)$ .

- (a) (10 points) Find the values for  $t$  at which the tangent line to the trajectory of the object is vertical.

Answer:

- (b) (5 points) Find the horizontal accelerations (not velocities) at these times.

Answer:

- (c) (5 points) Find the vertical accelerations (not velocities) at these times.

Answer:

4 (20 points) An object is suspended from a spring causing it to move sinusoidally between the heights 2 and 12 centimeters with a maximum velocity of 8 centimeters per second.

(a) (12 points) Find an equation for the velocity of the object as a function of time.

Answer:

(b) (8 points) At what height is the object when the acceleration is maximum?

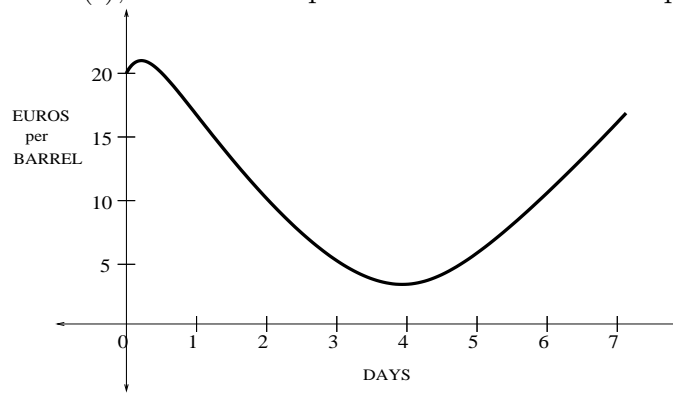
Answer:

5 (20 points) The equation  $V(t) = \frac{5+t^2}{1+t^2}$  gives the number of barrels of oil in geological deposits as a function of time in days. This quantity changes as a result of oil removal.

(a) (10 points) Find the rate in barrels per day that oil is being removed as a function of time in days.

Answer:

This graph gives  $P(t)$ , which is the price of crude oil in euros per barrel as a function of



time in days.

(b) (10 points) Using  $V(t)$  and  $P(t)$  above, estimate the rate of change in euros per day of the total value of the oil remaining in the deposits after  $t = 3$  days.

Answer: