Homework 13

The **due date** for this homework is **Tue 7 May 2013 12:00 AM EDT**.

Question 1

A group of scientists computes the position, velocity and acceleration of a particle at time $t = 0$. The position is $p(0) = 2$, the velocity $v(0) = 4$, and the acceleration $a(0) = 3$. Using this information, which Taylor series should they use to approximate $p(t)$, and what is the estimated value of $p(4)$ using this approximation?

- $p(t) = 2 + 4t + \frac{3}{2}t^2 + O(t^3), p(4) \simeq 42.$
- $p(t) = 2 + 4t + 3t^2 + O(t^3), p(4) \simeq 66.$
- $p(t) = 2 + 2t + \frac{3}{2}t^2 + O(t^3), p(4) \simeq 34.$
- $p(t) = 2 + 2t + 6t^2 + O(t^3), p(4) \simeq 106.$
- $p(t) = 2 + 2t + 3t^2 + O(t^3), p(4) \simeq 58.$
- $p(t) = 2 + 4t + 6t^2 + O(t^3), p(4) \simeq 114.$

Question 2

If a particle moves according to the position function $s(t) = t^3 - 6t$, what are its position, velocity and acceleration at $t = 3$?

- $s(3) = 9, v(3) = 21, a(3) = 18$
- $s(3) = 9, v(3) = 21, a(3) = 9$
- $s(3) = 9, v(3) = 21, a(3) = 36$
- $s(3) = 21, v(3) = 18, a(3) = 6$
- $s(3) = 21, v(3) = 18, a(3) = 18$

- $s(3) = 9, v(3) = 18, a(3) = 18$

Question 3

If the position of a car at time t is given by the formula $p(t) = t^4 - 24t^2$, for which times t is its velocity decreasing?

- $-\sqrt{24} < t < \sqrt{24}$
- $-2 < t < 2$
- Never: the velocity always increases.
- $t > 2$
- $t < -2$
- $-\sqrt[3]{12} < t < \sqrt[3]{12}$

Question 4

What is a formula for the second derivative of $f(t) = t^2 \sin 2t$? Use this formula to compute $f''(\pi/2)$.

- $f''(t) = -4t^2 \sin 2t$, and $f''(\pi/2) = 0$
- $f''(t) = 4t \cos 2t + (2 - 4t^2) \sin 2t$, and $f''(\pi/2) = -2\pi$
- $f''(t) = -8 \sin 2t$, and $f''(\pi/2) = 0$
- $f''(t) = 8t \cos 2t - 4t^2 \sin 2t$, and $f''(\pi/2) = -4\pi$
- $f''(t) = 8t \cos 2t + (2 - 4t^2) \sin 2t$, and $f''(\pi/2) = -4\pi$
- $f''(t) = 4t \cos 2t$, and $f''(\pi/2) = -2\pi$

Question 5

Use a Taylor series expansion to compute $f^{(3)}(0)$ for $f(x) = \sin^3(\ln(1 + x))$.

- 3
- -6
- 12
- -3
- 0
- 6

Question 6

Compute the first few derivatives $\frac{df}{dx}$, $\frac{d^2f}{dx^2}$ and $\frac{d^3f}{dx^3}$ of the function $f(x) = xe^x$ with respect to x. Based on your calculations, what is likely to be the general formula for the n^{th} derivative $\frac{d^nf}{dx^n}$?

- $\frac{d^nf}{dx^n} = (x + n^2)e^x$
- $\frac{d^nf}{dx^n} = x^{n+1}e^x$
- $\frac{d^nf}{dx^n} = e^x$
- $\frac{d^nf}{dx^n} = (x + 1)^n e^x$
- $\frac{d^nf}{dx^n} = (x + n)e^x$
- $\frac{d^nf}{dx^n} = n(x + 1)e^x$

Question 7

What is the curvature of the graph of the function $f(x) = -2\sin(x^2)$ at the point $(0, 0)$?

- 1
- 2
- -4
- $\frac{1}{2}$
- 0
- 4

☐ In accordance with the Honor Code, I certify that my answers here are my own work.

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